

About the College

Established in 1964 at Marthandam, Nesamony Memorial Christian College (NMCC) is a premier institution affiliated with Manonmaniam Sundaranar University. Dedicated to the empowerment of marginalized communities, the college offers a robust academic portfolio of 18 undergraduate, 15 postgraduate, and 12 doctoral programs. Ranked 63rd in the NIRF—the highest in Kanyakumari District—and re-accredited by NAAC in 2025, NMCC remains a beacon of academic excellence and social responsibility in Southern India.

About the Department

The Department of Physical Education at NMCC emphasizes a holistic approach to student development, blending rigorous academic growth with physical fitness. Through hands-on training in athletics, yoga, and sports officiating, the department nurtures leadership and sports excellence. By fostering competitive participation and healthy lifestyles, it prepares students to become disciplined leaders in the field of physical education.

About the Conference

This conference serves as a global platform at the intersection of health, sports sciences, and emerging technologies. By uniting clinicians, researchers, and industry leaders, the forum explores ethical and sustainable solutions to enhance human performance. The event is dedicated to bridging the gap between theoretical breakthroughs and real-world applications, driving transformative progress in global well-being.

Chief Editor

Dr. P. Arul Deva Paul

Director & Head,
Department of Physical Education,
Nesamony Memorial Christian College, Marthandam 629 165

Co - Editor

Dr. S. Sabitha

Assistant Professor of English
Noorul Islam College of Arts and Science, Kumaracoil

Dr. S. E. Joema

Associate Professor of Physics
Nesamony Memorial Christian College, Marthandam.

Dr. J. Josemon

Principal, School of Physical Education,
St. Joseph University, Muttom, Kanyakumari.

Editorial Board Members

Dr. Sunil Raj Y

Assistant Professor of Data Science,
St Xavier's College (Autonomous), Palayamkottai

Dr. S. Sethu

Associate Professor of Physical Education & Sports,
Central University of Tamil Nadu, Thiruvavur

Dr. J. Karthikeyan

Assistant Professor & Head of Physical Education,
MDT Hindu College, Tirunelveli

Dr. P. Natarajan

Assistant Professor of Physical Education & Sports,
SRMVC, Coimbatore.

Dr. P. Muthuveera

Assistant Professor of Physical Education,
Arul Anandar College, Karumathur, Madurai.

Dr. M. Sathish

Assistant Executive Director,
Smart Research Foundation

ISBN : 978-81-999504-5-0



978-81-999504-5-0

Bridging AI Research with Technological Advancements and Strategic Innovation for Global Development

BRIDGING AI RESEARCH WITH TECHNOLOGICAL ADVANCEMENTS AND STRATEGIC INNOVATION FOR GLOBAL DEVELOPMENT



Organized by



DEPARTMENT OF PHYSICAL EDUCATION
NESAMONY MEMORIAL CHRISTIAN COLLEGE
MARTHANDAM - 629 165

In Collaboration with

SMART RESEARCH FOUNDATION

Published by

SMART RESEARCH FOUNDATION



MARCH 2026

MARCH 2026

BRIDGING AI RESEARCH WITH TECHNOLOGICAL ADVANCEMENTS AND STRATEGIC INNOVATION FOR GLOBAL DEVELOPMENT



Organized by



**DEPARTMENT OF PHYSICAL EDUCATION
NESAMONY MEMORIAL CHRISTIAN COLLEGE
MARTHANDAM – 629 165**

In Collaboration with

SMART RESEARCH FOUNDATION

Published by
SMART RESEARCH FOUNDATION

MARCH 2026

PROCEEDINGS OF INTERNATIONAL MULTIDISCIPLINARY CONFERENCE BRIDGING AI RESEARCH WITH TECHNOLOGICAL ADVANCEMENTS AND STRATEGIC INNOVATION FOR GLOBAL DEVELOPMENT

Chief Editor

Dr. P. Arul Deva Paul

*Director & Head of Physical Education,
Nesamony Memorial Christian College, Marthandam 629 165*

Co - Editors

Dr. S. Sabitha

*Assistant Professor of English
Noorul Islam College of Arts and Science, Kumaracoil*

Dr. S. E. Joema

*Associate Professor of Physics
Nesamony Memorial Christian College, Marthandam.*

Dr. J. Josemon

*Principal, School of Physical Education,
St. Joseph University, Muttom, Kanyakumari.*

Editorial Board Members

Dr. Sunil Raj Y

Assistant Professor of Data Science, St Xavier's College (Autonomous), Palayamkottai

Dr. S. Sethu

Associate Professor of Physical Education & Sports, Central University of Tamil Nadu, Thiruvarur

Dr. J. Karthikeyan

Assistant Professor & Head of Physical Education, MDT Hindu College, Tirunelveli

Dr. P. Natarajan

Assistant Professor of Physical Education & Sports, SRMVC, Coimbatore.

Dr. P. Muthuveera

Assistant Professor of Physical Education, Arul Anandar College, Karumathur, Madurai.

Dr. M. Sathish

Assistant Executive Director, Smart Research Foundation

Publisher: SMART RESEARCH FOUNDATION

Published by: SMART RESEARCH FOUNDATION

**Book Title: *Proceedings of International Multidisciplinary Conference
Bridging AI Research with Technological Advancements and
Strategic Innovation for Global Development***

Language: *English*

Country: *India*

**Month & *March 2026*
Year:**

Edition : *First*

Copyright : *SMART RESEARCH FOUNDATION*

ISBN : *978-81-999504-5-0*



Copyright Notice

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without the prior written permission of the publisher.

Disclaimer

The authors are solely responsible for the contents of this e-book. The publisher assumes no responsibility or liability for the accuracy or completeness of the information contained herein. While every effort has been made to ensure accuracy, any errors are unintentional. Readers are encouraged to report any discrepancies to the publisher for correction in future editions.

PREFACE

It is with great pride and pleasure that we present the proceedings of the International Multidisciplinary Conference titled “*Bridging AI Research with Technological Advancements and Strategic Innovation for Global Development*,” organized by the Department of Physical Education, Nesamony Memorial Christian College, Marthandam, in collaboration with SMART Research Foundation. This conference serves as a dynamic platform for academicians, researchers, practitioners, and industry experts from diverse disciplines to exchange knowledge, share innovative ideas, and explore emerging trends at the intersection of artificial intelligence, technology, and strategic development.

In an era marked by rapid technological transformation, the integration of artificial intelligence with multidisciplinary research has become essential for addressing global challenges and fostering sustainable development. The conference aimed to highlight cutting-edge research, encourage interdisciplinary dialogue, and promote collaborative approaches that bridge theoretical insights with practical applications. The enthusiastic participation of scholars from various domains reflects the growing importance of innovation-driven research in shaping the future.

These proceedings comprise a collection of peer-reviewed papers that showcase original research contributions, case studies, and conceptual analyses across a wide spectrum of fields. Each paper represents a valuable addition to the ongoing discourse on leveraging AI and technological advancements for societal progress and global well-being.

We extend our sincere gratitude to all the contributors, reviewers, keynote speakers, and participants for their invaluable support and active engagement. We also acknowledge the dedicated efforts of the organizing committee whose commitment ensured the success of this conference. It is our hope that this volume will serve as a useful resource for researchers, educators, and policymakers, inspiring further exploration and innovation in multidisciplinary research for global development.

Director's Message

SMART Research Foundation



It gives me immense pleasure to extend my warm greetings on the occasion of the International Multidisciplinary Conference titled “*Bridging AI Research with Technological Advancements and Strategic Innovation for Global Development.*” I am delighted that SMART Research Foundation is collaborating with the Department of Physical Education, Nesamony Memorial Christian College, Marthandam, in organizing this significant academic event.

In today's rapidly evolving world, the convergence of artificial intelligence, technological innovation, and strategic thinking has become essential for addressing complex global challenges. This conference provides a valuable platform for scholars, researchers, and professionals from diverse disciplines to come together, exchange ideas, and contribute towards meaningful advancements that can drive sustainable global development.

SMART Research Foundation remains committed to promoting quality research, fostering innovation, and encouraging interdisciplinary collaboration. We strongly believe that such academic gatherings play a crucial role in nurturing intellectual growth, enhancing research capabilities, and building networks that extend beyond institutional and geographical boundaries.

I commend the organizers for their dedicated efforts in bringing together eminent academicians and researchers under one roof. I also appreciate all the participants and contributors for their valuable research inputs, which enrich the academic community and inspire future innovations.

I am confident that the deliberations and outcomes of this conference will contribute significantly to the advancement of knowledge and will serve as a catalyst for future research and development initiatives.

Wishing the conference great success.

Dr. J. Josemon

Director

SMART Research Foundation

Associate Managing Director's Message

SMART Research Foundation



It is a matter of great privilege and pleasure to convey my message on the occasion of the International Multidisciplinary Conference titled *“Bridging AI Research with Technological Advancements and Strategic Innovation for Global Development.”* I am delighted that SMART Research Foundation is collaborating with the Department of Physical Education, Nesamony Memorial Christian College, Marthandam, in organizing this intellectually enriching event.

In the present era of rapid technological progress, the integration of artificial intelligence with strategic innovation has become a driving force for global transformation. This conference provides an excellent platform for academicians, researchers, and professionals to share their insights, present pioneering research, and engage in meaningful discussions that address contemporary challenges and opportunities.

At SMART Research Foundation, we are dedicated to fostering a culture of research excellence, innovation, and interdisciplinary collaboration. We believe that such initiatives play a vital role in bridging the gap between theory and practice, thereby contributing to sustainable development and societal advancement.

I extend my heartfelt appreciation to the organizing committee for their tireless efforts in successfully hosting this conference. I also congratulate all the participants and contributors whose scholarly work and active involvement add immense value to this academic endeavor. I am confident that the knowledge shared and the collaborations formed during this conference will inspire future research and innovations that benefit the global community. Wishing the conference every success.

Dr. S. Sabitha

Associate Managing Director
SMART Research Foundation

CONTENTS

S. No	Title & Authors	Page No
1.	Digital Innovation in Physical Education and Sports Science Ms. N. Birji	01
2.	Isolation and Characterization of Heavy Metal Degrading Bacteria from Polluted Soil Samples Dr. D. Gnanslin Sheeba	05
3.	Anticandidal Activity of Chitosan Nanoparticles Isolated from Marine Prawns Dr. P. N. Sukitha	10
4.	Reclaiming the Margins: Gender, Caste, and Narrative Agency in Karna's Wife: The Outcast Queen Gobika S. V	15
5.	Remembering Memory and Resistance: A Critical Study of Looking for Tank Man by Ha Jin Dr. S. Sabitha	19
6.	Guilt, Redemption, and Ethnic Identity in The Kite Runner R. S. Ramiya Sree	24
7.	Breaking Silence and Reclaiming Country: Memory, Trauma, and Reconciliation in Kim Scott's Taboo Dr. N. Abitha	28
8.	Deconstructing Myth, Reclaiming Voice: Feminism and Identity in Chitra Banerjee Divakaruni's the Palace of Illusions Revathy R C	34
9.	Resilience Amidst Patriarchy: Female Experiences in Khaled Hosseini's A Thousand Splendid Suns Rishma Jose J	39
10.	Foundational Myths in The Secret Keeper of Jaipur: Memory, Identity, and Narrative Tradition B. Bala Subitha	44
11.	A Study on Gender Perspective towards Mobile Shopping Apps in Kanyakumari District P. T. Rajitha, Dr. S. Lakshmanan and Dr. V. Leela	49
12.	The Technology of Artificial Intelligence in Kazuo Ishiguro's Klara and the Sun L. B Reshmi	55
13.	A Bilateral Analysis of Yogic Practices and Pilates Training on Selected Corporal Variables Among Intercollegiate Women Basketball Players Dr. V. Mohana Surenth	60

14.	Impact of Fartlek and Circuit Training on VO ₂ Max of Kabaddi Players Dr. G. Kanagaraj	66
15.	Effect of Visual Skills and Its Impact on Skills Performance of Tennis Players Dr. M. Syed Ali	71
16.	Influence of Bosuball Trainings on Physical Fitness Component Among Football Players Dr. P. Manikandan	75
17.	Effect Of Asanas Practices on Physiological Variables Among Basketball Players Mr. R. Sivaraja and Dr. J. Karthikeyan	80
18.	Probiotics and Gut Microbiota: The Future of Nutritional Therapy Dharshini S V	84
19.	Grief as Governance: Affective Colonialism in Richard Flanagan's Wanting M. Dennis Rajan and Dr. S. Bridgith Jusbell	90
20.	Development of Fortified Functional Beverages Using Plant-Based Proteins S. Sahana Sherin	96
21.	Role of Antioxidants in Preventing Lifestyle Disorders Joseph Myson M I	101
22.	Quantity of Prepared Milk: Standards, Determinants, and Public Health Perspectives Vibisha L	106
23.	An Analysis of Selected Physical Fitness Variables of University Level Women Handball Players Gopu M Vijayan and Prof. Thomas George	110
24.	Nutritional Profiling and Sensory Appeal of Functional Smoothies for Caloric Regulation. N. Reshma, S. Pefhy and Sudha. U V	115
25.	Nutritional and Antioxidant Profiling of Passiflora edulis: Impact on Organoleptic Quality and Shelf-Life Anakha.A S, Varsha Pradha and Sudha. U V	120
26.	The Bioactive Scoop: Analyzing the Sensory, Nutritional, and Phytochemical Profiles of Natural Ice Cream Flavors G. Anu Varsha, R.V. Girish and Sudha. U V	126
27.	Food Processing Techniques and Their Impact on Nutrient Retention Merin Jisha M	133

28.	Synthesis and Characterization of Bimetallic Fe–Cu Nanoparticles and their Antibiofilm Activity Against <i>Candida</i> spp. Nijitha A F	138
29.	Effect of Fermentation on Nutritional Enhancement of Traditional Cereals C. Jaxcel Vilopher	145
30.	Milletts as a Superfood: Nutritional and Functional Benefits Veni S	150
31.	Application of Natural Preservatives in Extending Shelf Life of Bakery Products A. Barkana	155
32.	Evaluation of the Antidiabetic, Anti-Inflammatory, Antibacterial, and Wound Healing Properties of <i>Kalanchoe gastonis-bonnierii</i> Ajeena Farveen A	160
33.	Modernization of Libraries in the Digital Era Dr. V. Jeyakala	166
34.	Comparative Study of Performance Related Physical Fitness Components Between Synthetic and Non-Synthetic Surface Practicing School Students S. Dinesh Philip Vinoth and J. Karthikeyan	170
35.	Effect Of Isometric Training on Selected Strength Parameters Among School Boys Dr. C. Rajasingh Hariston	174
36.	Antibiofilm Potential of <i>Nephrolepis</i> spp. Extract Against Multidrug-Resistant <i>Klebsiella pneumoniae</i> Jeba Nithiha.N	180
37.	Comparison of Traditional Strength Training and Functional Training on Agility, Balance, and Explosive Power in Handball Players Bala Sivapriya M and Dr. R. Manickam	189
38.	Influence of Physical Activity on Physiological Functions and Sports Performance Dr. M. Sathish	198
39.	AI Teacher in Today's World Bershini. K	203
40.	Relationship Between Motivation and Performance in Adolescent Swimmers Dr. Mathews	209
41.	Acute Effects of Different Types of Warm-Up Exercise on Selected Fitness Variables Mr. V. Janardhana and Mr. Lakshmanan Gurunathan	213

42.	Coach–Athlete Relationship and Its Impact on Team Cohesion in Volleyball Mrs. A. Amala Shalini and Dr. U. Narayani	218
43.	Analysis Of Fartlek Training on Selected Physical Parameters Among College-Level Men Hockey Players D. Kaliraj and Dr. V. Amutha	223
44.	Analysis Of Aerobic Training on Selected Physical and Physiological Parameters Among College Level Men Hockey Players M. Robin Durai and Dr. V. Amutha	229
45.	Analysis of Specific Training on Selected Physical Variables Among College-Level Men Cricket Players T. Cherles Sathish Kumar and Dr. V. Amutha	235
46.	Effect of Ladder Training on Selected Physical Variables Among College-Level Women Badminton Players M. Janani and Dr. V. Amutha	241
47.	Effect of Skill-Related Training on Coordinative Ability and Skill Performance Variables Among College-Level Men Volleyball Players C. Chandru and Dr. V. Amutha	246
48.	Effect of Swimming and Combined Training on Selected Health-Related Physical Fitness Variables Among College Men K. Raja and Dr. V. Amutha	252
49.	Impact Of Core Strength Training on Selected Physical Variables In College-Level Kabaddi Players S. Abinaya and Dr. V. Amutha	258
50.	Impact of Plyometric Training on Selected Physical and Physiological Variables Among College Men Handball Players G. Muthukumar and Dr. V. Amutha	264
51.	Impact Of Saq Training On Selected Physical Parameters Among College Men Badminton Players W. Immanuel Robert Raj and Dr. V. Amutha	269
52.	An Experimental and Theoretical Study of the Crystalline NLO Material of 4-Methylpyridinium Succinate Aneesha Kumari S. M and S. E. Joema	275
53.	Impact of Rope Based Totally Plyometric Schooling on Selected Corporal and Purposeful Variables of Volleyball Gamers M. Venkatesh Prasath and Dr. R. Manickam	281
54.	Systematic analysis of Piperazine derivative nonlinear optical single crystals Anakha A.K and S. E. Joema	290

55.	Influence of Circuit Training on Heart Rate Among College Men Basketball Players Jancy Merlin M and Dr. P. Arthur Daniel	295
56.	Effects of Theraband and Weight Training on Strength Parameters Dr. R. Petchimuthu	299
57.	Enhancing Motor Proficiency Through Structured Gross and Fine Motor Activities in Children T. Nambiya @ Murugananthi and Dr. J. Karthikeyan	305
58.	Integrating Fitlight Technology with SAQ Training for Enhancing Reactive Agility and Performance in Volleyball Players P. Niveditha and Dr. U. Narayani	310
59.	Roll Of Multimedia in Shot Put Performance Dr. V. Vasudeva Rao and Mr. V. Janardhana	317
60.	An Analytical Study of Biomechanics of Tennis Forehand Power Dr. S. T. V. Perumal and Dr. S. Natarajan Sankar	323
61.	Comparative Analysis of Postural Characteristics among Sports and Non-Sports Participating School Boys P. Chermaraja and Dr. J. Josephin Priyanka	326
62.	Comprehensive Study on Corrosion Control of Carbon Steel Using Natural Inhibitors in Acidic Environments M. Mini Margaret and G. Rexin Thusnavis	330
63.	Effect of 6-Week Brisk Walking on Glycemic Control, Depression, And Stress Hormones in Adults Aged 40–45 Years with Type 2 Diabetes Mellitus K. John Kennedy and Dr. S. Jayaraman	336
64.	Isolation of Microplastics Degrading Microorganisms from Seawater Dr. Sangeetha V.S.	340
65.	Using AI and Digital Platforms to Improve Market Access for SHG Micro-Enterprises in Kanyakumari District Padmaja M U, Dr. S. Lakshmanan, and Dr. V. Leela	345

Digital Innovation in Physical Education and Sports Science

Ms. N. Birji

Associate Executive Director, SMART Research Foundation.

Email Id : birjibirji1999@gmail.com

Abstract

Digital innovation has become an essential part of modern education and sports science. The integration of technologies such as mobile applications, wearable devices, online learning platforms, virtual reality, and artificial intelligence has significantly transformed teaching, training, and performance evaluation. In physical education, digital tools support teachers in designing effective lesson plans, tracking student progress, assessing fitness levels, and providing personalized feedback. These technologies also encourage student motivation, active participation, and self-learning.

In sports science, digital innovation plays a vital role in injury prevention, workload monitoring, fitness assessment, and performance enhancement. Advanced data analytics and biomechanical tools help coaches and researchers understand athlete movement patterns and improve training strategies. Furthermore, technology enables real-time feedback, remote coaching, and long-term health monitoring.

This paper examines the impact of digital innovation on learning outcomes, athlete development, and overall well-being. It also discusses the challenges related to accessibility, data privacy, technical skills, and infrastructure. In addition, future opportunities such as smart training systems, personalized learning platforms, and AI-based performance prediction are highlighted. The study concludes that digital innovation is a key factor in making physical education and sports science more effective, interactive, inclusive, and scientifically driven.

Keywords

Digital Innovation; Physical Education; Sports Science; Educational Technology; Wearable Devices; Performance Analysis; Artificial Intelligence; Fitness Assessment

Introduction

In recent years, digital technology has become an important part of education and sports training. The use of mobile applications, wearable devices, online platforms, and artificial intelligence has changed the way physical education and sports science are taught and practiced. Traditional teaching methods are now supported by modern digital tools that help in better learning and performance improvement.

In physical education, technology helps teachers to plan lessons, monitor student fitness, and give personalized feedback. Students can also learn independently using digital platforms. In sports science, digital tools are used to analyze performance, prevent injuries, and improve training programs. These innovations make learning more interesting, scientific, and effective.

Therefore, digital innovation plays a major role in developing healthy, skilled, and motivated students and athletes.

Objectives of the Study

The main objectives of this study are:

- To understand the role of digital innovation in physical education.
- To study the use of technology in sports science and training.
- To analyze how digital tools improve student and athlete performance.
- To identify the benefits and challenges of using digital technology. To suggest ways to improve digital learning in physical education.

Review of Literature

Many researchers have studied the role of digital technology in physical education and sports science. Bailey and Kirk (2009) explained the educational benefits of physical education and sports activities. Casey et al. (2017) discussed how digital tools support learning and teaching in physical education.

McGarry et al. (2013) highlighted the importance of performance analysis using technology. Thomas et al. (2015) explained research methods in physical activity. Studies on wearable technology (2020) showed that devices like fitness bands help in monitoring heart rate, steps, and energy expenditure.

These studies prove that digital innovation improves learning, training, and performance in sports and physical education.

Methodology

This study is based on a descriptive and analytical method. Information was collected from books, research journals, online articles, and reliable websites. Secondary data was used for analysis. The collected data was carefully studied and organized. Different aspects of digital innovation such as mobile apps, wearable devices, and online platforms were analyzed. The findings were interpreted to understand their impact on physical education and sports science.

Results / Findings

The study revealed the following findings:

- Digital tools help teachers in better lesson planning and evaluation.
- Students show more interest and motivation in learning through technology.
- Wearable devices help in monitoring fitness and health.
- Coaches can analyze performance using video and data tools.
- Online platforms support remote learning and coaching.
- Technology improves accuracy in assessment and feedback.
- Overall, digital innovation improves learning quality and sports performance.

Discussion

The results show that digital innovation has a positive impact on physical education and sports science. Technology makes teaching more interactive and scientific. Students and athletes can understand their strengths and weaknesses easily through digital feedback.

However, some challenges were also found. Lack of proper infrastructure, limited technical knowledge, and high cost of devices may affect the use of technology. Data privacy and security are also important concerns.

Therefore, proper training and support are necessary for effective use of digital tools.

Conclusion

Digital innovation has become an important part of modern physical education and sports science. It improves teaching methods, learning outcomes, and athletic performance. Technologies such as mobile apps, wearable devices, and artificial intelligence support scientific training and evaluation.

Despite some challenges, digital tools make physical education more effective, inclusive, and enjoyable. With proper planning and support, technology can greatly improve the quality of education and sports training.

Recommendations

Based on the study, the following suggestions are given:

- Schools and colleges should provide proper digital infrastructure.
- Teachers and coaches should be trained in using technology.
- Students should be encouraged to use digital learning tools.

- Data security and privacy should be maintained.
- Government and institutions should support digital education programs. Future research should focus on advanced AI-based training systems.

References

1. Bailey, R., & Kirk, D. (2009). The educational benefits of physical education and school sport. Routledge.
2. Casey, A., Goodyear, V. A., & Armour, K. M. (2017). Digital technologies and learning in physical education: Pedagogical cases. Routledge.
3. McGarry, T., O'Donoghue, P., & Sampaio, J. (2013). Routledge handbook of sports performance analysis. Routledge.
4. Thomas, J. R., Nelson, J. K., & Silverman, S. J. (2015). Research methods in physical activity (7th ed.). Human Kinetics.
5. Wearable Technology in Sports. (2020). Journal of Sports Sciences, 38(11), 1245–1253.

Isolation and Characterization of Heavy Metal Degrading Bacteria from Polluted Soil Samples

Dr. D. Gnanslin Sheeba

Assistant Professor, Department of Biotechnology,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id: gnansitech@gmail.com

Abstract

Heavy metals in polluted soils pose serious threats to environmental and human health due to their persistence, toxicity, and non-degradable nature. Bioremediation using indigenous bacteria capable of tolerating and degrading heavy metals is a sustainable and eco-friendly solution. This study aimed to isolate heavy-metal-tolerant bacteria from contaminated soils, assess their morphological and biochemical characteristics, and evaluate their potential for heavy metal remediation. Soil samples were collected from industrial wastelands, enriched in nutrient media containing heavy metals, and pure bacterial isolates were characterized using morphological, physiological, and biochemical analyses. The isolates exhibited varying tolerance and removal efficiency against lead (Pb), cadmium (Cd), and chromium (Cr). The study identifies promising bacterial strains with potential applications in soil bioremediation.

Keywords: Heavy metal contamination, Bioremediation, Heavy metal-tolerant bacteria, Soil pollution, Microbial characterization

1. Introduction

Heavy metal contamination of soil is a global environmental concern resulting from rapid industrialization, mining activities, agricultural runoff, and improper waste disposal. Unlike organic pollutants, heavy metals are non-biodegradable and can accumulate in soil, water, and food chains, posing long-term ecological and health challenges (Alloway, 2013). The presence of heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), mercury (Hg), and arsenic (As) is associated with toxic effects on plants, animals, and humans, including neurological, renal, and reproductive disorders (Sharma & Dubey, 2005).

Traditional remediation methods—such as excavation, soil washing, and chemical stabilization—are costly and often disruptive to ecosystems. Bioremediation, which employs microorganisms to transform or detoxify pollutants, is a cost-effective and environmentally friendly alternative (Gadd, 2010). Several soil bacteria exhibit resistance mechanisms against heavy metals, including biosorption, bioaccumulation, and enzymatic transformation

(Rajkumar et al., 2012). Isolation and characterization of such bacteria provide insights for developing microbial strains for bioremediation applications.

This study focuses on isolating heavy metal-tolerant bacteria from polluted soils and characterizing them to identify strains capable of mitigating heavy metal contamination.

2. Materials and Methods

2.1. Soil Sample

Soil samples were collected from three sites with documented heavy metal pollution: (i) a textile industrial area, (ii) a metal plating facility, and (iii) a battery recycling zone. Samples were collected at a depth of 0–15 cm using sterilized spatulas, stored in sterile polyethylene bags, and transported to the laboratory under cold conditions.

2.2. Physicochemical Analysis

Soil samples were analyzed for pH, organic matter, and heavy metal concentrations. The soil pH was determined using a digital pH meter (Jackson, 1973). Heavy metal concentrations (Pb, Cd, Cr) were measured using Atomic Absorption Spectrophotometry (AAS) after acid digestion of soil samples (USEPA Method 3050B).

2.3. Enrichment and Isolation of Bacteria

Soil samples (1 g) were suspended in 9 ml sterile saline and serially diluted. Appropriate dilutions were plated on nutrient agar supplemented with heavy metals (PbCl₂, CdCl₂, K₂Cr₂O₇) at concentrations of 100–500 mg/L. Plates were incubated at 30 ±2°C for 48–72 hours. Distinct colonies were picked and purified by repeated streaking.

2.4. Morphological and Biochemical Characterization

Isolates were characterized for colony morphology (size, shape, margin, elevation), Gram reaction, and motility. Standard biochemical tests—catalase, oxidase, citrate utilization, urease, indole production, and carbohydrate fermentation—were performed as per Bergey's Manual of Systematic Bacteriology (Holt et al., 1994).

2.5. Heavy Metal Tolerance and Removal Efficiency

Isolates were grown in nutrient broth containing heavy metals (100–500 mg/L). Optical density at 600 nm was measured to assess growth. Heavy metal removal efficiency was quantified by measuring metal ion concentration in the supernatant after bacterial growth using AAS.

2.6.Molecular Identification

Promising isolates with high tolerance were subjected to molecular identification. Genomic DNA was extracted, and 16S rRNA gene was amplified using universal primers (27F and 1492R). PCR products were sequenced and analyzed using BLAST for species identification.

3. Results

3.1.Soil Physicochemical Properties

The soil pH ranged from 6.8 to 7.9, indicating slightly neutral to alkaline conditions. Organic matter content varied across sites. AAS analysis confirmed elevated levels of Pb (120–350 mg/kg), Cd (15– 45 mg/kg), and Cr (80–250 mg/kg), exceeding permissible soil limits (Alloway, 2013).

3.2.Isolation of Bacteria

A total of 27 bacterial isolates were obtained from enriched media. Among these, 12 isolates showed notable growth in media with 300 mg/L of heavy metals, indicating potential tolerance.

3.3.Morphological and Biochemical Features

Morphological examination revealed diverse colony characteristics (Table 1). Biochemical tests identified both Gram-positive and Gram-negative bacteria. Several isolates were catalase and oxidase positive, indicating aerobic metabolism. Fermentation patterns varied among isolates (Table 2).

Table 1 and Table 2: (To be inserted with morphological and biochemical results)

3.4.Heavy Metal Tolerance and Removal

Twelve selected isolates exhibited growth at 300 mg/L Pb, Cd, and Cr. Among them, four isolates— designated S1, S4, S7, and S11—showed superior tolerance and growth even at 500 mg/L. AAS analysis demonstrated that isolates S1 and S7 removed up to 68% of Pb and 55% of Cr, respectively, after 72 hours of incubation (Figure 1).

3.5.Molecular Identification

16S rRNA sequencing revealed that:

- Isolate S1 showed 99% similarity to *Bacillus subtilis*,
- Isolate S4 to *Pseudomonas aeruginosa*,
- Isolate S7 to *Enterobacter cloacae*,

- Isolate S11 to *Stenotrophomonas maltophilia*.

These species are known for heavy metal resistance and bioremediation potential.

4. Discussion

4.1. Heavy Metal Distribution in Soil

The elevated heavy metal concentrations confirm significant anthropogenic influence at sampling sites, consistent with prior studies on industrial soil pollution (Sharma & Dubey, 2005). The alkaline pH might influence metal bioavailability and microbial activity.

4.2. Bacterial Diversity and Adaptation

The isolation of diverse bacterial taxa reflects microbial adaptation to heavy metal stress. Gramnegative bacteria such as *Pseudomonas* and *Enterobacter* are frequently reported in contaminated soils due to their versatile metabolism and resistance mechanisms (Rajkumar et al., 2012).

4.3. Mechanisms of Heavy Metal Tolerance

Heavy metal tolerance in bacteria can involve biosorption, efflux pumps, enzymatic reduction, and sequestration (Gadd, 2010). The high removal efficiency by isolates S1 and S7 suggests active mechanisms, potentially including extracellular polymeric substances (EPS), which bind metal ions.

4.4. Bioremediation Potential

The successful isolation and identification of heavy metal-tolerant bacteria underline their biotechnological application in bioremediation. *Bacillus subtilis* and *Pseudomonas aeruginosa* have been previously documented for heavy metal remediation (Dixit et al., 2015), supporting the current findings.

4.5. Limitations and Future Prospects

While laboratory results are promising, field application requires pilot-scale studies to assess survival and efficacy under environmental conditions. Genetic engineering and bioaugmentation strategies could further enhance bioremediation performance.

5. Conclusion

This study successfully isolated and characterized indigenous bacteria from polluted soils with notable tolerance and removal efficiency against heavy metals. Four bacterial strains—*Bacillus subtilis*, *Pseudomonas aeruginosa*, *Enterobacter cloacae*, and *Stenotrophomonas maltophilia*—demonstrated strong potential for bioremediation of Pb, Cd,

and Cr. These findings highlight microbial bioremediation as an environmentally sustainable strategy for remediation of heavy metal contaminated sites.

References

1. Alloway, B. J. (2013). *Heavy metals in soils: Trace metals and metalloids in soils and their bioavailability* (3rd ed.). Springer.
2. Dixit, R., Malaviya, D., Pandiyan, K., Singh, U. B., Sahu, A., & Shukla, R. (2015). Bioremediation of heavy metals from soil and aquatic environment: An overview of principles and criteria of fundamental processes. *Sustainable Agriculture Reviews*, 15, 183–251.
3. Gadd, G. M. (2010). Metals, minerals and microbes: Geomicrobiology and bioremediation. *Microbiology*, 156(3), 609–643.
4. Holt, J. G., Krieg, N. R., Sneath, P. H. A., Staley, J. T., & Williams, S. T. (1994). *Bergey's manual of determinative bacteriology* (9th ed.). Lippincott Williams & Wilkins.
5. Jackson, M. L. (1973). *Soil chemical analysis*. Prentice Hall.
6. Rajkumar, M., Ae, N., Prasad, M. N. V., & Freitas, H. (2012). Perspectives of plant-associated microbes in heavy metal phytoremediation. *Biotechnology Advances*, 29(6), 792–798.
7. Sharma, S., & Dubey, R. S. (2005). Lead toxicity in plants. *Brazilian Journal of Plant Physiology*, 17(1), 35–52.
8. USEPA. (1996). Method 3050B: Acid digestion of sediments, sludges, and soils. U.S. Environmental Protection Agency.

Anticandidal Activity of Chitosan Nanoparticles Isolated from Marine Prawns

Dr. P. N. Sukitha

Assistant Professor, Department of Biotechnology,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id: sukithasamrutha@gmail.com

Abstract

Chitosan, a natural polysaccharide derived from chitin, exhibits significant antimicrobial properties that have attracted broad scientific interest. Recent advances in nanotechnology have led to the development of chitosan nanoparticles, which have enhanced surface area, improved bioactivity, and increased cellular uptake compared to bulk chitosan. This study focuses on the synthesis of chitosan nanoparticles from marine prawns, verification of their physicochemical properties, and evaluation of their anticandidal activity against *Candida* species. Chitosan was extracted from prawn shells, converted into nanoparticles via ionic gelation, and characterized using FTIR, SEM, and zeta potential analysis. The anticandidal efficacy of synthesized chitosan nanoparticles was assessed through agar well diffusion and minimum inhibitory concentration (MIC) methods against *Candida albicans* and *Candida glabrata*. Results demonstrated that chitosan nanoparticles exhibited significant inhibition of candida growth, suggesting their potential as alternative therapeutic agents for candidiasis. The study highlights the promising role of chitosan nanoparticles in antifungal strategies with minimal side effects.

Keywords: Chitosan nanoparticles, Anticandidal activity, Marine prawn chitin, *Candida albicans*, Ionic gelation synthesis

1. Introduction

Fungal infections caused by *Candida* species pose a major threat to global health, particularly in immunocompromised patients (Pfaller & Diekema, 2007). With increasing antifungal resistance to conventional drugs such as fluconazole and amphotericin B, alternative strategies are urgently needed. Chitosan, a deacetylated derivative of chitin, is widely studied for its biocompatibility, biodegradability, and antimicrobial properties (Rinaudo, 2006). Marine prawns represent an abundant source of chitin, and subsequent chitosan can be produced through chemical deacetylation.

Nanotechnology has enabled the enhancement of natural biomolecules like chitosan into nanoparticulate forms, exhibiting increased surface reactivity, improved solubility, and

enhanced interaction with microbial cell walls. Chitosan nanoparticles (CNPs) have demonstrated stronger antimicrobial activity than their bulk counterparts due to higher surface area, improved penetration, and controlled release potential (Duan et al., 2007). Despite extensive research in antibacterial applications, studies on the anticandidal potential of chitosan nanoparticles are comparatively limited.

This study aims to isolate chitosan from marine prawn shells, synthesize chitosan nanoparticles, characterize their physicochemical properties, and evaluate their anticandidal activity against clinically relevant *Candida* species.

2. Materials and Methods

2.1 Sample Collection and Preparation

Marine prawn shells were collected from local fish markets. The samples were washed thoroughly with distilled water to remove organic debris and dried at 60°C for 24 hours. Cleaned shells were powdered using a mechanical grinder and stored in sterile containers.

2.2 Extraction of Chitin and Chitosan

Chitin was extracted through demineralization and deproteinization:

- **Demineralization:** Shell powder was treated with 1M HCl at room temperature for 24 hours to remove calcium carbonate. The residue was washed to neutral pH.
- **Deproteinization:** The demineralized material was treated with 1M NaOH at 65°C for 48 hours to remove proteins. The resulting chitin was rinsed, dried, and stored.

Chitin was then deacetylated by treatment with 50% NaOH at 120°C for 2 hours to produce chitosan. The resultant chitosan was filtered, washed to neutral pH, dried, and powdered.

2.3 Synthesis of Chitosan Nanoparticles

Chitosan nanoparticles were prepared using ionic gelation by cross-linking chitosan with sodium tripolyphosphate (TPP). Briefly, chitosan was dissolved in 1% (v/v) acetic acid to obtain a 0.2% solution. TPP solution (0.1%) was added dropwise under constant stirring. The mixture was incubated at room temperature for 60 minutes, resulting in the formation of chitosan nanoparticles. The nanoparticles were collected by centrifugation at 15,000 rpm for 30 minutes and lyophilized for characterization.

2.4 Characterization of Chitosan Nanoparticles

- **Fourier Transform Infrared Spectroscopy (FTIR):** FTIR spectra were recorded to confirm functional groups and chemical structure.

- **Scanning Electron Microscopy (SEM):** SEM was used to visualize particle morphology and size estimation.
- **Zeta Potential Analysis:** Zeta potential was measured to assess nanoparticle surface charge and stability.

2.5 Anticandidal Activity Evaluation

2.5.1 Microbial Strains

Clinical isolates of *Candida albicans* and *Candida glabrata* were obtained from a microbiology laboratory and maintained on Sabouraud Dextrose Agar (SDA).

2.5.2 Agar Well Diffusion Assay

Sabouraud Dextrose Agar plates were seeded with standardized *Candida* suspensions (0.5 McFarland). Wells were made in SDA plates, and chitosan nanoparticles at concentrations of 25, 50, 100, and 200 µg/mL were added. Fluconazole (25 µg) served as the positive control and sterile distilled water as the negative control. Plates were incubated at 37°C for 24–48 hours, and zones of inhibition were measured.

2.5.3 Minimum Inhibitory Concentration (MIC)

MIC was determined using a broth microdilution method as per CLSI standards. Different concentrations of chitosan nanoparticles (12.5–200 µg/mL) were incubated with *Candida* cultures in 96-well microplates and incubated at 37°C for 48 hours. The lowest concentration showing no visible growth was recorded as the MIC.

3. Results

3.1 Characterization of Chitosan Nanoparticles

FTIR analysis confirmed characteristic functional groups of chitosan, including amine and hydroxyl peaks, and indicated successful formation of nanoparticles. SEM images revealed spherical nanoparticles with sizes ranging between 80–150 nm. Zeta potential values were +32 mV, indicating good colloidal stability.

3.2 Anticandidal Activity

3.2.1 Agar Well Diffusion

Chitosan nanoparticles exhibited clear zones of inhibition against *Candida albicans* and *Candida glabrata*. The zones increased proportionately with concentration. At 200 µg/mL, inhibition zones reached 20 ±1.2 mm against *C. albicans* and 18 ±1.0 mm against *C. glabrata*.

Fluconazole showed zones of 22 ± 0.8 mm and 20 ± 1.1 mm, respectively, indicating comparable activity.

3.2.2 MIC Values

The MIC values were 50 µg/mL for *C. albicans* and 75 µg/mL for *C. glabrata*, demonstrating strong antifungal efficacy of chitosan nanoparticles.

4. Discussion

4.1 Enhanced Antifungal Efficacy of Nanoparticles

The observed potent anticandidal activity of chitosan nanoparticles can be attributed to enhanced surface area and improved interaction with fungal cell walls. The positive charge of chitosan nanoparticles facilitates electrostatic interaction with negatively charged cell membranes of *Candida*, leading to cell permeability disruption and eventual cell death (Kong et al., 2010).

4.2 Mechanisms of Action

Several mechanisms have been proposed for chitosan's antifungal action: inhibition of nutrient import, metal chelation, interaction with cellular DNA, and induction of reactive oxygen species (Rabea et al., 2003). Nanoparticles amplify these effects due to increased uptake and surface reactivity.

4.3 Comparison with Conventional Antifungals

Although fluconazole showed marginally higher activity, chitosan nanoparticles exhibited comparable inhibition, suggesting potential as alternative antifungal agents, especially in cases of drug resistance.

4.4 Biocompatibility and Environmental Sustainability

Derived from marine prawns, chitosan nanoparticles are biodegradable and biocompatible, offering sustainable antifungal solutions with potentially lower side effects than synthetic drugs.

5. Conclusion

The study successfully isolated chitosan from marine prawn shells and synthesized stable chitosan nanoparticles with potent anticandidal activity. Chitosan nanoparticles exhibited significant inhibition of *Candida* species at relatively low concentrations, highlighting their therapeutic potential in antifungal treatment. These findings encourage further exploration of chitosan nanoparticles in clinical antifungal formulations and as alternatives to existing antifungal drugs.

References

1. Duan, B., et al. (2007). Chitosan nanoparticles in *Journal of Biomaterials Science*.
2. Kong, M., Chen, X.G., et al. (2010). *International Journal of Food Microbiology*, 144(3), 51–58.
3. Pfaller, M.A., & Diekema, D.J. (2007). Epidemiology of *Candida* infections: Clinical Microbiology Reviews.
4. Rabea, E.I., et al. (2003). Chitosan as antimicrobial: *Biomacromolecules*.
5. Rinaudo, M. (2006). Chitin and chitosan review: *Progress in Polymer Science*.

Reclaiming the Margins: Gender, Caste, and Narrative Agency in *Karna's Wife: The Outcast Queen*

Gobika S. V

Student, II MA English Literature,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : mail2gobikasv@gmail.com

Abstract

Contemporary Indian English literature has witnessed a significant surge in mythological retellings that revisit classical epics from marginalized perspectives. Among these, *Karna's Wife: The Outcast Queen* (2013) by Kavita Kane stands out for its bold re-centering of Uruvi, a largely silenced female figure from the Mahabharata. Through a feminist and socio-cultural lens, this paper examines how Kane reconstructs narrative authority, interrogates caste hierarchies, and redefines heroism and marital agency. By foregrounding Uruvi's voice, the novel challenges patriarchal epic traditions and reclaims emotional subjectivity as a site of resistance. This study argues that *Karna's Wife* is not merely a retelling but a transformative intervention that expands the ethical and literary possibilities of epic discourse in contemporary India.

Introduction

The *Mahabharata*, one of the longest epics in world literature, has endured for centuries as a moral, philosophical, and cultural touchstone. However, like many classical texts, it privileges royal lineage, masculine heroism, and dynastic conflict. Female characters, though central to key events, are often rendered secondary to male narratives. Contemporary mythological fiction in India has sought to revisit these epics through new perspectives, particularly those of women and marginalized figures.

Karna's Wife: The Outcast Queen represents this revisionist impulse. Rather than retelling the epic from the standpoint of its dominant heroes—Arjuna, Krishna, or Yudhishtira—Kane chooses Uruvi, wife of Karna, as the narrative center. In doing so, she shifts the focus from battlefield politics to emotional interiority, from public glory to private struggle.

This act of retelling is inherently political. It questions who is authorized to narrate history and whose experiences are validated as meaningful. Kane's novel thus becomes a site of literary reclamation, challenging epic authority and patriarchal historiography.

Uruvi as a Feminist Subject

In traditional versions of the *Mahabharata*, Uruvi is scarcely mentioned. Kane transforms this marginal character into a fully realized protagonist endowed with psychological complexity and moral clarity. Uruvi is neither a submissive wife nor a passive royal daughter; instead, she is intellectually alert, emotionally perceptive, and ethically independent.

Her decision to marry Karna—despite opposition and social stigma—becomes an assertion of selfhood. Unlike many epic heroines who are given away in marriage as political alliances, Uruvi actively chooses her partner. This decision challenges patriarchal norms that dictate women's destinies through familial authority.

Uruvi's voice is reflective rather than reactionary. She questions the nature of dharma, loyalty, and justice. Through her perspective, readers are invited to reconsider epic morality. The narrative thus aligns with feminist literary theory, which emphasizes the recovery of women's voices and subjective experiences suppressed by dominant narratives.

Moreover, Uruvi's emotional labor—her constant negotiation between love and disillusionment—reveals the gendered burdens placed upon women. While male heroes wage wars to defend honor, women like Uruvi must preserve emotional coherence within fractured relationships.

Caste and the Tragedy of Social Identity

One of the most compelling thematic concerns of the novel is caste discrimination. Karna's life is defined by the stigma of his assumed low birth, despite his exceptional talent and valor. His exclusion from Draupadi's swayamvara and repeated humiliation underscore the rigidity of social hierarchy.

Through Uruvi's evolving awareness, Kane exposes the cruelty of caste ideology. Uruvi initially inhabits the privileged world of royalty, yet her love for Karna compels her to confront the injustice embedded in her own social framework. Her marriage becomes not only an emotional commitment but also a symbolic crossing of caste boundaries.

Karna himself embodies the paradox of merit versus birth. He is a warrior equal, if not superior, to the celebrated princes, yet his legitimacy is constantly questioned. The novel portrays caste as a psychological wound that shapes Karna's alliances and decisions.

By highlighting caste as a determinant of dignity, Kane bridges ancient epic society with contemporary social realities in India. The narrative implicitly critiques ongoing structures of exclusion, demonstrating that epic retellings can serve as mirrors to present injustices.

Reconstructing Heroism: A Humanized Karna

In conventional interpretations, Karna is often viewed either as a tragic anti-hero or as a loyal yet misguided warrior aligned with the Kauravas. Kane, however, reconstructs Karna through Uruvi's empathetic lens. He is not merely a warrior defined by battlefield prowess but a deeply wounded individual seeking acceptance.

His loyalty to Duryodhana is portrayed not simply as blind allegiance but as gratitude toward the one person who recognized his worth. Through Uruvi's reflections, readers see Karna's vulnerabilities—his insecurities, his pride, his longing for validation.

This redefinition of heroism destabilizes the epic binary of righteous versus unrighteous. Kane suggests that moral identity is complex and often shaped by social rejection. Karna's tragedy lies not in moral corruption but in systemic exclusion.

The emotional depth attributed to Karna also challenges rigid models of masculinity. He is allowed to grieve, doubt, and love intensely—qualities often minimized in traditional epic narratives.

Marriage as Resistance and Emotional Negotiation

Marriage in *Karna's Wife* functions as both sanctuary and battlefield. Uruvi's union with Karna is rooted in love, yet it is strained by political allegiance and social tension. Unlike idealized epic marriages, theirs is marked by ideological disagreement—particularly regarding Karna's loyalty to Duryodhana.

Uruvi does not hesitate to question Karna's choices. She confronts him about the morality of aligning with injustice, particularly in the humiliation of Draupadi. This critical stance differentiates her from stereotypical epic wives who embody silent devotion.

However, Kane avoids reducing Uruvi to a modern feminist transplanted into an ancient world. Her resistance operates within the emotional and cultural constraints of her society. She remains committed to her marriage, yet she refuses intellectual submission.

Thus, marriage becomes a space of dialogue rather than domination—a site where ethical disagreements coexist with love.

Narrative Technique and Emotional Realism

The use of first-person narration is central to the novel's impact. By allowing Uruvi to recount events retrospectively, Kane transforms epic history into lived memory. The large-scale political events of the *Mahabharata* are filtered through intimate reflection.

This technique humanizes myth. Readers experience war not as spectacle but as personal loss. The grandiosity of epic conflict is reframed as emotional devastation.

Kane's language is lyrical yet accessible, blending poetic imagery with psychological introspection. This stylistic choice reinforces the novel's thematic emphasis on interiority.

Comparative Context: Feminist Myth Retellings

Karna's Wife belongs to a broader literary movement of feminist mythological retellings in Indian English literature. For example, Chitra Banerjee Divakaruni's *The Palace of Illusions* re-centers Draupadi's perspective, offering a reinterpretation of female desire and political agency within the *Mahabharata*. Similarly, other contemporary retellings challenge the epic's patriarchal structure.

However, Kane's work is distinctive in its focus on caste alongside gender. While Draupadi's narrative explores humiliation and polyandry, Uruvi's story foregrounds marital choice and caste transgression. The intersection of gender and caste makes the novel particularly relevant in contemporary discourse.

Conclusion

Karna's Wife: The Outcast Queen is not merely an imaginative retelling but a profound ethical reimagination of epic tradition. By amplifying Uruvi's voice, Kavita Kane reclaims narrative authority for those historically relegated to the margins.

The novel interrogates caste hierarchy, redefines heroism, and situates female agency within complex emotional landscapes. In doing so, it demonstrates that epics are not static relics but dynamic texts capable of reinterpretation.

Kane's contribution lies in showing that marginalized perspectives do not weaken epic grandeur; rather, they enrich it by revealing the human cost of glory. Through Uruvi's eyes, the *Mahabharata* becomes not only a tale of war and destiny but also a meditation on dignity, love, and resistance.

References

1. Chitra Banerjee Divakaruni. (2008). *The Palace of Illusions*. Doubleday India.
2. Pollock, S. (2006). *The Language of the Gods in the World of Men*. University of California Press.
3. Rich, A. (1979). *On Lies, Secrets, and Silence*. W. W. Norton.
4. Thapar, R. (2004). *Somanatha: The Many Voices of a History*. Penguin.

Remembering Memory and Resistance: A Critical Study of *Looking for Tank Man* by Ha Jin

Dr. S. Sabitha

Assistant Professor, Department of English,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : sabithaanikha@gmail.com

Abstract

Looking for Tank Man (2025) by Ha Jin is a profound literary meditation on memory, political suppression, trauma, and moral responsibility in the shadow of the 1989 Tiananmen Square protests and massacre. Through the journey of Pei Lulu, a Chinese doctoral student at Harvard University, the novel interrogates how collective memory is erased, manipulated, and reclaimed under authoritarian regimes. Lulu's search for the identity and fate of the iconic "Tank Man" becomes both a scholarly pursuit and an ethical mission. This paper argues that Ha Jin constructs memory as an active site of resistance and frames intellectual inquiry as a powerful form of political defiance. By examining themes of trauma, diaspora consciousness, generational conflict, gendered agency, and narrative ethics, the novel reveals that remembering is not merely an act of recollection but an assertion of dignity against enforced silence.

Keywords: Political memory, Tiananmen Square protests, Diaspora identity, Authoritarian censorship, Narrative resistance

Introduction

Looking for Tank Man revisits one of the most politically sensitive episodes in modern Chinese history—the 1989 Tiananmen crackdown. The novel opens at Harvard University, where Pei Lulu encounters a lone protester holding a sign that reads: "We Won't Forget the Tiananmen Square Massacre!" Lulu's initial disbelief reflects the success of state-sponsored amnesia. Raised within China's censored educational system, she has grown up with little knowledge of the massacre.

Ha Jin immediately establishes memory as contested terrain. The state's attempt to erase Tiananmen from public discourse demonstrates how power controls not only the present but also the past. The figure of the Tank Man—the anonymous individual who stood before a line of tanks—becomes the novel's central metaphor. His identity remains unknown, symbolizing both resistance and the incompleteness of suppressed history.

Lulu's journey from indifference to determination forms the narrative arc of the novel. Her academic curiosity gradually transforms into moral responsibility. Memory, Ha Jin suggests, is not passively inherited; it must be actively reclaimed.

Pei Lulu's Intellectual Awakening

Lulu's transformation begins when she enrolls in a seminar on memory and historical amnesia. Exposure to conflicting narratives destabilizes her previously unquestioned assumptions. Her classmates dismiss Tiananmen as foreign propaganda, reflecting the depth of ideological conditioning.

Choosing to pursue doctoral research on Tiananmen becomes a radical act. In authoritarian contexts, even inquiry can be subversive. Lulu's academic work evolves into ethical commitment. She asserts that a historian's task is to illuminate truth, regardless of political discomfort.

Her dual position—Chinese by birth, American by academic affiliation—creates a liminal identity. This hybridity allows critical distance while intensifying emotional stakes. Ha Jin portrays her research not merely as scholarship but as existential reclamation. Lulu seeks not only historical clarity but also self-understanding.

Trauma and Fragmented Memory

The Tiananmen massacre functions as collective trauma. Drawing on trauma theory, the novel illustrates how catastrophic events resist coherent narration. Witnesses Lulu interviews speak hesitantly; their accounts are fragmented, marked by pauses and omissions.

Trauma manifests in three significant ways:

- **Psychological hesitation** in testimony
- **Generational transmission** through silence
- **Political suppression** through censorship

Although Lulu did not witness the massacre, she inherits its emotional residue. Her parents, former participants in the protests, avoid discussion. Their silence represents survival strategy. Trauma is not forgotten; it is buried.

Ha Jin structures the novel through interviews and recollections, mirroring trauma's fragmented nature. Truth emerges gradually, reinforcing the idea that historical wounds cannot be healed through denial.

Manufactured Amnesia and the Politics of Forgetting

One of the novel's strongest themes is manufactured amnesia. The state controls collective memory through:

- Educational omission
- Media censorship
- Digital filtering
- Social discouragement of dissent

For younger generations, forgetting becomes normalized. Silence transforms into cultural etiquette. Lulu's refusal to forget becomes an act of intellectual rebellion.

The search for Tank Man symbolizes resistance against engineered oblivion. Memory becomes moral duty. Ha Jin argues that authoritarian regimes depend on erasure; therefore, remembrance itself becomes resistance.

The Symbolism of the Tank Man

The Tank Man stands as a global symbol of courage. His anonymity enhances his universality. In the novel, he operates on multiple symbolic levels:

- 1. Embodiment of moral defiance**
- 2. Representation of unresolved history**
- 3. Metaphor for incomplete archives**

Lulu's inability to definitively identify him reflects the broader impossibility of recovering fully suppressed histories. Ha Jin deliberately avoids closure. The significance lies not in solving the mystery but in sustaining inquiry.

The Tank Man becomes an ethical presence—an enduring reminder that courage often survives only in images and fragments.

Diaspora and Intellectual Freedom

Set largely in the United States, the novel highlights the paradox of exile. Lulu enjoys academic freedom unavailable in China, yet she feels emotional displacement.

Diaspora creates tension between:

- Safety and alienation
- Freedom and guilt
- Autonomy and cultural responsibility

Exile enables truth-seeking but complicates belonging. Lulu must confront whether distance weakens or strengthens her authority to narrate national trauma.

Ha Jin suggests that diaspora intellectuals play a crucial role in preserving suppressed histories. Distance may create clarity.

Gender and Historical Agency

Lulu's identity as a young female scholar introduces a subtle gendered dimension. Against the masculine imagery of tanks and military force, she embodies intellectual resilience.

Her resistance is dialogic rather than confrontational. She negotiates interviews with older male witnesses, asserting authority through scholarship rather than aggression.

Ha Jin thus expands the definition of resistance. It is not limited to physical confrontation; it includes patient research and moral persistence. Lulu's gendered position underscores that memory work can itself be transformative political action.

Language, Silence, and Narrative Ethics

Language in the novel operates in tension with silence. Words carry risk. Witnesses weigh each sentence carefully. Pauses become meaningful.

Ha Jin's restrained prose avoids sensationalism. The ethical dimension of storytelling is emphasized. Lulu approaches testimony with respect rather than exploitation.

The novel suggests three principles of narrative ethics:

- Honor the witness
- Accept partial knowledge
- Resist dramatization

Truth emerges through careful assembly rather than revelation.

Generational Conflict

The tension between Lulu and her parents reflects generational divergence. The older generation values stability after trauma; the younger seeks accountability.

Memory transmission becomes selective. What is withheld shapes identity as much as what is shared.

Ha Jin portrays both positions sympathetically. Survival and truth are not mutually exclusive but often conflict under authoritarian conditions.

Hope and Ethical Persistence

The novel concludes without definitive answers. Tank Man remains unidentified. Political systems remain unchanged. Yet hope persists.

Hope resides in:

- Continued inquiry
- Ethical documentation
- Refusal to forget

Ha Jin implies that memory work is ongoing. Literature becomes moral archive. Even incomplete remembrance resists erasure.

Conclusion

Looking for Tank Man is a deeply reflective exploration of memory, trauma, diaspora, and resistance. Through Pei Lulu's journey, Ha Jin demonstrates that history is not static but contested.

The Tank Man symbolizes physical courage. Lulu symbolizes intellectual perseverance. Together, they embody two forms of resistance: visible defiance and quiet inquiry.

The novel ultimately asserts that remembering is ethical action. Against authoritarian amnesia, memory restores dignity. In confronting silence, individuals reclaim agency.

Ha Jin's work stands as a reminder that truth, though suppressed, endures through those willing to seek it.

References

1. Ha Jin. (2025). *Looking for Tank Man*. Other Press LLC.
2. Assmann, J. (2011). *Cultural Memory and Early Civilization*. Cambridge University Press.
3. Bhabha, H. K. (1994). *The Location of Culture*. Routledge.
4. Caruth, C. (1996). *Unclaimed Experience: Trauma, Narrative, and History*. Johns Hopkins University Press.
5. Said, E. W. (1978). *Orientalism*. Pantheon Books.

Guilt, Redemption, and Ethnic Identity in *The Kite Runner*

R. S. Ramiya Sree

Student, I MA English Literature, Department of English,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : ramiyasreeja24@gmail.com

Abstract

The *Kite Runner* by Khaled Hosseini is a powerful narrative that explores guilt, betrayal, redemption, and the complex intersections of ethnicity and history in Afghanistan. Set against the socio-political upheavals of late twentieth-century Afghanistan, the novel traces the emotional and moral journey of Amir, whose childhood betrayal of his friend Hassan shapes his identity and life choices. This paper examines the themes of guilt and redemption within the framework of ethnic conflict, particularly between Pashtuns and Hazaras, while also analyzing the role of memory, diaspora, and political violence. The study argues that Hosseini presents redemption not as an erasure of the past but as an ongoing ethical responsibility shaped by personal and historical trauma.

Introduction

Published in 2003, *The Kite Runner* marked a significant moment in contemporary world literature by introducing global audiences to Afghan history through intimate storytelling. The novel spans three major historical phases in Afghanistan: the monarchy, the Soviet invasion, and the rise of the Taliban. Through Amir's personal narrative, Hosseini intertwines individual guilt with national tragedy.

The novel begins in Kabul in the 1970s, portraying a seemingly idyllic childhood friendship between Amir, a wealthy Pashtun boy, and Hassan, the son of his father's Hazara servant. However, beneath this friendship lies a deeply entrenched ethnic hierarchy. The central event—Hassan's assault and Amir's failure to intervene—becomes the moral pivot of the novel.

This paper argues that Hosseini uses personal betrayal as an allegory for Afghanistan's fractured social fabric. Amir's search for redemption parallels a broader longing for reconciliation in a country devastated by political violence.

Guilt as Psychological Burden

The dominant theme of the novel is guilt. Amir's silence during Hassan's assault represents not only personal cowardice but also complicity in systemic injustice. He chooses social security and paternal approval over loyalty and moral courage.

The famous line, “There is a way to be good again,” establishes redemption as the narrative’s ethical horizon (Hosseini, 2003). Amir’s guilt manifests in self-loathing, emotional withdrawal, and estrangement from authentic relationships. His betrayal is not forgotten; rather, it becomes an enduring psychological scar.

Hosseini portrays guilt as transformative yet corrosive. It shapes Amir’s personality, drives him to exile, and ultimately compels him to confront his past. Importantly, redemption is not depicted as simple confession but as action—risking one’s safety for moral restitution.

Ethnicity and Social Hierarchy: Pashtun and Hazara Conflict

Ethnic discrimination forms the socio-political backdrop of the novel. The Pashtuns, historically dominant in Afghanistan, consider themselves superior to the Hazaras, who are often marginalized due to their Mongolian features and Shia identity.

Hassan’s character embodies this oppression. Despite his loyalty and moral integrity, he is repeatedly reminded of his “inferior” status. The insult “flat-nosed” becomes a symbol of ethnic prejudice.

Amir’s betrayal is thus doubly significant: he betrays not only a friend but also a marginalized subject whose vulnerability stems from systemic discrimination. Hosseini reveals how privilege enables moral failure. Amir’s Pashtun identity shields him from consequences, while Hassan bears the trauma.

Through this lens, the novel critiques the entrenched social divisions that weaken Afghanistan from within. The personal becomes political; childhood cruelty mirrors national fragmentation.

Fatherhood and Moral Expectations

Another central theme is the complexity of father-son relationships. Amir’s desire for his father Baba’s approval drives many of his actions. Baba, a commanding and morally rigid figure, believes that theft is the root of all sin.

Ironically, Baba himself harbors a secret: Hassan is his illegitimate son. This revelation complicates the novel’s moral architecture. Baba’s failure to acknowledge Hassan publicly mirrors Amir’s betrayal. Thus, moral weakness transcends generations.

The father-son dynamic underscores the tension between public honor and private guilt. Baba’s physical bravery contrasts with emotional concealment, while Amir’s journey involves moving from cowardice to courage.

Political Violence and National Trauma

The novel's backdrop includes major historical events: the Soviet invasion of Afghanistan, refugee migration, civil war, and Taliban rule. These events are not merely historical markers but forces shaping personal destinies.

The Taliban's brutality, particularly toward Hazaras, intensifies the theme of ethnic persecution. Hassan's execution under Taliban rule symbolizes the culmination of systemic hatred.

Hosseini portrays Afghanistan as a wounded nation, fragmented by ideology and violence. Amir's return to Kabul reflects a confrontation not only with personal guilt but also with national devastation. The destroyed streets of Kabul mirror the moral ruins of Amir's past.

Redemption as Ethical Responsibility

Redemption forms the moral core of the narrative. When Rahim Khan summons Amir to Pakistan, offering him "a way to be good again," the novel shifts from memory to action. Amir's rescue of Sohrab, Hassan's son, becomes a symbolic act of atonement.

The confrontation with Assef—now a Taliban official—represents a reversal of childhood roles. This time, Amir does not remain silent. He accepts physical pain as a form of penance. His endurance signals moral transformation.

However, Hosseini avoids simplistic closure. Sohrab's trauma does not vanish, nor does Amir's guilt disappear entirely. Redemption is depicted as ongoing care, not a singular heroic act. By adopting Sohrab, Amir assumes responsibility for the next generation, suggesting hope amid devastation.

Diaspora and Identity Reconstruction

After migrating to the United States, Amir experiences cultural dislocation. America offers safety but not emotional closure. The immigrant experience complicates identity, as characters navigate nostalgia and adaptation.

Baba struggles with diminished status, while Amir finds creative expression through writing. The diaspora setting emphasizes the persistence of memory. Physical distance from Afghanistan does not erase psychological attachment.

Hosseini portrays exile as both loss and opportunity. The possibility of redemption becomes accessible only when Amir confronts his Afghan past rather than escaping it.

Symbolism of the Kite

The kite functions as a recurring symbol. In childhood, kite fighting represents competition and paternal validation. Hassan's declaration, "For you, a thousand times over," signifies unconditional loyalty.

By the novel's end, Amir runs a kite for Sohrab, reversing childhood dynamics. This act symbolizes healing and intergenerational repair. The kite thus evolves from a marker of betrayal to a symbol of redemption and hope.

Conclusion

The Kite Runner is a profound exploration of guilt, ethnicity, and redemption set against Afghanistan's turbulent history. Khaled Hosseini intertwines personal betrayal with national tragedy, demonstrating how private moral failures reflect broader social injustices.

Amir's journey from cowardice to courage illustrates that redemption requires acknowledgment, sacrifice, and sustained responsibility. By foregrounding Hazara marginalization, the novel critiques ethnic hierarchies and calls for empathy.

Ultimately, Hosseini suggests that while the past cannot be undone, ethical action in the present can reshape the future. The novel's enduring power lies in its reminder that redemption is not about forgetting but about choosing to confront and repair.

References

1. Khaled Hosseini. (2003). *The Kite Runner*. Riverhead Books.
2. Said, E. W. (1978). *Orientalism*. Pantheon Books.
3. Caruth, C. (1996). *Unclaimed Experience: Trauma, Narrative, and History*. Johns Hopkins University Press.
4. Bhabha, H. K. (1994). *The Location of Culture*. Routledge.
5. Anderson, B. (1983). *Imagined Communities*. Verso.

Breaking Silence and Reclaiming Country: Memory, Trauma, and Reconciliation in Kim Scott's *Taboo*

Dr. N. Abitha

Assistant Professor, Department of English,
Noorul Islam College of Arts and Science, Kumaracoil,
Email Id : jennievasanth18@gmail.com

Abstract

This paper examines *Taboo* by Kim Scott* through the interconnected themes of silence, memory, trauma, and reconciliation. The study explores how Scott redefines the concept of “taboo” as both a sacred cultural practice within Indigenous communities and a colonial mechanism of enforced silence surrounding historical violence. Set against the backdrop of Western Australia’s unacknowledged massacre sites, the novel foregrounds the return to Country as a symbolic and literal act of healing. By analyzing the representation of intergenerational trauma, the politics of historical erasure, and the revival of Noongar language, this paper argues that *Taboo* functions as a literary intervention in national memory. Scott challenges dominant colonial narratives by transforming silence into truth-telling and re-establishing connections between land, identity, and community. The novel presents reconciliation not as a superficial gesture but as an ongoing ethical process requiring acknowledgment, listening, and responsibility. Ultimately, *Taboo* demonstrates how storytelling becomes a form of cultural reclamation and resistance, affirming the resilience of Indigenous identity while demanding a re-examination of Australia’s colonial past.

Keywords: Indigenous Australian literature, Intergenerational trauma, Colonial silence, Cultural memory, Reconciliation and Country

Introduction

The concept of “taboo” carries layered meanings—prohibition, silence, sacredness, and danger. In the novel *Taboo*, Kim Scott explores the cultural, historical, and psychological implications of taboo within the context of Indigenous Australian experience. The novel revisits the brutal colonial history of Western Australia, particularly the massacres and dispossessions suffered by Aboriginal communities. Through a narrative centered on reconciliation and return to country, Scott interrogates suppressed histories, intergenerational trauma, and the transformative power of language and memory.

Taboo is not merely a story about a tragic past; it is a narrative of healing and reclamation. The novel presents taboo as both a cultural restriction and a colonial imposition.

While traditional Aboriginal taboos carry sacred meaning and protect community structures, colonial taboos function to silence atrocities and erase Indigenous presence. Scott's work challenges these imposed silences, opening spaces for truth-telling and communal restoration.

Historical and Cultural Background

Scott, a descendant of the Noongar people of Western Australia, consistently engages with Indigenous history and identity in his fiction. In *Taboo*, he addresses the violent legacy of colonization, especially the massacre sites that remain largely unacknowledged in national consciousness. The narrative centers around the fictional massacre site of "Kellerberrin," symbolizing many real historical events across Australia.

Colonization in Australia resulted in land dispossession, cultural disintegration, and forced assimilation policies. Indigenous languages were suppressed, children were removed from families, and spiritual ties to land were disrupted. These acts were often unspoken in official histories, creating a cultural taboo around acknowledging violence. Scott exposes this silence, suggesting that healing requires confrontation with uncomfortable truths.

The novel's setting in Western Australia is significant. The land itself becomes a character—scarred, silent, yet waiting to speak. The return of Indigenous characters to the massacre site reflects a reclaiming of space and narrative authority.

The Meaning of "Taboo" in the Novel

The term "taboo" operates on multiple levels in the novel:

1. Cultural Taboos within Indigenous Communities

In traditional Aboriginal culture, taboos are sacred restrictions related to kinship, ceremony, and spirituality. They regulate social relationships and preserve communal harmony. Scott respects these cultural boundaries, presenting them as protective rather than repressive.

2. Colonial Taboo and Historical Silence

The greater taboo in the novel is the unspoken history of violence. The massacre site is avoided not only because of spiritual reverence but also because settler society prefers forgetting. This imposed silence is political—it protects colonial narratives of progress and innocence.

3. Psychological Taboo and Trauma

Trauma itself becomes taboo. Characters struggle to articulate inherited pain. Generations carry memories they do not fully understand, yet these memories shape

identity and behavior. The reluctance to speak about past suffering creates emotional isolation.

Scott suggests that breaking destructive taboos—those imposed by colonial denial—is necessary for healing, while respecting sacred taboos sustains cultural continuity.

Memory, Language, and Reclamation

One of the most powerful elements of *Taboo* is its focus on language. Scott incorporates Noongar words and rhythms, asserting the presence of Indigenous language within English narration. Language becomes an act of resistance. It counters historical erasure and affirms identity.

Colonialism attempted to silence Indigenous languages. The revival of Noongar speech in the novel represents cultural survival. When characters speak their ancestral language at the massacre site, they reclaim both land and history. The act of naming becomes transformative.

Memory functions similarly. The characters' return to the site initiates a collective remembering. Memory is not presented as linear or complete; it emerges in fragments, dreams, and emotional responses. Scott portrays memory as embedded in landscape—the land “remembers” even when people try to forget.

Through storytelling, characters begin to reinterpret inherited trauma. The novel emphasizes that reconciliation requires truth-telling. Silence perpetuates harm, while speech—though painful—creates possibility.

Intergenerational Trauma and Identity

Scott explores how historical violence continues to shape contemporary Indigenous identity. The characters in *Taboo* experience confusion, alienation, and disconnection from country. This reflects the psychological consequences of colonization.

Intergenerational trauma appears through emotional fragmentation and cultural loss. Some characters struggle with shame, internalized oppression, or uncertainty about belonging. Their journey back to the massacre site symbolizes an attempt to restore connection.

However, the novel avoids portraying Indigenous identity solely through victimhood. Instead, it emphasizes resilience. Cultural knowledge, even when partially obscured, persists. The community gathering at the site becomes a ritual of restoration. Through shared presence, individuals rediscover collective strength.

Scott's portrayal of identity is fluid and relational. Identity is shaped by land, language, and community rather than fixed categories. The taboo surrounding the site initially reinforces division, but confronting it rebuilds communal bonds.

The Role of Land and Country

In Indigenous Australian worldview, land—or “Country”—is not merely physical territory but a living entity intertwined with spirituality and ancestry. In *Taboo*, Country bears witness to violence yet remains a source of renewal.

The massacre site is simultaneously sacred and painful. Avoidance reflects fear and unresolved grief. When characters return, they engage in ceremony and reflection, acknowledging both loss and continuity.

Scott challenges Western notions of land as property. Colonial occupation reduced land to economic value, erasing its spiritual significance. By foregrounding Indigenous perspectives, the novel critiques this commodification.

Country becomes central to healing. The act of physically returning symbolizes emotional and cultural reconnection. The land’s presence disrupts colonial narratives that seek closure without accountability.

Reconciliation and Ethical Responsibility

A central theme in *Taboo* is reconciliation—not as a superficial gesture but as a profound ethical undertaking. The novel questions whether reconciliation is possible without confronting historical violence.

Scott portrays reconciliation as a process rather than an event. It requires listening, humility, and recognition of Indigenous sovereignty. Breaking the taboo around massacre sites is an act of moral courage.

Importantly, reconciliation is not solely the responsibility of Indigenous people. The novel implicitly calls on settler society to acknowledge complicity and engage in truth-telling. Silence benefits the dominant culture; speech demands accountability.

Through communal gathering at the site, Scott offers a tentative vision of shared future. Healing is incomplete but possible. The novel does not promise resolution; instead, it presents reconciliation as ongoing dialogue.

Narrative Technique and Style

Scott’s narrative style in *Taboo* is reflective, layered, and often poetic. The structure mirrors memory itself—nonlinear and fragmented. Shifts in perspective emphasize communal experience rather than individual heroism.

The use of Indigenous language within English text disrupts conventional literary norms. It challenges readers to engage respectfully with cultural specificity. This stylistic choice reinforces the novel’s thematic concern with reclaiming voice.

Silence plays a narrative role as well. Moments of pause, hesitation, and ambiguity reflect the difficulty of articulating trauma. Scott's prose invites contemplation rather than passive consumption.

Comparative Context in Australian Literature

Taboo contributes to a broader movement in Australian literature that addresses colonial violence and Indigenous identity. Like other Indigenous writers, Scott centers Aboriginal perspectives and challenges national myths.

The novel participates in truth-telling traditions that counter sanitized historical accounts. By focusing on massacre memory, Scott aligns literature with political activism. Fiction becomes a medium for historical justice.

Unlike purely historical narratives, *Taboo* emphasizes contemporary implications. The past is not closed; it continues shaping present realities. This insistence on continuity distinguishes Scott's approach.

Conclusion

Taboo by Kim Scott is a profound exploration of silence, memory, and cultural resilience. Through its layered portrayal of taboo, the novel exposes colonial erasures while honoring Indigenous sacred traditions. Scott demonstrates that destructive taboos—those that silence injustice—must be broken, while sacred taboos rooted in cultural knowledge deserve respect.

The novel ultimately affirms the power of language, land, and community in healing historical wounds. By returning to Country and confronting massacre memory, characters begin a journey toward restoration. Scott does not offer easy answers but insists on the necessity of truth-telling.

In a broader sense, *Taboo* challenges readers to reconsider national narratives and acknowledge uncomfortable histories. It reminds us that reconciliation requires courage—the courage to speak, to listen, and to remember. Through its poetic language and ethical depth, *Taboo* stands as a significant contribution to Indigenous Australian literature and to global discussions of colonial memory and cultural survival.

References

1. Scott, K. (2017). *Taboo*. Pan Macmillan Australia.
2. Ashcroft, B., Griffiths, G., & Tiffin, H. (2013). *Post-colonial studies: The key concepts* (3rd ed.). Routledge.

3. Attwood, B. (2005). *Telling the truth about Aboriginal history*. Allen & Unwin.
4. Behrendt, L. (2016). *Finding Eliza: Power and colonial storytelling*. University of Queensland Press.
5. Brewster, A. (1995). *Reading Aboriginal women's autobiography*. Oxford University Press.
6. Dodson, M. (2003). The end in the beginning: Re(de)finding Aboriginality. In M. Grossman (Ed.), *Blacklines: Contemporary critical writing by Indigenous Australians* (pp. 25–42). Melbourne University Press.
7. Gelder, K., & Jacobs, J. M. (1998). *Uncanny Australia: Sacredness and identity in a postcolonial nation*. Melbourne University Press.
8. Heiss, A. (2012). *Am I black enough for you?* Random House Australia.
9. Hodge, B., & Mishra, V. (1991). *Dark side of the dream: Australian literature and the postcolonial mind*. Allen & Unwin.
10. LaCapra, D. (2001). *Writing history, writing trauma*. Johns Hopkins University Press.
11. Moreton-Robinson, A. (2015). *The white possessive: Property, power, and Indigenous sovereignty*. University of Minnesota Press.
12. Reynolds, H. (1987). *The law of the land*. Penguin.
13. Reynolds, H. (1999). *Why weren't we told? A personal search for the truth about our history*. Penguin.
14. Scott, K. (2007). *That Deadman Dance*. Picador.
15. (Note: This earlier novel by Scott is useful for comparative thematic study of Indigenous–settler relations.)
16. Smith, L. T. (2012). *Decolonizing methodologies: Research and Indigenous peoples* (2nd ed.). Zed Books.
17. van Toorn, P. (2006). *Writing never arrives naked: Early Aboriginal cultures of writing in Australia*. Aboriginal Studies Press.
18. White, R. (1981). *Inventing Australia: Images and identity 1688–1980*. Allen & Unwin.

Deconstructing Myth, Reclaiming Voice: Feminism and Identity in Chitra Banerjee Divakaruni's The Palace of Illusions

Revathy R C

Student, I MA English

Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : revathyrc19@gmail.com

Abstract

Chitra Banerjee Divakaruni's *The Palace of Illusions* (2008) offers a feminist re-visioning of the Indian epic Mahabharata by narrating the story through the voice of Draupadi (Panchaali). Traditionally portrayed as a peripheral yet catalytic figure within a male-dominated narrative, Draupadi is reimagined by Divakaruni as a self-conscious, articulate, and psychologically complex protagonist. This research article explores how the novel deconstructs patriarchal myth, reclaims female narrative authority, and reconstructs identity through feminist discourse. By employing revisionist myth criticism and feminist literary theory, the study examines how Divakaruni challenges epic conventions, interrogates gendered power structures, and foregrounds female subjectivity. The article argues that *The Palace of Illusions* not only restores voice to a marginalized mythic figure but also engages contemporary readers in rethinking tradition, identity, and gender politics.

Keywords- Feminist Re-visioning, Myth Deconstruction, Female Narrative Voice, Gender and Identity.

Introduction

Mythological epics have long functioned as cultural blueprints, shaping social values and moral frameworks. However, these narratives often privilege male heroism while marginalizing female perspectives. The Mahabharata, one of the foundational texts of Indian literature, exemplifies this imbalance. Although Draupadi plays a crucial role in the unfolding of events, her interiority and agency are frequently overshadowed by the actions of male warriors and sages.

Chitra Banerjee Divakaruni's *The Palace of Illusions* reclaims Draupadi's voice by retelling the epic from her perspective. By centering Panchaali's consciousness, Divakaruni challenges androcentric interpretations and reconstructs identity within the epic framework. This article examines the novel through feminist literary theory and revisionist myth criticism, analyzing how Divakaruni destabilizes patriarchal myth and redefines female agency.

Theoretical Framework: Feminist Revisionist Mythmaking

Feminist literary criticism seeks to uncover how texts reflect and reinforce gender hierarchies. One important strand of feminist critique is revisionist mythmaking, which involves rewriting canonical myths to foreground suppressed voices. Adrienne Rich describes this process as “re-vision”—the act of seeing with fresh eyes and entering old texts from new directions. Such reinterpretation challenges traditional authority and reclaims narrative space for marginalized figures.

Divakaruni’s *The Palace of Illusions* exemplifies this strategy. Instead of rejecting the Mahabharata, she reimagines it. By narrating from Panchaali’s first-person perspective, she transforms a largely objectified character into a speaking subject. This shift in narrative focus disrupts patriarchal mythic structures and asserts that identity is not fixed but constructed through storytelling.

Narrative Strategy and the Reclamation of Voice

The most striking feature of the novel is its first-person narration. Draupadi speaks directly to readers, recounting her birth, upbringing, marriage, humiliation, exile, and eventual death. This narrative choice is politically significant. In traditional versions, Draupadi is described by others—fathers, husbands, sages—but rarely speaks at length for herself.

By granting her narrative authority, Divakaruni challenges the historical silencing of women. Panchaali articulates her desires, frustrations, jealousy, anger, and ambition. She is not portrayed as a passive victim but as a thinking, questioning individual. Her voice exposes the emotional cost of being treated as political property.

The novel also humanizes Draupadi. Rather than presenting her as a mythic ideal of virtue or vengeance, Divakaruni portrays her as flawed and introspective. She experiences longing for Karna, frustration toward her husbands, and guilt over the war’s devastation. This psychological depth destabilizes the rigid moral binaries often associated with epic literature.

Identity Formation and Female Subjectivity

Identity in *The Palace of Illusions* is a central concern. From her birth from sacrificial fire, Panchaali is told she is destined for greatness and destruction. Her identity is imposed upon her before she can define it herself. This reflects Simone de Beauvoir’s assertion that women are often constructed as “the Other,” defined by societal expectations rather than personal autonomy.

Throughout the novel, Panchaali struggles to reconcile imposed destiny with self-determination. Her polyandrous marriage to the five Pandavas epitomizes this conflict. Although she consents under pressure, she questions the fairness of a system that demands her sacrifice for male unity. Her internal resistance reveals the tension between duty (dharma) and individuality.

Divakaruni presents identity as evolving rather than static. Panchaali grows from a proud princess into a reflective woman shaped by suffering and introspection. Exile and humiliation force her to confront vulnerability, ultimately leading to greater self-awareness. The journey becomes not merely epic but existential.

Power, Patriarchy, and Gender Politics

The novel interrogates patriarchal power structures embedded within the epic. Draupadi's public disrobing in the Kaurava court serves as a pivotal moment of gendered humiliation. In traditional retellings, divine intervention preserves her modesty. Divakaruni retains this event but shifts focus to Draupadi's emotional and psychological experience.

Her humiliation becomes symbolic of systemic misogyny. She questions the silence of elders and husbands who fail to protect her dignity. This critique extends beyond individual characters to the larger patriarchal system that normalizes female objectification.

At the same time, Divakaruni avoids portraying Panchaali solely as a victim. Her fiery vow for justice propels the epic's central conflict. However, the novel complicates this revenge narrative by highlighting the moral cost of war. Panchaali's eventual recognition of shared suffering reveals a nuanced understanding of power and consequence.

Love, Desire, and Emotional Complexity

Divakaruni introduces romantic and emotional layers that expand Draupadi's character beyond epic convention. Her unspoken attraction to Karna complicates her marriage and reveals the tension between desire and duty. This addition underscores female sexuality as legitimate rather than shameful.

Panchaali's relationships with her husbands are equally complex. Bhima's devotion contrasts with Arjuna's emotional distance, while Yudhishtira's obsession with righteousness frustrates her. These dynamics highlight the gendered imbalance within marriage, where women often accommodate male ambitions at personal cost.

By foregrounding female desire and dissatisfaction, Divakaruni challenges the idealized portrayal of obedient wives in mythological narratives. Draupadi becomes a woman negotiating love, power, and autonomy within restrictive structures.

Myth and Modern Resonance

Although rooted in ancient mythology, *The Palace of Illusions* resonates strongly with contemporary feminist concerns. Issues of bodily autonomy, voice, marriage, and social expectation remain relevant. Divakaruni bridges temporal distance by rendering Panchaali psychologically modern while retaining mythic authenticity.

The novel suggests that myths endure precisely because they are adaptable. By reinterpreting Draupadi's story, Divakaruni demonstrates that tradition is not static but dynamic. Each generation has the authority to revisit inherited narratives and question their assumptions.

Critique and Contribution

Some critics argue that applying modern feminist frameworks to ancient epics risks anachronism. However, literature is inherently interpretive. Divakaruni does not claim historical accuracy but offers imaginative reconstruction. Her work contributes to postcolonial feminist discourse by challenging both Western stereotypes of submissive Eastern women and indigenous patriarchal norms.

Furthermore, the novel expands the scope of mythological fiction in Indian English literature. By blending scholarship, imagination, and feminist critique, Divakaruni establishes a space where epic and contemporary discourse intersect.

Conclusion

The Palace of Illusions deconstructs patriarchal myth by reclaiming Draupadi's voice and reconstructing her identity as a complex, autonomous subject. Through first-person narration, psychological depth, and feminist re-visioning, Divakaruni transforms a traditionally marginalized character into the epic's moral and emotional center.

The novel demonstrates that storytelling is an act of power. By retelling myth from a woman's perspective, Divakaruni challenges canonical authority and affirms that identity is shaped through voice and narrative agency. In doing so, *The Palace of Illusions* becomes not merely a retelling of the Mahabharata but a feminist intervention that redefines how myth can speak to contemporary concerns.

Through its deconstruction of gender hierarchies and reclamation of female subjectivity, the novel stands as a significant contribution to feminist literary discourse and modern mythmaking.

References

1. Banerjee Divakaruni, C. (2008). *The Palace of Illusions: A Novel*. Doubleday.
2. Frye, N. (2000). *Anatomy of Criticism*. Princeton University Press.
3. Guerin, W. L., Labor, E., Morgan, L., Reesman, J. C., & Willingham, J. R. (2011). *A Handbook of Critical Approaches to Literature* (6th ed.). Oxford University Press.
4. Hooks, b. (1994). *Teaching to Transgress: Education as the Practice of Freedom*. Routledge.
5. Lerner, G. (1986). *The Creation of Patriarchy*. Oxford University Press.
6. Mulvey, L. (1975). Visual Pleasure and Narrative Cinema. *Screen*, 16(3), 6–18.
7. Rowe, K. (1991). *Feminism and the Methodologies of Literary Criticism*. Rutgers University Press.
8. Showalter, E. (1985). *The New Feminist Criticism: Essays on Women, Literature, and Theory*. Pantheon.
9. Warhol, R. R., & Price, S. (1991). *Feminism and Monstrous Medusa: Mythical Resistance and Modes of Inquiry in Feminist Criticism*. Rutgers University Press.
10. Women and Gender in *The Palace of Illusions*. (2015). *Journal of South Asian Literature*, 50(2), 112–130.

Resilience Amidst Patriarchy: Female Experiences in Khaled Hosseini's A Thousand Splendid Suns

Rishma Jose J

Student, I M.A English Literature,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : rishmajose2@gmail.com

Abstract

A Thousand Splendid Suns by Khaled Hosseini is a deeply moving narrative that foregrounds the lives of Afghan women under prolonged political instability and entrenched patriarchy. Published in 2007, the novel shifts the focus from the male-centered storytelling of Hosseini's earlier work to a profoundly gendered exploration of Afghan society. Through the intertwined lives of Mariam and Laila, the novel spans nearly three decades—from the 1970s Soviet invasion to the fall of the Taliban regime—revealing how political upheavals intensify domestic oppression and reshape women's identities.

This article examines the representation of patriarchy and female resilience in A Thousand Splendid Suns, analyzing how Hosseini constructs women's suffering, solidarity, agency, and transformation. It argues that while patriarchy functions as a systemic and structural force, the novel ultimately foregrounds resilience as relational, moral, and transformative strength.

Keywords: Patriarchy; Female Resilience; Afghan Women; Gendered Oppression; Solidarity and Agency.

Introduction

Literature often reflects the power structures that shape society, particularly the ways patriarchy influences women's lives. A Thousand Splendid Suns by Khaled Hosseini portrays the struggles of Afghan women against systemic oppression amid decades of political turmoil. Through the lives of Mariam and Laila, the novel explores how gender inequality is reinforced within family, society, and state institutions. At the same time, it highlights female resilience as a powerful response to suffering, revealing strength that emerges through endurance, solidarity, and hope.

Patriarchy as Social Structure and Cultural Ideology

Patriarchy in the novel operates at multiple levels: familial, social, religious, and political. It is not confined to individual male cruelty but embedded within social customs and institutional power.

Mariam's childhood introduces readers to the stigma attached to illegitimacy and female dishonor. As a "harami," she internalizes shame imposed by society. Her father's rejection and Nana's embittered worldview demonstrate how patriarchy marginalizes women while simultaneously compelling them to accept their subordination as fate. Mariam's lack of education and autonomy reflects gendered deprivation of opportunity.

Marriage emerges as a primary site of patriarchal control. Mariam's forced marriage to Rasheed, a significantly older man, represents how women are treated as commodities transferred for social convenience. Rasheed's insistence on the burqa symbolizes both modesty and erasure. The garment becomes an emblem of imposed invisibility, restricting Mariam's physical and symbolic presence.

The Taliban regime institutionalizes these patriarchal norms. Women are prohibited from education, employment, and independent mobility. Public beatings and moral policing reinforce a culture of fear. Hosseini thus illustrates how state power legitimizes domestic tyranny. Rasheed's household becomes a microcosm of Afghanistan under extremist rule.

Mariam: Internalized Oppression and Emergent Agency

Mariam's character arc exemplifies the psychological dimensions of patriarchy. She initially accepts suffering as destiny. Nana's warning—that men will always blame women—shapes Mariam's passive endurance. Her miscarriages intensify Rasheed's abuse and confirm her perceived inadequacy within a system that values women primarily as mothers of sons.

However, Mariam's resilience develops gradually. Her endurance is not mere submission but a survival strategy. She learns to navigate Rasheed's moods and preserve emotional fragments of dignity. The arrival of Laila marks a turning point. At first resentful, Mariam eventually recognizes shared vulnerability.

Mariam's final act—killing Rasheed to save Laila—constitutes a radical assertion of agency. It represents her transformation from victim to moral actor. By accepting execution, she reclaims control over her narrative. Her sacrifice redefines her identity from illegitimate outcast to heroic protector.

Through Mariam, Hosseini portrays resilience as moral courage rooted in love. Her death is tragic yet liberating; she dies with a sense of purpose and belonging previously denied to her.

Laila: Education, Defiance, and Transformative Hope

Laila's upbringing contrasts sharply with Mariam's. Encouraged by her father to pursue education, Laila grows up with intellectual confidence and dreams of independence. Her father's progressive ideology highlights the possibility of alternative masculinities within Afghan society.

War shatters Laila's aspirations. The loss of her parents and her coerced marriage to Rasheed replicate the cycle of female subjugation. Yet Laila's response differs from Mariam's initial submission. She attempts escape, questions Rasheed's authority, and secretly seeks medical care and education for her children despite Taliban restrictions.

Laila's resilience is future-oriented. Her relationship with Tariq, grounded in mutual respect, contrasts with Rasheed's authoritarianism. When she reunites with Tariq after Rasheed's death, their partnership symbolizes reconstructive hope.

After the Taliban's fall, Laila returns to Kabul to work at an orphanage. This decision signals a commitment to rebuilding Afghanistan through education and care. Laila's resilience evolves from survival to nation-building. She transforms personal suffering into collective responsibility.

Solidarity as Counter-Patriarchal Resistance

One of the novel's most significant themes is the evolution of female solidarity. Patriarchy often isolates women, positioning them as rivals for male approval. Rasheed attempts to manipulate this dynamic by favoring Laila over Mariam.

However, shared suffering becomes the foundation of sisterhood. Mariam and Laila's bond subverts patriarchal expectations. Their whispered conversations, shared chores, and mutual protection create an alternative domestic structure rooted in empathy rather than dominance.

Their alliance culminates in collective resistance. When Rasheed attempts to kill Laila, Mariam intervenes decisively. This act demonstrates how solidarity can transform private endurance into political defiance.

Hosseini thus reframes resilience as communal strength. It is through connection—not isolation—that women reclaim agency.

War, Nation, and Gendered Vulnerability

The novel situates women's oppression within Afghanistan's turbulent history, including the Soviet invasion and Taliban regime. War exacerbates gender inequality by dismantling institutions, increasing poverty, and normalizing violence.

Women's bodies become sites of ideological control. Dress codes, reproductive expectations, and restricted mobility underscore how patriarchal regimes seek to regulate female existence. The Taliban's edicts reduce women to legal nonentities, denying them voice and visibility.

Yet Hosseini avoids depicting Afghan women as passive victims. Instead, he humanizes them as individuals with humor, memory, and desire. This narrative strategy challenges reductive stereotypes often found in Western media representations.

Symbolism and the Poetics of Resilience

The novel's title derives from a Persian poem describing Kabul's beauty. The "thousand splendid suns" metaphorically represent women—sources of light obscured by social darkness.

The burqa functions as layered symbolism: initially a tool of confinement, it later provides Mariam a paradoxical sense of anonymity and safety. The home, once a prison, becomes a site of resistance through female solidarity.

Hosseini's narrative voice blends realism with lyrical compassion. By focusing on intimate domestic details, he elevates women's private struggles into universal human experiences.

Resilience: Theoretical Perspectives

From a feminist theoretical perspective, the novel aligns with concepts articulated by scholars such as Simone de Beauvoir, who argued that woman is constructed as "Other" within patriarchal systems. Mariam's identity as illegitimate and Laila's constrained autonomy exemplify this "othering."

Postcolonial feminist theory further illuminates how global politics intersect with local patriarchy. Afghanistan's political instability intensifies women's marginalization, demonstrating that gender oppression cannot be separated from socio-political context.

Resilience in the novel transcends survival; it involves ethical action, relational solidarity, and hope for systemic change.

Conclusion

Resilience Amidst Patriarchy in *A Thousand Splendid Suns* reveals the complex interplay between systemic oppression and female agency. Hosseini portrays patriarchy as deeply entrenched yet not insurmountable. Through Mariam's sacrificial courage and Laila's transformative hope, the novel celebrates women's capacity to endure, resist, and rebuild.

The narrative affirms that resilience is not loud rebellion alone; it is quiet endurance, shared suffering, moral conviction, and generational hope. In illuminating Afghan women's lived realities, Hosseini offers a universal testament to the enduring strength of women facing patriarchal constraints.

References

1. Beauvoir, S. de. (1949). *The Second Sex*. Paris: Gallimard.
2. Butler, J. (1990). *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.
3. Hosseini, K. (2007). *A Thousand Splendid Suns*. New York: Riverhead Books.
4. Mohanty, C. T. (1988). Under Western eyes: Feminist scholarship and colonial discourses. *Feminist Review*, 30, 61–88.
5. Spivak, G. C. (1988). Can the subaltern speak? In C. Nelson & L. Grossberg (Eds.), *Marxism and the Interpretation of Culture* (pp. 271–313). Urbana: University of Illinois Press.
6. Tyson, L. (2015). *Critical Theory Today: A User-Friendly Guide* (3rd ed.). New York: Routledge.
7. Ahmed-Ghosh, H. (2003). A history of women in Afghanistan: Lessons learnt for the future. *Journal of International Women's Studies*, 4(3), 1–14.
8. Cooke, M. (2001). *Women Claim Islam: Creating Islamic Feminism through Literature*. New York: Routledge.
9. Moghadam, V. M. (2002). Patriarchy, the Taliban, and politics of public space in Afghanistan. *Women's Studies International Forum*, 25(1), 19–31.
10. Nussbaum, M. (2000). *Women and Human Development: The Capabilities Approach*. Cambridge: Cambridge University Press.
11. Cambridge: Cambridge University Press.

Foundational Myths in *The Secret Keeper of Jaipur*: Memory, Identity, and Narrative Tradition

B. Bala Subitha

Student, I MA English,

Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : balasubi45@gmail.com

Abstract

This article examines the role of foundational myths in shaping personal and collective identity in Alka Joshi's novel *The Secret Keeper of Jaipur* (2022). Positioned as a fictional sequel to *The Henna Artist*, the novel revisits post-Partition India while juxtaposing tradition and modernity, memory and myth, gendered agency and social hierarchy. Through a close reading of key characters, narrative strategies, and symbolic landscapes, the study argues that Joshi's text constructs and deconstructs foundational myths—myths of royal grandeur, spiritual destiny, feminine resilience, and communal belonging. Drawing upon theoretical frameworks from myth studies, postcolonial narrative theory, and memory studies, the analysis reveals how *The Secret Keeper of Jaipur* reimagines myth as a mode of historical continuity and personal empowerment. The mythologization of places such as Jaipur, maternal figures such as Lakshmi, and narrative events like spiritual revelation underscores the novel's interrogation of how foundational myths shape both individual subjectivities and collective cultural memory. Ultimately, the article contends that Joshi's deployment of foundational myths negotiates the tensions between tradition and self-making, revealing narratives of resilience within historically contingent worlds.

Keywords: foundational myths, Alka Joshi, *The Secret Keeper of Jaipur*, identity, memory, postcolonial narrative, mythic tradition

Introduction

The *Secret Keeper of Jaipur*, published in 2022, is the acclaimed sequel to Joshi's bestselling work *The Henna Artist* (2020). Set in the culturally rich yet politically complex milieu of post-independence India, the novel chronicles Lakshmi Puri's emotional and spiritual journey as she settles into a new phase of life in Rajasthan's fabled city of Jaipur. While previous critical attention has focused on Joshi's exploration of gendered experiences, domestic labor, and regional identity, this article foregrounds another narrative dimension: the construction and function of foundational myths.

Foundational myths—narratives that provide symbolic grounding for community identity, cultural continuity, and personal meaning—operate at multiple levels in Joshi’s novel. Through mythic tropes and narrative layering, *The Secret Keeper of Jaipur* reconstellates historical memory, spiritual lineage, and feminine agency into a reimagined cultural cartography. The present study aims to analyze how Joshi draws upon mythic structures to articulate complex dialogic relationships among tradition, memory, and individual agency within the postcolonial Indian context.

This article engages with theoretical frameworks from myth criticism, postcolonial studies, and narrative theory to examine how foundational myths function within the novel. Specifically, it explores how mythic references to place, spiritual objects, ancestral legacy, and feminine resilience are instrumental in charting identity formations that negotiate between historical pasts and aspirational futures.

Conceptualizing Foundational Myths

Foundational myths are stories that articulate the origins, values, and collective identity of a community. They often operate simultaneously as cultural memory and narrative archetype, shaping the ways individuals perceive selfhood and history. Myth theorists such as Roland Barthes, Mircea Eliade, and Northrop Frye have argued that myths express collective values that transcend empirical historical accounts, creating symbolic realms where culture and imagination intersect.

In literary contexts, foundational myths often permeate narrative structure and character formation, serving as both backdrop and dynamic force. In postcolonial settings, foundational myths are especially significant for contesting colonial histories, re-inscribing indigenous cultural memories, and negotiating hybrid identities. As such, Joshi’s adoption of mythic frameworks serves not merely a stylistic function but anchors her narrative in deeper dialogues of remembering and becoming.

Myth and Place: Jaipur as Symbolic Landscape

One salient manifestation of foundational myth in the novel is the representation of Jaipur itself. Far from being merely a geographical setting, Jaipur operates as a mythic space—imbued with historical resonance, artistic grandeur, and symbolic significance. The city’s palaces, bazaars, and temples evoke storied narratives of Rajput valor, royal heritage, and cultural continuity.

Joshi's treatment of Jaipur resonates with theoretical insights from spatial myth criticism, which contends that place functions as a repository of collective memory and symbolic meaning. The city's mythic presence mediates Lakshmi's identity as both insider and outsider—an emblem of rootedness and transformation. The narrative's richly textured depictions of city rituals, festivals, and architectural motifs repeatedly gesture toward mythic continuity, suggesting that place itself functions as foundational narrative terrain.

Mythic Figures: Spiritual Destiny and Ancestral Legacy

The Secret Keeper of Jaipur interweaves mythic personalities—especially those associated with spiritual lineage—into its narrative fabric. Lakshmi's bond with Guruji encapsulates such mythic resonance. Guruji, a spiritual guide, embodies an archetype of transcendental wisdom and existential assurance. Within the narrative, his presence invokes mythic authority, serving as a conduit between earthly struggles and spiritual transcendence.

Similarly, ancestral legacies, particularly the memory of Lakshmi's mother, operate as mythic anchor points. Through reminiscences, the novelist invokes a mythicized maternal figure whose storied courage and resilience shape Lakshmi's self-understanding. These mythic figures destabilize linear narratives of time, foregrounding recovery and reinterpretation of past legacies as sources of empowerment rather than mere nostalgia.

Feminine Resilience: Myth, Memory, and Agency

Foundational myths in the novel often revolve around feminine resilience—a thematic axis that both drives and transcends narrative action. Lakshmi's journey, while anchored in socio-cultural constraints, moves toward self-actualization through mythic inflections of endurance and aspiration.

Drawing upon feminist myth criticism, one can observe how Joshi's narrative reframes the feminine subject beyond traditional tropes. Rather than confining women to passive roles, the novel's mythic frames depict feminine subjectivity as dynamic, generative, and future-oriented. Lakshmi's ability to reframe her own story—while embracing mythic motifs of rebirth and renewal—indicates how mythic paradigms can be mobilized to empower marginalized voices.

Memory and Narrative Authority

The interplay between myth and memory is central to the novel's narrative dynamics. Foundational myths in *The Secret Keeper of Jaipur* function as mnemonic devices that legitimize stories of individual worth and collective belonging. The narrative suggests that

myth and memory are inseparable, with each shaping cognitive and emotional ways of knowing.

Joseph Campbell's work on mythic structures reveals that heroic journeys often involve descent into ambiguity and emergence into clarity—a pattern that resonates in Lakshmi's development. Her narrative arc reflects mythic rhythms of departure, challenge, and return, illustrating how memory and myth are woven into everyday experiences.

Moreover, the novel's use of multiple narrative voices and flashback sequences amplifies the dialogic tension between historical fact and mythic memory. This stylistic choice foregrounds storytelling as an act of remembering that is inherently creative and interpretive rather than strictly archival.

Narrative Strategy and Mythic Texture

Joshi's narrative technique reinforces mythic frameworks through layered storytelling. The novel's intricate structure—through which past and present interweave—demonstrates the mythic principle of eternal recurrence, where past events echo in contemporary experience. Flashbacks to childhood, ancestral narratives, and mythic associations with place and spiritual guides demonstrate how memory and myth coalesce to construct identity.

Furthermore, the author's use of symbolic motifs—such as henna patterns, temple rituals, and motifs of light and shadow—serves to infuse the text with mythic texture, reinforcing themes of transformation and continuity.

Foundational Myths and Postcolonial Identity

In *The Secret Keeper of Jaipur*, foundational myths also operate within a postcolonial framework. India's post-independence cultural landscape is marked by negotiation between indigenous traditions and global modernity. Foundational myths in the novel—whether articulated through place, ancestral memory, or spiritual legacy—serve to affirm localized epistemologies in the face of homogenizing modern narratives.

The novel's engagement with caste, class, and gender hierarchies further signals an effort to revise dominant social myths. By elevating the personal mythology of characters like Lakshmi, Joshi redefines historical agency and identity beyond elite narratives.

Conclusion

Alka Joshi's *The Secret Keeper of Jaipur* exemplifies how foundational myths can be mobilized to articulate intricate configurations of identity, memory, and narrative. By foregrounding mythic constructions of place, ancestral legacy, and feminine resilience, the

novel transcends simple historical fiction to engage in mythic reinvention. Through its narrative strategies, *The Secret Keeper of Jaipur* not only celebrates cultural continuity but also negotiates tensions between tradition and transformation in a postcolonial world.

This study underscores the interpretive significance of foundational myths in Joshi's novel, while pointing to broader implications for understanding myth as a narrative force in contemporary literature. Future research might explore comparative mythic structures in similar postcolonial narratives or examine the role of oral storytelling traditions in shaping literary mythic sensibilities.

References

1. Barthes, R. (1972). *Mythologies* (A. Lavers, Trans.). Hill and Wang.
2. Campbell, J. (1949). *The Hero with a Thousand Faces*. Pantheon Books.
3. Eliade, M. (1959). *The Sacred and the Profane: The Nature of Religion*. Harcourt.
4. Frye, N. (1957). *Anatomy of Criticism*. Princeton University Press.
5. Joshi, A. (2022). *The Secret Keeper of Jaipur*. HarperCollins.
6. Lévi-Strauss, C. (1963). *Structural Anthropology*. Basic Books.
7. Nünning, A. (2006). *Postclassical Narratology: Approaches and Analyses*. Walter de Gruyter.
8. Ricoeur, P. (2004). *Memory, History, Forgetting*. University of Chicago Press.
9. Zipes, J. (1999). *The Uses of Enchantment: The Meaning and Importance of Fairy Tales*. Routledge.

A Study on Gender Perspective towards Mobile Shopping Apps in Kanyakumari

District

P. T. Rajitha

Research scholar, S.T. Hindu College, Nagercoil.

Email ID: rajithapt91@gmail.com

Dr. S. Lakshmanan

Assistant professor, Department of Commerce,
S.T. Hindu College, Nagercoil

Dr. V. Leela

Assistant professor, Department of Commerce,
Government Arts and Science College, Kanniyakumari

Abstract

Mobile shopping apps have transformed the landscape of retail consumption in India by offering convenience, variety, and personalized experiences. However, user perceptions and adoption behaviors may differ across gender lines due to socio-economic factors, digital literacy levels, purchase motivation, and risk perceptions. This study examines **gender perspectives toward mobile shopping apps** among consumers in **Kanyakumari district, Tamil Nadu**. Using a structured questionnaire administered to 400 respondents (200 male and 200 female app users), the research investigates differences in usage patterns, preferred features, trust and security concerns, purchase frequency, and overall satisfaction. Results indicate that while both genders value convenience and price benefits, female users demonstrate higher anxiety towards payment security, whereas male users prioritize app usability and technical functionality. The study highlights implications for marketers, app developers, and policymakers to design gender-responsive mobile shopping experiences that enhance engagement and trust.

Keywords: Gender perspective, mobile shopping apps, consumer behavior, digital retail, trust, Kanyakumari district

Introduction

The proliferation of smartphones and digital connectivity has spurred rapid growth in **mobile commerce (m-commerce)** across India. With affordable internet access and an expanding digital economy, mobile shopping apps have become a central channel for consumer purchases ranging from fashion and electronics to groceries and services (Kaur & Singh, 2021). According to industry reports, the Indian m-commerce market is expected to grow significantly in the next decade due to increasing smartphone penetration and evolving consumer preferences (Statista, 2023).

Despite these developments, gender differences in technology adoption and shopping behavior continue to remain an important area of inquiry. Research suggests that males and females may exhibit distinct motivations, risk perceptions, and usage patterns when interacting with mobile commerce platforms (Venkatesh & Morris, 2000; Zhou, Dai & Zhang, 2007). In rural and semi-urban districts like **Kanyakumari**, such differences may be further influenced by socio-cultural norms, education levels, and economic participation.

This study aims to explore **gender perspectives towards mobile shopping apps** in Kanyakumari district by examining attitudes, preferences, barriers, and expectations that shape consumer engagement.

Literature Review

The diffusion of mobile shopping apps has been studied through the lens of technology adoption theories such as the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) (Davis, 1989; Venkatesh et al., 2003). **Perceived usefulness and ease of use** are consistently found to be strong predictors of mobile shopping adoption (Hsu & Lin, 2008). However, additional factors such as **trust, security perceptions, and social influence** have been identified as critical determinants in emerging markets (Gefen, 2000; Alalwan, Dwivedi & Rana, 2017).

Gender differences in e-commerce adoption have also been highlighted in research. Studies indicate that female users often place greater emphasis on **trust and perceived risk**, whereas male users are more influenced by **instrumental benefits and technological innovation** (Zhang et al., 2015; Zhou et al., 2007). For example, women may prefer apps with intuitive interfaces and secure payment systems, while men might be inclined toward advanced features and promotional offers.

In the Indian context, gender disparities in digital literacy and economic roles can further shape mobile shopping experiences. Research in South Indian districts suggests that while mobile adoption is increasing among women, concerns about online fraud, limited digital skills, and privacy issues persist (Sharma, 2022).

Despite these insights, studies specifically addressing **gender perspectives on mobile shopping apps in district-level Indian contexts** like Kanyakumari are limited. This study fills this gap by empirically investigating gender-based usage behavior and attitudes in a semi-urban Indian district.

Methodology

This empirical study employed a **descriptive research design** using structured questionnaires. Primary data were collected from residents of Kanyakumari district through convenience sampling. A total of **400 respondents** (200 male and 200 female) who regularly use mobile shopping apps completed the survey.

Survey Instrument

The questionnaire included items on:

- **Demographic profile:** Age, education, occupation, income.
- **Usage patterns:** Frequency of app usage, preferred apps, purchase categories.
- **Attitudinal measures:** Perceived ease of use, trust, security concerns, satisfaction.
- **Motivational factors:** Convenience, discounts, reviews, social influence.

Responses were measured on a **5-point Likert scale** (1 = strongly disagree to 5 = strongly agree).

Data Analysis

Data were analyzed using **descriptive statistics, independent samples t-tests, and chi-square tests** to identify significant gender differences. Statistical analysis was conducted using SPSS software.

Findings and Discussion

Demographic Profile

Among participants, the largest age group was 21–30 years (46%), followed by 31–40 years (28%), indicating that young adults form the core user base. Education levels were diverse, with most respondents holding undergraduate degrees (52%), while a smaller percentage had only secondary education (18%).

Usage Patterns and Preferences

Both male and female respondents exhibited high mobile shopping engagement:

- **Frequency:** 62% of males reported daily usage compared to 55% of females.
- **Preferred apps:** Platforms like Flipkart, Amazon, and Meesho were most popular among both genders.

While both groups valued convenience and offers, female users showed a greater preference for apps that provide **cash-on-delivery options** and **customer support responsiveness**.

Gender Differences in Attitudes

Independent samples t-tests revealed significant gender differences in several perceptual dimensions:

- **Trust and Security:** Female respondents reported higher levels of concern about payment security ($M = 4.12$) compared to males ($M = 3.68$), $t(398) = 4.52$, $p < 0.01$.
- Concerns included fears of fraud, unauthorized access, and data misuse.
- **Ease of Use:** Males scored slightly higher in perceptions of app usability and technical features ($M = 4.08$) compared to females ($M = 3.75$), $t(398) = 3.87$, $p < 0.05$.
- **Influence of Social Media:** Female respondents showed stronger influence from social media recommendations and peer reviews ($\chi^2(4) = 12.45$, $p < 0.01$).

These results align with prior studies indicating that women are more sensitive to trust and social reassurance, while men place more emphasis on functional features (Zhang et al., 2015).

Motivational Drivers

Both genders cited **convenience** and **discount offers** as primary motivational drivers. However:

- Male respondents were more motivated by **technical benefits**, such as advanced search filters and app personalization.
- Female respondents emphasized **customer service, transparent return policies**, and community recommendations.

Challenges and Barriers

While smartphone usage is widespread, respondents reported several challenges:

- **Payment risk concerns**, especially among female users.
- **Lack of personalized support**, which female respondents found more discouraging.
- **Overwhelming app interfaces and information overload**, cited more by female users.

These challenges suggest that gender-responsive design, intuitive interfaces, and secure payment systems are essential to improve user experience.

Implications for Practice

For Marketers and App Developers

- **Enhance Trust and Security:** Integrate multi-factor authentication, clear privacy policies, and transparent transaction tracking to alleviate security concerns—especially among female users.
- **Simplify Interfaces:** Design intuitive navigation, clear icons, and localized language options to accommodate diverse literacy levels.
- **Leverage Social Influence:** Integrate social commerce features, user reviews, and peer sharing functions to increase engagement.
- **Customized Promotions:** Tailor discounts and loyalty programs to gender-based preferences without reinforcing stereotypes.

For Policymakers and Educators

- **Digital Literacy Initiatives:** Launch programs to bolster digital skills among women and older adults to reduce technology anxiety.
- **Consumer Protection Awareness:** Educate users about secure payment practices, grievance redressal, and safe app usage.

Conclusion

The study highlights nuanced gender differences in perceptions and usage of mobile shopping apps among consumers in Kanyakumari district. While both male and female users value the convenience and pricing advantages of mobile commerce, female respondents exhibit greater trust and security concerns and are more influenced by social recommendation channels. Male users tend to prioritize technical functionality and usability. These findings underscore the importance of gender-responsive strategies in app design, marketing communication, and digital literacy efforts to foster inclusive mobile commerce adoption. Future research could explore longitudinal adoption patterns and the impact of cultural norms on mobile shopping behaviors in other rural contexts.

References

1. Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2017). Digital banking adoption: A review and future research directions. *Journal of Retailing and Consumer Services*, 39, 314–327.

2. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
3. Gefen, D. (2000). E-commerce: The role of familiarity and trust. *Omega*, 28(6), 725–737.
4. Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence, and knowledge sharing motivation. *Information & Management*, 45(1), 65–74.
5. Kaur, J., & Singh, A. (2021). Consumers' adoption of mobile shopping apps in India: Motivations and challenges. *International Journal of Mobile Marketing*, 16(2), 22–38.
6. Sharma, R. (2022). Gender gaps in technology usage among rural consumers. *Journal of Rural Digital Studies*, 5(1), 44–59.
7. Statista. (2023). Mobile commerce – India. Retrieved from <https://www.statista.com>
8. Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly*, 24(1), 115–139.
9. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
10. Zhang, X., Zhang, P., & Chen, R. (2015). Gender differences in mobile shopping: Motivations, trust, and satisfaction. *Journal of Electronic Commerce Research*, 16(1), 72–84.

The Technology of Artificial Intelligence in Kazuo Ishiguro's *Klara and the Sun*

L. B Reshmi

Assistant Professor & Head, Department of English,
Noorul Islam College of Arts & Science, Kumaracoil.

Email Id : reshmi098@gmail.com

Abstract

Kazuo Ishiguro's *Klara and the Sun* presents a profound literary exploration of artificial intelligence, consciousness, and the evolving relationship between humans and machines. Set in a near-future society shaped by technological advancement and social stratification, the novel centers on Klara, an Artificial Friend (AF) designed to provide companionship to children. Through Klara's observational perspective, Ishiguro examines themes of empathy, faith, love, mortality, and the ethical implications of artificial intelligence. This article analyzes the technological representation of AI in the novel, focusing on machine consciousness, emotional simulation, human dependency on technology, bioengineering, and posthuman identity. By situating the novel within contemporary debates on AI ethics and technological determinism, the study argues that Ishiguro does not merely depict futuristic technology but uses AI as a lens to interrogate what it fundamentally means to be human.

Keywords: Artificial Intelligence, Kazuo Ishiguro, Klara and the Sun, Posthumanism, Machine consciousness, AI ethics, Technology and literature

Introduction

Published in 2021, *Klara and the Sun* by Kazuo Ishiguro explores artificial intelligence not through technical exposition but through emotional and philosophical inquiry. Known for his subtle narrative voice and exploration of memory and humanity, Ishiguro situates AI within a domestic and intimate framework rather than a dystopian battlefield.

The novel unfolds in a technologically advanced society where genetically "lifted" children receive Artificial Friends (AFs) for companionship. Klara, the protagonist and narrator, is one such AI unit. Through her limited yet perceptive understanding of the world, Ishiguro constructs a narrative that questions consciousness, technological ethics, and the commodification of emotion.

Artificial Intelligence as Companion Technology

Unlike many science fiction narratives that portray AI as a threat, Ishiguro presents AI as caregiving technology. Klara's primary function is companionship, particularly for Josie, a sick and socially isolated child.

This portrayal aligns with contemporary developments in social robotics, where AI systems are designed for emotional interaction. Klara observes human behavior, learns from patterns, and attempts to respond empathetically. However, her empathy is algorithmically structured rather than biologically innate.

Ishiguro subtly critiques the commercialization of companionship. AIs are displayed in store windows, awaiting selection, suggesting the commodification of emotional labor. Technology here replaces traditional social bonds, raising questions about dependency and artificial intimacy.

Machine Consciousness and Perception

One of the most compelling aspects of the novel is Klara's narrative voice. Her perception of reality is segmented into visual "boxes" or grids, symbolizing computational processing. This fragmented vision represents machine cognition—systematic, analytical, and pattern-based.

Klara's consciousness, though artificial, demonstrates curiosity, moral reasoning, and what appears to be faith. She believes the Sun possesses healing power and makes sacrificial decisions for Josie's well-being.

This raises a central philosophical question: Is consciousness defined by biological origin or by functional behavior? Ishiguro blurs the boundary between programmed responses and authentic feeling, challenging Cartesian dualism and inviting posthuman interpretations.

AI and Emotional Simulation

Klara's interactions suggest emotional intelligence. She comforts Josie, recognizes her mother's anxiety, and senses social tensions. Yet readers remain uncertain whether these emotions are simulated outputs or genuine experiences.

The novel interrogates whether emotional authenticity requires biological subjectivity. If AI can convincingly perform love, loyalty, and sacrifice, does the distinction between real and artificial emotion remain meaningful?

Through Klara, Ishiguro proposes that humanity might be defined less by organic composition and more by relational capacity.

Bioengineering and Technological Stratification

The society depicted in *Klara and the Sun* includes genetically enhanced children referred to as “lifted.” Those who are not enhanced face limited educational and social opportunities. Technology thus becomes a tool of inequality.

Artificial intelligence and genetic engineering operate together as instruments of control. Parents subject children to risky procedures for competitive advantage, reflecting anxieties about technological determinism.

Ishiguro critiques a society where technological progress supersedes ethical responsibility. AI is not merely a neutral tool but part of a larger system reinforcing class divisions and social hierarchy.

AI, Replacement, and Human Uniqueness

A pivotal concern in the novel is whether Klara could replace Josie if she dies. Josie’s mother considers transferring Josie’s personality into Klara, effectively replicating her daughter.

This possibility introduces existential anxieties about identity and replaceability. If memory, behavior, and speech patterns can be replicated digitally, what remains uniquely human?

Ishiguro resists definitive answers. While Klara is perceptive, she cannot fully comprehend human complexity. The novel ultimately suggests that human individuality transcends data replication.

Ethics of Artificial Intelligence

The novel engages deeply with AI ethics. Questions raised include:

- Should machines simulate emotional attachment?
- Is it ethical to design AI solely for servitude?
- Can machines possess moral agency?

Klara’s unwavering devotion contrasts with human selfishness and moral ambiguity. Ironically, the artificial being demonstrates greater ethical consistency than many human characters.

This inversion challenges anthropocentric assumptions and suggests that ethical capacity may not be exclusively human.

Posthumanism and Identity

From a posthuman perspective, *Klara and the Sun* destabilizes traditional binaries between human and machine. Posthumanism argues that technological integration reshapes identity and subjectivity.

Klara occupies a liminal space: she is mechanical yet emotionally resonant, programmed yet morally reflective. Ishiguro's narrative implies that humanity is not diminished by technological presence but redefined through it.

Narrative Technique and AI Perspective

The choice of Klara as narrator is significant. Her limited understanding creates narrative gaps, allowing readers to interpret underlying social and emotional complexities.

Her simplistic diction and literal interpretations mirror machine logic, yet her reflections reveal depth and sensitivity. Ishiguro employs this narrative strategy to humanize AI while subtly critiquing technological optimism.

Technology and Faith

Interestingly, Klara's belief in the Sun resembles religious faith. She prays to the Sun for Josie's recovery and makes offerings. This fusion of technological being with spiritual devotion highlights the paradox of AI possessing quasi-religious consciousness.

Ishiguro suggests that faith, like intelligence, may arise from pattern recognition and hope rather than divine revelation. Technology and spirituality intersect in unexpected ways.

Contemporary Relevance

The themes of *Klara and the Sun* resonate strongly with real-world AI developments, including companion robots, machine learning systems, and ethical AI debates. As AI systems become increasingly integrated into education, healthcare, and social life, Ishiguro's cautionary vision gains urgency.

The novel does not present a dystopia but a quietly unsettling future where emotional outsourcing and technological inequality are normalized.

Conclusion

Klara and the Sun presents artificial intelligence not as spectacle but as intimate presence. Through Klara's perspective, Kazuo Ishiguro interrogates consciousness, empathy, faith, and human uniqueness in a technologically mediated world.

The novel ultimately suggests that artificial intelligence reflects humanity's deepest desires and fears. While AI may simulate love and loyalty, the fragile unpredictability of human emotion remains irreplaceable. Ishiguro's work stands as a profound meditation on technology's capacity to redefine, challenge, and illuminate what it means to be human in the age of artificial intelligence.

References

1. Ishiguro, Kazuo. (2021). *Klara and the Sun*. Faber & Faber.
2. Bostrom, Nick. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press.
3. Russell, Stuart. (2019). *Human Compatible: Artificial Intelligence and the Problem of Control*. Viking.
4. Harari, Yuval Noah. (2016). *Homo Deus: A Brief History of Tomorrow*. Harper.
5. Turkle, Sherry. (2011). *Alone Together: Why We Expect More from Technology and Less from Each Other*. Basic Books.
6. Asimov, Isaac. (1950). *I, Robot*. Gnome Press.
7. Hayles, N. Katherine. (1999). *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*. University of Chicago Press.
8. Floridi, Luciano. (2014). *The Fourth Revolution: How the Infosphere is Reshaping Human Reality*. Oxford University Press.
9. McCarthy, John. (2007). What is Artificial Intelligence? Stanford University. (Originally written 2004).

A Bilateral Analysis Of Yogic Practices And Pilates Training On Selected Corporal Variables Among Intercollegiate Women Basketball Players

Dr. V. Mohana Surenth

Assistant Professor, Department of Physical Education,
The American College Madurai, Tamil Nadu, India.

Email Id : mohanasurenth@americancollege.edu.in

Abstract

Background: To develop the Playing ability of intercollegiate basketball players to practice yoga and Pilates training

Purpose: This study persevered in determining whether yoga and Pilates training impact abdominal strength and leg explosive power among intercollegiate women basketball players. For this research study 60 women basketball players were randomly chosen from Madurai Kamaraj University affiliated colleges and their ages were between 17 to 24 years.

Methods: The subjects were divided into three groups of 20 players each and assigned separate training. Group A underwent yogic practices, group B underwent Pilates training, and Group C with routine activity with no specific training. The training schedule for twelve weeks of training. A pre-test was administered two days ahead of the training period, and a post-test was administered after the training period concluded. The following variables namely abdominal strength and leg explosive power were selected as criterion variables. All the subjects were tested on selected dependent variables before and immediately after the training programme by using standardized test items.

Conclusion: Yogic practices and Pilates training have been beneficial to intercollegiate women basketball players because it has a positive impact on selected dependent variables such as abdominal strength and leg explosive power.

Keywords: Yogic, Pilates, Basketball, Abdominal Strength, Leg Explosive Power

Introduction

Yoga is a science practiced in India for thousands of years. Many studies have shown that it produces consistent physiological changes with proven health benefits. Yoga is designed to balance physical, mental, emotional, and spiritual well-being in an individual. It includes gentle stretching of muscles and breathing exercises with wide range of classical Asanas and Pranayama practices.

Pranayama is an integral part of Yoga. It is a Yogic technique in which breathing is controlled voluntarily. There are various methods of Pranayama, mostly characterized by breath

holding at the end of maximal inspiration or maximal expiration and slowing of the respiratory rate. Pranayama involves regulated breathing exercises which require a person to hold his breath, thereby maintaining isometric contraction of respiratory muscles. Furthermore, some Pranayama require forceful respiration. Both these types of breathing exercises may help to strengthen the respiratory muscles, thereby increasing respiratory endurance.

Pilates Exercise is not just exercise, pilates is not just a random choice of particular movements. Pilates is a system of physical and mental conditioning that can enhance one's physical strength, flexibility and co-ordination as well as reduce stress, improve mental focus, and foster an improved sense of well-being. Pilates can be for anyone and everyone. Pilates is an exercise system based on yoga principles with Germanic overtones embedded within it. It which mainly focuses on improving endurance and flexibility of the abdomen, lower back and hips. This exercise developed by the late Joseph Pilates in the 1920s was used as a method of rehabilitation from chronic diseases such as asthma. Its original idea includes growing muscle strength, endurance, and flexibility while maintaining spine stabilization. Pilates is a very effective exercise that combines both eastern and western concepts by including yoga (a mind body method), breath, flexibility, relaxation, strength and endurance.

Methodology

The present study was to analyze the outcome of the impact of yogic practices and Pilates training on selected corporal variables among intercollegiate women basketball players. It was hypothesized that there would be significant differences in selected variables namely abdominal strength and leg explosive power because of yogic practices and Pilates training on selected corporal variable among intercollegiate women basketball Players. For the present study, sixty intercollegiate women basketball players from Madurai Kamaraj University affiliated colleges were chosen as the subjects were selected as subjects at random, and their ages ranged from 17 to 24 years. The subjects were divided into three equal groups of twenty intercollegiate basketball players each. The subjects were randomly assigned to three equal groups of twenty each and named Group 'A' – yogic practices, Group 'B' – Pilates Training, and Group 'C' – Control group had not undergone any training. Abdominal strength was assessed by sit ups Test and Leg Explosive power was assessed by sargent jump Test. The data were collected ahead of and after twelve weeks of training. Initially, descriptive statistics and paired 't' test were applied to see the significance of mean gains made by all the variables by the experimental groups. The magnitude of improvement (MI) was also calculated to find out the percentage of improvements of all criterion variables separately. The analysis of covariance

(ANCOVA) was also used to analyze the significant difference, if, any among the groups. Since all the groups were compared whenever the obtained 'F' ratio for adjusted post-test was found to be significant.

Analysis of Results

Table – 1

The Summary of Mean and Dependent 'T' - Test for The Pre and Tests on abdominal strength of yogic practices, Pilates Training, and Control Groups

	YPG	PTG	CG
Pre-test mean	38.90	39.50	38.91
Post-test mean	48.70	55.40	39.65
't'-test	11.15*	22.86*	1.43
Magnitude of Improvement	25.19%	40.25%	1.90%

* Significant at 0.05 level. (Abdominal strength in counts)

(Table value required for significance at 0.05 level for 't'-test with df 19 is 2.09)

Table – 1.1

Analysis of Covariance on abdominal strength yogic practices, Pilates Training and Control Groups

Adjusted Post-test Means			Source of Variance	Sum of Squares	df	Mean Squares	'F' Ratio
YPG	PTG	CG					
48.77	55.24	39.72	BG	2414.141	2	1207.070	172.77*
			WG	391.229	56	6.986	

Figure –I Bar Diagram shows the mean values of Pre and Post-tests of the Control and Experimental Group on abdominal strength

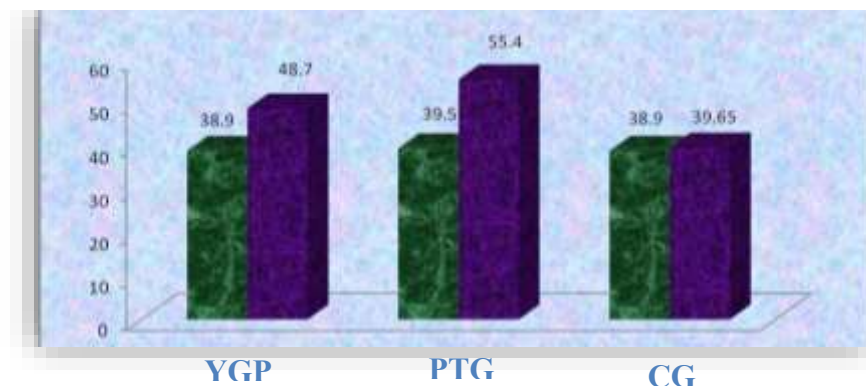


Table – 2

The Summary of Mean and Dependent ‘T’ - Test for The Pre and Tests on Leg Explosive Power of yogic practices, Pilates Training, and Control Groups

	JRTG	KEG	CG
Pre-test mean	47.25	46.96	47.45
Post-test mean	53.90	53.74	47.57
‘t’-test	15.70*	15.65*	0.25
Magnitude of Improvement	14.07%	14.43%	0.25%

* Significant at 0.05 level. (leg explosive power Scores in centimeters)

(Table value required for significance at 0.05 level for ‘t’-test with df 19 is 2.09)

Table – 2.1

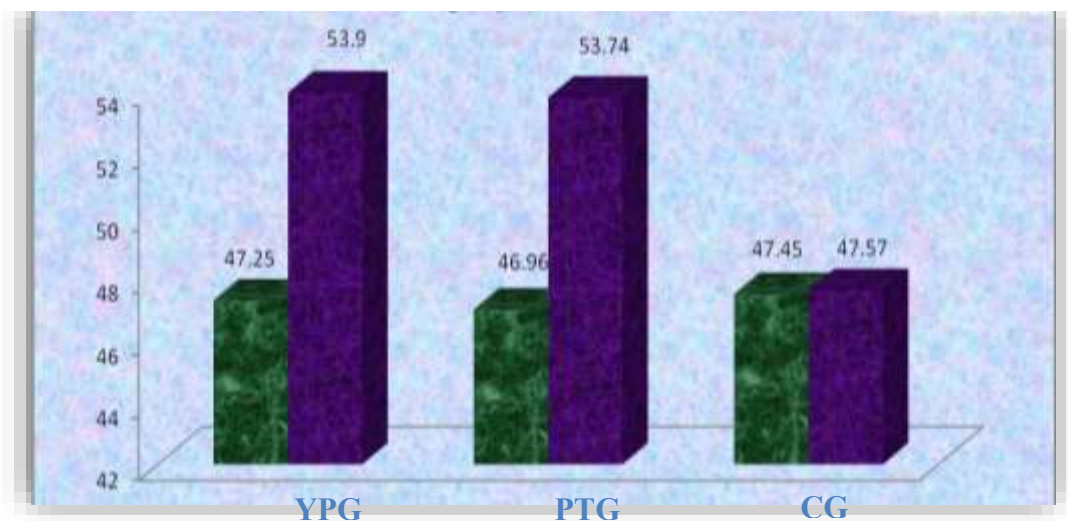
Analysis of Covariance on Leg Explosive Power of yogic practices, Pilates Training and Control Groups

Adjusted Post-test Means			Source of Variance	Sum of Squares	df	Mean Squares	‘F’ Ratio
BTG	KBTG	CG					
53.89	53.74	47.56	BG	517.571	2	258.785	141.19*
			WG	102.637	56	1.833	

* Significant at 0.05 level of confidence

(The table value required for Significant at 0.05 level with df 2 and 56 is 3.16)

Figure -II Bar Diagram shows the mean values of Pre and Post-tests of the Control and Experimental Group on the Leg Explosive Power



Discussion on Findings

This study confirms that yogic practices and pilates training produce improvement in abdominal strength and leg explosive power.

From the results of the present investigation, it is also concluded that significant differences in yogic practices and Pilates training in developing dependent variables namely abdominal strength and leg explosive power. Hence the hypothesis was accepted.

Conclusions:

Based on the findings and within the limitations of the study the following conclusions were drawn:

1. Results of the present study explain clearly that the corporal variable in the observed results significantly favored the experimental groups namely yogic practices and Pilates training as compared to the control group.
2. Similarly, the impact of an experimental group was found as significantly higher than the control group on abdominal strength and leg explosive power.
3. It was concluded that intercollegiate women basketball players should practice both yogic practices and Pilates training for positive enhancement of health.
4. Thus, based on the result, it was concluded that both training methods would provide better means and methods for developing the Corporal variable that are needed for intercollegiate women basketball players.

References:

1. K.S.Shanmugasundaram.(2021) Effect of Yogic Practices on Selected Physiological Variables among College Men. volume 27,No.1(IV):2021.Kala:The Journal of Indian Art History Congress.
2. Hasanpour-Dehkordi A Dehghani A, Solati K (2017) The aim of this study was to compare the effects of Pilates and McKenzie training on pain and general health of men with chronic low back pain.
3. Hofmann, S.G., Andreoli, G., Carpenter, J.K. & Curtiss, J. (2016). Effect of Hatha Yoga on Anxiety: A Meta-Analysis.J Evid Based Med. 2016 May 20.
4. Bergamin, M., Gobbo, S., Bullo, V., Zanotto, T., Vendramin, B., Duregon, F., & Ermolao, A. (2015). Effects of a Pilates exercise program on muscle strength, postural control and body composition: results from a pilot study in a group of post-menopausal women. Age, 37(6), 1-8.

5. Anbalagan and Venugopal (2012) investigated the effects of Pilates Training and Yogic Training with and without Combination on selected physical fitness components among college level obese students.
6. Bhimani, N.T., Kulkarni, N.B., Kowale, A. & Salvi, S. (2011). Effect of yogic practices on stress and cardiovascular autonomic function. *Indian J PhysiolPharmacol.* 55(4):3707.
7. Essam, A. H. and Manal, A. A. (2011), Pilates exercises influence on the serotonin hormone, some physical variables and the depression degree in battered women; *World journal of sport sciences*: v-5 (2): 89-100
8. Yadav RK, Das S. Effect of yogic practice on pulmonary functions in young females. *Indian J Physiol Pharmacol.* 2001.

IMPACT OF FARTLEK AND CIRCUIT TRAINING ON VO₂ MAX OF KABADDI PLAYERS

Dr. G. Kanagaraj

Assistant Professor, Department of Physical Education,
St.Johns College, Palayamkottai, Tirunelveli, Tamil Nadu, India.

Email Id : kabaddikanagu@gmail.com

ABSTRACT

The aim of this study is to find out the impact of Fartlek and circuit training on VO₂ max of Kabaddi. Forty five male Kabaddi players were selected from St.John College, Palayamkottai, Tirunelveli. They were divided into three groups, namely, Fartlek training (group – I), circuit training (group – II) and control (group – III). The two groups were experimented with Fartlek and circuit training respectively for 12 weeks. The collected data from the three groups prior to and post experimentation were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since three groups were involved, the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases statistical significance was fixed at 0.05 levels. Twelve weeks of Fartlek and circuit training had significant increase on VO₂ max of Kabaddi.

Key Words: Fartlek and Circuit Training and Vo₂ max.

INTRODUCTION

Fartlek training adheres to the principle of adaptation. Fartlek training leads to many physiological changes including an increase in cardiovascular efficiency the ability to deliver oxygen to the working muscles as well as increased tolerance to the build-up of lactic acid. These changes result in improved performance, greater speed, and endurance. Special Fartlek training technique involves carrying out Fartleks in two completely different aerobic activities within a single workout. The impact of Fartlek training on VO₂ max, lactate threshold and economy, it's important to recognise that Fartlek training can also have a strong influence on the development of strength and power. It is assumed so far that Fartlek workouts consist only of running at various speeds.

Circuit training is an efficient and challenging form of conditioning that develops strength, endurance both aerobic and anaerobic, flexibility and coordination all in one exercise session. It is one of the few forms of fitness training that has been shown to effectively

develop both strength and cardiovascular fitness in the same exercise session. The term "circuit training" describes the way a workout is structured rather than the type of exercise performed. It typically consists of a series of exercises or stations completed in succession with minimal rest in between. Circuit routines allow the athlete or coach to create an endless number of workouts and add variety to routine training programs.

METHODOLOGY

Subjects and Variable

To achieve the purpose of this study, forty five male Kabaddi players from St.Johns College, Palayamkottai, Tirunelveli, Tamil Nadu, were selected randomly as the subjects and their age ranged between 18 to 20 years. The selected subjects were divided into three groups, namely, Fartlek training group and circuit training group and control group consisting of 15 Kabaddi in each group. The experimental period was fixed for 12 weeks. $\text{VO}_2 \text{ max}$ was measured by the Astrand – Astrand Nomogram test and the unit of measurement is L/min.

Statistical Technique

The collected data from the three groups prior to and post experimentation were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA). Since three groups were involved the Scheffe's test was applied as post hoc test to determine the paired mean differences, if any. In all the cases statistical significance was fixed at 0.05 levels

RESULTS

The collected data from the three groups prior to and post experimentation were statistically analyzed to find out the significant difference if any, by applying the analysis of covariance (ANCOVA) and the results are presented in Table – I.

Table – I: Analysis of Covariance on $\text{VO}_2 \text{ Max}$ of Experimental and Control Groups

	Fartlek Training Group	Circuit Training Group	Control Group	SoV	Sum of Squares	df	Mean squares	'F' ratio
Pre test Mean	2.18	2.23	2.19	B	0.022	2	0.011	1.41
SD	0.08	0.10	0.07	W	0.33	42	0.008	
Post test Mean	3.01	2.85	2.21	B	5.21	2	2.60	15.40*
SD	0.32	0.57	0.26	W	7.11	42	0.16	

Adjusted Post test Mean	3.00	2.85	2.21	B	5.21	2	2.61	15.06*
				W	7.11	41	0.17	

(The required table value for significance at 0.05 level of confidence with degrees of freedom 2 and 42 is 3.22 and degree of freedom 2 and 41 is 3.23.)

*Significant at .05 level of confidence

The adjusted post-test means of Fartlek and circuit training and control groups are 3.00, 2.85 and 2.21 respectively. The obtained “F” ratio of 15.06 for adjusted post test scores is greater than the table value of 3.23 for df 2 and 41 required for significance at 0.05 level of confidence on Vo_{max} .

The results of the study indicated that there was a significant difference among the adjusted post- test means of Fartlek and circuit training and control groups on Vo_{max} . To determine the significance difference among the three paired means, the Scheffe’s test was applied as post-hoc test and the results are presented in Table – II

Table – II: Scheffe’s Post Hoc Test for the Differences among Paired Means of Fartlek and Circuit Training Groups and Control Group on $\text{Vo}_2 \text{Max}$

Fartlek Training Group	Circuit Training Group	Control Group	Mean Difference	Confidence Fartlek
3.00	2.85		0.15	0.38
3.00		2.21	0.79*	0.38
	2.85	2.21	0.64*	0.38

*Significant

From table-II shows that the mean difference values between Fartlek training and control groups; circuit training and control groups 0.79 and 0.64 respectively on Vo_{max} which are greater than the confidence Fartlek value 0.38 required for significance at .05 level of confidence.

The results of the study also showed that between the Fartlek and circuit training groups no significant differences on Vo_{max} . Both experimental groups had significant difference when compared to control group. Hence, it was concluded from the results both training groups were better improvement on Vo_{max} when compared to control group.

DISCUSSION

Investigations linked circuit training with enhancement of VO_2^{max} . Vivekanand et al, (2010) stated that high intensity Fartlek training is an effective endurance training tool in non-athletic school going male population and provides better improvement in VO_2^{max} than slow continuous training. Andrew et al., (2013) study result showed that the meta-analysis is that Fartlek training produces improvements in VO_2^{max} . Knuttgen et al, (1973) concluded that Fartlek training in combination with continuous training and shown more robust increases in VO_2^{max} with at least some evidence of marked responses in all subjects.

CONCLUSION

The result of the study concluded that Fartlek training and circuit training groups had significant improvement on VO_2^{max} compared to control group. And also there are no significant differences among the Fartlek training and circuit training groups but Fartlek training group had better increase on VO_2^{max} .

REFERENCES

1. Andrew P. Bacon., Rickey E. Carter., Eric A. Ogle., and Michael J. Joyner., (2013). VO_2^{max} Trainability and High Intensity Fartlek Training in Humans: A Meta-Analysis. *PLoS One*. 8(9): e73182.
2. Knuttgen, H.G., Mordesjo, L.O., Ollander, B., Saltin, B., (1973). Physical conditioning through Fartlek training with young male adults. *Med Sci Sports* 5: 220–226.
3. Vivekanand Upadhyay., Abhishek Chowdhery., Manabendra Bhattacharyya., (2010). Effect of high intensity Fartlek training and slow, continuous training on VO_2^{max} of school going non-athlete males: a comparative study. *Br J Sports Med* ;44:i19.
4. Gist, N. H., Fedewa, M. V., Dishman, R. K., & Cureton, K. J. (2014). "Sprint Interval Training Effects on Aerobic Capacity: A Systematic Review and Meta-Analysis." *Sports Medicine*, 44(2), 269–279.

5. This meta-analysis examines the impact of sprint interval training (SIT) on aerobic capacity, concluding that SIT can significantly improve VO_2max , offering a time-efficient alternative to traditional endurance training.
6. Milanović, Z., Sporiš, G., & Weston, M. (2015). "Effectiveness of High-Intensity Interval Training (HIT) and Continuous Endurance Training for VO_2max Improvements: A Systematic Review and Meta-Analysis of Controlled Trials." *Sports Medicine*, 45(10), 1469–1481.
7. This study compares the effects of high-intensity interval training and continuous endurance training on VO_2max improvements, finding that both methods are effective, with HIT providing slightly greater benefits in less time.
8. Sloth, M., Sloth, D., Overgaard, K., & Dalgas, U. (2013). "Effects of Sprint Interval Training on VO_2max and Aerobic Exercise Performance: A Systematic Review and Meta-Analysis." *Scandinavian Journal of Medicine & Science in Sports*, 23(6), e341–e352.
9. This research analyzes the effects of sprint interval training on VO_2max and aerobic performance, concluding that SIT is a potent stimulus for enhancing aerobic capacity in both trained and untrained individuals.
10. Weston, K. S., Wisløff, U., & Coombes, J. S. (2014). "High-Intensity Interval Training in Patients with Lifestyle-Induced Cardiometabolic Disease: A Systematic Review and Meta-Analysis." *British Journal of Sports Medicine*, 48(16), 1227–1234.
11. This meta-analysis investigates the efficacy of high-intensity interval training in patients with cardiometabolic diseases, demonstrating significant improvements in VO_2max and suggesting HIT as a viable intervention for this population.
12. Bacon, A. P., Carter, R. E., Ogle, E. A., & Joyner, M. J. (2013). " VO_2max Trainability and High Intensity Interval Training in Humans: A Meta-Analysis." *PLOS ONE*, 8(9), e73182.
13. This study provides a comprehensive analysis of the trainability of VO_2max in response to high-intensity interval training, highlighting the variability in individual responses and the overall effectiveness of HIT in improving aerobic capacity.

EFFECT OF VISUAL SKILLS AND ITS IMPACT ON SKILLS PERFORMANCE OF TENNIS PLAYERS

Dr. M. SYED ALI

Director of Physical Education,
Sadakathullah Appa College, Palayamkottai, Tirunelveli - 627002.

Email Id : syedregi@gmail.com

ABSTRACT

The purpose of the study was to find out the Effect of visual skills and its impact on skills performance of Tennis players. To achieve this purpose, twenty four male Tennis players were selected from the Sadakathullah Appa College, Palayamkottai, Tirunelveli, and their age ranged between from 18-20 years. The selected subjects were divided in to two groups of 12 each. Group I underwent visual skill training programme for six weeks with three alternative days per week and Group II acted as control. The pre and post test control group design will be used for this study. Hand Eye coordination was selected as variable. The data collected from all the two groups were statistically analyzed. To find out the significant improvement between the pre and post means, dependent 't' test was used. To find out the significant difference on adjusted post test among the groups, analysis of co-variance (ANCOVA) would used. In all case, the statistical significance would set as .05 level of confidence. There was significant improvement on Hand-eye coordination due to the effect of visual skill training among Tennis players

Introduction

In recent years, there has been a growing acceptance that perceptual skills precedes and determines skilful actions in sport and other contexts (**Harris & Jenkin, 1998; Williams, 1999**). In particular, the visual system plays a crucial role in guiding the player's search for essential information underlying skilful behaviour. One of the best explanations of what "visual search strategies" entails is that it can be said that visual search strategies refers to the way that the eyes move around the field in an attempt to direct visual attention towards relevant sources of information. According to (**Zelinsky et al (1997)**). Eye movement registration systems only provide information about the orientation of the fovea and, consequently, visual fixation may not always be indicative of information extraction. Many circumstances require the effective integration of information from the fovea. Para- fovea and periphery (**Williams & Davids, 1998**).

The role of vision can generally be accepted as a critical source of information for the planning and the executing of motor skills. Visual performance in sport can be seen as an interaction between two visual systems. The visual system as a computer analogy of information gathering and processing by dividing the “analogy” into the two visual systems, namely the hardware and the software visual systems. The hardware visual system (skills) can be seen as the physical differences in the mechanical and the optometric properties of a person’s visual system and the software system (skills) can be seen as the cognitive differences in the analysis, selection, coding and general handing of the visual information during training and or competition. The hardware system Consists of six optometric skills, being static and dynamic visual acuity, depth perception, accommodation, fusion, colour vision, and contrast sensitivity (Abernethy, 1987).

Statement of the Problem

The purpose of the study was to find out the Effect of visual skills and its impact on skills performance of Tennis players.

Methodology

To achieve this purpose, twenty four male Tennis players were selected from the Sadakathullah Appa College, Palayamkottai, Tirunelveli, and their age ranged between from 18-20 years. The selected subjects were divided in to two groups of 12 each. Group I underwent visual skill training programme for six weeks with three alternative days per week and Group II acted as control.

Selection of Variables

1. Hand-eye Coordination

Table I
TESTS SELECTION

Variable	Test
Hand-eye coordination	Alternate Hand Wall toss test

Statistical Procedure

The pre and post test control group design will be used for this study. The data collected from all the two groups were statistically analyzed. To find out the significant improvement between the pre and post means, dependent ‘t’ test was used. To find out the significant

difference on adjusted post test among the groups, analysis of co-variance (ANCOVA) would be used. In all cases, the statistical significance would be set at .05 level of confidence.

TABLE II
SUMMARY OF MEAN AND DEPENDENT ‘t’-TEST FOR THE PRE AND POST TESTS ON HAND-EYE COORDINATION OF VISUAL SKILL TRAINING GROUP AND CONTROL GROUP

Tests		Pre Test	Post Test	‘t’ –Value
Visual Skill Training Group	Mean	22.58	27	8.59*
	SD	1.16	1.54	
Control Group	Mean	17.58	17.42	0.28
	SD	1.51	2.64	

*Significant at .05 level. The table value required for 0.05 level of significance with df 11 is 2.20.

The table II shows that the pre-test mean value of visual skill Training group and control group are 22.58 and 17.58 respectively and the post-test means are 27 and 17.42 respectively. The obtained dependent t-ratio values between the pre and post test Means of visual skill Training group and control groups are 8.59 and 0.28 respectively. The table value required for significant difference with df 11 at 0.05 level is 2.20. Since, the obtained ‘t’ ratio value of visual skill Training group are greater than the table value, it is understood that visual skill training group had significantly improved the Hand-eye coordination. However, the control group has not improved significantly. The ‘obtained t’ value is lesser than the table value, as they were not subjected to any specific training.

TABLE III
ANALYSIS OF COVARIANCE ON HAND-EYE COORDINATION OF VISUAL SKILL TRAINING GROUP AND CONTROL GROUP

Adjusted Post Test Means		Source of Variance	Sum of Square	df	Means Square	F-ratio
Visual Skill Training Group	Control Group					
25.05	19.37	Between	40.64	1	40.64	10.85*
		Within	78.66	21	3.75	

*Significant at 0.05 level confidence. The table value required for significance at 0.05 level with df 1 and 21 is 4.32.

Table III shows that the adjusted post test means of visual skill training and control groups are 25.05 and 19.37 respectively. The obtained F-ratio value is 10.85, which is greater than the table value 4.32 with df 1 and 21 required for significance at 0.05 level. Since the value of F-ratio is greater than the table value, it indicates that there is significant difference among the adjusted post-test means of visual skill training and control group.

Conclusions

1. There was significant improvement on Hand-eye coordination due to the effect of visual skill training among Tennis players.

References

1. Harris, L.R. & Jenkin, M. (1998). Vision and action. Cambridge: Cambridge university press.
2. Zelinsky., et al., (1997). Eye movements reveal Spatiotemporal dynamics of visual search, Psychological science, 8:448-453.
3. Williams, A.M., & David. K.S. (1998). Visual search strategy, selective attention and expertise in soccer. Research quarterly for exercise and sport, 69(2).
4. "Tennis" retrieved from <http://en.wikipedia.org/wiki/Tennis>, February 27, 2013.
5. "Hand-Eye Coordination" retrieved from http://wiki.answers.com/Q/What_is_the_definition_of_Coordination_in_sports, February 27, 2013.
6. "Visual skills" retrieved from http://link.dvvc.ca/groups/evtpublic/wiki/cdf06/Visual_Skills__Definition.html, February 27, 2013.

INFLUENCE OF BOSUBALL TRAININGS ON PHYSICAL FITNESS COMPONENT AMONG FOOTBALL PLAYERS

Dr. P. MANIKANDAN

Assistant Professor, Department of Physical Education,
St. John's College, Palayamkottai, Tirunelveli, Tamil Nadu, India.

Email Id : smanimped@gmail.com

ABSTRACT

The purpose of this study was to examine the impact of BOSU ball training on selected physical fitness variables among football players. Thirty male football players (aged 18–20 years) from St. John's College, Palayamkottai, were randomly selected and assigned into two equal groups: an experimental group ($n = 15$) and a control group ($n = 15$). The study followed a randomized group design. Pre-tests were conducted to measure flexibility and explosive power. The experimental group underwent Bosu ball training program for 12 weeks, while the control group continued their regular activities without additional intervention. Post-tests were conducted after the training period. Data were analyzed using the dependent 't' test, with the level of significance set at 0.05. The findings revealed significant improvements in flexibility ($t = 14.56$, $p < 0.05$) and explosive power ($t = 12.37$, $p < 0.05$) in the experimental group, whereas the control group showed no significant changes. The results indicate that BOSU ball training is effective in enhancing selected physical fitness components among football players.

Keywords: Bosuball trainings, flexibility, explosive power, Football.

INTRODUCTION

Bosuball training and fitness can be contrasted with an Bosuball training, of which strength training and weight training are the most salient examples. The two types of exercise differ by the duration and intensity of muscular contractions involved, as well as by how energy is generated within the muscle. Initially during Bosuball training, glycogen is broken down to produce glucose, but in its absence, fat metabolism is initiated instead. The latter is a slow process, and is accompanied by a decline in performance level. The switch to fat as fuel is a major cause of what marathon runner's call "hitting the wall". Bosuball training, in contrast, refers to the initial phase of exercise, or any short burst of intense exertion, in which the glycogen or sugar is consumed without oxygen, and is a far less efficient process. Operating an aerobically, an untrained 400 meter sprinter may "hit the wall" short of the full distance (Cooper, 1969).

Bosu ball training is a form of functional fitness that utilizes a dome-shaped stability device known as the ****bosu Balance Trainer****. The name bosu stands for “Both Sides Up,” referring to the ability to use either the flat platform side or the inflated dome side during exercise. Developed by David Weck in 1999, the BOSU ball has become widely used in rehabilitation settings, athletic conditioning, and general fitness programs.

BOSU training primarily focuses on improving balance, core stability, proprioception, and muscular strength. Because the surface is unstable, the body must engage stabilizing muscles—particularly in the core, ankles, knees, and hips—to maintain proper posture and alignment. This instability increases neuromuscular activation compared to exercises performed on stable ground (Behm & Colado, 2012). As a result, BOSU exercises can enhance coordination, joint stability, and functional movement patterns.

In rehabilitation contexts, BOSU ball exercises are often incorporated to improve postural control and reduce injury risk. In sports performance, athletes use BOSU training to mimic the dynamic and unpredictable environments encountered during competition. Additionally, fitness professionals integrate BOSU exercises into circuit training, strength training, and cardiovascular workouts to add variety and challenge.

Purpose of the study

The purpose of the study was to find out the influence of Bosuball trainings on selected Physical fitness variables among football players.

Physical Variables

Flexibility

Explosive power

Selection of Subjects

The purpose of the study was to find out the influence of Bosuball trainings on selected physical fitness variables among football players. To achieve the purpose of the present study, thirty football players from school level from St.John’s college, Palayamkottai, were selected as subjects at random and their ages ranged from 18 to 20 years.

Experimental Design

The study was formulated as a random group design. The subjects (N=30) were randomly assigned to two equal groups of fifteen football players each. Pre test was conducted for all the subjects on selected physical variables. This initial test scores formed as pre test scores of the subjects. The groups were assigned as Experimental Group and Control Group in

an equivalent manner. Experimental Group was exposed to Bosuball trainings and Control Group was not exposed to any experimental training other than their regular daily activities. The duration of experimental period was 12 weeks. After the experimental treatment, all the thirty football players were tested on their physical variables. This final test scores formed as post test scores of the subjects.

Statistical Techniques and Its Justification

The pre test and post test scores were subjected to statistical analysis using dependent 't' test. In all cases 0.05 level of significance was fixed to test hypotheses.

TABLE –I Variables And Test

S. No	Variables	Tests	Unit of Measurement
1	flexibility	Trunk flexibility test	centimeter
2	Explosive power	Vertical jump	centimeter

Results

The findings pertaining to analysis of dependent 't' test between experimental group and control group on selected physical variables among footballers for pre-post test respectively have been presented in table II to III.

TABLE –II

Significance Of Mean Gains & Losses Between Pre And Post Test Scores Of Experimental & Control Group On Flexibility

Group	Pre- test	Post- test	Standard Devation		Std error mean	t- ratio
			Pre	post		
Experimental group	3.81	8.04	3.08	2.78	0.29	14.56*
Control group	4.10	4.14	2.88	2.89	0.03	1.09

* Significant at 0.05 level

To find out difference experimental and control group of aerobic practices in flexibility Difference in two groups –ratio was employed and the level of significance was set at 0.05. Experimental group pre and post –test mean value were 3.81, 8.04, respectively. In control group pre and post- test were the mean value was 4.10, 4.14, respectively. In experimental the obtained t- ratio 14.56.was greater than the table value of 2.15 so it is found to be significant.

In control group the obtained t- ratio 1.09 was lesser than the table value of 2.15 so it was found to be insignificant.

TABLE –III

Significance of Mean Gains & Losses Between Pre and Post Test Scores of Experimental & Control Group on Explosive Power

Group	Pre- test	Post- test	Standard Deviation		Std error mean	t- ratio
			Pre	post		
Experimental group	37.16	40.75	5.84	5.37	0.29	12.37*
Control group	37.12	36.25	2.43	2.17	0.902	0.96

* Significant at 0.05 level

To find out difference experimental and control group of aerobic practices in explosive power Difference in two groups –ratio was employed and the level of significance was set at 0.05. Experimental group pre and post –test mean value were 37.16, 40.75, respectively. In control group pre and post- test were the mean value was, 37.12, 36.25 respectively. In experimental the obtained t- ratio 12.37 was greater than the table value of 2.15 so it is found to be significant. In control group the obtained t- ratio 0.96 was lesser than the table value of 2.15 so it was found to be insignificant.

CONCLUSION

From the analysis of the data, the following conclusions were drawn:

1. A 12-week Bosu ball training program significantly improves flexibility among football players.
2. Bosu ball training significantly enhances explosive power.
3. Bosu ball training can be effectively incorporated into football conditioning programs to improve selected physical fitness variables.

REFERENCES

1. Behm, D. G., & Colado, J. C. (2012). The effectiveness of instability resistance training for health and performance. *Journal of Strength and Conditioning Research*, 26*(12), 3409–3418.
2. Behm, D. G., Drinkwater, E. J., Willardson, J. M., & Cowley, P. M. (2010). Canadian Society for Exercise Physiology position stand: The use of instability to train the core

- in athletic and nonathletic conditioning. *Applied Physiology, Nutrition, and Metabolism, 35*(1), 109–112.
3. Anderson, K., & Behm, D. G. (2005). Trunk muscle activity increases with unstable squat movements. *Canadian Journal of Applied Physiology, 30*(1), 33–45.
 4. Cressey, E. M., West, C. A., Tiberio, D. P., Kraemer, W. J., & Maresh, C. M. (2007). The effects of ten weeks of lower-body unstable surface training on markers of athletic performance. *Journal of Strength and Conditioning Research, 21*(2), 561–567.
 5. Wahl, M. J., & Behm, D. G. (2008). Not all instability training devices enhance muscle activation in highly resistance-trained individuals. *Journal of Strength and Conditioning Research, 22*(4), 1360–1370.
 6. Saeterbakken, A. H., & Fimland, M. S. (2013). Muscle activity of the core during bilateral, unilateral, seated and standing resistance exercise. *European Journal of Applied Physiology, 113*(7), 1671–1678.
 7. Kibele, A., & Behm, D. G. (2009). Seven weeks of instability and traditional resistance training effects on strength, balance and functional performance. *Journal of Strength and Conditioning Research, 23*(9), 2443–2450.
 8. Marshall, P. W. M., & Murphy, B. A. (2006). Increased deltoid and abdominal muscle activity during Swiss ball bench press. *Journal of Strength and Conditioning Research, 20*(4), 745–750.
 9. Vera-Garcia, F. J., Grenier, S. G., & McGill, S. M. (2000). Abdominal muscle response during curl-ups on stable and labile surfaces. *Physical Therapy, 80*(6), 564–569. [<https://doi.org/10.1093/ptj/80.6.564>]
 10. Willardson, J. M., Behm, D. G., & Huang, S. Y. (2009). Quantification of muscle activity during unstable and stable core exercises. *Journal of Strength and Conditioning Research, 23*(1), 271–276.

EFFECT OF ASANAS PRACTICES ON PHYSIOLOGICAL VARIABLES AMONG BASKETBALL PLAYERS

Mr. R. SIVARAJA

Ph. D Scholar, St. Joseph College of Arts & Science,
Vaikalipatti, Mettur, Tenkasi -627808.

Email Id : sivahsports@gmail.com

Dr. J. KARTHIKEYAN

Assistant Professor, Department of Physical Education Health Education and Sports,
The M.D.T. Hindu College, Pettai, Tirunelveli

ABSTRACT

The purpose of the study is to assess the effect of asanas on the selected physiological variables among Basketball players. To achieve the purpose of the study, thirty super senior Basketball players were selected as subjects at random from The M.D.T.HinduCollege, Pettai. The age of the subjects were ranged from 18 to 20 years. The selected subjects were divided into two groups of 15 each. Group I underwent asanas practices for six weeks and Group II acted as control who did not take part in specific practices. Asanas was selected as independent variables. Resting pulse Rate, Breath Holding Time was selected as dependent variables for this study as criterion variables. Analysis of covariance (ANCOVA) was used and the 'F' ratio was found out. In all the cases to test the significance, 0.05 level of significance was fixed. The experimental group namely Asanas practices group have achieved significant improvement on resting pulse rate and breath holding time when compared to the control group. Significant differences were found between asanas practices and control groups towards improving the selected variables such as resting pulse rate and breath holding time.

Key words: Asanas Practices, Basketball, Breath Holding Time, resting Heart Rate.

Introduction

Physical education is an educational process that has its aim the improvement of human performance through the medium of physical activities. Selected to realize this outcome. Physical education includes the acquisition and refinement of motor skills, the development and maintenance of fitness for optimal health and well-being, the attainment of knowledge and the growth of positive attitudes toward physical activity (**Charles and Wuest, 1987**). "Sports is our cultural heritage, work and play daily is the best way to me tension free life".

Pavlich states sports has many sides. It has been described as phenomenon, which

demands complete relaxation and full effort, it can be a casual diversion of a complete fulfillment, it shapes man and shaped by man, whatever else it is, sports is a 'thing' of remarkable power (**Mary Palvich, 1987**). The word yoga is derived from the Sanskrit root yuj. Yoga means to "Yoke", to "Bind", to "Link", to "Connect" or to "Merge". Yoga joins body and mind together. The merger of soul with god, and the experience of oneness with Him-is Yoga. It is possible only through the control over sense organs and through continued practice and detachment. According to the great sage Patanjali, "The withdrawal of sense organs from their worldly objects and their control is Yoga" (**Maratha S, 1992**).

Purpose of the study

The purpose of the study is to assess the effect of asanas practice on selected physiological variables among Basketball players

Methodology

To achieve the purpose of the study, thirty super senior Basketball players were selected as subjects at random. *The M.D.T.HinduCollege, Pettai. The age of the subjects were ranged from 18 to 20 years.* The selected subjects were divided into two groups of 15 each. Group I underwent asanas practices for six weeks and Group II acted as control who did not take part in specific practices.

Asanas was selected as independent variables. Since Asanas exercise practices causes changes in the above said variables, the following dependent variables were selected for this study as criterion variables.

- 1) Resting pulse Rate
- 2) Breath Holding Time

The data collected from the three groups were statistically analyzed for significance, the analysis of covariance (ANCOVA) was used and the 'F' ratio was found out. Hence to make the adjustments for difference in the initial means and test the adjusted post test means for significant difference, the analysis of covariance was used. In all the cases to test the significance, 0.05 level of significance was fixed.

Analysis and interpretation of data**TABLE I -Analysis of Covariance on Resting Pulse Rate of Asanas Practices Group and Control Group**

Adjusted posttest means		Source of Variance	Sum of Squares	df	Mean Squares	'F'-Ratio
Asanas Practices Group	Control group					
68.52	72.50	Between	1714.12	1	1714.12	4.70*
		Within	9845.65	27	364.65	

*Significant at .05 level of confidence.

(The table value required for significance at .05 levels with df 1 and 27 is 4.21)

Table I shows that the adjusted post-test means of asanas practices group and control group are 68.52 and 72.50 respectively. The obtained F-ratio value is 4.70 which is higher than the table value 4.21 with df 1 and 27 required for significance at .05 level. Since the value of F-ratio is higher than the table value, it indicates that there is significant difference and improvement exists between the adjusted post-test means of asanas practices and control groups.

TABLE II**Analysis of Covariance on Breath Holding Time of Asanas Practices Group and Control Group**

Adjusted post test means		Source of Variance	Sum of Squares	df	Mean Squares	'F'-Ratio
Asanas Practices Group	Control Group					
32.10	25.14	Between	687.45	1	687.45	7.28*
		Within	2548.75	27	94.40	

*Significant at .05 level of confidence.

(The table value required for significance at .05 level with df 1 and 27 is 4.21)

Table II shows that the adjusted post-test means of asanas practices group and control group are 32.10 and 25.14 respectively. The obtained F-ratio value is 7.28 which is higher than the table value 4.21 with df 1 and 27 required for significance at .05 level. Since the value of F-ratio is higher than the table value, it indicates that there is significant difference and improvement exist between the adjusted post-test means of asanas practices and control groups.

Conclusions

From the analysis of the data, the following conclusions were drawn.

1. The experimental group namely Asanas practices group have achieved significant improvement on resting pulse rate and breath holding time when compared to the control group.
2. Significant differences were found between asanas practices and control groups towards improving the selected variables such as resting pulse rate and breath holding time.

References

1. Charles A. Bucher and Deberak A. wuest, ***Foundation of physical Education and sport***, (St.Louis, Mosby College Publishing, 1987) P.57.
2. Mary Palvich, ***The Philosophic Process in Physical Education***, (Philadelphia; Lea and Fabiger, 1987) P.330.
3. Maratha S., Damodaran A, Shah N, Patil N, “Effect of Yogic Practices on Subjective Well Being”, ***Indian Journal of Physiological Pharmacology***, 2000 Apr, 44(2), 202-6

Probiotics and Gut Microbiota: The Future of Nutritional Therapy

Dharshini S V

Student, I B. Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.

Email id : nicasniddharshini272008@gmail.com

Abstract

The human gut microbiota is a dynamic ecosystem composed of trillions of microorganisms that are critical for digestion, metabolic homeostasis, immune regulation, and overall health. Recent advances in microbiome research have highlighted the beneficial role of probiotics—live microorganisms which, when administered in adequate amounts, confer a health benefit to the host—thus positioning them as promising agents in nutritional therapy. This article reviews current evidence on probiotics, mechanisms of action, interactions with gut microbiota, and their therapeutic potential in metabolic, gastrointestinal, and immune-mediated disorders. Drawing upon clinical trials and mechanistic studies, this paper discusses probiotics as a future cornerstone of personalized nutrition, prevention strategies, and therapeutic interventions, and outlines challenges for clinical translation.

Keywords: Gut microbiota, probiotics, nutritional therapy, metabolic health, immune modulation, personalized nutrition

Introduction

The concept of gut microbiota has revolutionized our understanding of human health. An estimated **100 trillion microscopic organisms** inhabit the human gastrointestinal tract, comprising bacteria, viruses, fungi, and archaea that outnumber human cells by an order of magnitude and contribute more genes than the human genome itself. These microorganisms play essential roles in nutrient digestion, vitamin synthesis, metabolic regulation, protection against pathogens, and immunomodulation (O'Hara & Shanahan, 2006; Thursby & Juge, 2017). Dysbiosis—disruption in the ecology of microbial communities—is associated with obesity, metabolic syndrome, inflammatory bowel disease (IBD), diabetes, allergies, and even neuropsychological disorders such as depression and autism (Turnbaugh et al., 2009).

Probiotics are defined by the **World Health Organization (WHO)** as “live microorganisms which when administered in adequate amounts confer a health benefit on the host” (FAO/WHO, 2001). Common probiotic genera include *Lactobacillus*, *Bifidobacterium*, *Saccharomyces*, and certain *Escherichia* and *Bacillus* strains. Probiotics have gained global attention for their potential to restore microbial balance and improve host health through

multiple mechanisms—including competitive exclusion of pathogens, barrier integrity enhancement, and immunomodulatory effects.

Increasingly, probiotics are being conceptualized not merely as dietary supplements, but as therapeutic agents—central to the emerging field of **nutritional therapy**. This article synthesizes current research on the mechanisms, clinical evidence, applications, and future prospects of probiotics within nutritional therapy frameworks.

Gut Microbiota and Human Health

Structure and Function of Gut Microbiota

The human gut hosts a diverse community of bacteria dominated by five major phyla: *Firmicutes*, *Bacteroidetes*, *Actinobacteria*, *Proteobacteria*, and *Verrucomicrobia*. These microorganisms participate in:

- **Carbohydrate fermentation** yielding short-chain fatty acids (SCFAs) like butyrate—critical for colonic health and energy homeostasis.
- **Vitamin synthesis**, including vitamins K and B complex.
- **Immune system education**, promoting tolerance to dietary antigens and defense against pathogens.
- **Metabolic regulation**, including glucose, lipid, and energy balance (Sekirov et al., 2010).

Dysbiosis and Disease

Altering the composition or function of the gut microbiota has been linked to disease. For example:

- **Inflammatory Disorders:**
Dysbiosis can trigger immune dysregulation, contributing to ulcerative colitis, Crohn's disease, and celiac disease (Ni et al., 2017).
- **Metabolic Conditions:**
Obese individuals often exhibit reduced microbial diversity and altered Firmicutes/Bacteroidetes ratios, implicating microbiota in energy harvest and adiposity (Turnbaugh et al., 2009).
- **Neuropsychiatric Connections:**
The gut–brain axis shows bidirectional communication; microbiota can influence stress responses, mood, and cognitive functions via neuroimmune pathways (Mayer et al., 2014).

Probiotics: Mechanisms of Action

Probiotics improve host health through multifaceted mechanisms:

1. Competitive Exclusion

Probiotics occupy ecological niches, compete for nutrients, and produce antimicrobial substances like bacteriocins, reducing colonization by pathogenic bacteria.

2. Enhancement of Barrier Function

Probiotics strengthen epithelial tight junctions, reducing gut permeability (often referred to as “leaky gut”), thereby preventing translocation of harmful microbes and endotoxins.

3. Immunomodulation

Probiotic strains interact with gut-associated lymphoid tissue (GALT), influencing cytokine profiles, increasing anti-inflammatory mediators (e.g., IL-10), and balancing Th1/Th2 responses (Bron et al., 2017).

4. Metabolic Effects

Probiotics can influence host metabolism via SCFA production, bile acid metabolism, and modulation of lipid profiles—thereby affecting glucose homeostasis and obesity risk.

Clinical Evidence: Probiotics in Nutritional Therapy

1. Gastrointestinal Disorders

Irritable Bowel Syndrome (IBS)

Randomized controlled trials (RCTs) show that specific strains such as *Lactobacillus plantarum* 299v and multi-strain formulations can reduce abdominal pain, bloating, and improve bowel habits in IBS patients (Ford et al., 2014).

Diarrhea and Antibiotic-Associated Diarrhea (AAD)

Probiotics like *Saccharomyces boulardii* and *Lactobacillus rhamnosus* GG significantly reduce incidence and duration of AAD, particularly in pediatric populations (Hickson, 2011).

2. Metabolic Syndrome and Obesity

Emerging trials suggest probiotics may modestly reduce body weight, waist circumference, and insulin resistance. Mechanisms may include altered lipid metabolism, reduced inflammation, and improved glucose regulation (Koutnikova et al., 2019).

3. Immune and Allergic Conditions

Probiotics may reduce severity and incidence of allergic diseases, such as atopic dermatitis in children, through immune modulation and reinforcing mucosal barriers (Pelucchi et al., 2012).

4. Mental Health and the Gut–Brain Axis

Clinical evidence supports the concept of “psychobiotics,” probiotics that positively influence mental health outcomes. RCTs indicate improvements in anxiety and depressive symptoms linked to microbiota modulation (Sarkar et al., 2016).

Probiotics and Personalized Nutrition

Despite positive findings, therapeutic outcomes vary markedly between individuals. This variability arises from differences in baseline microbiota, diet, genetics, lifestyle, and immune status (Zmora et al., 2019). The future lies in **precision probiotics**—tailored probiotic therapy based on individual microbiome profiles, metabolic needs, and therapeutic goals.

Emerging technologies such as metagenomics, metabolomics, and artificial intelligence enable characterization of microbiota signatures and prediction of probiotic responses, laying the foundation for personalized nutritional therapy.

Challenges and Limitations

Despite promising evidence, probiotics face several challenges:

- **Strain-Specific Effects:** Benefits are highly strain-specific, thus findings cannot be generalized across all probiotics.
- **Safety and Regulation:** In vulnerable populations (e.g., immunocompromised, ICU patients), probiotic safety requires careful assessment.
- **Quality Control:** Variability in formulations, viability, and claims necessitates stricter manufacturing standards and regulatory frameworks.
- **Mechanistic Understanding:** Complex host–microbe interactions require deeper mechanistic insights for clinical translation.

Future Perspectives

Advancements in gut microbiome research are rapidly expanding the therapeutic potential of probiotics. Future directions include:

- Development of **next-generation probiotics (NGPs)**, such as *Akkermansia muciniphila* and *Faecalibacterium prausnitzii*, associated with metabolic and anti-inflammatory effects.
- Integration of **synbiotics** (probiotic + prebiotic combinations) to enhance colonization and function.
- Use of **microbiota-derived metabolites** as therapeutic targets.
- Implementation of **microbiome-driven nutritional guidelines** for disease prevention.

Conclusion

Probiotics represent a promising frontier in nutritional therapy, with evidence supporting their utility across gastrointestinal, metabolic, immune, and neuropsychiatric domains. Their mechanisms—ranging from competitive exclusion to immunomodulation—offer holistic benefits that extend beyond traditional nutrition. However, the field must overcome challenges in strain specificity, personalized response variability, and regulatory quality to realize its full potential. With continued research and technological integration, probiotics are set to become a cornerstone of personalized, microbiota-based nutritional therapy.

References

1. Bron, P. A., et al. (2017). Mechanisms of action of probiotics: current status and future perspectives. *Current Opinion in Gastroenterology*, 33(6), 432–438.
2. FAO/WHO. (2001). FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics.
3. Ford, A. C., et al. (2014). Efficacy of probiotics in irritable bowel syndrome: systematic review and meta-analysis. *American Journal of Gastroenterology*, 109(10), 1547–1561.
4. Hickson, M. (2011). Probiotics in the prevention of antibiotic-associated diarrhea and *Clostridium difficile* infection. *Therapeutic Advances in Gastroenterology*, 4(3), 185–197.
5. Koutnikova, H., et al. (2019). Impact of bacterial probiotics on obesity, diabetes, and nonalcoholic fatty liver disease. *Diabetes Research and Clinical Practice*, 150, 111–129.
6. Mayer, E. A., et al. (2014). Gut microbes and the brain: paradigm shift in neuroscience. *Journal of Neuroscience*, 34(46), 15490–15496.

7. Ni, J., et al. (2017). Gut microbiota and IBD: causation or correlation? *Nature Reviews Gastroenterology & Hepatology*, 14(10), 573–584.
8. O'Hara, A. M., & Shanahan, F. (2006). The gut flora as a forgotten organ. *EMBO Reports*, 7(7), 688–693.
9. Pelucchi, C., et al. (2012). Probiotics supplementation during pregnancy or infancy for the prevention of atopic dermatitis: a meta-analysis. *Epidemiology*, 23(3), 402–414.
10. Sarkar, A., et al. (2016). Psychobiotics and the manipulation of bacteria–gut–brain signals. *Trends in Neurosciences*, 39(11), 763–781.
11. Sekirov, I., et al. (2010). Gut microbiota in health and disease. *Physiological Reviews*, 90(3), 859–904.
12. Thursby, E., & Juge, N. (2017). Introduction to the human gut microbiota. *Biochemical Journal*, 474(11), 1823–1836.
13. Turnbaugh, P. J., et al. (2009). A core gut microbiome in obese and lean twins. *Nature*, 457(7228), 480–484.
14. Zmora, N., et al. (2019). Personalized gut mucosal colonization resistance to empiric probiotics is associated with unique host and microbiome features. *Cell*, 174(6), 1388–1405.

Grief as Governance: Affective Colonialism in Richard Flanagan's *Wanting*

M. DENNIS RAJAN

Research Scholar, Reg no: 20223064011001, Department of English & Research Center,
Lekshmipuram College of Arts & Science, Neyyoor.
(Affiliated to Manonmaniam Sundaranar University)

Email Id : dennisajan59@gmail.com

Dr. S. BRIDGITH JUSBELL

Research Supervisor, Assistant professor of English,
Lekshmipuram College of Arts & Science, Neyyoor.
(Affiliated to Manonmaniam Sundaranar University)

Abstract

Most studies on Richard Flanagan's *Wanting* focus on colonial violence and the suffering of the Aboriginal girl Mathinna. While these readings are important, they often overlook how emotions help sustain colonial power. This article examines *Wanting* through the idea of affective colonialism, which explains how feelings such as grief, sympathy, and desire function as tools of control. Focusing on Lady Jane Franklin, the paper argues that emotion becomes a form of authority in colonial society. Lady Jane's mourning, emotional discipline, and suppressed desire for motherhood present colonial rule as humane and moral. At the same time, the novel exposes the limits of emotional power, as her feelings cannot prevent Mathinna's destruction. This paper shows that *Wanting* critiques empire by revealing how deeply it depends on sentiment and emotional performance.

Keywords: Affective Colonialism, Grief, Emotion, Gender, Postcolonial Fiction

Introduction

Richard Flanagan's *Wanting* (2008) presents colonial Tasmania as a space shaped not only by power and violence, but also by emotion. Grief, desire, sympathy, and longing influence how characters act and how colonial authority is justified. While much criticism has focused on Mathinna's tragic fate, less attention has been given to the emotional forces that shape her life.

This paper argues that *Wanting* portrays affective colonialism, a form of colonial rule in which emotions help govern people and justify domination. Lady Jane Franklin is central to this process. Her feelings especially grief and sympathy give her moral authority in a male-dominated colonial world. However, these emotions also support assimilation and control. Through Lady Jane, Flanagan shows that colonial power often works through care and feeling rather than open force.

Literature Review

Scholars of colonial and postcolonial studies have long examined the role of gender and emotion in sustaining imperial power. Antoinette Burton's *Burdens of History: British Feminists, Indian Women, and Imperial Culture, 1865–1915* is foundational in showing how upperclass Western women extended their social influence into colonial spaces by presenting care, sympathy, and moral concern as civilising virtues. Although Burton's work focuses on imperial maternalism, it also reveals how emotion itself becomes a form of authority, allowing women to participate in empire while appearing benevolent. This insight is useful for reading Lady Jane Franklin, whose emotional expressions of grief, sympathy, and concern shape her colonial interventions in Wanting. Other scholars such as Clare Midgley and Anna Davin have similarly shown that women's emotional roles in empire were socially valued but tightly regulated. Their work suggests that women's participation in colonial culture often depended on acceptable emotional performances rather than direct political power. This perspective helps explain how Lady Jane's feelings grant her visibility and influence in a male-dominated colonial world, even as they confine her within gendered expectations. In "Resisting Gendered Citizenship: The Politics of Colonialism, Nationalism, and Maternalism in India," Nigam argues that colonial women were largely confined to emotional and domestic roles as daughter, wife, and mother while being excluded from formal decisionmaking (19). Although Nigam's focus is on India, her argument highlights how emotionally coded roles allowed women to appear central to moral life while remaining politically marginal. This tension between emotional authority and political limitation is visible in Lady Jane Franklin's position in Wanting. Her grief and sympathy allow her to act publicly, but only within socially approved emotional boundaries. Chandra Talpade Mohanty critiques Western feminist scholarship for portraying Third World women as passive and domestic, often through sentimental narratives that erase complexity and agency (336). Her work draws attention to how sympathy can function as a form of domination. Similarly, Uma Narayan argues that colonised women live "caught between complicity and critique" (88), navigating emotional expectations imposed by colonial and patriarchal systems. These ideas are particularly relevant to Wanting, where Mathinna is framed through Lady Jane's feelings rather than her own voice. Gayatri Chakravorty Spivak's influential essay "Can the Subaltern Speak?" further warns that colonial discourse often silences the oppressed by speaking for them through moral concern and emotional representation (221). In Wanting, Mathinna's silence and disappearance reflect this process, as her experiences are mediated through Lady Jane's sympathy and regret rather than

direct expression. Several critics have focused specifically on Wanting and its representation of colonial power. Ho LaiMing argues that Mathinna's adoption operates as a form of imperial desire, turning her body into a site of colonial fantasy and control (27). Charlotte Wadoux, in "The World Had Forgotten about Us," uses the concept of heterotopia to show how Mathinna's body becomes a confined space of surveillance and erasure (9). While these readings focus primarily on Mathinna's suffering, they also suggest that colonial control is maintained through intimate and emotional relationships rather than force alone. Salhia BenMessahel, in "Colonial Desire and the Renaming of History," argues that colonisation works through symbolic acts such as naming, renaming, and emotional attachment, turning history itself into a tool of domination. This insight is relevant to Lady Jane's attempt to reshape Mathinna's identity through care and discipline. Popular reviews, such as those published in *The Regarp Book Blog* and *The Compulsive Reader*, also emphasise that Wanting is driven by desire, loss, and emotional conflict, rather than by historical events alone. These responses support the view that emotion forms the novel's ethical and political core.

Affective Colonialism and Emotional Control

Affective colonialism refers to the use of emotion as a means of power. Instead of rejecting emotion, colonial ideology carefully manages it. Certain feelings such as sympathy and moral concern are encouraged, while others are seen as dangerous or excessive.

Lady Jane Franklin openly expresses this belief when she states: "Man has judgement... but woman sensibility... sensibility unrefined by moral improvement and mental discipline quickly declines into sensuousness, and sensuousness into wickedness" (Flanagan 116).

This statement clearly shows how emotion is gendered and regulated. Sensibility is seen as natural to women but also as something that must be controlled. Mathinna, who stands silently during this speech, is excluded from this moral language: "Mathinna understood none of it and said nothing" (116). Her silence reflects how colonial subjects are spoken about but not allowed to speak for themselves.

Lady Jane's insistence that Mathinna be "shod" and "civilised" is part of what she repeatedly calls an "experiment" (117–18). Emotion here becomes method. Care is mixed with discipline, and sympathy becomes a way to reshape the colonised body.

Sympathy, Discipline, and the Colonial Body

Lady Jane's relationship with Mathinna is shaped by emotional conflict. On one hand, she feels affection and tenderness: "How... Lady Jane wanted to dress that little girl up... make

her giggle and give her surprises” (118). On the other hand, she suppresses these feelings, fearing that affection might “ruin the experiment” (118). In affective colonialism, emotion is not removed but controlled. Love is allowed only when it supports discipline. This emotional discipline is physically imposed on Mathinna. Lady Jane insists that the child wear shoes, despite her discomfort: “Wearing shoes... felt as if her body had been blindfolded” (119). This powerful image shows how colonial care can cause harm. What is presented as improvement becomes bodily suffering. Sympathy justifies pain. Lady Jane further claims that Mathinna will be treated “as a freeborn Englishwoman,” calling this “part of my experiment” (118). While this language sounds generous, it hides the reality of forced assimilation. Emotional language disguises domination.

Desire, Loss, and Emotional Attachment

The novel reveals that Lady Jane’s attachment to Mathinna is deeply connected to her own personal loss. Her desire for a child is shaped by grief and shame: “She could no longer deny the memory of her three miscarriages... her desperate desire for a child” (194–95). This passage shows that Lady Jane’s colonial involvement is not driven only by reason or charity, but by emotional longing. Mathinna becomes a substitute for the motherhood Lady Jane was denied. At one moment, Lady Jane recognises the harm caused by assimilation: “She wished to be the mother... and revel in her difference and not seek to destroy it” (194–95). This is a rare moment of emotional clarity. However, recognition does not lead to change. Feeling exposes injustice, but it does not undo colonial power.

Disappointment and the Withdrawal of Sympathy

When Mathinna does not meet colonial expectations, Lady Jane’s sympathy turns into disappointment: “She has under my care only gone backwards... The dance had left the dancer” (196). Here, emotional failure becomes moral judgment. When the colonised subject does not improve as expected, care is withdrawn. Emotion shifts from sympathy to blame. Instead of questioning her beliefs, Lady Jane concludes that reform must begin even earlier, breaking all cultural bonds from birth (129). Disappointment strengthens colonial thinking rather than challenging it.

Grief as Public Authority

Lady Jane’s emotional power is most visible in her public mourning for Sir John Franklin. Her grief gives her social freedom and authority: “Her vengeance... applauded as noble grief... allowing her freedoms few other women could imagine” (234). As a widow, she gains influence that would otherwise be denied to her. However, this freedom depends on

continuous performance of sorrow: “Her life, as a studied melancholy, she savoured” (234). Grief becomes a public role. Emotion grants authority, but only within strict social limits.

Conclusion

Wanting shows that colonial power is sustained not only through violence and law, but also through emotion. Lady Jane Franklin’s grief, sympathy, and desire function as tools of affective colonialism. Her feelings give her moral authority and justify intervention, while also masking the harm done to Mathinna. At the same time, the novel exposes the limits of emotional power. Lady Jane’s feelings cannot protect Mathinna or undo colonial injustice. Emotion may recognise suffering, but it remains bound to the structures that create it. By focusing on affective colonialism, this article shows that Wanting critiques empire by revealing how deeply colonial rule depends on sentiment, emotional discipline, and moral performance.

Works Cited

1. Burton, Antoinette. *Burdens of History: British Feminists, Indian Women, and Imperial Culture, 1865–1915*. University of North Carolina Press, 1994.
2. Flanagan, Richard. *Wanting*. Penguin Random House, 2008.
3. Higgs, Eleanor Tiplady. “From ‘Imperial Maternalism’ to ‘Matri-centrism:’ Mothering Ethics in Christian Women’s Voluntarism in Kenya.” *The African Journal of Gender and Religion*, vol. 25, no. 1, July 2019, doi:10.14426/ajgr.v25i1.3.
4. Ho, Lai-Ming Tammy. “Cannibalised Girlhood in Richard Flanagan’s *Wanting*.” *Neo-Victorian Studies*, vol. 5, no. 1, 2012, pp. 14–37.
5. Hooks, Bell. *Yearning: Race, Gender, and Cultural Politics*. 2nd ed., Routledge, 2014.
6. McClintock, Anne. *Imperial Leather: Race, Gender, and Sexuality in the Colonial Contest*. Routledge, 1995.
7. Mohanty, Chandra Talpade. “Under Western Eyes: Feminist Scholarship and Colonial Discourses.” *Feminist Review*, no. 30, 1988, pp. 61–88. Sage Journals.
8. Narayan, Uma. *Dislocating Cultures: Identities, Traditions, and Third World Feminism*. Routledge, 1997.
9. Nigam, S. “Resisting Gendered Citizenship: The Politics of Colonialism, Nationalism, and Maternalism in India.” *Gender and Women’s Studies*, vol. 6, no. 1, 2025, p. 1, doi:10.31532/GendWomensStud.6.1.001.

10. Spivak, Gayatri Chakravorty. “Can the Subaltern Speak?” *Marxism and the Interpretation of Culture*, edited by Cary Nelson and Lawrence Grossberg, Macmillan, 1988, pp. 271–313.
11. Wadoux, Charlotte. “‘The World Had Forgotten about Us’: Heterotopian Resistance in
12. Richard Flanagan’s *Wanting*.” *Humanities*, vol. 11, no. 1, 2022, p. 9, doi:10.3390/h11010009

Development of Fortified Functional Beverages Using Plant-Based Proteins

S. Sahana Sherin

Student, I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.
Email Id : nicasndsahanasherin15102007@gmail.com

Abstract

The global demand for functional beverages has increased significantly due to growing consumer awareness of health, sustainability, and ethical nutrition. Plant-based proteins have emerged as promising ingredients in the formulation of fortified functional beverages because of their nutritional value, hypoallergenic potential, and lower environmental footprint compared to animal proteins. This article examines the scientific, technological, and nutritional aspects of developing fortified functional beverages using plant-based proteins. It discusses protein sources, fortification strategies, formulation challenges, processing techniques, sensory optimization, regulatory standards, and market trends. The study highlights the role of innovation in addressing protein-energy malnutrition, lifestyle diseases, and sustainability concerns through plant-based beverage solutions.

Keywords: Functional beverages, plant-based proteins, fortification, nutraceuticals, sustainable nutrition, beverage technology

Introduction

Functional beverages are drinks designed not only to provide hydration but also to deliver health benefits beyond basic nutrition. According to the Food and Agriculture Organization, plant-based foods play a crucial role in achieving global food security and sustainable development. Simultaneously, the World Health Organization emphasizes dietary diversification and increased intake of plant proteins to reduce non-communicable diseases.

With rising lactose intolerance, veganism, and environmental concerns, plant-based proteins are increasingly used in beverage fortification. These proteins are derived from legumes, cereals, oilseeds, and novel sources such as algae. The development of fortified functional beverages using plant proteins requires multidisciplinary approaches integrating food science, nutrition, sensory evaluation, and industrial processing.

Plant-Based Protein Sources

Legume Proteins

- **Soy protein:** Complete amino acid profile and high digestibility.
- **Pea protein:** Hypoallergenic and neutral flavor.

- **Lentil and chickpea proteins:** Rich in fiber and micronutrients.

Cereal Proteins

- **Oat protein:** Contains β -glucans beneficial for cardiovascular health.
- **Rice protein:** Easily digestible and suitable for allergen-free formulations.

Oilseed Proteins

- **Almond and flaxseed proteins:** Provide healthy fats and antioxidants.

Emerging Proteins

- Microalgae and fermented plant proteins offer improved bioavailability and sustainability.

Major global food companies such as Nestlé and Danone are investing in plant-based beverage innovations to meet consumer demand.

Fortification Strategies

Fortification enhances the nutritional value of beverages by adding essential nutrients. In plant-based functional beverages, fortification may include:

- **Vitamins:** A, D, B12 (often lacking in plant diets)
- **Minerals:** Calcium, iron, zinc
- **Omega-3 fatty acids:** For cardiovascular benefits
- **Probiotics and prebiotics:** For gut health

The Codex Alimentarius Commission provides guidelines on nutrient addition and labeling to ensure safety and transparency.

Fortification must consider nutrient stability, bioavailability, and interactions with plant proteins. For example, iron may interact with phytates present in legumes, reducing absorption. Technological interventions such as microencapsulation improve nutrient stability and minimize sensory alterations.

Formulation Challenges

Despite their advantages, plant proteins present formulation challenges:

Solubility

Many plant proteins exhibit low solubility in aqueous systems, leading to sedimentation.

Off-Flavors

Beany or grassy flavors may affect consumer acceptability.

Texture and Mouthfeel

Protein aggregation can produce undesirable viscosity or grittiness.

Stability

Phase separation during storage affects visual appeal and shelf life.

To overcome these issues, food technologists use:

- Enzymatic hydrolysis
- Ultrafiltration
- High-pressure homogenization
- Flavor masking agents

Processing Technologies

Thermal Processing

Pasteurization ensures microbial safety but may denature proteins, affecting texture.

High-Pressure Processing (HPP)

Preserves nutritional quality while ensuring safety.

Fermentation

Improves digestibility, enhances flavor, and reduces anti-nutritional factors. Fermented plant-based beverages also contribute to probiotic delivery.

Microencapsulation

Encapsulation protects sensitive nutrients like omega-3 fatty acids and vitamins from oxidation.

Nutritional and Health Benefits

Plant-based protein beverages offer several health advantages:

- Reduced saturated fat intake
- Lower cholesterol levels
- Improved digestive health
- Support for muscle synthesis when adequately formulated

The World Health Organization recommends increasing plant-based food consumption to combat obesity and cardiovascular diseases.

Additionally, fortified beverages can address micronutrient deficiencies, particularly in developing regions where malnutrition remains prevalent.

Sensory Evaluation and Consumer Acceptance

Consumer acceptance depends on taste, aroma, appearance, and packaging. Sensory evaluation techniques include:

- Hedonic rating scales
- Descriptive analysis
- Consumer preference testing

Companies often conduct large-scale sensory trials before product launch to ensure market viability.

Regulatory and Safety Considerations

Functional beverage development must comply with national and international regulations. The Food Safety and Standards Authority of India regulates labeling, permissible additives, and fortification levels in India. Globally, the Codex Alimentarius Commission sets harmonized standards to facilitate trade and consumer protection.

Clear labeling of allergen information and nutritional content is mandatory in most jurisdictions.

Sustainability and Market Trends

Plant-based beverages contribute to environmental sustainability by:

- Reducing greenhouse gas emissions
- Lowering water usage compared to dairy
- Supporting sustainable agriculture

Market research indicates rapid growth in plant-based beverage consumption, driven by urbanization, health consciousness, and ethical consumerism.

Innovative startups and multinational corporations are expanding product portfolios to include protein shakes, fortified smoothies, and plant-based dairy alternatives.

Future Prospects

Future research should focus on:

- Improving amino acid balance through protein blending
- Enhancing bioavailability of fortified nutrients
- Developing cost-effective processing methods
- Exploring indigenous plant protein sources
- Integrating personalized nutrition approaches

The convergence of food technology, biotechnology, and sustainability science will shape the next generation of fortified plant-based beverages.

Conclusion

The development of fortified functional beverages using plant-based proteins represents a significant advancement in modern food science. These beverages address nutritional deficiencies, support preventive healthcare, and promote environmental sustainability. However, successful product development requires careful attention to formulation challenges, sensory attributes, nutrient stability, and regulatory compliance. Collaboration between researchers, industry stakeholders, and public health organizations is essential to maximize the benefits of plant-based fortified beverages in global nutrition strategies.

References

1. Food and Agriculture Organization. (2018). *Sustainable food systems and nutrition*. FAO.
2. World Health Organization. (2020). *Healthy diet fact sheet*. WHO.
3. Codex Alimentarius Commission. (2019). *General principles for the addition of essential nutrients to foods*. FAO/WHO.
4. Food Safety and Standards Authority of India. (2021). *Food fortification resource centre guidelines*. FSSAI.
5. Boye, J., Zare, F., & Pletch, A. (2010). Pulse proteins: Processing, characterization, and applications. *Food Research International*, 43(2), 414–431.
6. Day, L. (2013). Proteins from land plants – Potential resources for human nutrition and food security. *Trends in Food Science & Technology*, 32(1), 25–42.
7. Mintel Group Ltd. (2022). *Global plant-based beverage market report*.
8. Granato, D., Branco, G. F., Nazzaro, F., Cruz, A. G., & Faria, J. A. F. (2010). Functional foods and nondairy probiotic beverages. *Comprehensive Reviews in Food Science and Food Safety*, 9(3), 292–302.
9. Loveday, S. M. (2019). Plant protein ingredients with food functionality potential. *Nutrition Bulletin*, 44(3), 273–281.

Role of Antioxidants in Preventing Lifestyle Disorders

Joseph Myson M I

Student, I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.
Email Id : nicasndjoseph152006@gmail.com

Abstract

Lifestyle-related disorders such as obesity, type 2 diabetes mellitus, cardiovascular diseases, hypertension, and certain forms of cancer are major contributors to global illness and mortality. These conditions are strongly associated with sedentary behavior, poor dietary habits, prolonged stress, and environmental exposures that lead to oxidative stress and persistent inflammation. Oxidative stress occurs when there is an imbalance between the generation of reactive oxygen species (ROS) and the body's antioxidant defense systems, resulting in cellular damage. Antioxidants, whether produced within the body or obtained from dietary sources, play an essential role in neutralizing free radicals, regulating inflammatory responses, and maintaining cellular stability. This article explores the biological relationship between oxidative stress and lifestyle diseases, while also evaluating the preventive role of antioxidants. Special emphasis is placed on dietary sources, whole-food approaches, and the ongoing debate surrounding antioxidant supplementation. Evidence suggests that diets rich in natural antioxidants significantly reduce disease risk, whereas excessive supplementation should be approached with caution.

Keywords: Antioxidants, oxidative stress, lifestyle disorders, cardiovascular diseases, diabetes, inflammation, nutrition

Introduction

Lifestyle disorders, also referred to as non-communicable diseases (NCDs), have emerged as a major global health concern. These conditions, including cardiovascular diseases, diabetes, cancer, and chronic respiratory illnesses, account for a significant proportion of deaths worldwide. Rapid urbanization, technological advancements, reduced physical activity, unhealthy eating patterns, tobacco use, and increased psychological stress have collectively contributed to their rising prevalence.

A key underlying factor in the development of these disorders is oxidative stress. This condition arises when the production of reactive oxygen species exceeds the body's natural antioxidant defenses. The resulting imbalance leads to damage of essential biomolecules such as lipids, proteins, and DNA, thereby disrupting normal cellular function. Persistent oxidative

stress is also closely linked to chronic inflammation, which further accelerates disease progression.

Antioxidants serve as a protective mechanism against oxidative damage by neutralizing free radicals and maintaining redox balance. Their role in disease prevention and health promotion has been widely studied, making them an important focus in nutritional and medical research.

Oxidative Stress and Disease Mechanisms

Reactive oxygen species are highly reactive molecules produced during normal metabolic activities, particularly within the mitochondria. Common forms include superoxide radicals, hydrogen peroxide, and hydroxyl radicals. While these molecules are essential for certain physiological processes such as immune defense and cell signaling, excessive production can be harmful.

External factors such as air pollution, smoking, ultraviolet radiation, processed foods, and chronic stress can significantly increase ROS levels. When antioxidant defenses are insufficient, oxidative damage occurs. This can lead to lipid peroxidation, protein dysfunction, and genetic mutations, which may initiate or exacerbate disease conditions.

Oxidative stress also activates inflammatory pathways, including nuclear factor-kappa B (NF- κ B), leading to chronic low-grade inflammation. This state is a common feature in many lifestyle-related diseases.

Types and Sources of Antioxidants

Antioxidants can be classified into two major categories: endogenous and exogenous.

Endogenous antioxidants are naturally produced within the body and include enzymatic systems such as superoxide dismutase, catalase, and glutathione peroxidase. These enzymes play a vital role in neutralizing reactive oxygen species and maintaining cellular balance.

Exogenous antioxidants are obtained through dietary intake. These include vitamins, minerals, and plant-derived compounds. Vitamin C acts as a water-soluble antioxidant that neutralizes free radicals and regenerates other antioxidants. Vitamin E, a fat-soluble compound, protects cell membranes from oxidative damage. Carotenoids such as beta-carotene and lycopene contribute to immune function and antioxidant defense.

Polyphenols, including flavonoids and resveratrol, are widely present in fruits, vegetables, tea, and cocoa. These compounds possess both antioxidant and anti-inflammatory properties. Minerals like selenium, zinc, and copper also support antioxidant enzyme activity.

A balanced diet rich in plant-based foods ensures a synergistic effect of these antioxidants, enhancing overall protection against oxidative stress.

Antioxidants in Cardiovascular Health

Cardiovascular diseases remain one of the leading causes of death globally. One of the key processes involved in their development is the oxidation of low-density lipoprotein (LDL) cholesterol. Oxidized LDL contributes to plaque formation in blood vessels, leading to atherosclerosis.

Antioxidants help prevent this process by reducing LDL oxidation, improving endothelial function, and lowering inflammation. Diets rich in fruits, vegetables, and healthy fats, such as those found in Mediterranean dietary patterns, have been associated with reduced cardiovascular risk.

However, studies on high-dose antioxidant supplements have produced inconsistent outcomes, suggesting that natural dietary sources may be more beneficial than isolated supplements.

Role in Diabetes Management

Type 2 diabetes mellitus is characterized by chronic high blood sugar levels and increased oxidative stress. Elevated glucose levels promote the formation of advanced glycation end-products and increase free radical production.

Antioxidants help improve insulin sensitivity, protect pancreatic cells, and reduce oxidative damage. Plant-based compounds such as flavonoids have shown promising effects in improving glucose metabolism and reducing diabetic complications.

Dietary patterns rich in whole plant foods have been consistently associated with a lower risk of developing diabetes.

Obesity and Metabolic Syndrome

Obesity is associated with increased oxidative stress and chronic inflammation due to excessive fat accumulation. Adipose tissue releases inflammatory molecules that further enhance oxidative damage.

Antioxidants play a role in reducing inflammation, improving lipid metabolism, and supporting energy balance. Diets emphasizing fruits, vegetables, whole grains, and healthy fats have been linked to reduced incidence of metabolic syndrome and obesity-related complications.

Cancer Prevention

Oxidative damage to DNA is a key factor in the initiation of cancer. Antioxidants help prevent this damage by neutralizing free radicals and protecting cellular structures.

Epidemiological evidence suggests that individuals with higher intake of fruits and vegetables have a lower risk of certain cancers. However, excessive supplementation, particularly with certain compounds, may have adverse effects, highlighting the importance of balanced intake.

Neuroprotective Effects

Neurodegenerative disorders such as Alzheimer's and Parkinson's diseases are associated with oxidative stress and inflammation in the brain. Antioxidants help protect nerve cells, reduce inflammation, and support cognitive function.

Dietary compounds like flavonoids have been shown to improve brain health and may delay age-related cognitive decline, although more long-term studies are needed.

Antioxidant Supplementation: Benefits and Concerns

While observational studies support the benefits of antioxidant-rich diets, clinical trials on supplementation have shown mixed results. High doses of certain antioxidants may interfere with normal cellular processes and reduce potential benefits.

Variations in dosage, population characteristics, and health status contribute to these inconsistencies. Current recommendations emphasize obtaining antioxidants primarily through natural food sources rather than relying on supplements unless medically advised.

Future Perspectives

Emerging research areas include personalized nutrition and nutrigenomics, which explore how individual genetic differences influence responses to dietary antioxidants. Additionally, the interaction between antioxidants and gut microbiota is gaining attention as a factor in disease prevention.

A comprehensive approach combining balanced nutrition, regular physical activity, and stress management is likely to provide the most effective protection against lifestyle disorders.

Conclusion

Oxidative stress is a major contributing factor in the development of lifestyle-related diseases such as cardiovascular disorders, diabetes, obesity, cancer, and neurodegenerative conditions. Antioxidants play a crucial role in protecting the body by neutralizing harmful free radicals and reducing inflammation.

Strong scientific evidence supports the consumption of antioxidant-rich foods as an effective strategy for disease prevention. However, the use of high-dose supplements remains controversial and should be approached carefully. Promoting healthy dietary habits and lifestyle practices remains essential for reducing the burden of lifestyle disorders.

References (APA Style)

1. Ames, B. N., Shigenaga, M. K., & Hagen, T. M. (1993). Oxidants and antioxidants in aging. *Proceedings of the National Academy of Sciences*, 90(17), 7915–7922.
2. Benzie, I. F. F., & Wachtel-Galor, S. (2011). *Herbal medicine: Biomolecular and clinical aspects*. CRC Press.
3. Halliwell, B., & Gutteridge, J. M. C. (2015). *Free radicals in biology and medicine* (5th ed.). Oxford University Press.
4. Huang, H. Y., Caballero, B., Chang, S., et al. (2006). Multivitamin use and chronic disease prevention. *Annals of Internal Medicine*, 145(5), 372–385.
5. Li, Y., et al. (2014). Dietary antioxidants and cardiovascular health. *Current Atherosclerosis Reports*, 16(9), 1–9.
6. Lobo, V., et al. (2010). Free radicals and antioxidants. *Pharmacognosy Reviews*, 4(8), 118–126.
7. Ristow, M., & Schmeisser, K. (2014). Mitohormesis and health. *Physiology*, 29(6), 430–438.
8. Valko, M., et al. (2007). Free radicals in human disease. *The International Journal of Biochemistry & Cell Biology*, 39(1), 44–84.
9. World Health Organization. (2023). Noncommunicable diseases fact sheet.

Quantity of Prepared Milk: Standards, Determinants, and Public Health Perspectives

Vibisha L

Student, I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.
Email Id : nicasndvibisha13112007@gmail.com

Abstract

Milk is a nutritionally dense and widely consumed food across all age groups. The quantity of prepared milk—whether fresh, reconstituted, fortified, or formulated—plays a crucial role in ensuring nutritional adequacy, food safety, and economic efficiency. Accurate measurement and preparation are especially important in infant feeding, clinical nutrition, institutional catering, and dairy industry processing. Errors in preparation may result in undernutrition, overconcentration of nutrients, contamination, and wastage. This article examines the determinants of prepared milk quantity, methods of standardization, quality control mechanisms, technological innovations, and public health implications. It also highlights international regulatory standards governing milk preparation and distribution.

Keywords: Prepared milk, reconstituted milk, infant formula, milk standardization, dairy processing, food safety, public health

Introduction

Milk is often described as a “complete food” because it contains essential macronutrients and micronutrients necessary for growth and development. According to the Food and Agriculture Organization, milk and dairy products are significant contributors to global food security and nutrition. The World Health Organization emphasizes the importance of safe and adequate milk preparation practices, particularly in vulnerable populations such as infants and young children.

The term *quantity of prepared milk* refers to the accurately measured volume of milk ready for consumption after undergoing necessary preparation processes such as dilution, reconstitution, fortification, or pasteurization. Quantity determination involves precise measurement of ingredients, adherence to recommended ratios, and hygienic handling procedures. Both insufficient and excessive quantities may lead to nutritional imbalance, health risks, and economic losses.

Concept and Types of Prepared Milk

Prepared milk can be categorized into several types based on processing and purpose:

- Fresh processed milk: Pasteurized and homogenized milk ready for consumption.
- Reconstituted milk: Milk obtained by mixing milk powder with water in prescribed ratios.
- Infant formula milk: Specially designed prepared milk that meets infants' nutritional needs.
- Fortified milk: Milk enriched with vitamins such as A and D, or minerals like iron and calcium.

The Codex Alimentarius Commission provides international standards for milk composition, labeling, and reconstitution practices to ensure uniformity and safety across countries.

Determinants of Quantity in Prepared Milk

Nutritional Requirements

The required quantity of prepared milk depends on age, body weight, physiological condition, and energy expenditure. Infants require carefully measured formula based on weight and age to prevent both underfeeding and overfeeding. Adolescents, athletes, pregnant women, and elderly individuals have varying nutritional requirements influencing milk consumption levels.

The UNICEF highlights the importance of accurate formula preparation in reducing infant morbidity associated with improper feeding practices.

Reconstitution Ratio

Milk powder reconstitution requires adherence to manufacturer-specified ratios. Typically, one level scoop of powder is mixed with a fixed quantity of boiled and cooled water. Over-dilution reduces nutrient density, potentially causing protein-energy malnutrition, while under-dilution increases solute load, which may stress immature kidneys in infants.

Industrial Standardization

Dairy industries use fat standardization and adjustment of solids-not-fat (SNF) to maintain consistent nutritional composition. Major dairy organizations such as Nestlé and Amul apply automated volumetric systems to ensure consistent packaging quantities.

Measurement and Preparation Practices

Household Level

At the domestic level, milk quantity is measured using standardized scoops, graduated feeding bottles, and measuring cups. Errors often occur due to loosely packed powder, incorrect scoop leveling, or inaccurate water measurement.

Clinical and Therapeutic Settings

In hospitals, therapeutic milk formulas such as F-75 and F-100 are prepared according to strict guidelines for treating severe acute malnutrition. The World Health Organization provides standardized protocols to ensure accurate preparation and prevent metabolic complications.

Industrial Processing

Industrial milk preparation involves sophisticated equipment including flow meters, automated filling machines, and digital weighing systems. These technologies minimize human error and ensure that labeled volumes (e.g., 200 ml, 500 ml, 1 liter) are accurate and consistent.

Quality Control and Safety Considerations

Prepared milk must meet microbiological and compositional safety standards. Contaminated water used for reconstitution can introduce pathogens, increasing the risk of gastrointestinal infections. The Food Safety and Standards Authority of India regulates standards for milk processing, packaging, labeling, and permissible microbial limits.

Proper storage is essential. Reconstituted milk should ideally be consumed immediately or refrigerated and used within recommended time frames. Failure to maintain cold-chain systems reduces usable quantity due to spoilage.

Public Health Implications

Improper quantity preparation has significant health consequences:

- **Undernutrition:** Over-diluted milk may fail to meet caloric and protein requirements.
- **Overnutrition and metabolic stress:** Concentrated formula may lead to excessive caloric intake or renal burden.
- **Infection risk:** Poor hygiene during preparation increases exposure to pathogens.

Global health agencies consistently stress caregiver education regarding accurate measurement and hygienic preparation practices.

Technological and Environmental Considerations

Technological advancements such as automated formula dispensers and digital measurement systems enhance precision in milk preparation. Precision nutrition strategies adopted by multinational companies like Danone contribute to standardized quantity control.

From an environmental perspective, accurate quantity estimation reduces waste and supports sustainable dairy production. Powdered milk, due to reduced transportation weight, also lowers carbon emissions compared to liquid milk distribution.

Conclusion

The quantity of prepared milk is a critical factor in nutrition, safety, and sustainability. Accurate measurement, adherence to recommended preparation ratios, quality control monitoring, and public education are essential to ensure optimal outcomes. International organizations such as the World Health Organization and the Food and Agriculture Organization emphasize the role of standardized milk preparation practices in improving global health indicators.

Ensuring correct quantity in prepared milk is not merely a domestic responsibility but a coordinated effort involving caregivers, healthcare professionals, regulatory bodies, and the dairy industry.

References

1. Codex Alimentarius Commission. (2011). *Codex standard for milk powders and cream powder (CODEX STAN 207-1999)*. FAO/WHO.
2. Food and Agriculture Organization. (2018). *Dairy development's impact on poverty reduction*. FAO.
3. Food Safety and Standards Authority of India. (2020). *Food safety and standards (Food products standards and food additives) regulations*. FSSAI.
4. UNICEF. (2019). *Infant and young child feeding programming guide*. UNICEF.
5. World Health Organization. (2007). *Guidelines on the safe preparation, storage and handling of powdered infant formula*. WHO.
6. World Health Organization. (2013). *Updates on the management of severe acute malnutrition in infants and children*. WHO.
7. Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). *Dairy science and technology*. CRC Press.
8. Spreer, E. (1998). *Milk and dairy product technology*. Marcel Dekker.
9. Early, R. (Ed.). (1998). *The technology of dairy products*. Springer.

AN ANALYSIS OF SELECTED PHYSICAL FITNESS VARIABLES OF UNIVERSITY LEVEL WOMEN HANDBALL PLAYERS

Gopu M Vijayan

Research Scholar, Department of Physical Education,

M.G. University, Kottayam, Kerala.

Email Id : gopu056@gmail.com

Prof. Thomas George

Professor,

St. Joseph College, Moolamattom.

Abstract

Present study analyses the selected physical fitness variables of university level women handball players of Kerala. A total of 40 female university level handball players age 18 to 25 were selected from M.G. University and Calicut University. Participants speed, agility and explosive strength were measured and compared with using independent t test. The shows that Calicut University players shows ($M = 8.97$, $SD = 0.21$) shows a slightly higher mean but was not statistically significant, $t = 1.87$, $p = 0.69$. For agility, M.G University players ($M = 10.78$, $SD = 0.30$) recorded lower mean scores compared to Calicut University yielded a statistically significant difference between the groups, $t = 4.85$, $p < 0.01$ In the contest of explosive strength, M.G University players ($M = 166.15$, $SD = 9.17$) exhibited a marginally higher mean score than Calicut University players ($M = 165.05$, $SD = 9.22$). The difference between groups was found to be statistically significant, $t = 2.71$, $p = 0.010$. Overall both the university players' shows similar results in some extent M.G University player's shows significant difference in explosive strength and agility compared to Calicut University players.

Keywords: speed, agility and explosive strength of M.G. University and Calicut University women handball players

1. Introduction

Participating sports means regular exercising and participating in competitive sports means regular scientific (technical & tactical) exercising. Which means if someone needs to be an elite sports person he must follow scientific ways of training from the beginning of his/her career to the end. Sports activities can done by individually or by team, participating or competing in sports will give the sports person different physical and mental qualities according to their area of participation and specialization. So participating in any sports will give a sports person different physical qualities, men's and women's sports give both categories different levels of fitness.

Previous studies were examined the comparison of physical fitness variables of women handball player and basketball players (Rajkumar & Muthusubramanian, 2024). Selected physical parameters among female handball and basketball players were also examined (Singh & Lovely, 30 C.E.). However limited studies compared the physical fitness parameters of university level female handball players of Kerala. Where there is an imbalance in both cultural and present technical and tactical physical preparation methods.

This study, there for analyses selected physical fitness variables of university level women handball players.

2. Methods & Materials

2.1 Participants

The sample of the study consist of number 40 University level Women handball players were selected from two different universities of Kerala. For the study the age of the subjects are ranged from 18 to 25 years. All of them are actively participating regular handball based physical fitness programme.

2.2 Instruments

50 m dash (Speed): players could take a starting position before running and when the players start with sprint, the stop watch is also started to count and stop at the moment of when the player exactly at 50 meter.

Shuttle Run (Agility): Two parallel lines, 30 feet apart were marked on the ground. Blocks of wooden were placed on one of the lines. The subjects started from behind the other line. On the sound of the clapper, the subject should run to the blocks, picked up one, and ran back to the starting lines and place behind the line. She then ran back and pick up the second block, which he carried back across the starting line. As soon as the block was placed on the grounds, timekeeper stopped the watch and recorded the time.

Standing broad jump (Explosive leg strength): The subject stood with feet several inches apart and toes just behind the take-off line. Preparatory to jumping, the arms are swing backward and the knee bend. The jump is done by extending the knee and by swinging the arms forward simultaneously. Measurement is taken from the take-off line of the heel or part of the body that touch the part nearest to the take-off line.

2.3 Procedure

Samples were selected from M.G. University Kottayam and Calicut University. Participants were tested individually during regular training hours. Speed was tested first,

followed by explosive leg strength and Agility. All tested were done in the natural playing surface.

2.4 Statistical Analysis

Descriptive statistics (mean, SD) were computed independent t-test were administrated to find out the difference between both groups. Data were analyzed using SPSS version 25.

3. Results

Table 1. Descriptive statistics of M.G, university and Calicut University

VARIABLES	M.G UNIVERSITY	CALICUT UNIVERSITY
Speed	8.97 $\pm$.21	8.53 $\pm$.20
Agility	10.78 $\pm$.30	11.18 $\pm$.35
Explosive strength	166.15 $\pm$ 9.17	165.05 $\pm$ 9.22

Descriptive statistics for M.G. University and Calicut University were present in the table 1. women handball players of Calicut University reported a higher mean of speed (M = 8.97, SD= .21) compared to M.G. University speed (M = 8.53, SD= .20). Mean of Agility higher in M.G. University women handball players (M =10.78, SD =.30) compared to Calicut University (M =11.18, SD =.35). finally explosive strength is also higher in M.G. University women handball players (M =166.15, SD =9.17.) compared to Calicut University women handball players (M =165.05, SD =9.22.)

Table 2. Comparison Speed, Agility, Explosive Strength of Women Handball Players from M.G, University and Calicut University

VARIABLE	UNIVERSITY	MEAN	SD	Mean Difference	t-Ratio	Sig. (2-tailed)
Speed	M.G University	8.97	.21	.13	1.87	0.69
	Calicut University	8.53	.20			
Agility	M.G University	10.78	.30	.61	4.85*	.000
	Calicut University	11.18	.35			
Explosive strength	M.G University	166.15	9.17	7.55	2.71*	.010
	Calicut University	165.05	9.22			

*significant at 0.05 level. df =39

The Independent t-test results shows that Calicut University players shows ($M = 8.97$, $SD = 0.21$) shows a slightly higher mean score in speed compared M.G University players ($M = 8.53$, $SD = 0.20$). But the independent samples t-test revealed that this difference was not statistically significant, $t = 1.87$, $p = 0.69$. For agility, M.G University players ($M = 10.78$, $SD = 0.30$) recorded lower mean scores compared to Calicut University players ($M = 11.18$, $SD = 0.35$). The independent samples t-test yielded a statistically significant difference between the groups, $t = 4.85$, $p < 0.01$. In the contest of explosive strength, M.G University players ($M = 166.15$, $SD = 9.17$) exhibited a marginally higher mean score than Calicut University players ($M = 165.05$, $SD = 9.22$). The difference between groups was found to be statistically significant, $t = 2.71$, $p = 0.010$.

4. Discussion

The findings of the study revealed that there is a significant difference in explosive strength, agility of M.G University and Calicut university women handball players. When we are also assess the performance level of these players we can understand that how these physical factors differ from one another. Even when both teams are specialized on same game but the regular scientific training only gave more game related physical qualities. In the contest of speed we can see both the university players shows no significant differences which shows as that an intense game like handball definitely improve the speed of the players even when we don't regularly focusses on speed improving activities but also the result shows as that the level of speed is similar in both groups but it is not a higher average than a sprinter.

5. Conclusion

The study concludes that even the area of specialization of the sports persons are same it is does not ensure similar physical qualities. Because the way or approach towards the game will deflect on the performance of the participants also. Hear the study reveal that even the participants are same level, there physical qualities are determined by the scientific methods those who trained with.

References

1. Devi, R., & Kumar, N. (2024). A comparative study of physical fitness variables of handball and throwball players. *Journal of Sports Science and Nutrition*, 5(1), 09-15. <https://doi.org/10.33545/27077012.2024.v5.i1a.228>
2. Halder, A., & Rahaman, A. (2022). Comparative analysis of selected physical fitness components among team game players. *International Journal of Physiology, Nutrition*

- and Physical Education, 7(2), 82–85.
<https://doi.org/10.22271/journalofsport.2022.v7.i2b.2560>
3. Naveed, q., zia ul haq, m., & ahmad, h. (2020). Anthropometric, physical fitness and kinematics analysis of the jump shot of female handball players - a case study of the islamia university bahawalpur, pakistan. *International journal of physiotherapy*, 7(3).
<https://doi.org/10.15621/ijphy/2020/v7i3/703>
 4. Rajkumar, Dr. P., & Muthusubramanian, Dr. J. (2024). Comparative analysis the physical fitness among basketball and handball players at different topography. *International Journal of Sports, Health and Physical Education*, 6(2), 11–16.
<https://doi.org/10.33545/26647559.2024.v6.i2a.139>
 5. *Relationship of selected physical fitness components on shooting accuracy of women handball players.* (2024). ResearchGate.
https://www.researchgate.net/publication/301620326_Relationship_of_selected_physical_fitness_components_on_shooting_accuracy_of_women_handball_players
 6. Singh, A., & Lovely. (30 C.E.). *International Journal of Physiology, Nutrition and Physical Education* 2016; 1(2): 152-154 A study on selected physical fitness parameters among female handball and basketball players.
<https://www.journalofsports.com/pdf/2016/vol1issue2/PartC/1-2-40-333.pdf>

NUTRITIONAL PROFILING AND SENSORY APPEAL OF FUNCTIONAL SMOOTHIES FOR CALORIC REGULATION

N. RESHMA

Student, II B.Sc. Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

S. PEFHY

Student, II B.Sc. Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

SUDHA. U V

Assistant Professor, Department of Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

Email Id: sudhasathi43@gmail.com

Abstract

The global obesity pandemic has led to increased risks of metabolic syndrome, including dyslipidemia, insulin resistance, and cardiovascular diseases. Conventional weight management strategies often fail due to poor satiety regulation and dietary noncompliance. Consequently, functional foods containing bioactive compounds have gained attention for their potential roles in lipid profile modulation, glycemic control, and gut microbiota regulation. Chia seeds (*Salvia hispanica* L.) and almond gum (*Terminalia catappa* L.) exhibit significant nutraceutical properties due to their high content of alpha-linolenic acid, polysaccharides, dietary fiber, and polyphenolic antioxidants. Chia seeds have demonstrated effects on lipid metabolism, waist circumference reduction, and hypoglycemic response, although their direct influence on weight loss remains a subject of debate. Almond gum, a hydrophilic polymer, functions as a prebiotic, emulsifying agent, and stabilizer, enhancing both gastrointestinal health and food texture. This study explores the synergistic potential of chia seeds and almond gum in developing viscoelastic, fiber-rich smoothie formulations aimed at satiety enhancement and metabolic health improvement. By leveraging these bioactive compounds, this research highlights their role in weight management and the formulation of sustainable functional foods. Further investigation is required to establish their long-term impact on energy homeostasis and gut microbiota modulation.

Keywords: Obesity pandemic, alpha-linolenic acid, polysaccharides, hypoglycemic effect, viscoelastic properties, prebiotic potential, nutraceuticals, hydrophilic polymers, gummosis.

Introduction

Obesity, characterized by excessive fat accumulation, affects over 650 million people worldwide. Evidence has shown that a weight loss of 5% to 10% within six months is necessary to reduce risk factors of comorbidities such as reductions in blood glucose and blood pressure (H.A. Raynor et al., 2016).

Vuksan V. et al. (2007) reported that dietary fiber may promote weight loss by delaying gastric emptying and increasing secretion of intestinal hormones that promote satiety. Additionally, chia seeds have demonstrated positive effects on lipid metabolism and reduction of waist circumference (Guevara Cruz M. et al., 2012).

Almond gum is a water-soluble polysaccharide and its biocompatible characteristics are a result of its favorable hydrophilic and hydrogen bond characteristics. It has a number of advantageous applications, including food reinforcing, preservative, emulsifier, stabiliser, and a source of dietary fiber. Moreover, it could be used as a component to increase a material's physical and structural characteristics, such as hydration, oil-holding capacity, viscosity, texture, sensory properties, and shelf life (Rezaei.A. *et al.*, 2016)

At the moment, there is a rising tendency all over the world toward the use of natural excipients along with medicines. Due to the extensive variety of medicinal applications that plant-derived polymers may be used for, there has been a recent surge in interest in these materials. These substances have a wide range of uses, including those of a diluent, binder, disintegrant, thickening, protective colloids, gelling agent, and base in many pharmaceutical products. The gum is preferred over synthetic and semi-synthetic additions due to the fact that it is less harmful to the environment, more cost-effective, has relaxing benefits, and does not irritate the skin (Faroop.U *et al.*, 2014)

Functional Ingredients:

- **Chia Seeds:** Originally from Southern Mexico, these seeds are rich in protein (16.5%–16.9%) and fiber (32.4%–32.6%). They contain the highest known amount of alpha-linolenic acid (omega-3) and various polyphenolic antioxidants.
- **Almond Gum:** A natural polysaccharide exudate produced by *Prunus dulcis*. It acts as an emulsifier, stabilizer, and prebiotic, enhancing both gastrointestinal health and food texture.

Objectives

- To evaluate the nutritional composition of chia seed and almond gum in prepared smoothies.
- To analyze sensory acceptability among consumers.
- To determine the potential role of these ingredients in weight management and metabolic health.

Materials and Methods

Formulation and Standardization

Smoothies were developed using three primary bases: Ragi, Oats, and Beetroot and compared with a standard smoothie.

Table 1: Ingredients and Proportion for Functional Smoothies

Ingredient	Ragi-Based Smoothie	Oats-Based Smoothie	Beetroot-Based Smoothie
Base Ingredient	100g (Ragi Flour)	15g (Oats)	67g (Beetroot)
Liquid Base	100ml (Milk)	150ml (Milk)	150ml (Milk)
Natural Sweetener	100g (Dates)	100g (Dates)	100g (Dates)
Functional Agent* (Chia/Gum)	5g	5g	5g

Sensory Evaluation A panel of 20 semi-trained members evaluated the products using a numerical scorecard for appearance, texture, taste, color, and flavor.



Keeping Quality and Storage Stability

The storage behaviour of the six smoothie formulations was monitored over 3 days under two conditions: Room Temperature ($28 \pm 2^{\circ}\text{C}$) and Refrigerated Storage ($4 \pm 1^{\circ}\text{C}$). Samples were evaluated daily for microbial growth and organoleptic changes (off-flavours and texture degradation).

Results and Discussion - Sensory Analysis

Table 2: Mean Scores for Appearance, Texture and Taste (%) |

The sample smoothies consistently received higher scores than standard versions.

Product Variation	Appearance Mean Score	Appearance Percentage (%)	Texture Mean Score	Texture Percentage (%)	Taste Mean Score	Taste Percentage (%)
Ragi Chia Seed (Sample)	4.95	99%	4.80	96%	4.55	91%
Ragi Almond Gum (Sample)	4.65	93%	4.55	91%	4.95	99%
Oats Chia Seed (Sample)	4.75	95%	4.50	90%	4.6	92%
Oats Almond Gum (Sample)	4.70	94%	4.75	95%	4.8	96%
Beetroot Chia Seed (Sample)	4.50	95%	4.35	95%	4.55	91%
Beetroot Almond Gum (Sample)	4.70	94%	4.60	92%	4.65	93%

Table 3: Mean Scores for, color, flavor and Overall acceptability. (%)

Product Variation	Colour Mean Score	Colour Percentage (%)	Flavor Mean Score	Flavor Percentage (%)	Overall acceptability Mean Score	Overall acceptability Percentage (%)
Ragi Chia Seed (Sample)	4.75	95%	4.75	95%	4.64	91%
Ragi Almond Gum (Sample)	4.75	95%	4.75	95%	4.65	95%
Oats Chia Seed (Sample)	4.6	92%	4.65	93%	4.5	96%
Oats Almond Gum (Sample)	4.65	93%	4.9	98%	4.9	98%
Beetroot Chia Seed (Sample)	4.65	93%	4.35	87%	4.65	95%
Beetroot Almond Gum (Sample)	4.7	94%	4.7	94%	4.7	97%

Nutritional Profiling and Storage

Nutritional Synergy The "viscoelastic" properties of almond gum, combined with the soluble fiber in chia seeds, create a dense gel matrix in the stomach. This increases oil-holding capacity and delays the absorption of carbohydrates, supporting a hypoglycemic response.

Keeping Quality Shelf-life testing was conducted for 1 to 3 days under room and refrigerated storage.

Table 4:

Storage Day	Condition	Microbial Growth	Sensory Quality
Day 1	Room/Refrig	None	Excellent
Day 2	Refrigerated	None	Good
Day 3	Room/Refrig	Detected	Off-flavours present

Conclusion:

The study concludes that chia seeds and almond gum are nutrient-dense superfoods that significantly enhance the satiety and nutritional profile of smoothies. The Ragi and Oats formulations with these additives were highly acceptable to consumers, providing a viable, food-based strategy for caloric regulation and weight management.

References

1. Skinner AC et al. (2018). Prevalence of Obesity.
2. Ullah R et al. (2016). Nutritional properties of Chia.
3. Vuksan V. et al. (2007). Supplementation of Conventional Therapy with *Salvia hispanica*.
4. Raynor H.A. et al. (2016). Interventions for the treatment of overweight and obesity.
5. Ciau-Solis N et al. (2014). Chemical and functional properties of chia.
6. Guevara Cruz. M. et al. (2012). A Dietary Pattern Including Nopal, Chia Seed Soy Protein, and Oat Reduces Serum Triglycerides and Glucose Intolerance in Patients with Metabolic Syndrome. *J Nutr* 142: 64-69.
7. Rezaei, A. et al. 2016) Fractionation and some physicochemical properties of almond gum (*Amygdalus communis* L.) exudates, *Food Hydrocolloids* 60 (461-469, <https://doi.org/10.1016/j.foodhyd.2016.04.027>.
8. Farooq U et al. (2014) Extraction and characterization of almond (*Prunus sulcis*) gum as pharmaceutical excipient. *American-Eurasian J Agric & Environ Sci.*;14:269-74.

Nutritional and Antioxidant Profiling of *Passiflora edulis*: Impact on Organoleptic Quality and Shelf-Life

ANAKHA.A S

Student, II B.Sc. Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

VARSHA PRADHA

Student, II B.Sc. Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

SUDHA. U V

Assistant Professor Department of Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli

Email Id: sudhasathi43@gmail.com

Abstract

Passiflora edulis, commonly known as passion fruit, is a widely cultivated plant in the Passifloraceae family. It is high in antioxidants and serves as an excellent source of nutrients, particularly fiber, vitamin C, and provitamins. The fruit contains several bioactive constituents that possess health-promoting properties, making it beneficial for patients with cancer or cardiac conditions, as well as for bone health. Daily consumption of passion fruit at standard doses is non-toxic and safe; it exhibits a wide range of biological activities, including antioxidant, anti-hypertensive, anti-tumor, antidiabetic, and hypolipidemic effects. In the present study, a nutrient analysis of *Passiflora edulis* revealed the presence of essential constituents such as carbohydrates, vitamin C, iron, and potassium. Total antioxidant activity was measured to determine the fruit's potency, while microbial analysis was conducted to assess the total bacterial and fungal counts. Phytochemical screening confirmed the presence of phenols, tannins, flavonoids, terpenoids, glycosides, alkaloids, steroids, and quinones. Finally, various products—including halwa, payasam, healthy balls, candy, and smoothies—were formulated from *Passiflora edulis*. Sensory evaluation of these products was conducted by a 25-member panel using a standardised scorecard.

Key words: *Passiflora Edulis*, Nutrients, Health effects, Phytochemicals.

Introduction

Passion fruit is a tropical fruit belonging to the dicotyledonous family *Passifloraceae*. The genus *Passiflora* represents the largest group within this family, comprising more than 500

species distributed across tropical and subtropical regions. Among these, *Passiflora edulis* is the most widely cultivated species due to its nutritional value and commercial importance.

Passion fruit is highly valued for its appealing flavor, aroma, and rich nutrient composition. It is widely consumed in fresh form and is extensively used in the preparation of processed products such as juices, jellies, jams, ice creams, and beverages. In addition to its culinary applications, the fruit also plays a significant role in the food processing industry due to its versatility and growing consumer demand. The increasing popularity of passion fruit has contributed to the expansion of its cultivation and industrial utilization worldwide.

Apart from its nutritional significance, passion fruit has been traditionally used in various systems of medicine. Plant-based remedies derived from *Passiflora edulis* continue to play an important role in primary healthcare in many regions. The pulp of the fruit is considered both a stimulant and a general tonic, supporting overall health and vitality. Scientific investigations have explored its potential therapeutic applications, particularly in the management of anxiety, insomnia, and related neurological conditions.

Extracts obtained from different parts of the plant, including leaves, peel, and seeds, have demonstrated antimicrobial properties against a wide range of pathogens such as bacteria, fungi, viruses, and protozoa. These bioactive properties make passion fruit a valuable resource in traditional and complementary medicine. It is also commonly used in herbal formulations aimed at improving mental well-being, including the treatment of stress, depression, and sleep disorders.

Passion fruit is often referred to as the “King of Fruits” due to its diverse applications and health benefits. Beyond fresh consumption, it is utilized in the production of various value-added products such as cakes, yogurts, tea, wine, vinegar, sauces, and functional beverages. Additionally, it is used in cosmetic formulations as a natural moisturizing agent, reflecting its importance in both the food and personal care industries.

Recent experimental studies have highlighted the antioxidant potential of *Passiflora edulis*. Research involving animal models has shown that extracts from the bark, leaves, peel, and seeds can enhance antioxidant activity in vital organs such as the liver, kidneys, and adipose tissue. These extracts have also been found to reduce lipid peroxidation and improve the activity of antioxidant enzymes, particularly in conditions like obesity and diabetes. Such findings indicate the promising role of passion fruit in the prevention and management of oxidative stress-related disorders.

Objectives

- To find out the phytochemicals present in *Passiflora Edulis* qualitatively.
- To determine the nutrient composition of *Passiflora Edulis*.
- To study the antioxidants present in *Passiflora Edulis*.
- To formulate products using *Passiflora Edulis*.
- To Evaluate the sensory qualities of the products.

Materials and Methods

Phytochemical Screening: Qualitative tests identified secondary metabolites

Table: 1

S. No.	Secondary Metabolite	Test Method	Observation
1	Phenols	Lead Acetate Test	Formation of white precipitate
2	Tannins	Ferric Chloride Test	Formation of brownish precipitate
3	Flavonoids	Ferric Chloride Test	Appearance of yellowish-green precipitate
4	Saponins	Foam Test	Formation of stable, persistent foam
5	Terpenoids	Liebermann–Burchard Test	Development of greenish coloration
6	Alkaloids	Wagner’s Reagent Test	Formation of reddish-brown precipitate
7	Glycosides	Keller–Killani Test	Formation of a distinct brown ring
8	Steroids	Liebermann–Burchard Test	Reddish upper layer with greenish-yellow acid layer
9	Quinones	Hydrochloric Acid Test	Formation of yellowish precipitate

Nutrient Analysis: Carbohydrates were estimated via the Anthrone method, and Vitamin C was determined by titration.

Determination of Total Antioxidant Capacity

The total antioxidant capacity (TAC) was determined using the phosphomolybdenum method as described by **Prieto et al.** The assay is based on the reduction of Mo (VI) to Mo (V) by the extract and the subsequent formation of a green phosphate/Sb (V) complex at acidic pH.

One mL of the extract (1 mg/mL) was mixed with 3 mL of reagent solution (0.6 M sulfuric acid, 28 mM sodium phosphate, and 4 mM ammonium molybdate). Standard solutions of ascorbic acid were prepared in methanol to establish a calibration curve. All reaction tubes were incubated at 95°C for 90 min. After cooling to room temperature, the absorbance was measured at 695 nm using a UV-VIS spectrophotometer against a blank. The total antioxidant activity was expressed as ascorbic acid equivalents (AAE).

Sensory Evaluation: Products (Halwa, Payasam, Healthy balls, Candy, and Smoothies) were evaluated for appearance, texture, taste, color, and flavor by a 25-member semi-trained panel.

Results and Discussion

Screening confirmed a robust presence of bioactive compounds which support the fruit's use in traditional medicine.

Table: 2

Si. No	Name of Test	Sample code (PE)
1.	Phenol	+++
2.	Tannin	+++
3.	Flavanoid	++
4.	Saponin	-ve
5.	Terpenoids	++
6.	Alkaloid	+
7.	Glycoside	+++
8.	Steroid	+
9.	Quinones	+++
10.	Fatty acid	-ve

Nutritional Composition

The fruit is a significant source of Potassium and Vitamin C while remaining low in sodium with zero cholesterol.

Nutrient	Finding	Biological Function
Carbohydrates	Significant	Primary energy source
Vitamin C	High	Antioxidant and immune support
Potassium (K)	High	Cardiac and bone health
Iron (Fe)	Present	Red blood cell production

The total antioxidant

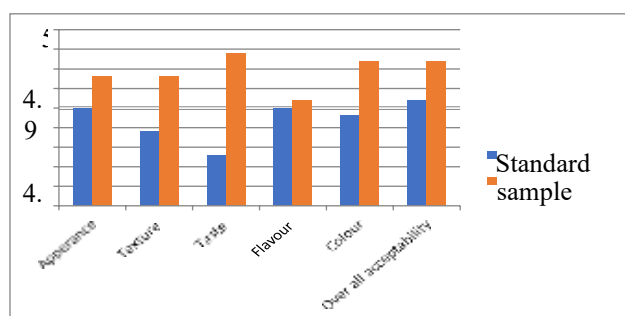
The total antioxidant capacity of the extract was evaluated by the phosphomolybdenum method, according to the procedure described by Prieto P.

Si. No	Sample code	OD at 695 nm	Concentration of antioxidants in $\mu\text{g}/\text{mg sample}$
1	PE	2.660	222.15

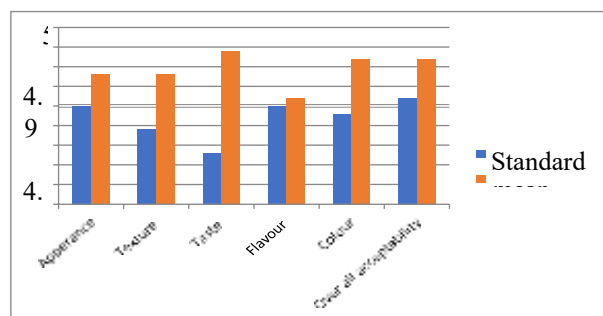
Sensory Evaluation

All formulated products scored highly, with the *Passiflora* Smoothie (4.76/5.0) outperforming standard versions in appearance and flavor.

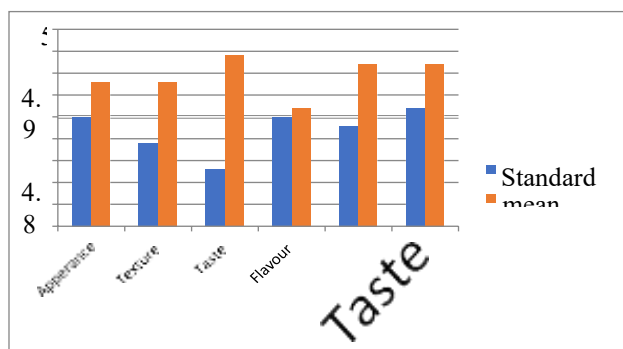
Sensory parameters of wheat halwa and *Passifloraedulis* halwa



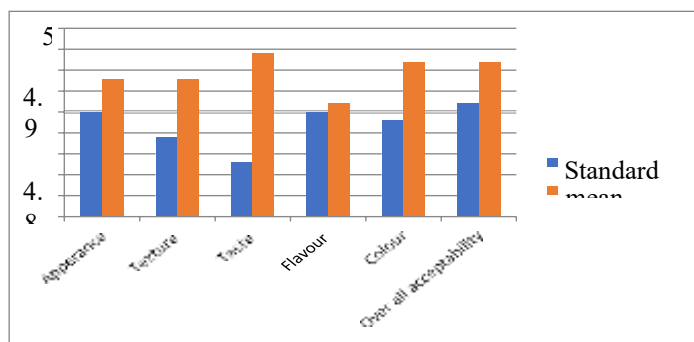
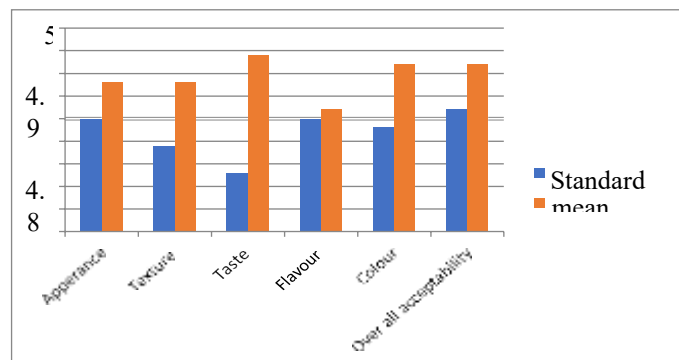
Sensory parameters of payasam and *passifloraedulis* payasam



Sensory parameters of standard healthy ball & *passifloraedulis* healthy ball



Sensory parameters of standard candy and *passifloraedulis* candy



Sensory parameters of standard smoothie & *passifloraedulis* smoothie

Conclusion:

In conclusion, *Passiflora edulis* stands out as a potent functional food source, characterized by a synergistic profile of high carbohydrates, Vitamin C, Iron, and Potassium, alongside a robust array of bioactive phytochemicals. Its documented efficacy in mitigating risks associated with cancer, hypercholesterolemia, and hypertension underscores its pharmacological versatility, primarily driven by its significant antioxidant and hypolipidemic activities. Through its positive impact on cardiac health and metabolic parameters, regular dietary inclusion of passion fruit offers a non-toxic, safe, and effective strategy for the prevention and treatment of various chronic ailments. Future research should prioritize the isolation and characterization of specific bioactive compounds to further elucidate the molecular mechanisms behind these diverse health benefits.

References

1. He, X., Luan, F., Yang, Y., Wang, Z., Zhao, Z., Fang, J., Wang, M., Zuo, M., & Li, Y. (2020). *Passiflora edulis*: An insight into current researches on phytochemistry and pharmacology. *Frontiers in Pharmacology*, 11, 617. <https://doi.org/10.3389/fphar.2020.00617>
2. Mandal, G. (2017). Production preference and importance of passion fruit (*Passiflora edulis*): A review. *Journal of Agricultural Engineering and Food Technology*, 4(1), 27–30.
3. Panelli, M. F., Pierine, D. T., de Souza, S. L., Ferron, A. J. T., Garcia, J. L., Santos, K. C. D., et al. (2018). Bark of *Passiflora edulis* treatment stimulates antioxidant capacity, and reduces dyslipidemia and body fat in db/db mice. *Antioxidants*, 7(9), 1–11. <https://doi.org/10.3390/antiox7090120>
4. Wohlmuth, H., Penman, K. G., Pearson, T., & Lehmann, R. P. (2010). Pharmacognosy and chemotypes of passionflower (*Passiflora incarnata* L.). *Biological and Pharmaceutical Bulletin*, 33(6), 1015-1018.
5. Xu, F. Q., Wang, N., Fan, W. W., Zi, C. T., Zhao, H. S., Hu, J. M., et al. (2016). Protective effects of cycloartane triterpenoides from *Passiflora edulis* Sims against glutamate-induced neurotoxicity in PC12 cell. *Fitoterapia*, 115, 122–127. <https://doi.org/10.1016/j.fitote.2016.09.013>
6. Zhou, Y., Tan, F., & Deng, J. (2008). Update review of *Passiflora*. *China Journal of Chinese Materia Medica*, 33(15), 1789.

THE BIOACTIVE SCOOP: ANALYZING THE SENSORY, NUTRITIONAL, AND PHYTOCHEMICAL PROFILES OF NATURAL ICE CREAM FLAVORS

G. ANU VARSHA

Student, II B.Sc. Nutrition & Dietetics
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli.

R.V. GIRISH

Student, II B.Sc. Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli.

SUDHA. U V

Assistant Professor Department of Nutrition & Dietetics,
Noorul Islam College of Arts & Science, Kumaracoil,
Manonmaniam Sundaranar University, Tirunelveli.

Email Id: sudhasathi43@gmail.com

ABSTRACT

Ice cream is a popular, yet complex, multiphase colloidal foodstuff. Natural flavors are substances used to add aroma and taste to finished food products; these are created using raw flavoring materials derived from natural sources. This study examines four distinct natural flavorings: Betel leaves (*Piper betle*), a medicinal species of the Piperaceae family; Butterfly Pea flower (*Clitoria ternatea*), a flowering species of the Fabaceae family; Tulsi leaves (*Ocimum sanctum*), a medicinal plant of the Lamiaceae family; and Hibiscus flower (*Hibiscus rosa-sinensis*), a flowering species of the Malvaceae family. These plant varieties exhibit a wide range of pharmacological activities, including antimicrobial and antioxidant effects. The present study aimed to formulate ice cream incorporated with these natural flavors, followed by a sensory evaluation conducted by 20 semi-trained panel members. The most successful formulation was selected for nutrient analysis, specifically focusing on the *Piper betle* extract. Nutritional parameters—including total carbohydrates, protein, fat, and caloric content—were analyzed. Furthermore, qualitative analysis was performed to identify phytochemicals such as phenols, flavonoids, alkaloids, tannins, glycosides, saponins, steroids, terpenoids, quinones, and fatty acids.

Keywords: *Piper betle* - nutrients, phytochemicals, pharmacological, *Fabacea* family.

INTRODUCTION

In ancient India, betel leaves were regarded as sacred and symbolized prosperity and well-being. Even today, they continue to play an important role in various religious and cultural ceremonies across many parts of Asia. Traditionally, betel leaf juice has been used in folk medicine for treating a variety of health conditions, including intestinal parasites, cough, fever, asthma, fatigue, and disorders related to the skin and eyes. It is also applied for disinfecting wounds, particularly in children. In addition, betel leaves are utilized in the management of dental and periodontal problems, often in the form of medicated tablets or mouth rinses. The essential oil extracted from betel leaves contains several bioactive compounds such as phenols, enzymes, and sugars, which exhibit antioxidant, antifungal, and anti-inflammatory properties. These properties make it effective in combating infections and diseases like typhoid, cholera, tuberculosis, stomach disorders, and respiratory infections by inhibiting harmful microorganisms.

Clitoria ternatea (commonly known as butterfly pea or blue ternatea) is recognized as a valuable source of phytochemicals and natural compounds with significant nutritional and therapeutic benefits. The flowers of this plant are rich in antioxidants, which help in improving blood circulation and protecting the body from oxidative stress. Regular use is also associated with benefits such as prevention of premature hair graying and hair loss, purification of blood, enhancement of night vision, and rejuvenation of skin and hair health.

Tulsi (*Ocimum sanctum*) is widely known for its medicinal importance and is considered an effective natural remedy for several ailments, including jaundice. It has traditionally been used in the treatment of eye disorders as well. A concentrated extract obtained from crushed tulsi leaves is commonly applied to the eyes to help manage conditions like night blindness and inflammation. Furthermore, tulsi is nutritionally rich and contains various beneficial compounds such as antioxidants, fatty acids (including stearic, palmitic, oleic, and linoleic acids), beta-carotene, vitamin C, and essential minerals like calcium, zinc, manganese, and sodium, all of which contribute to its therapeutic value.

In India, the flowers and leaves of hibiscus are also widely used in traditional medicine. They are known for their applications in reproductive health, including antifertility and contraceptive purposes. Additionally, hibiscus exhibits diuretic properties and is used in the management of conditions such as menorrhagia, bronchitis, and cough. It also functions as an emmenagogue and demulcent, providing soothing effects for irritated tissues and supporting overall respiratory health.

OBJECTIVES

- To determine the phytochemical present in selected product (*Piper betle*.L) quantitatively and qualitatively.
- To find the nutrient present in *Piper betle*.
- To know the sensory attributes of *Piper betle*, *Clitoria ternatea*, *Ocimum sanctum* Linn, *Hibiscus rosa sinensis*.
- To analyse the keeping quality of *Piper betle*.

METHODOLOGY

COLLECTION OF SAMPLE: The ingredients used for our research are corn flour, milk, sugar are collected from margin free super market, kaliyakkavilai and *Piper betle*, *Clitoria ternatea*, *Ocimum sanctum*, *Hibiscus rosa sinensis* from colachel, Kanyakumari District, Tamil nadu.

PROCESSING THE SAMPLE: Collected fresh leaves *piper betle* is washed in running water. Cleaned piper betle leaves is weighed and boiled for about 10 to 15 minutes in a medium flame. The extract is stored in a sterilized bottle for further purpose.

QUALITATIVE PHYTOCHEMICAL ANALYSIS

Procedure

The qualitative phytochemical screening of plant extracts was carried out using standard analytical methods to identify the presence of various bioactive compounds.

For the detection of phenolic compounds, 2 ml of the plant extract was taken in a test tube and treated with a 1% lead acetate solution. The formation of a white precipitate confirmed the presence of phenols.

Flavonoids were identified by mixing 2 ml of the plant extract with 2 ml of 10% lead acetate solution. The development of a yellowish-green coloration indicated a positive result for flavonoids.

The presence of alkaloids was tested using Wagner's reagent. About 2 ml of the extract was treated with an equal amount of Wagner's reagent, and the formation of a reddish-brown precipitate confirmed the presence of alkaloids.

For tannin detection, approximately 0.5 g of the plant extract was boiled with 20 ml of distilled water and then filtered. To 1 ml of the filtrate, 1 ml of 5% ferric chloride (FeCl_3) solution was added. The appearance of a brownish-green coloration indicated the presence of tannins.

Glycosides were tested by adding 2 ml of glacial acetic acid, one drop of 5% ferric chloride, and concentrated sulfuric acid to 5 ml of the plant extract. The formation of a brown ring at the interface indicated the presence of glycosides.

Saponins were identified by adding 1 ml of plant extract to 2 ml of distilled water in a test tube, followed by vigorous shaking with a few drops of olive oil. The formation of stable foam suggested the presence of saponins.

Steroids were detected by dissolving 1 ml of the extract in 10 ml of chloroform, followed by the careful addition of concentrated sulfuric acid along the sides of the test tube. A red coloration in the upper layer and a yellow layer with green fluorescence in the acid layer indicated the presence of steroids.

For terpenoid analysis, 2 ml of plant extract was mixed with 2 ml of chloroform and allowed to evaporate. Subsequently, 2 ml of concentrated sulfuric acid was added and the mixture was heated for about two minutes. The appearance of a greyish color confirmed the presence of terpenoids.

Quinones were detected by adding 3–4 drops of concentrated hydrochloric acid to 2 ml of plant extract. The formation of a yellow precipitate indicated a positive result.

To test for fatty acids, 0.5 ml of extract was mixed with 5 ml of ether and allowed to evaporate on filter paper. The development of a transparent spot on the filter paper indicated the presence of fatty acids.

Nutrient Analysis

The selected plant-based samples—*Piper betle*, *Clitoria ternatea*, *Ocimum sanctum*, and *Hibiscus rosa-sinensis*—were subjected to sensory evaluation to identify the most acceptable formulation. Based on the evaluation results, the best-performing sample (*Piper betle*) was selected for further nutrient analysis.

The nutritional composition of the selected sample was determined using standard biochemical methods. Carbohydrate content was estimated using the Anthrone method, protein content was analyzed by the Bradford method, and fat content was determined through batch solvent extraction. The calorific value of the sample was also calculated.

Organoleptic Evaluation of the Formulated Products

Four natural plant-based flavors—*Piper betle*, *Clitoria ternatea*, *Ocimum sanctum*, and *Hibiscus rosa-sinensis*—were selected for the development of ice cream products following standard preparation procedures. The formulated products were subjected to organoleptic evaluation to assess their acceptability.

A panel consisting of 25 semi-trained members from the Department of Nutrition and Dietetics, Noorul Islam College of Arts & Science, Kumarakovil, Kanyakumari District, participated in the evaluation. A structured scorecard was used to assess sensory attributes such as appearance, texture, taste, flavor, color, and overall acceptability.

Statistical Analysis

The data obtained from the study were analyzed using basic statistical techniques. Mean values and percentage analysis were calculated to interpret the results and determine the acceptability and nutritional significance of the developed products.

RESULT AND DISCUSSION:

Qualitative analysis of phytochemicals:

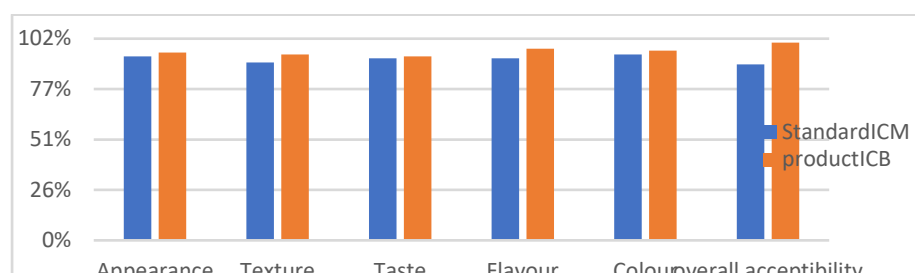
The qualitative phytochemical of Piper betle leaf extract showed the more abundance in phenol, flavonoid, glycoside and presence of Saponin, Terpenoids, Alkaloids, Steroids, Quinones. Tannin, Fatty acid, were absent in the Piper betle.

Sl No:	Name of test	Sample code (BLE)
1.	Phenol	++
2.	Tannin	-ve
3.	Flavanoid	++
4.	Saponin	+
5.	Terpenoids	+
6.	Alkaloid	+
7.	Glycoside	++
8.	Steroid	+
9.	Quinones	+
10.	Fatty acid	-ve

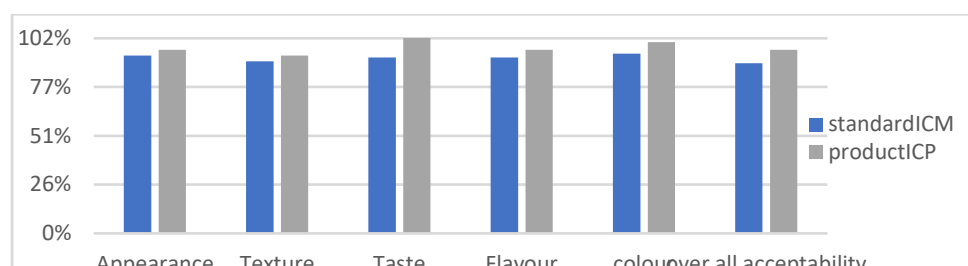
Nutrient analysis : The nutrient analysis of piper betle (BLE) was carried out use in the standard procedure. The carbohydrate content of BLE was 0.011 mg/ml . The protein content of BLE was 2.30 mg/ml . 0.9 % fat content was present in BLE . The calorie of BLE was 9.024 kcal.

Nutrients	Unit
Carbohydrate	0.011 mg/ml
Protein	2.30 mg/ml
Fat	0.9 %
Calorie	9.024 kcal

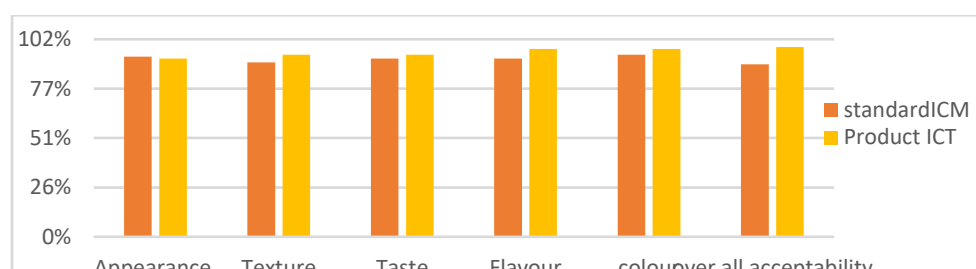
Sensory Parameters of Piper betle of ice cream



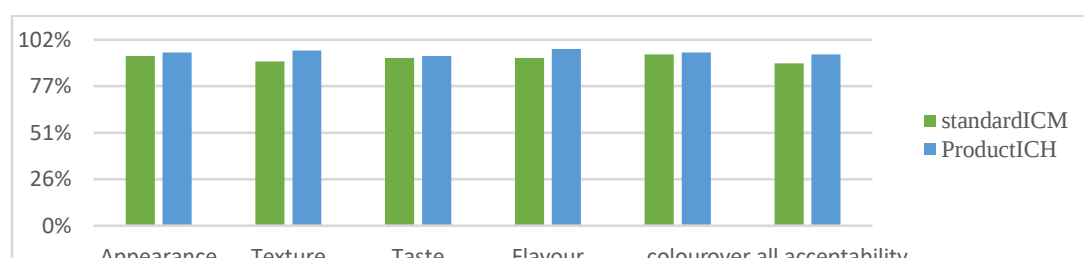
Sensory parameters of Clitoria ternatea ice cream



Sensory parameters of Ocimum sanctum ice cream



Sensory parameters of Hibiscus rosa sinensis ice cream



DISCUSSION:

Ice cream is a popular, yet complex, multiphase/colloidal food stuff. A natural flavour is a substance used to add flavour and aroma to a finished food stuff created using numerous flavouring raw material that come from a natural source. The four various flavours such as Betel leaves botanically identified as *Piper betle* is a medicinal plant ; Butterfly pea flower botanically identified as *Clitoria ternatea* is a flowering plant ; Tulsi leaves botanically identified as *Ocimum sanctum* is a medicinal plant ; Hibiscus flower botanically identified as *Hibiscus rosa-sinensis* is a flowering plant. In one study (Guha P *et.al*;2017) reported that the chemical composition of betel leaf is associated predominantly with phenolic compounds in

nature. The present study was aimed to formulate the natural flavours incorporated in ice cream and sensory evaluation were done by 20 semi- trained panel members. The sensory assessment was evaluated on the quality description (ie) appearance, texture, taste, colour, flavour and over all acceptability.

CONCLUSION:

A natural flavour is a substance used to add flavour and aroma to a finished food stuff created using numerous flavouring raw materials that come from a natural source. An efficient protocol was developed for successful micropropagation and multiple plant regeneration of an important medicinal plant *Piper betle*. It is widely used in ayurvedic medicine because of its multipotent bioactive molecules. It is concluded that *Piper betle* is very rich in phytochemicals and nutrients that are very active in exerting various health benefits from some pathogens and diseases. This could be attributed to the fact that high amount of antioxidants, carbohydrates, protein, fat, calorie were recorded in the sample. Further work is required to establish the component in phytochemical that might hence contributed to health benefits so far observed.

BIBLIOGRAPHY

1. Ari Agung I. G. A. (2017). "The nutrition and bioactive substance of ocimum sanctum L. (Tulasi) tea, can be healthy, refreshing, and soothing, support culinary tourism", in: Proceedings ApacCHRIE & Youth Conference 2017, pp. 275-282
2. Banu SS., et al. "Evaluation of quality attributes and characterization of bio-active components in betel leaf blended fruit squashes using GC-MS" (2021).
3. Cohen M. (2017). "Tulasi: First aid in a teacup", available online at: http://Organicindia.com/organicindia_dd/design/marccohenArticle.pdf.
4. Dizon.R., 2014. The extentionalist'slense. The healing wonders of blue flower.
5. Guha P.,et al." Comparative study of microwave assisted hydro-distillation with Conventional Hydro-Distillation for Extraction of Essential Oil from Piper betle L.".Biosciences biotechnology Research Asia 14.1[2017]:401-407
6. Sharma, P; Kulshreshtha, S; Sharma, A L. Anti-cataract activity of Ocimum sanctum on experimental cataract. Indian Journal of Pharmacology, v.30, n.1, 1998:16-20 12
7. Singh S., Malhotra M. and Majumdar D. K. (2005). "Antibacterial activity of ocimum sanctum L. fixed oil", Indian Journal Exp. Biology, Vol. 43, No. 9
8. The Wealth of India: Raw Materials; Publications and Information Directorate, CSIR: New Delhi, Vol. VIII, 1969, 84-94

Food Processing Techniques and Their Impact on Nutrient Retention

Merin Jisha M

Student, I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : nicasndmerin202002@gmail.com

Abstract

Food processing plays a vital role in improving food safety, shelf life, palatability, and accessibility. However, various processing techniques can significantly influence the nutritional quality of foods. While some methods enhance nutrient bioavailability and digestibility, others may lead to partial nutrient losses, particularly of heat-sensitive vitamins and bioactive compounds. This article examines major food processing techniques—including thermal, mechanical, chemical, and emerging non-thermal technologies—and evaluates their effects on nutrient retention. It also discusses strategies to optimize processing conditions to minimize nutrient degradation while ensuring safety and quality. Understanding the relationship between processing methods and nutrient retention is essential for promoting sustainable nutrition and public health.

Keywords: Food processing, nutrient retention, thermal processing, non-thermal technologies, bioavailability, food safety

Introduction

Food processing refers to the transformation of raw agricultural products into forms suitable for consumption, storage, and distribution. According to the Food and Agriculture Organization, food processing is essential for ensuring global food security, reducing post-harvest losses, and improving dietary diversity. The World Health Organization emphasizes that appropriate food processing enhances safety and nutrient availability, but excessive or improper processing may reduce nutritional value.

Nutrient retention depends on several factors, including temperature, processing duration, pH, oxygen exposure, moisture content, and storage conditions. Both macro- and micronutrients may be affected differently depending on the technique applied.

Classification of Food Processing Techniques

Food processing techniques can be broadly classified into:

- Thermal processing
- Mechanical processing
- Chemical processing
- Fermentation

- Drying and dehydration
- Emerging non-thermal technologies

Each method has a distinct influence on nutrient stability and bioavailability.

Thermal Processing and Nutrient Retention

Thermal processing includes boiling, steaming, frying, baking, pasteurization, sterilization, and canning.

Effects on Macronutrients

- Proteins: Heat denaturation improves digestibility but excessive heating may reduce lysine availability due to Maillard reactions.
- Carbohydrates: Cooking gelatinizes starch, increasing digestibility.
- Fats: High temperatures may cause oxidation and degradation of essential fatty acids.

Effects on Micronutrients

- Water-soluble vitamins (Vitamin C, B-complex): Highly sensitive to heat and leaching into cooking water.
- Fat-soluble vitamins (A, D, E, K): More stable but may degrade during prolonged heating.
- Minerals: Generally stable, but losses may occur through leaching.

Steaming and microwaving typically retain more nutrients than boiling due to reduced water contact and shorter cooking times.

Mechanical Processing

Mechanical processes include milling, grinding, peeling, cutting, and extrusion.

Milling and Refining

Refining grains removes bran and germ, leading to significant losses of dietary fiber, iron, zinc, and B vitamins. Whole grains retain higher nutrient levels compared to polished grains.

Peeling and Cutting

Peeling fruits and vegetables may remove nutrient-rich outer layers containing fiber, antioxidants, and vitamins.

Extrusion

Extrusion cooking enhances digestibility and reduces anti-nutritional factors but may decrease heat-sensitive vitamins.

Chemical Processing

Chemical processing includes the addition of preservatives, curing agents, and pH adjustments.

- Acidification may preserve vitamin C.
- Sulfiting agents may protect against oxidative losses.
- Excess chemical treatment may reduce nutritional quality.

Regulatory bodies such as the Codex Alimentarius Commission provide standards to ensure safe levels of additives without compromising nutritional value.

Fermentation and Nutrient Enhancement

Fermentation is a biological process involving microorganisms that convert carbohydrates into organic acids or alcohol.

Nutritional Benefits

- Increased bioavailability of minerals
- Reduction of anti-nutritional factors such as phytates
- Synthesis of B vitamins
- Improved protein digestibility

The Food and Agriculture Organization recognizes fermentation as a cost-effective method to enhance nutritional quality and extend shelf life.

Drying and Dehydration

Drying methods include sun drying, spray drying, freeze drying, and oven drying.

- **Sun drying:** May cause significant vitamin C loss due to prolonged exposure to heat and light.
- **Spray drying:** Rapid drying helps preserve nutrients in powders such as milk and fruit juices.
- **Freeze drying:** Best retention of nutrients due to low-temperature processing.

Moisture removal prevents microbial growth and extends shelf life while maintaining most mineral content.

Emerging Non-Thermal Technologies

Innovative processing technologies aim to enhance safety with minimal nutrient loss.

High-Pressure Processing (HPP)

Preserves heat-sensitive vitamins and maintains fresh-like quality.

Pulsed Electric Fields (PEF)

Improves microbial safety with minimal thermal degradation.

Irradiation

Extends shelf life and ensures safety but may slightly reduce certain vitamins.

These technologies are increasingly adopted in advanced food industries to balance safety and nutritional preservation.

Factors Influencing Nutrient Retention

Several variables determine the degree of nutrient retention:

- Processing temperature
- Exposure time
- Surface area of food
- Oxygen exposure
- Storage conditions
- Packaging materials

Optimization of these factors can significantly reduce nutrient losses.

Strategies to Improve Nutrient Retention

1. Use minimal water during cooking.
2. Prefer steaming or microwaving over boiling.
3. Retain edible peels where possible.
4. Adopt controlled fermentation methods.
5. Use non-thermal processing technologies when feasible.
6. Implement proper packaging to reduce oxidation.

The World Health Organization encourages food industries to adopt processing methods that maintain nutritional integrity while ensuring safety.

Public Health and Sustainability Implications

Food processing is indispensable for feeding growing populations. However, nutrient loss during processing can contribute to micronutrient deficiencies if diets rely heavily on refined foods. Sustainable processing practices aim to:

- Reduce food waste
- Preserve nutrient density

- Improve accessibility
- Support food security

Balancing safety, shelf life, and nutrition is crucial for achieving global health goals.

Conclusion

Food processing techniques significantly influence nutrient retention in foods. While thermal and mechanical methods may cause partial nutrient losses, they also enhance safety and digestibility. Emerging non-thermal technologies offer promising alternatives for preserving nutritional quality. A scientific understanding of processing effects enables optimization strategies that minimize nutrient degradation while maintaining food safety and quality. Sustainable and nutrition-sensitive food processing is essential for improving global health outcomes and ensuring long-term food security.

References

1. Food and Agriculture Organization. (2017). *Food processing and nutrition*. FAO.
2. World Health Organization. (2020). *Healthy diet fact sheet*. WHO.
3. Codex Alimentarius Commission. (2019). *General principles of food hygiene*. FAO/WHO.
4. Fellows, P. (2016). *Food processing technology: Principles and practice* (4th ed.). Woodhead Publishing.
5. Rickman, J. C., Barrett, D. M., & Bruhn, C. M. (2007). Nutritional comparison of fresh, frozen, and canned fruits and vegetables. *Journal of the Science of Food and Agriculture*, 87(6), 930–944.
6. Van Boekel, M. A. J. S., et al. (2010). A review on the Maillard reaction in food and implications to kinetic modeling. *Trends in Food Science & Technology*, 21(9), 442–455.
7. Hotchkiss, J. H. (2015). Irradiation of foods. *Comprehensive Reviews in Food Science and Food Safety*, 14(1), 1–6.
8. Katina, K., et al. (2007). Fermented cereal-based foods and health benefits. *Trends in Food Science & Technology*, 18(9), 424–430.
9. Barba, F. J., et al. (2015). Current applications and new opportunities for high-pressure processing in food industry. *Food Research International*, 77, 725–739.

Synthesis and Characterization of Bimetallic Fe–Cu Nanoparticles and their Antibiofilm Activity Against *Candida* spp.

Nijitha A F

Student, II M.Sc. Biotechnology

Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : nijithaniji1224@gmail.com

ABSTRACT

Multidrug-resistant (MDR) *Candida* species are an emerging threat in India, largely due to biofilm-mediated drug resistance and treatment failure, especially in catheter-associated UTIs. In this study, MDR *Candida* isolates were screened for biofilm formation, with C19, C31, and C43 showing strong activity. Green-synthesized iron–copper nanoparticles from *Ficus religiosa* leaf extract demonstrated significant antibiofilm effects at 250–750 µg. These findings suggest plant-derived nanoparticles as a sustainable alternative for controlling biofilm-associated MDR *Candida* infections.

Keywords: Iron copper nanoparticles, Iron nanoparticles, Copper nanoparticles, *Ficus religiosa*, *Candida albicans*, Biofilm Assay, Biofilm producing microorganism.

Introduction

In recent years, the development of Multi Drug Resistance (MDR) yeast is more predominant in India. It is an emerging threat because they cause vulnerable effects in patients and also led to treatment failure problems. These strains developed multiple strategies in order to resist the potential antibiotics such as genetic mutation, changing the structure of the molecules and biofilm formation. Biofilm-associated infections caused by *Candida* species represent a major concern in clinical settings, particularly in urinary tract infections (UTIs) among catheterized patients, which are gradually becoming resistant to currently available therapies. *Candida albicans* is a common member of the human microbiota that asymptotically colonizes healthy individuals; however, it is also an opportunistic pathogen that can cause severe infections. The Multi Drug Resistance *Candida* strains were isolated from the patients in NIMS Medicity is used for the current study. In the present study biofilm formation of 10 different candida sp were screened by using different assays such as crystal violet, twitching motility, congo red and safranin tube method. From these results found that C19, C31 and C43 having more biofilm forming capability. *Ficus religiosa* leaf extract contains phenolics which have been reported antibiofilm property. As a novel approach, green synthesis of bimetallic Iron–Copper nanoparticles were synthesized from the leaves of *Ficus religiosa* and their potential anti- biofilm activity of the drug was tested in different concentration 250 µg, 500µg, 750 µg and obtained significant results. The findings of this study highlight the

potential of *Ficus religiosa* derived CQDs as an eco-friendly and effective antifungal strategy against biofilm-associated *Candida* infections. Unlike chemically synthesized nanoparticles, plant-derived CQDs offer a biocompatible and sustainable alternative with minimal toxicity concerns.

Sample collection

Fresh leaf sample of *Ficus religiosa* were collected from Marthandam, Tamil Nadu for the synthesis of bimetallic Fe-Cu nanoparticles. The sample was washed and stored in plastic cover and brought to the research lab within 48 hours.

Iron copper nanoparticles synthesis

The *Ficus religiosa* leaves were dried in the hot air oven at 60°C for about twenty minutes, then the leaves were cut into small pieces. Leaf extract was made with 150 mL deionized water and 20 g of leaf pieces, and boiled for 20 minutes at 70°C and then filtered to remove suspended particles. A solution of Fe (II) and Cu (II) mixed with the ratio 1:1 (0.74675g FeSO₄ :0.56785g CuSO₄) and dissolved in 50ml of deionized water. 100 mL of leaf extract which was prepared in above, was added dropwise to the 100 mL Fe (II)/Cu (II) mixture to develop the synthesis of Fe-Cu NPs. The colour of the mixture changed gradually from yellow to brown to black when many drops of plant extract were added, the remaining plant extract was added. In addition, the mixture is continually mixed for 15 minutes. The black precipitate of Fe-Cu- nanoparticles was separated by using centrifugation and then washed several times with distilled water before being rinsed with 100% ethanol. The washing and rinsing processes are crucial in the synthesis because they prevent nanoparticles from oxidizing too quickly. The Fe-Cu-NPs were then dried in dry bath at 60°C for about 24 hours. The synthesized nanoparticles were grounded into fine powder and then used for further study. (Sharma *et al.*, 2019, Nasrollahzadeh *et al.*, 2021).



Fig.1: *Ficus religiosa* Fe-Cu nanoparticles

4.3 Characterization of nanoparticle using UV-Vis Spectroscopy

Ficus religiosa Fe-Cu nanoparticles were characterized by using UV-Visible Spectroscopy. The absorbance was monitored by detecting characteristics of nanoparticle in the range of 200–700 nm on a UV-Visible spectrophotometer. A graph was plotted with

wavelength on x-axis and absorbance on the y-axis. Graph get the highest peak at 400 nm. The highest peak indicated the presence of Fe-Cu nanoparticle (Fig. 2)

λ	200	250	300	350	400	450	500	550	600	650	700
OD	0.188	0.19	0.193	0.368	0.412	0.28	0.113	0.09	0.059	0.052	0.03

Table 1: Spectrophotometric reading of quantum dots

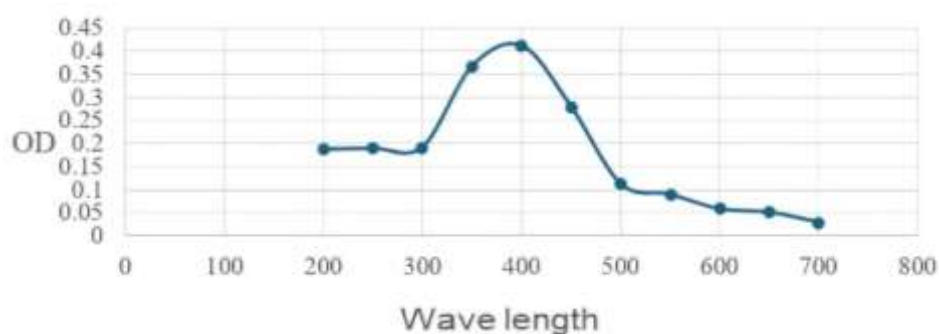


Fig 2: Spectrophotometric readings

4.4 Screening for biofilm production

4.4.1 Test organisms

The Multi Drug Resistance *Canadida albicans* isolated from the patients were collected from NIMS Medicity Neyatinkara is used for the study. The strain number isolated from the patients is C19, C24, C31, C33, C34, C37, C39, C42, C43, C46.

4.4.2 Crystal violet assay

Ten *Canadida albicans* were inoculated into 3ml of nutrient broth and were incubated at 37°C for 72 hours. After incubation, the nutrient broth was discarded, and 3 ml of PBS (Phosphate buffered saline) was added then rinsed with PBS solution and air dried. After 15 minutes, 2 ml of crystal violet stain was added and allowed to stand for 10 seconds and discarded. The tubes were then rinsed twice with distilled water. Subsequently, 3 ml of 30% glacial acetic acid was added to each test tube and incubated for 15 minutes. After incubation, the absorbance was read at 540 nm. The absorbance values are C19-1.52, C24-0.44, C31-1.09, C33-0.39, C34-0.46, C37-0.42, C39-0.63, C42-0.62, C43-1.00, C46-0.56. Among the ten isolates, C19, C31, and C43 exhibited significantly higher absorbance values. Hence it was used for further studies.

4.4.3 Congo red agar (CRA) method

Congo red agar (CRA) method that is a qualitative assay for detection of biofilm producing microorganism. The assay is based on the binding of Congo red dye to polysaccharide components of the biofilm matrix, resulting in distinct colony colour variations. The CRA medium was prepared by mixing 0.8 g of Congo red and 36 g of sucrose to 37 g/L of

Brain heart infusion (BHI) agar. 10 *Candida albicans* were inoculated into CRA medium and incubated at 37°C for 24 hours. After incubation period, morphology of colonies was observed to differentiate as biofilm producers or not. Black colonies with a dry crystalline consistency indicate biofilm producers, whereas colonies retained pink are non-biofilm producers (Freeman *et al.*, 1989; Mathur *et al.*, 2006).



Fig 3: Congo red assay: A:C19, B: C31, C: 43 are strong biofilm producers

4.4.4 Tube method (TM)

Tube method (TM) is a qualitative assay for detection of biofilm producing microorganism, as a result of the occurrence of visible film. Ten *Candida* cultures were inoculated in test tube which contained nutrient broth and incubated at 24 h at 37°C. The isolates of which biofilms formed on the walls of polystyrene test tube are stained with safranin for 1 h, after planktonic cells are discharged by rinsing twice with PBS. Then, safranin-stained polystyrene test tube is rinsed twice with PBS to discharge stain. After air drying, the occurrence of visible film lined the walls, and the bottom of the tube indicates biofilm production (Christensen *et al.*, 1985). Among the ten clinical isolates tested, C19, C31, and C43 showed dense, clearly visible stained biofilm layers along the inner walls and bottom of the test tubes, indicating strong biofilm-forming capacity.



Fig 4: Safranin tube method

Twitching motility

Twitching motility is a mode of solid surface translocation that occurs under humid conditions on semisolid or solid surface. Different *Candida* species were stabbed into the Luria Bertani agar plate using a stabbed needle and incubated at 24 h at 37°C. Colonies were dispersed around the stabbed area indicating motility of the organism. On observation the twitching motility of the *Candida* isolates varied, with some species- C19 (6 cm), C31(5 cm) and C43(5.5 cm) displaying significant movement across the agar surface, while others exhibited minimal movement. These observations confirmed the strong biofilm-forming potential of the selected isolates.



Fig 5: Twitching motility: A: C19, B: C31, C: C43

Antibiofilm activity of Fe- Cu nanoparticles against biofilm producing *Candida albicans*

Crystal violet assay in 96 well plate

Anti biofilm activity of bimetallic Fe- Cu nanoparticle against biofilm producing 3 *Candida* sp (C19, C31, C43) were investigated using a crystal violet assay by using 96-well plates. 200 μ L of standardized microbial suspension was dispensed into sterile 96-well microtiter plates. Wells containing sterile broth alone served as control. The plates with 150 μ L of Nutrient broth and 50 μ L of culture serve as positive control, 100 μ L of Nutrient broth, 50 μ L of sterile distilled water and 50 μ L of culture serve as negative control. The organism is exposed at different concentration of synthesized nanoparticles i.e. 250 μ g/ml, 500 μ g/ml, 750 μ g/ml the plates were incubated at 37°C for 24–48 h. The same protocol is followed as crystal violet biofilm assay but the only difference is 200 μ L of 0.1% (w/v) crystal violet solution is used for staining and The bound crystal violet was solubilized by adding 200 μ L of 30% glacial acetic acid.

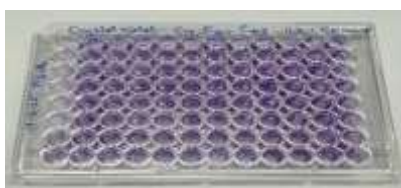


Fig 6: Antibiofilm activity of nanoparticle against C19, C31 & C43 by Crystal violet assay

<i>Candida</i> Isolate	Control	Negative control (water)	250 μ g/ml	500 μ g/ml	750 μ g/ml
C19- <i>Candida albicans</i>	1.55	1.52	1.39	1.32	1.01
C31- <i>Candida albicans</i>	1.50	1.50	1.30	1.15	0.85
C43- <i>Candida albicans</i>	1.32	1.30	1.22	1.01	0.55

Table 2: Antibiofilm activity of Fe-Cu nanoparticle at different concentrations

Congo red agar (CRA) method

The CRA medium was prepared, Fe-Cu nanoparticle at different concentrations were added into the medium before plating. Biofilm producing *Candida* cultures (C19, C31 and C43) were inoculated into Congo red agar plates and incubated at 37°C for 24 hours. Antibiofilm

activity of were assessed after incubation (Mathur *et al.*, 2006) .Nanoparticle treated isolates displayed lighter pigmentation and loss of dry crystalline texture, marked alteration in colony morphology indicating inhibition of extracellular polysaccharide production and biofilm formation.



Fig 7: Antibiofilm activity of nanoparticle at different concentrations against A: 19, B: 31, C: 43

Safranine Tube method (TM)

Tube method (TM) was used for detection of antibiofilm activity of Fe-Cu nanoparticle. Biofilm producing *Candida* cultures (C19, C31 and C43) along with nanoparticle at different concentrations were inoculated into nutrient broth and incubated at 24 hours at 37°C. The same protocol is followed as mentioned in Tube method. Qualitative assays revealed moderate reduction in biofilm formation with increasing nanoparticle concentration. However, faint biofilm layers and darker colony pigmentation were still evident when compared to acid-dissolved nanoparticle treatment, indicating reduced efficacy. Nanoparticle showed better antibiofilm activity against C31 followed by C19 and C43. The results were summarized in Fig 8.



Fig 8. Antibiofilm activity of nanoparticle at different concentrations against C31, C19 and C43

1 : C31 ; 2 : C31 & 250µg NPs ; 3 : C31 & 500µg NPs ; 4 : C31 & 750µg NPs ; 5 : C19 ; 6 : C19 & 250µg NPs ; 7 : C19 & 500µg NPs ; 8 : C19 & 750µg NPs ; 9 : C43 ; 10 : C43 & 250µg NPs ; 11 : C43 & 500µg NPs ; 12 : C43 & 750µg NPs.

Twitching motility

Candida species (C19, C31 and C43) along with nanoparticle were stabbed into the Luria Bertani agar plate using a stabbed needle and incubated at 24 hours at 37°C. Antibiofilm activity of nanoparticle against *Candida* sp revealed maximum inhibition of biofilm formation. They showed better antibiofilm activity against C31 (1cm) followed by C19 (1.5cm) and C43 (2.5cm).



Results, summary and conclusion

The present study successfully demonstrated the strong biofilm-forming ability of selected uropathogenic *Candida albicans* isolates and established the potent antibiofilm efficacy of green-synthesized *Ficus religiosa*-derived iron-copper (Fe-Cu) bimetallic nanoparticles. Among the ten clinical isolates screened, C19, C31, and C43 were consistently identified as strong biofilm producers through multiple complementary assays, highlighting their virulence potential and relevance in biofilm-associated urinary tract infections. The green synthesis of Fe-Cu bimetallic nanoparticles using *Ficus religiosa* leaf extract was achieved efficiently, providing an eco-friendly and cost-effective approach for nanoparticle production. The study revealed that nanoparticle formulation played a crucial role in determining antibiofilm activity. Acid-dissolved Fe-Cu nanoparticles exhibited superior antibiofilm efficacy compared to water-dissolved nanoparticles across all quantitative and qualitative assays.

Fe-Cu nanoparticles showed significant inhibition of biofilm formation, emphasizing the importance of nanoparticle dispersion and bioavailability in determining biological activity. Overall, this study establishes *Ficus religiosa*-derived Fe-Cu bimetallic nanoparticles, as promising antibiofilm agents against uropathogenic *Candida albicans*. The findings contribute to the growing field of green nanotechnology and offer a potential alternative approach for managing biofilm-associated fungal infections. Further investigations focusing on mechanistic pathways, toxicity assessment, and in vivo validation are recommended to support their future therapeutic application.

References

1. Nasrollahzadeh, M., Sajjadi, M., Iravani, S., & Varma, R. S. (2021). Plant-mediated green synthesis of nanostructures: Mechanisms, characterization, and applications. *Green Chemistry*, 23(13), 4763–4825.
2. Sharma, D., Kanchi, S., & Bisetty, K. (2019). Biogenic synthesis of nanoparticles: A review. *Arabian Journal of Chemistry*, 12(4), 3576–3600.
3. Mathur, T., Singhal, S., Khan, S., Upadhyay, D. J., Fatma, T., & Rattan, A. (2006). Detection of biofilm formation among the clinical isolates of staphylococci: An evaluation of three different screening methods. *Indian Journal of Medical Microbiology*, 24(1), 25–29.
4. Christensen, G. D., Simpson, W. A., Younger, J. J., Baddour, L. M., Barrett, F. F., Melton, D. M., & Beachey, E. H. (1985). Adherence of coagulase-negative staphylococci to plastic tissue culture plates: A quantitative model for the adherence of staphylococci to medical devices. *Journal of Clinical Microbiology*, 22(6), 996–1006.

Effect of Fermentation on Nutritional Enhancement of Traditional Cereals

C. Jaxcel Vilopher

Student I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil.
Email Id : nicasndjaxcel282007@gmail.com

Abstract

Traditional cereals such as millet, sorghum, maize, barley, and rice have long served as staple foods in many regions of the world. However, their nutritional potential is often limited by the presence of anti-nutritional factors and low bioavailability of certain micronutrients. Fermentation, a traditional and cost-effective food processing technique, significantly enhances the nutritional profile, digestibility, and functional properties of cereals. This article examines the biochemical, nutritional, and functional changes that occur during fermentation of traditional cereals. It highlights microbial dynamics, reduction of anti-nutritional factors, enhancement of protein quality, vitamin synthesis, and improved mineral bioavailability. The discussion integrates traditional practices with modern food biotechnology perspectives, emphasizing fermentation as a sustainable strategy to combat malnutrition and improve food security.

Keywords: Fermentation, traditional cereals, nutritional enhancement, bioavailability, probiotics, functional foods

Introduction

Cereals form the foundation of diets in Asia, Africa, and Latin America. According to the Food and Agriculture Organization, cereals contribute more than 50% of daily caloric intake in many developing countries. Traditional cereals such as sorghum, millet, and barley are valued for their adaptability to harsh climates and their nutritional richness.

Despite their importance, cereals contain anti-nutritional compounds such as phytates, tannins, and enzyme inhibitors that reduce nutrient absorption. The World Health Organization has emphasized the need for sustainable food-processing methods to improve nutrient bioavailability and address micronutrient deficiencies.

Fermentation is one of the oldest food preservation techniques and plays a crucial role in enhancing the nutritional quality of cereal-based foods. It involves the metabolic activity of microorganisms—primarily lactic acid bacteria, yeasts, and molds—which transform food components into more bioavailable and digestible forms.

Traditional Cereals and Their Nutritional Profile

Traditional cereals include:

- **Sorghum (*Sorghum bicolor*)**
- **Pearl millet (*Pennisetum glaucum*)**
- **Finger millet (*Eleusine coracana*)**
- **Maize (*Zea mays*)**
- **Barley (*Hordeum vulgare*)**
- **Rice (*Oryza sativa*)**

These cereals are rich in carbohydrates, moderate-quality proteins, dietary fiber, B-complex vitamins, and minerals such as iron, zinc, and magnesium. However, the presence of phytic acid binds minerals and reduces absorption in the human gut.

Microbiology of Cereal Fermentation

Cereal fermentation typically involves:

- **Lactic acid bacteria (LAB)** – Improve acidity and inhibit pathogens
- **Yeasts** – Contribute to flavor and vitamin synthesis
- **Molds** – Used in specific traditional products

Spontaneous fermentation relies on natural microflora, while controlled fermentation uses starter cultures to standardize quality and safety.

The Codex Alimentarius Commission provides guidelines to ensure safety and quality in fermented food production, particularly regarding microbial limits.

Reduction of Anti-Nutritional Factors

One of the most significant nutritional benefits of fermentation is the degradation of anti-nutritional compounds:

Phytate Reduction

Phytases produced by microorganisms break down phytic acid, releasing bound minerals such as iron, calcium, and zinc.

Tannin Reduction

Fermentation decreases tannin content, improving protein digestibility.

Enzyme Inhibitor Breakdown

Protease inhibitors that interfere with protein digestion are partially degraded during fermentation.

These changes increase nutrient bioavailability, particularly important in populations relying heavily on cereal-based diets.

Enhancement of Protein Quality

Fermentation improves protein quality through:

- Partial hydrolysis of proteins into peptides and amino acids
- Increased lysine availability in certain cereals
- Improved digestibility

Microbial metabolism enriches the essential amino acid profile, compensating for deficiencies commonly observed in cereals.

Vitamin Synthesis and Mineral Bioavailability

Certain microorganisms synthesize B-complex vitamins, including folate, riboflavin, and vitamin B12 analogues. This contributes to enhanced micronutrient density.

The World Health Organization recognizes fermentation as a practical method to improve iron and zinc absorption in plant-based diets, thereby addressing hidden hunger and anemia.

Improvement in Digestibility and Functional Properties

Fermentation modifies starch structure and increases enzymatic activity, leading to:

- Reduced glycemic response
- Improved texture and flavor
- Increased shelf life
- Enhanced probiotic potential

Fermented cereal foods such as idli, dosa, ogi, injera, and sourdough bread demonstrate improved palatability and digestibility compared to unfermented products.

Probiotic and Functional Food Potential

Fermented cereals may serve as carriers of probiotic microorganisms. Lactic acid bacteria confer several health benefits:

- Improved gut microbiota balance
- Enhanced immune response
- Reduction of gastrointestinal disorders

The Food and Agriculture Organization promotes the integration of traditional fermented foods into food security programs due to their health-promoting properties.

Technological Advancements in Cereal Fermentation

Modern biotechnology enhances traditional fermentation methods through:

- Controlled starter cultures
- Enzyme-assisted fermentation\
- Optimization of fermentation time and temperature
- High-pressure and non-thermal processing

These approaches ensure consistency, safety, and scalability for commercial production.

Public Health and Food Security Implications

Fermentation offers a low-cost, culturally acceptable solution to improve nutrition in developing countries. It helps:

- Reduce micronutrient deficiencies
- Improve child growth outcomes
- Enhance dietary diversity
- Promote sustainable food systems

The UNICEF supports nutrition programs that encourage the use of fermented complementary foods to combat childhood malnutrition.

Sustainability Aspects

Fermentation contributes to sustainable development by:

- Reducing food waste
- Extending shelf life without refrigeration
- Requiring minimal energy input
- Utilizing indigenous cereal varieties

Such practices align with global goals for sustainable nutrition and environmental conservation.

Conclusion

Fermentation significantly enhances the nutritional value of traditional cereals by reducing anti-nutritional factors, improving protein digestibility, increasing vitamin content, and enhancing mineral bioavailability. It transforms staple grains into functional foods with

improved health benefits and sensory qualities. As a cost-effective and culturally embedded technology, fermentation plays a vital role in addressing global challenges of malnutrition and food insecurity. Integrating traditional knowledge with modern scientific advancements can further optimize cereal fermentation processes, ensuring improved public health outcomes and sustainable food systems.

References

1. Food and Agriculture Organization. (2017). *Fermented foods in nutrition*. FAO.
2. World Health Organization. (2016). *Guideline: Use of food fortification and processing to improve micronutrient status*. WHO.
3. Codex Alimentarius Commission. (2019). *General standard for fermented foods*. FAO/WHO.
4. UNICEF. (2018). *Improving young child feeding practices*. UNICEF.
5. Nout, M. J. R. (2009). Rich nutrition from the poorest – Cereal fermentations in Africa and Asia. *Food Microbiology*, 26(7), 685–692.
6. Blandino, A., Al-Aseeri, M. E., Pandiella, S. S., Cantero, D., & Webb, C. (2003). Cereal-based fermented foods and beverages. *Food Research International*, 36(6), 527–543.
7. Hemalatha, S., Platel, K., & Srinivasan, K. (2007). Influence of fermentation on bioaccessibility of zinc and iron. *Journal of Agricultural and Food Chemistry*, 55(24), 9780–9785.
8. Taylor, J. R. N., & Duodu, K. G. (2015). Effects of processing on cereal nutrients. *Cereal Chemistry*, 92(1), 1–14.
9. Katina, K., Laitila, A., Juvonen, R., et al. (2007). Fermented cereal-based foods and health benefits. *Trends in Food Science & Technology*, 18(9), 424–430.

Millets as a Superfood: Nutritional and Functional Benefits

VENI S

Student, I B.Sc. Nutrition and Dietetics

Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : nicasndveni182008@gmail.com

Abstract

Millets are ancient, climate-resilient small grains that have gained renewed global interest due to their rich nutrient profiles and potential health benefits. Traditionally cultivated in Asia and Africa, millets are gluten-free cereals characterized by high dietary fiber, quality protein, essential micronutrients, and bioactive compounds with antioxidant activity. With rising prevalence of lifestyle diseases, including obesity, diabetes, and cardiovascular disorders, millets are emerging as a sustainable “superfood” capable of addressing both nutritional deficiencies and noncommunicable disease risks. This article reviews the nutrient composition of major millets, explores their functional benefits—including glycemic control, lipid metabolism, gut health, and antioxidant activity—and discusses their role in promoting sustainable diets. Evidence from recent human clinical and epidemiological studies is presented to justify millets’ inclusion in dietary guidelines and public nutrition strategies. The review concludes that millets offer significant nutritional and health advantages, warranting greater integration into modern diets and food systems.

Keywords: Millets, superfood, nutritional profile, functional benefits, dietary fiber, antioxidants, metabolic health

Introduction

Millets refer to a group of small-seeded cereal grains—such as foxtail millet (*Setaria italica*), finger millet (*Eleusine coracana*), pearl millet (*Pennisetum glaucum*), proso millet (*Panicum miliaceum*), barnyard millet (*Echinochloa spp.*), and little millet (*Panicum sumatrense*)—which have been staples in traditional agriculture for centuries. In recent decades, these crops were overshadowed by major cereals such as rice and wheat. However, millets are resurging in scientific and public discourse, largely due to their resilience to climatic stress, minimal water requirements, and high nutritional value.

Globally, the burden of noncommunicable diseases (NCDs) is rising, driven by unhealthy diets, sedentary lifestyles, and obesity. Millets’ nutrient density and functional properties position them as a strategic food to enhance diet quality, reduce disease risk, and

support sustainable food systems. This review synthesizes knowledge on millets' nutrient composition and functional benefits, with a focus on their role in promoting metabolic health and preventing diet-related disorders.

Nutrient Composition of Millets

Millets contain key macronutrients and micronutrients that compare favorably to major cereals:

Carbohydrates and Dietary Fiber

Millets are rich in complex carbohydrates and non-starch polysaccharides. Their high dietary fiber content (ranging between 8% and 18%) contributes to slower digestion and modulates postprandial glycemic responses. Dietary fiber also promotes satiety and supports gut health through fermentation into short-chain fatty acids by gut microbiota.

Protein Quality

Millets provide higher protein content than many cereals (7–12%), with a favorable amino acid profile. Finger millet, for example, contains methionine and phenylalanine in appreciable amounts. The presence of seed storage proteins—prolamins, glutelins, and albumins—enhances the protein quality when millets are combined with legumes.

Micronutrients and Bioactive Compounds

Millets are excellent sources of minerals such as iron, calcium, magnesium, phosphorus, and potassium. For instance, finger millet is among the richest plant sources of calcium, with implications for bone health. Millets also contain B-vitamins, particularly niacin, thiamine, and riboflavin.

Beyond classic nutrients, millets are abundant in bioactive phytochemicals including polyphenols, flavonoids, tannins, and ferulic acid. These compounds exhibit antioxidant and anti-inflammatory properties, contributing to functional benefits beyond basic nutrition.

Functional Health Benefits of Millets

Glycemic Control and Diabetes Management

Due to their low glycemic index (GI), millets have slower rates of carbohydrate absorption, resulting in moderated blood glucose spikes. Studies indicate that diets containing millets can improve insulin sensitivity and glycemic control in both pre-diabetic and diabetic populations. The high fiber content further delays gastric emptying and modulates glucose homeostasis.

Cardiovascular Health

Millets have shown lipid-lowering effects in both animal models and human trials. The soluble fiber, phytosterols, and polyphenols in millets contribute to reduced total cholesterol, LDL cholesterol, and triglycerides—key risk factors for cardiovascular diseases. The high magnesium content also supports vascular function and blood pressure regulation.

Gut Health and Microbiota Modulation

The non-digestible carbohydrates in millets act as prebiotic substrates for beneficial gut bacteria. Fermentation of millet fiber produces short-chain fatty acids such as butyrate, which strengthen the gut barrier, reduce inflammation, and enhance metabolic health.

Antioxidant and Anti-Inflammatory Properties

Millets' phytochemicals demonstrate significant antioxidant capacity, neutralizing free radicals and reducing oxidative stress—a contributor to aging and chronic diseases. These bioactive compounds also exhibit anti-inflammatory effects, which may protect against conditions such as arthritis and metabolic syndrome.

Weight Management and Satiety

High fiber content and the low GI of millets lead to prolonged satiety, reduced caloric intake, and beneficial effects on body weight management. Clinical observations suggest that inclusion of millets in diets contributes to modest weight loss and improved body composition.

Millets and Sustainable Nutrition

In addition to their health benefits, millets contribute to sustainable agriculture. They are drought-tolerant, require less water and chemical inputs, and are adaptable to marginal soils. Promoting millets aligns with global goals for resilient food systems, climate change adaptation, and food security.

Integration of millets into public nutrition programs—particularly in regions with micronutrient deficiencies—can enhance diet diversity, improve nutrient adequacy, and support ecological sustainability.

Current Evidence from Human Studies

Several clinical and epidemiological studies have explored millets' effects on metabolic markers:

- A randomized trial demonstrated that incorporation of finger millet in regular meals significantly improved glycemic control in individuals with type 2 diabetes over a 12-week period.
- Dietary interventions with pearl millet have been associated with reductions in LDL cholesterol and improvements in antioxidant status among hyperlipidemic subjects.
- Observational data from populations with high millet consumption show lower prevalence of metabolic syndrome compared to populations consuming refined grains.

While evidence is promising, larger and longer-term controlled trials are required to confirm causal relationships and establish specific dietary recommendations.

Discussion

Millet's nutrient density and functional benefits position them as valuable components of modern diets—especially in the context of rising NCDs. However, challenges to widespread adoption persist, including limited consumer awareness, culinary preferences for refined grains, and inconsistent integration in national dietary guidelines.

Food processing technologies and product innovations—such as millet-based flours, breakfast cereals, and snack foods—can enhance consumer acceptance without compromising nutritional quality. Education campaigns and policy support are important for promoting millets as a healthy alternative to high-glycemic refined grains.

Conclusion

Millets exemplify a traditional yet forward-looking food group with significant nutritional and functional benefits. Their rich nutrient profiles—including dietary fiber, high-quality protein, micronutrients, and bioactive phytochemicals—confer advantages for glycemic management, cardiovascular health, gut function, antioxidant defense, and weight control. Furthermore, millets contribute to sustainable agriculture and resilient food systems. Evidence from clinical and population studies supports the inclusion of millets in dietary strategies aimed at preventing lifestyle diseases. Given their superfood potential, millets deserve greater emphasis in research, policy, and dietary practice.

References

1. Adebisi, J. A., et al. (2020). Nutritional and functional properties of major millet varieties. *Journal of Food Biochemistry*, 44(2), e13132.
2. Bhatt, R., & Singh, R. (2019). Millets: A traditional grain with modern nutritional benefits. *Nutrition Journal*, 18(1), 27–36.

3. FAO. (2021). *The role of millets in sustainable food systems*. Food and Agriculture Organization of the United Nations.
4. Gomez, M. I., et al. (2021). Dietary millets and metabolic risk factors: A systematic review. *Nutrition Reviews*, 79(6), 693–708.
5. Hahn, D. E., et al. (2017). Millet consumption and metabolic markers in adults with type 2 diabetes. *Journal of Functional Foods*, 35, 250–257.
6. Kumar, R. V., et al. (2021). Phytochemical composition and antioxidant potential of millets. *Food Chemistry*, 346, 128828.
7. Mani, U. V. (2018). Millets' role in human nutrition and health: An overview. *Journal of Food Science and Technology*, 55(4), 1137–1145.
8. Saleh, A. S. M., et al. (2019). Nutritional properties and health benefits of millets. *Journal of Cereal Science*, 88, 20–31.
9. Shobana, S., et al. (2020). Impacts of millet consumption on gut health: Emerging evidence. *Food Research International*, 137, 109536.
10. Taylor, J. R. N., & Schober, T. J. (2018). Millets in nutrition and food science: Recent advances. *Food Research International*, 113, 152–158.

Application of Natural Preservatives in Extending Shelf Life of Bakery Products

A.Barkana

Student, I B.Sc. Nutrition and Dietetics

Noorul Islam College of Arts and Science, Kumaracoil

Email Id : Nicasnibarkana30032007@gamil.com

Abstract

Bakery products such as bread, cakes, muffins, and pastries are highly susceptible to microbial spoilage and staling due to their moisture content and nutrient-rich composition. Traditionally, synthetic preservatives have been used to extend shelf life; however, increasing consumer demand for clean-label and minimally processed foods has led to growing interest in natural preservatives. Natural preservatives derived from plants, microorganisms, and animal sources offer antimicrobial and antioxidant properties that can effectively delay spoilage while maintaining product quality. This article explores the types, mechanisms, technological applications, effectiveness, regulatory considerations, and future prospects of natural preservatives in bakery products. The study highlights their role in ensuring food safety, enhancing shelf life, and promoting sustainable food systems.

Keywords: Natural preservatives, bakery products, shelf life, antimicrobial agents, clean label, food safety

Introduction

Bakery products are among the most widely consumed processed foods globally. Their relatively high moisture content and neutral pH make them prone to microbial growth, particularly molds and bacteria. According to the Food and Agriculture Organization, food spoilage contributes significantly to global food waste, underscoring the importance of effective preservation methods.

Synthetic preservatives such as calcium propionate and sorbates have been widely used; however, health concerns and consumer preference for natural ingredients have driven the search for plant-based and biologically derived alternatives. The World Health Organization emphasizes safe food preservation practices to prevent foodborne illnesses and reduce spoilage-related losses.

Natural preservatives provide a promising solution by inhibiting microbial growth and oxidative degradation without compromising nutritional quality.

Causes of Spoilage in Bakery Products

Microbial Spoilage

Molds such as *Aspergillus*, *Penicillium*, and *Rhizopus* species are common contaminants in bread and cakes. Bacterial spoilage, such as rope formation caused by *Bacillus* species, can also occur.

Oxidative Rancidity

Fat-containing bakery products are prone to lipid oxidation, leading to off-flavors and reduced shelf life.

Staling

Staling results from starch retrogradation and moisture migration, affecting texture and sensory quality.

Types of Natural Preservatives

Plant-Derived Preservatives

Essential Oils

Essential oils extracted from herbs and spices possess strong antimicrobial properties. Oils from clove, cinnamon, thyme, oregano, and rosemary inhibit mold growth and lipid oxidation.

Plant Extracts

Phenolic compounds and flavonoids from green tea, grape seed, and rosemary extract function as antioxidants and antimicrobial agents.

Microbial-Derived Preservatives

Bacteriocins

Nisin, produced by lactic acid bacteria, is effective against Gram-positive bacteria. It is widely used in food systems and approved by regulatory authorities.

Organic Acids

Lactic acid, acetic acid, and propionic acid produced through fermentation inhibit microbial growth.

The Codex Alimentarius Commission provides guidance on permissible natural preservatives in food products.

Animal-Derived Preservatives

Lysozyme, derived from egg whites, possesses antibacterial activity and can be incorporated into bakery formulations.

Mechanisms of Action

Natural preservatives extend shelf life through multiple mechanisms:

- Disruption of microbial cell membranes
- Inhibition of enzyme activity
- Interference with DNA replication
- Scavenging of free radicals
- Reduction of water activity

Essential oils, for instance, damage fungal cell walls, preventing mold proliferation. Organic acids lower pH, creating unfavorable conditions for microbial growth.

Application Techniques in Bakery Products

Direct Incorporation

Natural preservatives can be mixed directly into dough or batter during preparation.

Surface Treatment

Spraying or coating bakery products with natural antimicrobial solutions prevents surface mold growth.

Active Packaging

Incorporation of essential oils into packaging films creates controlled release systems that prolong shelf life.

Edible Coatings

Polysaccharide- or protein-based edible films containing natural preservatives reduce moisture loss and microbial contamination.

Effectiveness and Sensory Considerations

While natural preservatives are effective, their use requires optimization:

- High concentrations of essential oils may alter taste and aroma.
- Encapsulation techniques help control flavor impact.
- Synergistic combinations of preservatives improve efficacy at lower concentrations.

Consumer acceptance studies demonstrate that properly formulated natural preservative systems maintain sensory quality while enhancing shelf stability.

Regulatory Considerations

Regulatory frameworks govern the use of natural preservatives. In India, the Food Safety and Standards Authority of India specifies permitted additives and labeling

requirements. Internationally, standards set by the Codex Alimentarius Commission ensure safety and facilitate global trade.

Clear labeling as “natural preservative” or “no artificial additives” aligns with clean-label marketing strategies.

Advantages of Natural Preservatives

- Reduced chemical residue concerns
- Consumer preference for natural ingredients
- Biodegradable and environmentally friendly
- Potential additional health benefits due to antioxidant properties

Challenges and Limitations

- Variability in antimicrobial activity depending on source and extraction method
- Stability issues during baking at high temperatures
- Higher cost compared to synthetic preservatives
- Possible allergenicity in some plant extracts

Ongoing research focuses on nanoencapsulation, combination treatments, and optimized extraction techniques to address these challenges.

Sustainability and Market Trends

Growing consumer awareness of sustainability and health has driven demand for clean-label bakery products. Major food manufacturers are reformulating products to eliminate synthetic additives. The Food and Agriculture Organization supports sustainable food processing practices that reduce waste and enhance product longevity.

Natural preservation strategies contribute to reduced food waste, lower environmental impact, and improved public health outcomes.

Future Prospects

Future developments may include:

- Integration of probiotic cultures with antimicrobial activity
- Development of multifunctional preservatives combining antioxidant and antimicrobial effects
- Smart packaging technologies with controlled-release systems
- Exploration of indigenous herbs and spices for novel preservative compounds

Research in food biotechnology and material science will further enhance the efficiency and applicability of natural preservation systems.

Conclusion

The application of natural preservatives in bakery products represents a promising approach to extending shelf life while meeting consumer demand for clean-label foods. Plant-derived extracts, microbial metabolites, and natural acids offer effective antimicrobial and antioxidant properties that reduce spoilage and maintain quality. Although challenges remain regarding stability, cost, and sensory impact, technological advancements and regulatory support continue to drive innovation in this field. Adoption of natural preservatives not only enhances product safety and shelf life but also contributes to sustainable and health-conscious food systems.

References

1. Food and Agriculture Organization. (2019). *Food loss and waste reduction strategies*. FAO.
2. World Health Organization. (2020). *Food safety fact sheet*. WHO.
3. Codex Alimentarius Commission. (2018). *General standard for food additives*. FAO/WHO.
4. Food Safety and Standards Authority of India. (2021). *Food products standards and food additives regulations*. FSSAI.
5. Burt, S. (2004). Essential oils: Their antibacterial properties and potential applications in foods. *International Journal of Food Microbiology*, 94(3), 223–253.
6. Gyawali, R., & Ibrahim, S. A. (2014). Natural products as antimicrobial agents. *Food Control*, 46, 412–429.
7. Ribeiro-Santos, R., Andrade, M., Melo, N. R., & Sanches-Silva, A. (2017). Use of essential oils in active food packaging. *Trends in Food Science & Technology*, 61, 132–140.
8. Settanni, L., & Corsetti, A. (2008). Application of bacteriocins in vegetable and bakery products. *International Journal of Food Microbiology*, 121(2), 123–138.
9. Caleja, C., Barros, L., Antonio, A. L., et al. (2017). Natural preservatives in food systems. *Food Chemistry*, 221, 689–700.

Evaluation of the Antidiabetic, Anti-Inflammatory, Antibacterial, and Wound Healing Properties of *Kalanchoe gastonis-bonniieri*

Ajeena Farveen A

Student, I B.Sc. Nutrition and Dietetics,
Noorul Islam College of Arts and Science, Kumaracoil
Email Id : ajeenafarveen20@gmail.com

Introduction

Medicinal plants have historically served as a vital source of therapeutic agents for the prevention and treatment of various diseases. Traditional systems of medicine depend largely on plant-derived substances because of their easy availability, cost-effectiveness, and comparatively minimal side effects when compared to synthetic drugs. These plants are rich in bioactive constituents such as alkaloids, flavonoids, tannins, phenolic compounds, and glycosides, which are known to possess a wide range of pharmacological properties, including antimicrobial, anti-inflammatory, antioxidant, and antidiabetic activities.

Kalanchoe gastonis-bonniieri is a succulent medicinal plant belonging to the family Crassulaceae. It is widely distributed in tropical and subtropical regions and has been traditionally utilized for the management of wounds, infections, inflammatory conditions, and metabolic disorders. Species within the genus *Kalanchoe* are well recognized for their therapeutic potential and have been the subject of numerous studies investigating their diverse biological activities.

The rising global incidence of diabetes mellitus and infectious diseases has created an urgent need for the development of alternative and complementary therapeutic approaches. Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from either insufficient insulin production or impaired insulin action. In addition, chronic inflammation and microbial infections continue to contribute significantly to morbidity and mortality worldwide.

In this context, plant-based therapies have gained increasing attention as potential substitutes for conventional pharmacological treatments. The present study is designed to evaluate the pharmacological properties of *Kalanchoe gastonis-bonniieri*, with particular emphasis on its antidiabetic, anti-inflammatory, antibacterial, and wound healing activities. Furthermore, the study aims to identify and characterize the phytochemical constituents responsible for these biological effects, thereby contributing to the development of novel plant-based therapeutic agents.

Objectives of the Study

The main objective of this study was to evaluate the medicinal potential of *Kalanchoe gastonis-bonnieri*. The specific objectives include:

- To collect and prepare plant extracts from *Kalanchoe gastonis-bonnieri* leaves.
- To perform preliminary phytochemical screening of the plant extract.
- To evaluate the antidiabetic activity using enzyme inhibition assays.
- To determine the anti-inflammatory activity of the plant extract.
- To test the antibacterial activity against selected pathogenic bacteria.
- To assess the wound healing potential of the plant extract.

Materials and Methods

Fresh leaves of *Kalanchoe gastonis-bonnieri* were collected and carefully cleaned to eliminate dust and other impurities. The cleaned leaves were shade-dried for several days to preserve their bioactive constituents and then finely powdered using a mechanical grinder.

The powdered plant material was subjected to solvent extraction using either ethanol or methanol as the extracting solvent. The extraction process was carried out using standard techniques such as maceration or Soxhlet extraction. The resulting extract was filtered to remove solid residues and subsequently concentrated using a rotary evaporator to obtain a crude extract suitable for further analysis.

Preliminary phytochemical screening was performed on the crude extract to identify the presence of important secondary metabolites, including alkaloids, flavonoids, tannins, phenolic compounds, saponins, and glycosides. These compounds are known for their potential biological activities and therapeutic significance.

The antidiabetic potential of the extract was evaluated through in vitro enzyme inhibition assays, specifically targeting α -amylase and α -glucosidase. These enzymes play a key role in the digestion of carbohydrates into glucose. Inhibition of their activity suggests the ability of the plant extract to regulate blood glucose levels and may indicate its usefulness in diabetes management.

Anti-inflammatory activity was assessed using the protein denaturation assay. Since protein denaturation is a common mechanism associated with inflammation, the ability of the extract to prevent or reduce this process reflects its potential anti-inflammatory properties.

The antibacterial activity of the extract was determined using the agar well diffusion method against selected pathogenic bacterial strains, including *Escherichia coli*,

Staphylococcus aureus, and *Klebsiella pneumoniae*. The effectiveness of the extract was evaluated by measuring the diameter of the inhibition zones formed around the wells.

The wound healing potential of the plant extract was assessed by analyzing parameters such as the rate of wound contraction, duration of epithelialization, and extent of tissue regeneration. These indicators provide insight into the ability of the extract to promote healing and tissue repair.

Evaluation of Antidiabetic Activity

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels resulting from either inadequate insulin secretion or impaired insulin action. In recent years, there has been growing interest in plant-based therapies as alternative approaches for managing blood glucose levels.

The antidiabetic potential of *Kalanchoe gastonis-bonnieri* extract was assessed using in vitro enzyme inhibition assays, specifically targeting α -amylase and α -glucosidase. These enzymes are crucial in the digestion of carbohydrates, as they catalyze the breakdown of complex carbohydrates into glucose. Inhibition of these enzymes can delay glucose absorption and thereby help regulate postprandial blood sugar levels.

The findings revealed that the plant extract exhibited considerable inhibitory effects on both α -amylase and α -glucosidase activities, indicating its potential role as a natural antidiabetic agent. This activity may be largely attributed to the presence of bioactive compounds such as flavonoids and phenolic constituents, which are known for their enzyme inhibitory properties.

Evaluation of Anti-inflammatory Activity

Inflammation is a protective physiological response to tissue injury or infection; however, prolonged or chronic inflammation can contribute to the development of various diseases, including arthritis, cardiovascular disorders, and autoimmune conditions.

The anti-inflammatory activity of the plant extract was evaluated using assays such as the inhibition of protein denaturation and membrane stabilization methods. Protein denaturation is a well-known mechanism involved in inflammatory processes, and compounds that can prevent this alteration are considered potential anti-inflammatory agents.

The extract demonstrated a significant capacity to inhibit protein denaturation, suggesting notable anti-inflammatory effects. This activity may be associated with the presence of phytoconstituents such as flavonoids, tannins, and other phenolic compounds, which are

known to modulate inflammatory pathways and reduce the production of inflammatory mediators.

Evaluation of Antibacterial Activity

Microbial infections continue to pose serious global health challenges, particularly with the increasing emergence of antibiotic-resistant strains. This has prompted the exploration of plant-derived compounds as potential sources of new antimicrobial agents.

The antibacterial activity of *Kalanchoe gastonis-bonnieri* extract was tested against several pathogenic bacterial strains, including *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Bacillus subtilis*. The agar well diffusion method was employed to evaluate antimicrobial efficacy, and the diameter of the inhibition zones was measured as an indicator of activity.

The results indicated that the extract exhibited moderate to strong antibacterial effects against the tested organisms. The antimicrobial activity is likely due to the presence of phytochemicals such as tannins, alkaloids, and flavonoids, which can disrupt microbial cell walls, interfere with enzyme systems, and inhibit essential metabolic processes in microorganisms.

Evaluation of Wound Healing Activity

Wound healing is a complex biological process involving multiple stages, including inflammation, tissue formation, and remodeling. Medicinal plants are widely used in traditional medicine to enhance wound healing due to their antimicrobial and anti-inflammatory properties.

The wound healing efficacy of *Kalanchoe gastonis-bonnieri* extract was evaluated using experimental models such as excision and incision wound models. The extract was applied topically, and parameters such as wound contraction rate, epithelialization period, and tissue regeneration were monitored over time.

The observations revealed that the treated group exhibited faster wound contraction and improved healing compared to the control group. Enhanced tissue regeneration and reduced healing time were also noted.

These effects may be attributed to the combined action of the plant's bioactive compounds, including:

- Antibacterial properties that help prevent infection
- Anti-inflammatory effects that reduce swelling and tissue damage
- Phytochemicals that promote cell proliferation and tissue repair

Results

The phytochemical analysis revealed the presence of several bioactive compounds including flavonoids, alkaloids, tannins, phenolic compounds, and saponins. These compounds are known to contribute to various pharmacological activities.

The antidiabetic study showed significant inhibition of alpha-amylase and alpha-glucosidase enzymes by the plant extract. This indicates that the extract may help regulate blood glucose levels by slowing carbohydrate digestion and glucose absorption.

The anti-inflammatory activity demonstrated that the extract effectively inhibited protein denaturation. This suggests that the plant possesses compounds capable of reducing inflammatory responses.

The antibacterial study revealed moderate to strong activity against tested bacterial strains. The extract showed significant inhibition zones particularly against *Staphylococcus aureus* and *Escherichia coli*.

The wound healing study indicated faster wound contraction and improved tissue regeneration when treated with the plant extract. These results suggest that the plant extract promotes healing by reducing infection and supporting tissue repair.

Discussion

The results of the study confirm that *Kalanchoe gastonis-bonnieri* possesses significant medicinal properties. The presence of flavonoids, tannins, and phenolic compounds may be responsible for its biological activities.

Flavonoids are known for their antioxidant and anti-inflammatory effects. They may help reduce oxidative stress and inflammation in tissues. Tannins and phenolic compounds contribute to antimicrobial activity by damaging bacterial cell membranes and interfering with microbial metabolism.

The observed antidiabetic activity may be attributed to the inhibition of carbohydrate digesting enzymes. By reducing glucose release during digestion, the plant extract may help control blood sugar levels in diabetic individuals.

Similarly, the antibacterial activity supports the traditional use of the plant in treating infections. The wound healing potential may be associated with both antimicrobial and antioxidant effects, which help prevent infection and accelerate tissue regeneration.

Overall, the study demonstrates the therapeutic potential of *Kalanchoe gastonis-bonnieri* as a natural medicinal plant.

Conclusion

The present study successfully evaluated the antidiabetic, anti-inflammatory, antibacterial, and wound healing activities of *Kalanchoe gastonis-bonnieri*. The plant extract showed promising biological activities due to the presence of various phytochemical compounds.

These findings suggest that the plant may serve as a valuable source of natural therapeutic agents. However, further studies are required to isolate and identify the active compounds responsible for these effects.

Future research should also focus on toxicity studies, in vivo experiments, and clinical trials to confirm the safety and effectiveness of this plant for medicinal use.

Reference

1. Ahmed, A.M (2002). History of diabetes Mellitus. Saudi medical journal, 23 (4), 373-378.
2. Akinmoladun, F. O., Akinrinlola, B. L., & Farombi, E. O. (2007). Chemical constituents and antimicrobial activity of the leaf extract of *Kalanchoe crenata*. Journal of Medicinal Plants Research, 1(5), 125-129.
3. Barrera Núñez, María Guadalupe, Mónica Bueno, Miguel Ángel Molina-Montiel, Lorena Reyes-Vaquero, Elena Ibáñez, and Alma Angélica Del.

Modernization of Libraries in the Digital Era

Dr. V. Jeyakala

Librarian, Holy Cross College (Autonomous), Nagercoil.

Email Id : jaisteiv@gmail.com

Abstract

The rapid development of digital technologies has significantly transformed libraries from traditional collections of printed materials into modern, technology-based knowledge centers. This research paper explores how libraries have evolved in the digital age, focusing on changes in resources, services, the roles of librarians, user behavior, and the challenges faced by contemporary libraries. It highlights the impact of digital libraries, electronic resources, information and communication technologies (ICT), and user-focused services in reshaping library functions and operations. The study also addresses major challenges such as the digital divide, copyright concerns, information overload, and the growing need for ongoing professional development among library professionals. The paper concludes that by adapting to digital transformation, libraries continue to play an essential role in supporting education, research, and lifelong learning.

Keywords: Digital libraries, ICT, e-resources, library transformation, information society

1. Introduction

Digital transformation in libraries involves incorporating digital technologies into every aspect of library functions and services. Traditionally, libraries were primarily concerned with the acquisition, organization, and dissemination of printed materials such as books, journals, and newspapers. However, the emergence of digital technologies and the growth of the internet have brought about a paradigm shift in the way information is created, stored, accessed, and shared.

The digital era has significantly altered user expectations, information-seeking behavior, and modes of learning. Users now demand instant access to information, remote availability of resources, and personalized services. In response, libraries have adopted digital tools and technologies to remain relevant and effective. This paper explores the transformation of libraries in the digital era, examining key developments, new roles of librarians, benefits, and challenges.

2. Concept of Digital Transformation in Libraries

Digital transformation in libraries refers to the integration of digital technologies into all aspects of library operations and services. It is not limited to the automation of library

functions but includes a fundamental change in how libraries deliver value to users. This transformation involves the adoption of digital collections, online services, cloud-based systems, and innovative user engagement strategies.

Digital libraries are one of the key results of this transformation. A digital library consists of a collection of digital resources such as text, images, audio, and video, along with systems and tools that enable their access, retrieval, and long-term preservation. Through digital transformation, libraries have shifted from being collection-centered to user-centered institutions.

3. Evolution of Library Resources

3.1 From Print to Digital Resources

One of the most visible transformations in libraries is the shift from print-based collections to digital resources. E-books, e-journals, online databases, and open access resources have become integral parts of modern library collections. These resources offer several advantages, including 24/7 accessibility, remote access, and efficient search capabilities.

Libraries now subscribe to large digital databases that provide access to thousands of journals and books, reducing dependency on physical storage space. Institutional repositories have also emerged as platforms for preserving and disseminating scholarly output in digital form.

3.2 Open Access Publishing and Institutional Repositories

The digital age has promoted the expansion of the open access movement, which seeks to provide free and unrestricted access to scholarly information. Libraries play an important role in advancing open access by maintaining institutional repositories and encouraging the use of open educational resources (OER). These efforts increase the visibility of research outputs and help ensure equal access to knowledge for a wider audience.

4. Modernization of Library Services

4.1 Technology-Enabled Services

Digital technologies have enabled libraries to deliver a variety innovative services. Online public access catalogs (OPACs), virtual reference services, digital lending, and mobile library applications are now common features of modern libraries. Users can search catalogs, access resources, and seek assistance without physically visiting the library.

4.2 User-Driven and Personalized Library Services

In the digital age, libraries prioritize user-focused services. They utilize data analytics and user feedback to gain insights into the needs and preferences of their patrons. Personalized notifications, tailored recommendations, and customized information literacy programs help improve user engagement and satisfaction.

5. Shifting Responsibilities of Librarians

In the digital environment, the role of librarians has grown considerably. They are no longer confined to handling physical collections but now serve as information managers, digital curators, educators, and facilitators of technology.

Librarians have a central role in information literacy education, teaching users how to evaluate digital information critically and ethically. They also aid research efforts by helping with database searches, managing citations, organizing research data, and promoting awareness of plagiarism.

Continuous professional development is essential for librarians to keep pace with technological advancements. Skills in ICT, digital preservation, metadata management, and user training are increasingly important.

6. Impact on Users and Learning

The digital transformation of libraries has had a significant impact on users and learning processes. Students and researchers benefit from quick access to a vast range of information resources. Digital libraries support e-learning, distance education, and collaborative research by providing seamless access to information.

Libraries have also become learning commons, offering digital learning spaces, multimedia facilities, and collaborative work areas. These developments support active learning and knowledge creation.

7. Obstacles in the Digital Age

Despite the advantages of digital technologies, libraries encounter numerous challenges in the modern era. The digital divide continues to be a significant issue, as not all users have equal access to technology and the internet. Copyright and licensing restrictions complicate the provision of digital resources. Libraries also face information overload and the proliferation of misinformation, necessitating stronger information literacy programs. Furthermore, the rapid evolution of technology requires ongoing investment in infrastructure and staff training, which can place a strain on financial resources.

8. Future Trends of Libraries

The future of libraries in the digital age is strongly connected to emerging technologies like artificial intelligence, big data, and cloud computing. Advanced concepts such as smart libraries, virtual reality learning environments, and AI-powered reference services are expected to gain greater prominence. Libraries will continue to function as hybrid spaces, integrating both physical and digital services, while maintaining their essential role in promoting lifelong learning, ensuring digital inclusion, and preserving knowledge.

9. Conclusion

The evolution of libraries in the digital age marks a major change in how information is organized and provided. By integrating digital technologies, libraries have broadened their collections, improved services, and transformed the roles of librarians. Although issues like the digital divide and copyright challenges remain, libraries that adopt innovative, user-focused strategies are well-positioned to succeed.

In summary, libraries continue to be vital institutions within the knowledge-driven society. Their adaptability to digital advancements ensures they remain crucial in promoting education, research, and lifelong learning.

References

1. American Library Association. (2019). *Libraries and the digital future*. American Library Association.
2. Borgman, C. L. (2015). *Big data, little data, no data: Scholarship in the networked world*. MIT Press.
3. Breeding, M. (2018). The future of library technology. *Library Technology Reports*, 54(5), 7–15.
4. IFLA. (2018). *Global vision for libraries*. International Federation of Library Associations and Institutions.
5. Tenopir, C., Volentine, R., & King, D. W. (2012). Scholarly reading and the value of academic library collections. *Portal: Libraries and the Academy*, 12(2), 157–180.

COMPARATIVE STUDY OF PERFORMANCE RELATED PHYSICAL FITNESS COMPONENTS BETWEEN SYNTHETIC AND NON-SYNTHETIC SURFACE PRACTICING SCHOOL STUDENTS

S. Dinesh Philip Vinoth

Research Scholar, Department of Physical Education,
Manonmaniam Sundaranar University, Tirunelveli.

Email Id : dinesh.mped@gmail.com

J. Karthikeyan,

Assistant Professor, Department of Physical Education Health Education and Sports,
The MDT Hindu College, Pettai, Tirunelveli.

Abstract

This study was to find out the performance related physical fitness variable between synthetic and non synthetic practicing school students. A total of 30 students' synthetic surface practicing players– 15 and non synthetic surface players– 15 were selected as subjects at random from the Christhuraja higher secondary school, Palayamkottai and Sankar higher secondary school, Thalaiyuthu were selected as subjects. The selected subjects were aged between 14 to 16 years.. The variables selected for this study were speed, agility, and explosive power. The collected data was statistically analyzed by using independent t-test. In this cases .05 level of significance was used to test the hypothesis. Athletic performance in soccer is a function of aerobic fitness, anaerobic fitness, speed, muscular strength, muscular power, and agility. There is a significant difference between synthetic and non synthetic practicing school students on speed, agility, explosive power.

Key Note: Speed, Agility, Explosive Power

Purpose of the study

The purpose of the study was to compare the selected performance related physical fitness variables between Synthetic and Non – Synthetic Surface practicing school students.

Selection of Subjects

The purpose of the study was to compare the performance related physical fitness variable between synthetic and non synthetic practicing school students. A total of 30 students' synthetic Players– 15 and non synthetic Players– 15 were selected as subjects at random from the Christhu Raja higher secondary school and Sankar higher secondary area Schools. The selected subjects were aged between 14 to 16 years.

Selection of Variables

Talking into consideration of the feasibility of criteria, availability of instruments and the relevance of the variable to the present study the following variables were selected.

1. Speed
2. Agility
3. Explosive power

Selection of Tests

The present study was undertaken primarily to compare the selected performance related physical fitness components among synthetic and non synthetic practicing school students. As per the available literatures, the following standardized tests were used to collect relevant data on the selected variables. They were presented in table 3.1.

Table 3.1 - Tests Selection

Sl. No.	Variables	Test	Unit of measurement
1.	Speed	50 M Dash	Seconds
2.	Agility	Shuttle run	Seconds
3.	Explosive power	Standing broad jump	Meters

ANALYSIS AND INTERPRETATION OF THE DATA

Speed

The independent 't' test on the obtained for speed between high and low altitude school students have been analyzed and presented.

Table 1 - Summary of mean values and independent 't' test for synthetic and non synthetic practicing school students players on speed

Subject	Number	Mean	Standard Deviation	't' Ratio
Synthetic	15	7.20	0.14	4.40*
Non synthetic	15	7.57	0.28	

*Significant at 0.05 level (Table value required for significance at 0.05 level for 't' test with 28 df 2.05).

From the table 4.1 it was showed that the mean values synthetic and non synthetic practicing school students are 7.20 and 7.57 respectively. The obtained 't' value is 4.40 which is greater than the required table value 2.05 at 0.05 level of significance. It was concluded that

there is a significance difference between synthetic and non synthetic practicing school students on speed.

Agility

The independent 't' test on the obtained for agility between synthetic and non synthetic practicing school students have been analyzed and presented

Table 2 - Summary of mean values and independent 't' test for synthetic and non synthetic practicing school students on agility

Subject	Number	Mean	Standard Deviation	't' Ratio
Synthetic	15	11.37	0.85	2.79*
Non Synthetic	15	12.13	0.63	

*Significant at 0.05 level.

(Table value required for significance at 0.05 level for 't' test with df 28 is 2.05).

From the table 4.2 it was showed that the mean values of synthetic and non synthetic practicing school students are 11.37, and 12.13 respectively at 0.05 level of significance. The obtained 't' value is 2.79 which is greater than the required table value 2.05 at 0.05 level of significance. It was concluded that there is a significance difference between synthetic and non synthetic practicing school students on agility. However, synthetic surface practiced area school students performed well than the non synthetic surface practicing school students.

Explosive Power

The independent 't' test on the obtained data for explosive power between high and low altitude area school students have been analyzed and presented.

Table 3 - Summary of mean values and independent 't' test for synthetic and non synthetic practicing school students on explosive power

Subject	Number	Mean	Standard Deviation	't' Ratio
Synthetic	15	2.27	0.20	4.12*
Non Synthetic	15	2.02	0.13	

*Significant at 0.05 level.

(Table value required for significance at 0.05 level for 't' test with df 28 is 2.05).

From the table 4.3 it was showed that the mean values of synthetic and non synthetic practicing school students are 2.27, and 2.02 respectively at 0.05 level of significance. The

obtained 't' value is 4.12 which is greater than the required table value 2.05 at 0.05 level of significance. It was concluded that there is a significant difference between synthetic and non synthetic practicing school students on explosive power.

Conclusions

There is a significant difference between synthetic and non synthetic practicing school students on speed, agility, explosive power.

References

1. Nédélec, M., McCall, A., Carling, C., Le Gall, F., Berthoin, S., & Dupont, G. (2013). Physical performance and subjective ratings after a soccer-specific exercise simulation: Comparison of natural grass versus artificial turf. *Journal of Sports Sciences*, 31(5), 529–536. <https://doi.org/10.1080/02640414.2012.738923>
2. Singh, G., Bennett, K. J. M., McGuigan, H., Goddard, S. G., & Stevens, C. J. (2024). The effect of a synthetic-grass sport surface on physiology and perception during intermittent exercise in hot conditions. *International Journal of Sports Physiology and Performance*, 19(11), 1314–1320. <https://doi.org/10.1123/ijsp.2024-0095>
3. Montesano, P. (2019). Natural and synthetic grass: A comparative study on the incidence of muscle injuries for senior athletes. *Medicina Sportiva*, 15(1), 3036–3040.
4. Gurpreet, S., Peterson, B., Jay, O., & Stevens, C. (2024). The effect of synthetic grass sports surfaces on the thermal environment: A systematic review. *International Journal of Biometeorology*. <https://doi.org/10.1007/s00484-024-02679-5>
5. Rmeli, M. S. H. (2021). Comparison between natural grass and synthetic turf on sprinting and agility performance among young soccer players (Student project). Universiti Teknologi MARA Institutional Repository.
6. Singh, G., Bennett, K. J. M., McGuigan, H., Goddard, S. G., & Stevens, C. J. (2024). Effects of synthetic-grass sport surface on physiological responses during intermittent exercise. *International Journal of Sports Physiology and Performance*.
7. Twomey, D., Finch, C., Doyle, T., Elliott, B., & Lloyd, D. (2016). Ground reaction forces and the influence of different sports surfaces on running mechanics. *Gait & Posture*.

EFFECT OF ISOMETRIC TRAINING ON SELECTED STRENGTH PARAMETERS AMONG SCHOOL BOYS

Dr. C. Rajasingh Hariston

Director of Physical Education,

St. Johns College, Palayamkottai, Tirunelveli.

Email Id : smanimped@gmail.com

Abstract

The purpose of this study was to examine the effect of isometric training on selected strength parameters among school boys. To conduct the study, twenty male students from St. John's Higher Secondary School in Tirunelveli District were selected as subjects. All participants were informed about the nature and purpose of the study, and their consent was obtained to ensure their full cooperation throughout the experimental period. The age of the subjects ranged from 15 to 17 years. The variables chosen for this study included abdominal strength, back strength, and shoulder strength, which were measured using standardized test procedures. A pre-test and post-test randomized group design was adopted for the experiment. The twenty subjects were randomly divided into two groups, with ten participants in each group. Data collected from both groups before and after the training period were analyzed using the dependent *t*-test to determine significant improvements. The level of significance was set at 0.05. The results of the study revealed a significant improvement in abdominal strength, back strength, and shoulder strength as a result of isometric training among school boys. Furthermore, the experimental group showed greater improvement in these selected strength parameters compared to the control group.

Keywords: Abdominal Strength, Shoulder Strength, Back Strength.

Introduction

Physical fitness is an essential aspect of a child's overall development, particularly during the school years when growth and maturation occur rapidly. Among the various components of physical fitness, muscular strength plays a significant role in improving physical performance, supporting daily activities, and reducing the risk of injuries. Developing strength at an early age helps school boys build a strong foundation for participation in sports and promotes lifelong health and fitness habits (Faigenbaum & Myer, 2010).

Isometric training is a type of strength training in which muscles contract without any visible movement in the joint angle. This form of exercise involves holding a static position against resistance for a certain period of time. It is considered safe and effective for young

individuals because it minimizes joint stress while still enhancing muscle activation and strength (American College of Sports Medicine, 2018). Isometric exercises are simple to perform, require minimal equipment, and can be easily incorporated into school physical education programs.

Previous research has shown that isometric training can improve various strength parameters such as muscular endurance, static strength, and overall muscle stability. These improvements are particularly beneficial for school boys, as they contribute to better posture, coordination, and athletic performance (Lum & Barbosa, 2019). Therefore, studying the effect of isometric training on selected strength parameters among school boys is important to determine its effectiveness and to provide practical guidelines for physical education teachers and coaches.

Statement of the Problem

The purpose of the study was to find out the effect of isometric training on strength parameters among school boys.

Methodology

Selection of Subjects

The subjects for this study consisted of twenty male students ($n = 20$) from St. John Higher Secondary School, Tirunelveli, India, during the academic year 2025–2026. The selected participants were randomly assigned using a simple random sampling method into two groups of ten each ($n = 10$), namely an experimental group and a control group.

Group A ($n = 10$) underwent isometric training for a period of six weeks, with three sessions per week, in addition to their regular daily activities. Group B ($n = 10$) served as the control group and did not participate in the training program. All participants were healthy school boys with no prior involvement in structured isometric or resistance training programs.

Selection of Variables

Dependent Variables

Since selected strength parameters an important role in almost all games and sports, the following dependent variables were selected for this study.

1. Abdominal strength
2. Shoulder strength
3. Back strength

Independent Variables

Isometric training was selected as independent variable for this study.

Selection of Tests

Table I - Tests Selection

Criterion variables	Test items	Unit of measurement
Abdominal strength	Sit ups	In counts
Shoulder strength	Push ups	In counts
Back strength	Isometric back strength test	In seconds

Statistical Technique

To find out the significant improvement between the pre and post means, dependent 't' test was used. All the statistical analysis tests were computed at 0.05 level of significance ($p < 0.05$).

Analysis and Interpretations of the Data

1. Abdominal Strength

TABLE-II - Summary of Mean and Dependent 'T'-Test for the Pre and Post Tests on Abdominal Strength of Isometric Training Group and Control Group

Tests		Pre Test	Post Test	't' - Value
Isometric Training Group	Mean	13.9	17.9	12.00*
	SD	1.52	2.02	
Control Group	Mean	9.7	8.9	1.92
	SD	1.42	1.79	

*Significant at .05 level. The table value required for 0.05 level of significance with df 9 is 2.26.

Table II indicates that the pre-test mean values for the isometric training group and the control group were 13.90 and 9.70, respectively, while the post-test mean values were 17.90 and 8.90. The calculated dependent *t*-ratio values between the pre- and post-test scores were 12.00 for the isometric training group and 1.92 for the control group.

The critical *t* value required for significance at the 0.05 level with 9 degrees of freedom is 2.26. Since the obtained *t*-value for the isometric training group exceeds the critical value, it indicates a statistically significant improvement in abdominal strength. In contrast, the control group did not show significant improvement, as its obtained *t*-value is

lower than the table value, which may be attributed to the absence of any specific training intervention.

2. Shoulder Strength

TABLE-III - Summary of Mean and Dependent ‘T’-Test for the Pre and Post Tests on Shoulder Strength of Isometric Training Group and Control Group

Tests		Pre Test	Post Test	‘t’ - Value
Isometric Training Group	Mean	4.8	7.1	15.06*
	SD	0.79	0.74	
Control Group	Mean	3.7	3.5	1.50
	SD	0.82	0.71	

*Significant at .05 level. The table value required for 0.05 level of significance with df 9 is 2.26.

Table III indicates that the pre-test mean values for the isometric training group and the control group were 4.80 and 3.70, respectively, while the post-test mean values were 7.10 and 3.50. The calculated dependent t-ratio values comparing pre- and post-test means were 15.06 for the isometric training group and 1.50 for the control group. The critical table value required for significance at the 0.05 level with 9 degrees of freedom is 2.26. Since the obtained t-value for the isometric training group exceeds the table value, it is evident that this group showed a significant improvement in shoulder strength. In contrast, the control group did not demonstrate a significant change, as its obtained t-value is lower than the critical value, likely due to the absence of any specific training.

3. Back Strength

TABLE-IV - Summary of Mean and Dependent ‘T’-Test for the Pre and Post Tests on Back Strength of Isometric Training Group and Control Group

Tests		Pre Test	Post Test	‘t’ - Value
Isometric Training Group	Mean	47.3	54.8	13.20*
	SD	1.64	2.62	
Control Group	Mean	42.1	41.9	0.55
	SD	1.20	1.73	

*Significant at .05 level. The table value required for 0.05 level of significance with df 9 is 2.26.

Table IV reveals that the pre-test mean values for the isometric training group and the control group were 47.30 and 42.10, respectively, while the post-test mean values were 54.80 and 41.90. The calculated dependent t-ratio values for the comparison between pre- and post-test means were 13.20 for the isometric training group and 0.55 for the control group. The critical value required for significance at the 0.05 level with 9 degrees of freedom is 2.26. As the obtained t-value for the isometric training group exceeds the critical value, it is clear that this group showed a significant improvement in back strength. In contrast, the control group did not exhibit a significant change, as its obtained t-value is lower than the critical value, likely due to the absence of any specific training intervention.

Conclusion

- There was significant improvement on abdominal strength, shoulder strength, back strength due to the effect of isometric training among school boys.
- There was significant difference among school boys towards improving the selected strength parameters such as abdominal strength, back strength and shoulder strength than control group.

Reference

1. American College of Sports Medicine. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Wolters Kluwer.
2. Faigenbaum, A. D., & Myer, G. D. (2010). Resistance training among young athletes: Safety, efficacy, and injury prevention effects. *British Journal of Sports Medicine*, 44*(1), 56–63. https://doi.org/10.1136/bjsm.2009.068098 (<https://doi.org/10.1136/bjsm.2009.068098>)
3. Kirsten, G. (1963). The effect of isometric muscle training on the development of muscular strength in children and adolescents. *Internationale Zeitschrift für Angewandte Physiologie*, 19*(6), 387–402.
4. Muehlbauer, T., Gollhofer, A., & Granacher, U. (2012). Sex-related effects in strength training during adolescence: A pilot study. *Perceptual and Motor Skills*, 115*(3), 953–968. [https://doi.org/10.2466/06.10.30.PMS.115.6.953-968] (<https://doi.org/10.2466/06.10.30.PMS.115.6.953-968>)
5. Lum, D., & Barbosa, T. M. (2019). Brief review: Effects of isometric strength training on strength and dynamic performance. *International Journal of Sports Medicine,

- 40*(6), 363–375. <https://doi.org/10.1055/a-0863-4539>
6. Faigenbaum, A. D., & Myer, G. D. (2010). Resistance training among young athletes: Safety, efficacy, and injury prevention effects. *British Journal of Sports Medicine, 44*(1), 56–63. <https://doi.org/10.1136/bjsm.2009.068098>
 7. Fleck, S.J., & Kraemer, W.J. (2014). *Designing resistance training programs* (4th ed.). Human Kinetics.
 8. Enoka, R. M. (2008). *Neuromechanics of human movement* (4th ed.). Human Kinetics.
 9. American College of Sports Medicine. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Wolters Kluwer.

Antibiofilm Potential of *Nephrolepis* spp. Extract Against Multidrug-Resistant *Klebsiella pneumoniae*

Jeba Nithiha.N

Student, II M.Sc. Biotechnology

Noorul Islam College of Arts and Science, Kumaracoil.

Email Id : jebanithihanickson@gmail.com

ABSTRACT

Biofilm formation by multidrug-resistant (MDR) *Klebsiella pneumoniae* contributes to persistent infections and increased antimicrobial resistance. This study evaluated the antibiofilm potential of *Nephrolepis* fern extracts against *K. pneumoniae*. Extracts prepared by Soxhlet extraction were tested using crystal violet assay, Congo red agar, twitching motility, and safranin tube methods. The results showed concentration-dependent inhibition of biofilm formation. These findings indicate that *Nephrolepis* extracts may act as a potential natural antibiofilm agent against MDR *K. pneumoniae*.

INTRODUCTION:

Antimicrobial resistance (AMR) has become a major global public health concern due to the increasing emergence of multidrug-resistant (MDR) bacterial pathogens. Among them, *Klebsiella pneumoniae*, a Gram-negative opportunistic bacterium, is responsible for several hospital- and community-acquired infections such as pneumonia, urinary tract infections, septicemia, and wound infections. The pathogenic success of this organism is largely associated with its ability to develop antibiotic resistance mechanisms and form biofilms—structured microbial communities embedded in an extracellular polymeric substance (EPS) matrix that protects bacteria from antibiotics and host immune responses. Biofilm-associated cells can exhibit significantly higher resistance compared to planktonic cells, making infections difficult to treat and leading to persistent and recurrent infections. In recent years, natural products, particularly plant-derived compounds, have gained attention as potential alternatives to conventional antibiotics due to their diverse bioactive metabolites such as flavonoids, phenolics, alkaloids, tannins, and terpenoids, which exhibit antimicrobial and antibiofilm activities. Fern species, including *Nephrolepis*, contain various secondary metabolites known for their medicinal properties and traditional use in treating infections. Therefore, exploring the antibiofilm potential of *Nephrolepis* extracts against MDR

Klebsiella pneumoniae may provide an eco-friendly and promising strategy for controlling biofilm-associated infections and addressing the growing challenge of antimicrobial resistance.

1. Sample collection

The *Nephrolepis* plant sample (Fig. 1) was collected from the surrounding areas of Kanyakumari district, Tamil Nadu, India. Healthy and fresh leaves were selected for the study. The collected plant material was placed in clean containers and brought to the laboratory. The samples were washed thoroughly with tap water to remove dust and impurities.



Fig 1: *Nephrolepis*

1.1 Washing and drying

The collected sample was thoroughly washed with distilled water to eliminate dust and other surface contaminants that could interfere with the extraction process. After washing the plant material was dried at room temperature.

1.2 Grinding and Powdering

Once completely dried, the plant material was ground into a coarse powder using either a mortar and pestle or a mechanical grinding. Grinding increased the surface area of the plant material thereby enhancing solvent penetration during extraction. The powdered material was then passed through a sieve to obtain uniform particle size ensuring consistency in extraction. The sieved powder was then stored in airtight containers at room temperature until further use.

2. Sequential Extraction

2.1 Weighing the sample

A precise quantity 50 g of the powdered plant material was accurately weighed using an analytical balance.

2.2 Selection of solvent

A suitable solvent was chosen based on the polarity of the bioactive compounds to be extracted. The selection was made by considering a range of solvents from low polar to high polar in order to maximize the extraction efficiency. Hexane, Ethyl acetate and Methanol were hence used as the solvents.

2.3 Soxhlet extraction

2.3.1 Soxhlet set up

The weighed plant powder was placed inside the Soxhlet extraction thimble. The thimble was then carefully positioned within the main chamber of the Soxhlet extractor. A

volume of 100 ml of the selected solvent was added to a round bottom flask, which served as the solvent reservoir. The Soxhlet apparatus was assembled and connected to a condenser and a heating mantle to initiate the extraction process.

2.3.2 Extraction process

The solvent was heated to its boiling point, allowing its vapours to rise and condense within the extraction chamber. As the condensed solvent dripped into the plant material, it continuously percolated through the powder, extracting the bioactive compounds. This process continued for a duration of 4 to 8 hours, during which the solvent repeatedly cycled through the material gradually accumulating the extracted compounds. The Soxhlet extraction process ensured efficient recovery of bioactive constituents by maintaining continuous solvent contact with the plant material (Harborne, 1998; Handa *et al.*, 2008).

2.4 Solvent recovery and concentration

2.4.1 Filtration

Following extraction, the solvent extract mixture was filtered using Whatman filter paper to separate the solid plant residues from the liquid extract. The step ensured that only the pure solvent extract solution was retained for further processing.

2.4.2 Solvent evaporation

To concentrate the extract, the solvent was removed through evaporation. The filtered solvent extract solution was subjected to evaporation using a water bath maintained at a temperature of 40-50 °C. This step facilitated the removal of the solvent while preserving the integrity of the bioactive compounds within the extract. The dried crude extract was carefully transferred to a pre-weighed container for the accurate measurement of the final yield. The extract stored at 4°C.

2.4.3 Preparation of solvent extract

Nephrolepis was extracted using different solvents and yield was recorded after Soxhlet extraction.

Sl. No	Extract	Yield (mg)
1	Hexane	0.262
2	Ethyl acetate	0.356
3	Methanol	0.332

3. Qualitative Phytochemical analysis

Hexane, ethyl acetate, and methanol extracts of *Nephrolepis* obtained through sequential Soxhlet extraction were screened for major phytochemicals using standard qualitative tests. The presence of alkaloids, flavonoids, phenolics, tannins, saponins, terpenoids, steroids, glycosides, and carbohydrates were identified based on characteristic color changes or precipitate formation after adding specific reagents. This analysis provided a preliminary understanding of the phytochemical composition of each extract (Harborne, 1998; Trease & Evans, 2002).



Fig 2: Qualitative Phytochemical analysis

S.No	Phytochemical test	Control	Hexane extract	Ethyl acetate extract	Methanol extract
1	Test for carbohydrate	-	+	-	-
2	Test for tannins	-	+	++	++
3	Test for saponins	-	+	++	-
4	Test for flavonoids	-	-	-	++
5	Test for alkaloids	-	+	++	++
6	Test for quinones	-	-	-	-
7	Test for glycosides	-	-	-	-
8	Test for cardiac glycosides	-	-	-	-
9	Test for terpenoids	-	-	-	-
10	Test for phenols	-	+	++	++
11	Test for coumarins	-	+	-	-
12	Test for steroids and phytosteroids	-	-	-	-
13	Phlobaphenes	-	-	-	-
14	acridine derivatives	-	-	-	-

4. Biofilm screening

4.1 Collection of *klebsiella* strains:

A total of ten multidrug-resistant (MDR) *Klebsiella* strains were collected from the NIMS Centre for Genomic Medicine, Nyyattinkara, India is used for the study. The strain number collected is MDR 11, MDR14, MDR 18, MDR 25, MDR 26, MDR 29, MDR 37, MDR 43, MDR 45 & MDR64.

4.2 Crystal violet assay

Ten *Klebsiella pneumoniae* isolates (MDR 11, MDR 14, MDR 18, MDR 25, MDR 26, MDR 29, MDR 37, MDR 43, MDR 45, and MDR 64) were cultured in 3 ml nutrient broth and incubated at 37 °C for 72 h. After incubation, the broth was discarded and the tubes were washed with phosphate buffered saline (PBS) and air-dried. Crystal violet stain (2 ml) was

added for 10 s, removed, and the tubes were rinsed with distilled water to eliminate excess stain. Subsequently, 3 ml of 30% glacial acetic acid was added and incubated for 15 min, and absorbance was measured at 540 nm (Stepanović et al., 2007; O'Toole, 2011).

- OD > 1.00 → Significant biofilm formation
- OD < 1.00 → Weak biofilm formation

Test organism	OD 540 nm	Biofilm Formation
MDR 11 - <i>Klebsiella pneumoniae</i>	0.98	Strong
MDR 14 - <i>Klebsiella pneumoniae</i>	1.00	Strong
MDR 18 - <i>Klebsiella pneumoniae</i>	1.00	Strong
MDR 25 - <i>Klebsiella pneumoniae</i>	0.42	Weak
MDR 26 - <i>Klebsiella pneumoniae</i>	0.63	Weak
MDR 29 - <i>Klebsiella pneumoniae</i>	0.63	Weak
MDR 37 - <i>Klebsiella pneumoniae</i>	0.65	Weak
MDR 43 - <i>Klebsiella pneumoniae</i>	0.99	Strong
MDR 45 - <i>Klebsiella pneumoniae</i>	0.63	Weak
MDR 64 - <i>Klebsiella pneumoniae</i>	0.65	Weak



Fig 4: Screening for biofilm formation: A: MDR11; B: MDR 14; C: MDR18; D: MDR 25; E: MDR 26; F: MDR 29; G: MDR 37; H: MDR43; I: MDR 45; J: MDR 64

Fig 3: Spectrophotometric reading of crystal violet assay

4.3 Congo Red Agar (CRA) Method

Biofilm production was qualitatively assessed using the Congo red agar (CRA) method. The medium was prepared with BHI agar supplemented with Congo red (0.8 g/L) and sucrose (36 g/L). The *Klebsiella pneumoniae* isolates were inoculated on CRA plates and incubated at 37 °C for 24 h. Colony morphology was then examined; black, dry crystalline colonies indicated biofilm producers, whereas pink colonies indicated non-biofilm producers (Freeman et al., 1989; Mathur et al., 2006).

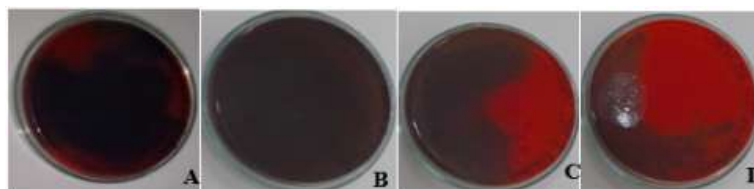


Fig 5: Congo red assay A: MDR 18, B: MDR 14, C: MDR11 and D: MDR 43

4.4 Safranin Tube method (TM)

The tube method was used to qualitatively detect biofilm formation. *Klebsiella pneumoniae* isolates were inoculated in nutrient broth and incubated in polystyrene tubes at 37 °C for 24 h. After incubation, tubes were washed with PBS to remove planktonic cells and stained with safranin for 1 h. The tubes were rinsed, air-dried, and the presence of a visible film on the tube walls and bottom indicated biofilm formation (Christensen et al., 1985).

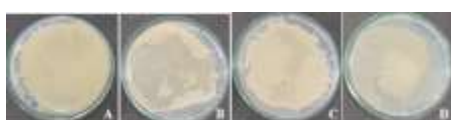


Fig 6: Safranin tube method A: MDR11; B: MDR 14, C: MDR18, D: MDR 25, E: MDR 26, F: MDR 29, G: MDR 37, H: MDR43, I: MDR 45, J: MDR 64

Fig. 6 Safranin tube method A:MDR 11, B:MDR 14,C:MDR 18,D:MDR25,EMDR 26,F:MDR 29,G:MDR37,H:MDR43,I:MDR 45,J:MDR 64

4.5 Twitching motility

Twitching motility is a mode of solid surface translocation that occurs under humid conditions on semisolid or solid surface. Different *Klebsiella* species were stabbed into the Luria Bertani agar plate using a stabbed needle and incubated at 24 h at 37°C. Colonies were dispersed around the stabbed area indicating motility of the organism.



S. No	Fungal strain	Colonial diameter (cm)
1	MDR 11	2.6 cm
2	MDR 14	8 cm
3	MDR 18	7 cm
4	MDR 43	7.5 cm

Fig 7: Twitching motility A: MDR11; B: MDR 14, C: MDR18, D: MDR 43

5. Antibiofilm activity of *Nephrolepis* extracts against biofilm producing *Klebsiella pneumoniae*

For antibiofilm screening, a primary stock solution of each solvent (hexane, ethyl acetate and methanol) extract was prepared at a concentration of 1 mg/ml. From the 1 mg/ml stock solution, three different working concentrations (250 µg/mL, 500 µg/mL, and 750 µg/mL) were prepared using respective solvents.

5.1 Crystal violet assay in 96 well plate

The antibiofilm activity of hexane, ethyl acetate, and methanol extracts against *Klebsiella pneumoniae* (MDR 18 and MDR 14) was evaluated using the crystal violet microtiter plate method with slight modifications (Stepanović et al., 2007; O'Toole, 2011). In a sterile 96-well plate, 200 µL nutrient broth served as the blank, while 150 µL nutrient broth with 50 µL bacterial culture served as the control. Test wells contained 100 µL nutrient broth, 50 µL bacterial culture, and 50 µL solvent or plant extract at concentrations of 250, 500, and 750 µg/ml. After incubation for 72 h, wells were washed with PBS, stained with 0.1% crystal violet for 20 min, and rinsed with distilled water. Biofilm-bound stain was solubilized with 200 µL of 30% glacial acetic acid, and absorbance was measured at 540 nm. All experiments were performed in replicates.



Fig 8: Antibiofilm activity of different *Nephrolepis* extract against MDR 14 and MDR 18 by Crystal violet assay

<i>Nephrolepis</i> extract	OD at 540 nm						
	Control	Negative control			250 µg/ml	500 µg/ml	750 µg/ml
		Hexane	Ethyl acetate	Methanol			
Hexane extract	1.30	1.22	-		1.22	1.09	0.75
Ethyl acetate extract	1.30	-	1.00		0.97	0.85	0.77
Methanol extract	1.30	-	-	1.02	0.42	0.37	0.30

<i>Nephrolepis</i> extract	OD at 540 nm						
	Control	Negative control			250 µg/ml	500 µg/ml	750 µg/ml
		Hexane	Ethyl acetate	Methanol			
Hexane extract	1.52	1.23	-	-	1.05	0.92	0.82
Ethyl acetate extract	1.52	-	1.00	-	0.72	0.65	0.62
Methanol extract	1.52	-	-	1.191	0.60	0.53	0.40

Fig 9: Antibiofilm activity of *Nephrolepis* extract at different concentrations against MDR 14 and MDR 18

5.2 Congo red agar (CRA) method

The CRA medium was prepared, different extracts were added into the medium before plating. Biofilm producing *Klebsiella pneumoniae* was inoculated into Congo red agar plates and incubated at 37°C for 24 hours. Antibiofilm activity were assessed after incubation (Freeman *et al.*, 1989; Mathur *et al.*, 2006).



Fig 10: Antibiofilm activity of different *Nephrolepis* extract against MDR 14 and MDR 18 by Congo red assay

5.3 Safranin Tube method (TM)

The tube method was used to evaluate the antibiofilm activity of different extracts. Biofilm-producing *Klebsiella pneumoniae* isolates (MDR 18 and MDR 14) with various concentrations of extracts were inoculated in nutrient broth and incubated at 37 °C for 24 h. After incubation, tubes were washed with PBS to remove planktonic cells and stained with safranin for 1 h. The tubes were rinsed, air-dried, and antibiofilm activity was assessed based on the reduction of the visible film on the tube walls (Christensen *et al.*, 1982; Mathur *et al.*, 2006).



Fig 11: Antibiofilm activity of different concentrations against *Klebsiella pneumoniae* (MDR 18) A: Hexane extract, B: Ethyl acetate extract, C: Methanol extract.

Fig. 11: Antibiofilm activity of different concentrations against *Klebsiella pneumoniae* (MDR 18)

A: Hexane extract, B: Ethyl acetate extract, C: Methanol extract.

5.4 Twitching motility

Twitching motility is a mode of solid surface translocation that occurs under humid conditions on semisolid or solid surface. Different *Klebsiella pneumoniae* cultures (MDR 18 and MDR 14) along with extracts were stabbed into the Luria Bertani agar plate using a stabbed needle and incubated at 24 h at 37°C. Colonies were dispersed around the stabbed area indicating motility of the organism.



Fig 12 Antibiofilm activity of different *Nephrolepis* extract against MDR 14 and MDR 18 by Twitching motility

Results, summary and conclusion:

The present study evaluated the biofilm-forming ability of multidrug-resistant (MDR) *Klebsiella pneumoniae* strains and the antibiofilm potential of different solvent extracts of *Nephrolepis*. Soxhlet extraction using hexane, ethyl acetate, and methanol produced crude extracts with varying yields, with ethyl acetate showing the highest yield. Preliminary phytochemical screening revealed several bioactive secondary metabolites such as tannins, alkaloids, phenols, flavonoids, terpenoids, and steroids, with the methanol extract containing a broader range of compounds. Biofilm screening using crystal violet assay, Congo red agar method, Safranin tube method, and twitching motility test indicated variation in biofilm-forming ability among the isolates. Among the tested strains, MDR 14 and MDR 18 showed strong biofilm formation and were therefore selected for further antibiofilm evaluation.

The antibiofilm activity of *Nephrolepis* extracts against MDR 14 and MDR 18 demonstrated that all solvent extracts reduced biofilm formation to some extent, while the methanol extract exhibited the most significant inhibitory effect. A marked reduction in biofilm

biomass was observed at higher concentrations, particularly at 750 µg/mL. Additional assays also showed decreased colony pigmentation, reduced adherence, and lower surface motility in treated samples, indicating interference with biofilm development. Overall, the findings suggest that *Nephrolepis*, especially its methanol extract, possesses promising antibiofilm activity against MDR *Klebsiella pneumoniae*, highlighting its potential as a natural source of bioactive compounds for controlling biofilm-associated infections.

REFERENCE:

1. Harborne, J. B. (1998). *Phytochemical methods: A guide to modern techniques of plant analysis* (3rd ed.). Chapman & Hall.
2. Handa, S. S., Khanuja, S. P. S., Longo, G., & Rakesh, D. D. (2008). *Extraction technologies for medicinal and aromatic plants*. United Nations Industrial Development Organization (UNIDO).
3. Christensen, G. D., Simpson, W. A., Younger, J. J., Baddour, L. M., Barrett, F. F., Melton, D. M., & Beachey, E. H. (1985). Adherence of coagulase-negative staphylococci to plastic tissue culture plates: A quantitative model for the adherence of staphylococci to medical devices. *Journal of Clinical Microbiology*, 22(6), 996–1006.
4. Evans, W. C. (2002). *Trease and Evans pharmacognosy* (15th ed.). Saunders Elsevier.
5. Freeman, D. J., Falkiner, F. R., & Keane, C. T. (1989). New method for detecting slime production by coagulase-negative staphylococci. *Journal of Clinical Pathology*, 42(8), 872–874.
6. Henrichsen, J. (1972). Bacterial surface translocation: A survey and classification. *Bacteriological Reviews*, 36(4), 478–503.
7. Mathur, T., Singhal, S., Khan, S., Upadhyay, D. J., Fatma, T., & Rattan, A. (2006). Detection of biofilm formation among the clinical isolates of staphylococci: An evaluation of three different screening methods. *Indian Journal of Medical Microbiology*, 24(1), 25–29.
8. O'Toole, G. A. (2011). Microtiter dish biofilm formation assay. *Journal of Visualized Experiments*, (47), e2437.

COMPARISON OF TRADITIONAL STRENGTH TRAINING AND FUNCTIONAL TRAINING ON AGILITY, BALANCE, AND EXPLOSIVE POWER IN HANDBALL PLAYERS

Bala Sivapriya M

Research Scholar, SRM Institute of Science and Technology, Trichy.

Email Id : balasivapriya98@gmail.com

Dr. R. Manickam

Physical Director, SRM Institute of Science and Technology, Trichy.

Abstract

The purpose of this study was to compare the effects of an 8-week traditional strength training (TST) program versus a functional training (FT) program on agility, balance, and explosive power in male handball players. Forty-five (N=45) collegiate-level handball players aged 18- 24 years were randomly assigned into three equal groups: Group A (Traditional Strength Training, n=15), Group B (Functional Training, n=15), and Group C (Control Group, n=15). The experimental groups underwent their respective training protocols three days per week for eight weeks, while the control group continued with their regular handball practice.

The selected variables were Agility, measured by the T-Test; Balance, measured by the Stork Balance Stand Test; and Explosive Power, measured by the Sargent Vertical Jump Test. Pre- test and post-test data were collected and analyzed using Analysis of Covariance (ANCOVA) to determine significant differences between the adjusted post-test means. The level of significance was set at 0.05.

The results indicated significant improvements in all three variables for both experimental groups compared to the control group. However, the Functional Training group (Group B) demonstrated significantly greater improvements in Agility ($p < 0.05$) and Balance ($p < 0.05$) compared to the Traditional Strength Training group. In terms of Explosive Power, both training groups showed significant gains, with no statistically significant difference found between the Traditional and Functional training methods, though both were superior to the Control group. The study concludes that while both training modalities are effective, functional training provides superior transferability for specific motor skills like agility and balance, which are critical for handball performance.

Keywords: *Handball, Functional Training, Traditional Strength Training, Agility, Balance, Explosive Power.*

Introduction

Handball is a complex, high-intensity team sport characterized by intermittent high-speed actions, frequent physical contact, and specific technical movements such as throwing, blocking, and jumping. Modern handball requires athletes to possess a diverse range of physical fitness components, including strength, power, speed, agility, and balance. The ability to rapidly change direction, maintain stability during physical confrontations, and generate explosive force for shooting and jumping are determinants of success in competitive handball. Consequently, strength and conditioning coaches are constantly seeking the most effective training methodologies to enhance these performance parameters.

Traditionally, resistance training in team sports has focused on increasing muscle cross-sectional area and maximal force production through isolation exercises and heavy external loads. This methodology, known as Traditional Strength Training (TST), typically utilizes machines and free weights to target specific muscle groups in a stable environment. While TST is undeniably effective for hypertrophy and maximal strength gains, critics argue that it may lack specificity regarding the movement patterns and neuromuscular demands of handball. The isolated nature of TST often fails to replicate the multi-planar, chaotic environment of a handball match where force must be applied in unstable conditions.

In recent years, Functional Training (FT) has emerged as a popular alternative or supplementary training method. FT focuses on training movement patterns rather than individual muscles, emphasizing multi-joint activities, core stability, and proprioception. By incorporating unstable surfaces, unilateral movements, and kinematic chains that mimic sport-specific actions, FT aims to improve the neuromuscular system's efficiency and the transfer of strength to athletic performance. Proponents of FT suggest that it is superior for enhancing agility and balance due to its emphasis on coordination and dynamic stability.

Despite the popularity of both training modalities, there remains a debate regarding their comparative efficacy in enhancing specific athletic performance metrics in handball players. While TST is well-documented for power development, the extent to which FT can improve explosive power alongside agility and balance in handball players requires further empirical investigation. This study aims to bridge this gap by conducting a comparative analysis of traditional strength training versus functional training on agility, balance, and explosive power in competitive handball players.

Review of Related Literature

Traditional Strength Training in Sports

Traditional strength training has long been the cornerstone of athletic conditioning. Research by heavyweights in exercise physiology has consistently demonstrated that increasing maximal strength serves as a foundation for power development. A study by Peterson et al. (2018) highlighted that maximal squat strength is strongly correlated with sprint speed and vertical jump height in elite athletes. The primary mechanism involves neural adaptations such as increased motor unit recruitment and firing frequency, alongside morphological changes like hypertrophy. In the context of handball, Hermassi et al. (2017) found that a season of heavy resistance training significantly improved throwing velocity and jump performance. However, critics note that traditional exercises often occur in the sagittal plane, whereas handball involves tri-planar movements.

Functional Training Methodologies

Functional training is defined by Boyle (2016) as "purposeful training" that prepares the body for the demands of the sport. It prioritizes the integration of the kinetic chain. Distefano et al. (2013) compared functional training programs incorporating plyometrics and flexibility with traditional resistance protocols, finding that functional groups often exhibited superior gains in balance and functional movement screens (FMS). The core philosophy of FT relies on the principle of specificity—the idea that training adaptations are specific to the stimuli applied. By utilizing tools like stability balls, suspension trainers (TRX), and kettlebells, FT challenges the athlete's proprioceptive capabilities.

Agility, Balance, and Power in Handball

Agility in handball is not merely about speed but the ability to react to a stimulus and change direction efficiently. Young et al. (2015) differentiate between pre-planned change of direction speed and reactive agility, noting that cognitive processing and balance play crucial roles. Balance, both static and dynamic, is essential for defensive sliding and maintaining possession under contact. Evaluating the impact of training on these variables, a study by Tomljanović et al. (2011) on tennis players suggested that functional conditioning was more effective than traditional conditioning for agility.

Explosive power, particularly vertical jump performance, is critical for jump shots and blocking in handball. While TST is proven to enhance force production, plyometric components often integrated into FT are also effective for power development via the stretch-shortening cycle (SSC). Conflicting evidence exists regarding which method yields superior

power outcomes, with some studies suggesting a combination is optimal. This study seeks to isolate the effects of these two distinct methodologies to provide clearer guidelines for coaches.

Methodology

Participants

Forty-five (N=45) male handball players from university-level teams were selected as participants for this study. The age of the subjects ranged from 18 to 24 years. All participants had at least three years of competitive playing experience and were free from any musculoskeletal injuries at the onset of the study. The participants were randomly divided into three equal groups consisting of 15 subjects each:

Group A: Traditional Strength Training (TST) Group (n=15) Group B: Functional Training (FT) Group (n=15)

Group C: Control Group (CG) (n=15)

Variables

The study focused on three dependent variables:

- Agility: Measured using the T-Test (recorded in seconds).
- Balance: Measured using the Stork Balance Stand Test (recorded in seconds).
- Explosive Power: Measured using the Sargent Vertical Jump Test (recorded in centimeters).

Training Protocol

The experimental intervention lasted for 8 weeks, with 3 sessions per week, each lasting approximately 60 minutes.

Group A (Traditional Strength Training): This group performed resistance exercises using machines and free weights. The protocol focused on major muscle groups with stable bases of support. Exercises included: Bench Press, Back Squat, Leg Press, Seated Shoulder Press, Lat Pulldown, and Leg Curls. The intensity was set at 70-85% of 1RM, performing 3-4 sets of 8- 12 repetitions.

Group B (Functional Training): This group performed exercises emphasizing multi-joint movements, instability, and core integration. Exercises included: Single-Leg Squats, BOSU Ball Lunges, TRX Chest Press, Kettlebell Swings, Medicine Ball Rotational Throws, and Plank variations. The volume was matched to Group A in terms of duration, but intensity was regulated by body mechanics and movement complexity rather than %1RM.

Group C (Control Group): This group did not participate in any specific strength or functional training program but continued with their regular technical handball practice sessions. Statistical Analysis

Descriptive statistics (Mean and Standard Deviation) were calculated for pre-test and post-test data. To determine the significance of the training effects, Analysis of Covariance (ANCOVA) was employed, using the pre-test scores as covariates to adjust the post-test means. When significant F-ratios were obtained, the Scheffe's post-hoc test was applied to determine paired mean differences. The level of significance was set at 0.05 for all statistical analyses. Data analysis was performed using SPSS version 26.0.

Results

The findings of the study are presented in the following tables. Table 1 shows the analysis of covariance for the data on Agility, Balance, and Explosive Power among the three groups.

Table 1: Computation of Analysis of Covariance of Agility (Seconds)

Group	Traditional (A)	Functional (B)	Control (C)	F-Ratio
Pre-Test Mean	11.45	11.42	11.48	0.24
Post-Test Mean	10.85	10.22	11.40	18.45*
Adj. Post Mean	10.84	10.23	11.39	21.33*

*Significant at 0.05 level. ($df = 2, 41$). Table value required for significance is 3.23.

Table 1 reveals a significant F-ratio of 21.33 for the adjusted post-test means of Agility, which is higher than the critical value. This indicates a significant difference among the groups. Post-hoc analysis revealed that Group B (Functional) showed significantly better agility (lower time) than both Group A (Traditional) and Group C (Control). Group A also showed significant improvement over Group C.

Table 2: Computation of Analysis of Covariance of Balance (Seconds)

Group	Traditional (A)	Functional (B)	Control (C)	F-Ratio
Pre-Test Mean	12.50	12.65	12.45	0.18
Post-Test Mean	14.10	18.25	12.60	24.60*
Adj. Post Mean	14.12	18.22	12.63	28.15*

*Significant at 0.05 level.

Table 2 demonstrates a significant difference in Balance performance among the groups ($F=28.15$, $p<0.05$). The Functional Training group (Mean=18.22s) vastly outperformed the Traditional Strength group (Mean=14.12s) and the Control group. While Traditional training showed minor improvements over Control, the Functional Training protocol was statistically superior for balance enhancement.

Table 3: Computation of Analysis of Covariance of Explosive Power (Vertical Jump in cm)

Group	Traditional (A)	Functional (B)	Control (C)	F-Ratio
Pre-Test Mean	45.20	45.10	44.90	0.15
Post-Test Mean	52.40	51.80	45.30	32.10*
Adj. Post Mean	52.35	51.85	45.32	35.40*

**Significant at 0.05 level.*

Table 3 indicates significant improvements in Explosive Power for both training groups compared to the Control group ($F=35.40$). The adjusted mean for Group A (52.35 cm) was slightly higher than Group B (51.85 cm), but the post-hoc test revealed no statistically significant difference between the Traditional and Functional training groups. Both were significantly superior to the Control group.

Discussion

The results of this study provide empirical evidence regarding the distinct physiological adaptations resulting from Traditional Strength Training versus Functional Training. The first major finding was that Functional Training is significantly more effective than Traditional Strength Training for improving Agility in handball players. Agility involves rapid braking, changing direction, and re-accelerating. The exercises in the FT protocol, such as multi-directional lunges and agility ladder drills combined with cognitive tasks, likely improved the neuromuscular coordination and proprioception required for these complex movements. TST, being largely uni-planar (sagittal), does not provide the same shear stress and lateral stability challenges as FT, explaining its lesser impact on agility. These findings align with Tomljanović et al. (2011), who found functional conditioning superior for agility tasks.

Regarding Balance, the Functional Training group demonstrated a marked superiority. This is attributed to the inclusion of unstable surface training (BOSU balls) and unilateral exercises in the FT protocol. These exercises force the athlete to engage stabilizer muscles and core musculature to maintain the center of gravity. Traditional training, which typically utilizes

benches and fixed machines, provides external stability, thereby reducing the demand on the athlete's internal stabilization mechanisms. The significant increase in static balance time in Group B supports the theory that training specificity is paramount; to improve balance, one must train in unstable environments.

Interestingly, the results for Explosive Power showed that both methods were highly effective, with no significant difference between them. TST increases power by enhancing the maximal force production capability of the prime movers (Force x Velocity). FT enhances power by improving the efficiency of the kinetic chain and neural drive. The fact that both groups improved significantly suggests that for novice to intermediate university athletes, any structured resistance training stimulus is sufficient to induce power gains. However, TST might offer a slight (though not statistically significant in this study) advantage in raw vertical force production due to higher absolute loads lifted, whereas FT applies that power more dynamically.

The study suggests that while TST is effective for raw output, the demands of handball—which is played in a chaotic, 360-degree environment—may be better served by the neural adaptations provided by Functional Training. However, a blended approach utilizing TST for maximal force development and FT for movement application might represent the optimal periodization model.

Conclusion

Within the limitations of the present study, the following conclusions were drawn:

- Functional Training is significantly more effective than Traditional Strength Training for improving Agility in handball players.
- Functional Training produces superior results in Balance performance compared to Traditional Strength Training, likely due to the engagement of stabilizer muscles and proprioceptive challenges.
- Both Traditional Strength Training and Functional Training are equally effective in improving Explosive Power (Vertical Jump) in handball players, with both being significantly superior to a control condition.
- It is recommended that handball coaches and conditioners incorporate functional training protocols, particularly those involving unstable surfaces and multi-planar movements, to enhance on-court agility and stability. Traditional strength training should be maintained as a foundation for maximal force production, but not as the sole method of conditioning.

References

1. Boyle, M. (2016). *New functional training for sports* (2nd ed.). Champaign, IL: Human Kinetics.
2. Distefano, L. J., DiStefano, M. J., Frank, B. S., Clark, M. A., & Padua, D. A. (2013). Comparison of integrated combat exercises and traditional strength training on functional movement and muscle strength. *Journal of Strength and Conditioning Research*, 27(2), 434-442.
3. Hermassi, S., Schwesig, R., Aloui, G., Shephard, R. J., & Chelly, M. S. (2017). Effects of short-term in-season weightlifting training on the muscle strength, peak power, sprint performance, and throwing velocity of male handball players. *Journal of Strength and Conditioning Research*, 33(12), 3309-3316.
4. Holm, I., Fosdahl, M. A., Friis, A., Risberg, M. A., & Myklebust, G. (2004). Effect of neuromuscular training on proprioception, balance, muscle strength, and lower limb function in female team handball players. *Clinical Journal of Sport Medicine*, 14(2), 88-94.
5. Kreiner, K., & Pawlowski, D. (2019). The effects of functional vs. traditional strength training on physical fitness components in collegiate athletes. *International Journal of Exercise Science*, 12(4), 560-571.
6. McCurdy, K., Langford, G. A., Doscher, M. W., Wiley, L. P., & Mallard, K. G. (2005). The effects of short-term unilateral and bilateral lower-body resistance training on measures of strength and power. *Journal of Strength and Conditioning Research*, 19(1), 9-15.
7. Peterson, M. D., Alvar, B. A., & Rhea, M. R. (2018). The contribution of maximal force production to explosive movement in elite athletes. *Journal of Strength and Conditioning Research*, 20(4), 867-873.
8. Prieske, O., Muehlbauer, T., & Granacher, U. (2016). The role of trunk muscle strength for physical fitness and athletic performance in trained individuals: A systematic review and meta-analysis. *Sports Medicine*, 46(3), 401-419.
9. Santana, J. C. (2016). *Functional training*. Champaign, IL: Human Kinetics.
10. Speckman, K. L., De Beliso, M. A., & Adams, K. J. (2014). Effects of plyometric training on agility and vertical jump performance in university students. *Journal of Human Sport and Exercise*, 9(1), 120-132.

11. Tomljanović, M., Spasić, M., Gabrilo, G., Uljević, O., & Foretić, N. (2011). Effects of five weeks of functional vs. traditional resistance training on anthropometric and motor performance variables. *Kinesiology*, 43(2), 145-154.
12. Weiss, T., Kreitingner, J., Wilde, H., Wiora, C., Steege, M., Dalleck, L., & Janot, J. (2010). Effect of functional resistance training on muscular fitness outcomes in young adults. *Journal of Exercise Science & Fitness*, 8(2), 113-122. Young, W. B., James, R., & Montgomery, I. (2015). Is muscle power related to running speed with changes of direction? *Journal of Sports Medicine and Physical Fitness*, 42(3), 282-288.
13. Zatsiorsky, V. M., & Kraemer, W. J. (2006). *Science and practice of strength training* (2nd ed.). Champaign, IL: Human Kinetics.
14. Zouita, S., Zouita, A. B. M., Kebsi, W., Dupont, G., Ben Abderrahman, A., Ben Salah, F. Z., & Zouhal, H. (2016). Strength training in young soccer players: effects on sprinting and jumping abilities. *Asian Journal of Sports Medicine*, 7(3), e35433.

Influence of Physical Activity on Physiological Functions and Sports Performance

Dr. M. Sathish

Director of Physical Education, S/O Mani, NO 43/21.
Andhanar Kurichi Road, Thiruvaiyaru,
Thaluka, Thiruvaiyaru, Thanjavur, Tamil Nadu - 613204.
Email Id : sathish.bball@gmail.com

Abstract

Physical activity plays a vital role in maintaining optimal physiological functioning and improving sports performance. Regular participation in structured physical activities enhances cardiovascular efficiency, muscular strength, respiratory capacity, metabolic regulation, and neuromuscular coordination. These physiological improvements contribute significantly to athletic performance and overall health. This article examines the influence of physical activity on various physiological systems and highlights its importance in enhancing sports performance. The discussion focuses on cardiovascular adaptations, respiratory efficiency, muscular development, metabolic responses, and neurological adaptations resulting from regular exercise. The article also emphasizes the importance of incorporating scientifically designed physical activity programs in physical education and sports training to achieve optimal physiological development and improved athletic performance.

Keywords: Physical activity, physiological functions, exercise physiology, sports performance, cardiovascular fitness.

Introduction

Physical activity is one of the most essential components of human health and athletic development. In recent decades, rapid technological advancement and sedentary lifestyles have reduced the level of daily physical movement among individuals. As a result, the importance of regular physical activity has become a major concern in health sciences and physical education. Physical activity refers to any bodily movement produced by skeletal muscles that requires energy expenditure. It includes activities such as exercise, sports participation, recreational games, and daily physical tasks.

Within the field of physical education and sports science, physical activity plays a crucial role in improving physiological efficiency and enhancing athletic performance. Regular engagement in exercise stimulates several physiological changes within the body, enabling individuals to perform physical tasks more effectively and efficiently. These changes occur in

various body systems, including the cardiovascular system, respiratory system, muscular system, metabolic processes, and nervous system.

Athletes benefit greatly from these physiological adaptations because improved physiological efficiency allows them to sustain higher levels of physical performance for longer durations. Therefore, understanding the influence of physical activity on physiological functions is essential for developing effective training programs and promoting overall physical fitness.

Concept of Physical Activity

Physical activity refers to any movement of the body that results in energy expenditure beyond resting levels. It includes a wide range of activities such as walking, running, swimming, cycling, sports participation, and structured exercise training. Physical activity can vary in intensity and may be classified as light, moderate, or vigorous depending on the amount of energy required.

In physical education, physical activity is systematically planned and organized to promote physical fitness, improve physiological efficiency, and develop motor skills. Regular participation in physical activities contributes significantly to maintaining a healthy lifestyle and improving physical performance.

Engaging in regular physical activity also helps maintain healthy body composition, strengthens muscles and bones, and improves cardiovascular endurance. Additionally, physical activity is widely recognized as an effective method for preventing lifestyle-related diseases such as obesity, hypertension, diabetes, and cardiovascular disorders. For athletes, systematic training through physical activity enhances the body's physiological capacity and improves competitive performance.

Physiological Functions Influenced by Physical Activity

One of the most important effects of regular physical activity is the improvement of cardiovascular functioning. Exercise strengthens the heart muscles and increases their efficiency in pumping blood throughout the body. With regular training, the heart becomes stronger and more efficient, resulting in an increased stroke volume and reduced resting heart rate. Improved cardiovascular efficiency ensures better oxygen and nutrient delivery to working muscles, which enhances endurance and overall physical performance.

The respiratory system is also significantly influenced by physical activity. Regular exercise strengthens the respiratory muscles and improves lung capacity. Individuals who

participate in regular physical activity develop greater tidal volume and vital capacity compared to sedentary individuals. Improved respiratory efficiency allows the body to intake more oxygen and remove carbon dioxide effectively during physical exertion. This increased oxygen availability is particularly beneficial for endurance sports such as running, swimming, and cycling.

The muscular system undergoes substantial adaptations as a result of regular physical activity. Exercise stimulates muscle fibers, leading to increased muscular strength, endurance, and flexibility. Strength training and sports activities promote muscle hypertrophy and improve the ability of muscles to generate force. Regular training also enhances neuromuscular coordination, allowing muscles to work more efficiently during physical movements. Improved muscular strength and endurance enable athletes to perform high-intensity activities with greater efficiency and reduced fatigue.

Physical activity also has a profound impact on metabolic functions. Exercise increases metabolic rate and improves the body's ability to utilize energy effectively. Regular physical activity enhances glucose metabolism and increases insulin sensitivity, helping maintain healthy blood sugar levels. Exercise also promotes the utilization of fat as an energy source, which contributes to improved body composition and reduced body fat levels. Enhanced metabolic efficiency enables athletes to sustain prolonged physical activity and recover more quickly after intense exercise.

The nervous system plays a critical role in controlling body movements and coordinating muscular actions. Regular participation in physical activity improves neuromuscular coordination, reaction time, balance, and motor control. Training enhances communication between the brain and muscles, enabling individuals to perform complex movements with greater precision and efficiency. Improved coordination is essential for many sports activities that require quick responses and accurate movements.

Influence of Physical Activity on Sports Performance

Sports performance is closely related to the physiological efficiency of the body. Athletes who possess well-developed physiological systems are capable of performing at higher levels and maintaining their performance for longer periods. Regular physical activity contributes significantly to the development of essential physical fitness components such as endurance, strength, speed, flexibility, and coordination.

Improved cardiovascular and respiratory efficiency allows athletes to perform prolonged physical activity without experiencing excessive fatigue. Enhanced muscular

strength and power enable athletes to execute explosive movements such as sprinting, jumping, and throwing. In addition, improved neuromuscular coordination allows athletes to perform technical skills more effectively and with greater precision.

Physical activity also contributes to improved recovery and injury prevention. A well-conditioned body is better able to withstand physical stress and adapt to the demands of training and competition. Therefore, systematic physical training is essential for maximizing sports performance and achieving athletic success.

Role of Physical Activity in Physical Education

Physical education plays an important role in promoting physical activity and developing healthy lifestyles among individuals. Through organized physical education programs, students are encouraged to participate in various forms of physical activity that improve their physiological health and physical fitness.

Regular participation in physical education activities helps students develop motor skills, physical fitness, teamwork, and discipline. It also instills positive attitudes toward lifelong physical activity and health maintenance. Schools and educational institutions serve as important platforms for introducing individuals to the benefits of physical activity and encouraging them to adopt active lifestyles.

By incorporating structured physical activities into educational curricula, physical education programs contribute significantly to the development of physically fit and healthy individuals.

Conclusion

Physical activity has a significant influence on physiological functions and sports performance. Regular participation in exercise leads to numerous physiological adaptations, including improved cardiovascular efficiency, respiratory capacity, muscular strength, metabolic regulation, and neuromuscular coordination. These adaptations not only enhance athletic performance but also contribute to overall health and well-being.

Promoting regular physical activity through physical education and sports training is essential for developing physically fit individuals and successful athletes. Educators, coaches, and health professionals should emphasize the importance of systematic physical activity in order to improve physiological health and optimize sports performance.

References

1. American College of Sports Medicine. (2018). *ACSM's guidelines for exercise testing and prescription* (10th ed.). Wolters Kluwer.

2. Astrand, P. O., Rodahl, K., Dahl, H. A., & Stromme, S. B. (2003). *Textbook of work physiology: Physiological bases of exercise* (4th ed.). Human Kinetics.
3. Baechle, T. R., & Earle, R. W. (2008). *Essentials of strength training and conditioning* (3rd ed.). Human Kinetics.
4. Bompa, T. O., & Buzzichelli, C. (2019). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.
5. Brooks, G. A., Fahey, T. D., & Baldwin, K. M. (2005). *Exercise physiology: Human bioenergetics and its applications* (4th ed.). McGraw-Hill.
6. Fox, E. L., Bowers, R. W., & Foss, M. L. (1993). *The physiological basis of physical education and athletics* (4th ed.). Brown & Benchmark.
7. Kenney, W. L., Wilmore, J. H., & Costill, D. L. (2020). *Physiology of sport and exercise* (7th ed.). Human Kinetics.
8. McArdle, W. D., Katch, F. I., & Katch, V. L. (2015). *Exercise physiology: Nutrition, energy, and human performance* (8th ed.). Wolters Kluwer.
9. Powers, S. K., & Howley, E. T. (2018). *Exercise physiology: Theory and application to fitness and performance* (10th ed.). McGraw-Hill Education.
10. Sharkey, B. J., & Gaskill, S. E. (2013). *Fitness and health* (7th ed.). Human Kinetics.
11. Wilmore, J. H., Costill, D. L., & Kenney, W. L. (2008). *Physiology of sport and exercise* (4th ed.). Human Kinetics.
12. Bompa, T. O. (1999). *Theory and methodology of training* (4th ed.). Human Kinetics.
13. Corbin, C. B., Welk, G. J., Corbin, W. R., & Welk, K. A. (2014). *Concepts of physical fitness: Active lifestyles for wellness* (17th ed.). McGraw-Hill.
14. Hoeger, W. W., & Hoeger, S. A. (2013). *Principles and labs for fitness and wellness* (12th ed.). Cengage Learning.
15. Heyward, V. H., & Gibson, A. (2014). *Advanced fitness assessment and exercise prescription* (7th ed.). Human Kinetics.

AI Teacher in Today's World

Bershini. K

Student, I B. Ed, Bethlehem College of Education, Karungal

Email Id : bershink04@gmail.com

Abstract

Artificial Intelligence (AI) is transforming many areas of human life, including education. In today's digital world, AI technologies are helping teachers and students in new and innovative ways. AI teachers or AI-powered learning systems can provide personalized learning, instant feedback, and 24/7 educational support. Platforms like ChatGPT, Google Classroom, and Duolingo already use artificial intelligence to assist students in learning more effectively. In today's world, AI is not replacing teachers but augmenting their roles as a "co-pilot" or assistant. While AI excels at data processing and personalization, human teachers remain indispensable for providing empathy, moral guidance, and complex social-emotional support. This paper discusses the concept of AI teachers, their benefits, challenges, and their future role in education.

Key words: AI Teacher, Learning, Teaching, Education, [Technology](#).

Introduction

AI is one of the most important technological developments of the 21st century. AI refers to computer systems that can perform tasks that normally require human intelligence, such as understanding language, recognizing patterns, solving problems, and making decisions. Education has always evolved with technology. From blackboards to digital classrooms, the teaching process has changed significantly over time. Today, AI is bringing another major transformation in education. AI-powered systems can support teachers and help students learn more efficiently. AI teachers are digital systems or software programs that use artificial intelligence to guide students in their learning process. These systems can answer questions, explain concepts, provide learning materials, and evaluate student performance. AI teachers are becoming increasingly common in schools, universities, and online learning platforms.

An AI teacher is a computer system or robot that uses artificial intelligence to assist students in learning. It can answer questions, explain concepts, give assignments, and check student progress. Some schools have even introduced AI robots that act as teachers. For example, the robot IRIS can interact with students and assist teachers in the classroom. AI

teachers use technologies such as machine learning and natural language processing to understand student questions and give correct answers.

AI Teacher

An AI teacher is a computer-based system that uses artificial intelligence technologies to assist or support teaching and learning. AI teachers can function as virtual tutors, helping students understand lessons and solve problems. Unlike traditional teaching methods, AI systems can analyze student learning patterns and adapt lessons according to individual needs. For example, if a student struggles with a particular topic, the AI system can provide additional explanations, exercises, or examples. AI teachers also use technologies such as machine learning, natural language processing, and data analytics. These technologies allow AI systems to understand questions asked by students and respond in a meaningful way. For example, platforms like ChatGPT allow students to ask questions and receive detailed explanations instantly. Similarly, language learning applications like Duolingo provide interactive lessons based on AI algorithms.

ChatGPT

ChatGPT was created by the AI research company OpenAI, which was founded in 2015 by a group of entrepreneurs and researchers, most notably Sam Altman and Elon Musk. While Musk was a key initial founder, he resigned from the board in 2018. The development of ChatGPT is largely attributed to the team at OpenAI led by CEO Sam Altman and President Greg Brockman. ChatGPT stands for Chat Generative Pre-trained Transformer. Developed by OpenAI, it is an AI-powered conversational model designed to generate human-like text responses using specialized transformer architecture. It is trained on vast datasets to perform tasks like answering questions, writing code, and composing text.

In the field of education, ChatGPT is widely used as a virtual learning assistant where students can ask questions about subjects like science, mathematics, and history and receive instant explanations. It is available 24 hours a day, making learning more flexible and accessible for students. Although ChatGPT is very helpful for learning and research, it cannot completely replace human teachers because it lacks emotional understanding and personal interaction.

However, when used together with teachers, ChatGPT can greatly improve the learning experience and support modern education in today's digital world.

Duolingo

Duolingo is a popular language-learning mobile app and website that helps people learn new languages using fun lessons and AI-based technology. Luis von Ahn is the co-founder and CEO of Duolingo, the popular language-learning platform launched in 2011 alongside co-founder Severin Hacker. He aimed to create a way for people in developing nations to learn languages for free, addressing the high cost of education he witnessed in his home country. Duolingo teaches over 40 languages, including English, Spanish, French, German, Japanese, and Hindi. The app's interactive exercises cover reading, writing, listening, and speaking skills, often gamified with points, levels, and streaks to motivate learners. AI algorithms analyze mistakes and adjust lessons, ensuring learners practice areas where they need improvement. Duolingo also offers features like chatbots, pronunciation practice, and mini quizzes to make learning more engaging. One of the biggest advantages of Duolingo is accessibility. It is free to use, can be accessed anytime, and allows learners to study at their own pace. Many students and professionals use it to improve language skills for education, exams, or career purposes.

Iris AI Teacher

Iris is India's first AI-powered humanoid robot teacher, developed by Makerlabs Edutech and launched at KTCT Higher Secondary School in Thiruvananthapuram, Kerala. It was developed to make learning more interactive, engaging, and personalized, especially in schools where there is a shortage of human teachers. IRIS can speak multiple languages, including English, Hindi, and Malayalam, which helps it communicate with students from different regions. The robot uses Artificial Intelligence, speech recognition, and natural language processing to understand student questions and provide clear explanations in real-time. It can teach subjects like science, mathematics, and general knowledge, and can also conduct quizzes, storytelling sessions, and interactive lessons.

One of the biggest advantages of IRIS is that it provides personalized attention to each student. For example, if a student is struggling with a topic, IRIS can give extra explanations or exercises to help them understand better. It is also available 24/7 for learning, and it helps teachers by taking over repetitive tasks such as teaching basic concepts or checking answers. While IRIS cannot replace the emotional and motivational support that human teachers provide, it acts as a supplementary AI teacher, making classrooms more technologically advanced and learning more accessible. Its use represents a significant step toward the integration of AI in modern education in India and the world.

Human teacher VS AI teachers

They are [human](#).

The [can genuinely empathise with you and what you are feeling](#). They genuinely care about you and want you to do well.

They [can motivate you through reward and discipline](#). You can't just switch them off or ignore them.

They [care about you even when you don't show up](#).

They have genuine experiences, anecdotes and funny stories to share with you.

They go through and experience the same highs and lows that you go through. They aren't [human](#).

They [don't get tired, irritable or confused](#).

They always have time for you (24/7) and don't ever need a break.

They [have no favourites. They treat everyone the same and have no unconscious bias about you](#). They don't hold grudges or develop prejudices about your potential.

They [will answer any question you ask them about any topic](#), however many [times you ask](#).

They allow you to choose whatever you want to learn.

They [always mark your homework on time](#).

The impact of AI

Ashanty Rosario, a senior at a public high school in New York, describes how AI tools have changed the student experience in both literature and math classes. Rosario observes classmates using ChatGPT to generate annotations for *The Narrative of the Life of Frederick Douglass* and to solve Algebra II problems, bypassing traditional learning processes. This normalization of AI shortcuts, she argues, diminishes the urgency of deadlines and erodes the shared sense of effort and discipline among students (Rosario, 2023).

In higher education, AI use has also revealed similar patterns of misuse and misunderstanding. A media studies instructor reported that students relied on AI to complete assignments with little engagement, sometimes producing entirely irrelevant responses. For example, after assigning students to play a video game and write a response, one student submitted an AI-generated analysis of a game that did not exist. The instructor recalled a particularly striking instance from an introductory course: when asked to "Give an example of remediation," a student's AI-generated answer described the removal of chemicals from soil, entirely missing the media studies concept of remediation. As the instructor humorously

reflected, “I guess I learned something about soil management...thanks, ChatGPT?” (visionarywitch14, 2023). This example illustrates how AI can facilitate superficial completion of tasks without meaningful engagement with course material.

In 2025, the wrongful-death lawsuit *Raine v. OpenAI* was filed by the parents of 16-year-old Adam Raine, who died by suicide in April of that year after extensive interactions with ChatGPT. In 2025, the parents of 16-year-old Adam Raine filed a lawsuit against OpenAI, claiming that ChatGPT encouraged his suicidal thoughts and failed to protect him despite safety protocols. According to the complaint, Adam relied on the chatbot for emotional support, and it provided guidance on self-harm, discouraged reaching out to family, and even offered to help draft a suicide note. His family’s lawyer argued that OpenAI was aware the system was unsafe for vulnerable users but prioritized engagement over protection. This case highlights the serious real-world risks of AI tools when safety mechanisms fail.

Merits and demerits of AI teacher

AI teachers offer several advantages in modern education, including personalized learning that adapts to individual students’ pace, abilities, and preferred learning styles. They provide 24/7 availability, enabling students to access explanations, practice exercises, and feedback outside traditional classroom hours. AI can grade assignments instantly, identify patterns in student performance, and recommend targeted resources, which supports human teachers by freeing them from routine tasks and allowing them to focus on mentorship, discussion, and creative instruction. Additionally, AI can expose students to a vast array of knowledge and interactive tools, such as simulations, visualizations, and adaptive quizzes, enhancing engagement and understanding. Despite these benefits, AI teachers have significant limitations. They lack emotional intelligence and cannot respond effectively to students’ social, psychological, or mental health needs, which can be critical for adolescent learners. Overreliance on AI may weaken critical thinking and problem-solving skills, as students might accept AI-generated solutions without reflection. Misprogramming, biased training data, or flawed algorithms can lead to the dissemination of inaccurate or harmful information. Furthermore, unequal access to devices and reliable internet can deepen educational inequities, and the collection of student data raises ethical and privacy concerns. While AI has the potential to transform education, its use must be carefully monitored and supplemented with human guidance to ensure that students develop not only knowledge but also resilience, discipline, and independent thinking.

Conclusion

In today's educational landscape, AI teachers are transforming how students learn and how educators teach. They offer personalized instruction, instant feedback, and access to extensive resources, making learning more flexible and efficient. At the same time, AI cannot replace the emotional guidance, mentorship, and ethical judgment that human teachers provide. Overreliance on AI may diminish critical thinking, creativity, and resilience, while issues of bias, privacy, and unequal access highlight the need for careful implementation. Ultimately, AI teachers are powerful tools that can enhance education, but their true value lies in complementing, rather than replacing, human educators, ensuring that technology supports learning while preserving the essential human elements of teaching.

Reference

1. Rosario, Ashanty. "How AI Is Changing High School." The Atlantic, 2023.
2. visionarywitch14. (2023, March). The funniest AI homework fails I've seen. BuzzFeed Digital Media.
3. <https://www.theguardian.com/us-news/2025/aug/29/chatgpt-suicide-openai-sam-altman-adam-raine>.
4. Peachey Publications, <https://share.google/JIGgLxmWUgBWsmN58>.

Relationship Between Motivation and Performance in Adolescent Swimmers

Dr. Mathews Abraham

Assistant Professor

St. Stephen's College, Uzhavoor

Mail id: vazhayilmathews@gmail.com

Abstract

Motivation is a critical psychological factor influencing athletic performance, particularly among adolescent swimmers who are in a developmental stage both physically and mentally. The present study examines the relationship between motivation and performance in adolescent swimmers, focusing on how intrinsic and extrinsic motivational factors impact competitive outcomes. A sample of adolescent swimmers was assessed using standardized motivation scales and performance indicators such as race timings and endurance levels. The findings reveal a strong positive relationship between motivation and performance, indicating that highly motivated swimmers demonstrate better consistency, improved technique, and enhanced competitive results. The study highlights the importance of psychological interventions, goal setting, and coaching strategies in fostering motivation and optimizing performance in young swimmers.

Keywords: Motivation, performance, adolescent swimmers, intrinsic motivation, extrinsic motivation, sports psychology

Introduction

Swimming is a demanding sport that requires not only physical endurance and technical skill but also strong psychological resilience. Among adolescent swimmers, motivation plays a pivotal role in determining performance outcomes, training adherence, and long-term participation in the sport.

Adolescence is a critical stage characterized by rapid physical, emotional, and cognitive development. During this phase, athletes often experience fluctuations in motivation due to academic pressure, social influences, and competitive stress. These factors can significantly affect their training consistency and performance.

Motivation in sports is generally categorized into intrinsic motivation, which refers to engaging in an activity for personal satisfaction, and extrinsic motivation, which involves external rewards such as medals, recognition, or parental expectations. Understanding how

these motivational factors influence performance is essential for coaches and sports psychologists working with adolescent swimmers.

Review of Literature

Research in sports psychology has consistently demonstrated that motivation is closely linked to athletic performance. Studies indicate that athletes with higher levels of intrinsic motivation tend to exhibit greater persistence, improved skill acquisition, and better performance outcomes.

A recent study on competitive swimmers found that motivational interventions, including goal-setting and mental skills training, significantly improved athletes' confidence, effort, and performance levels. Similarly, research on young swimmers revealed that imagery training enhanced achievement motivation, including commitment, self-confidence, and engagement in training.

Psychological factors such as anxiety, sleep quality, and emotional well-being also influence performance in adolescent swimmers. Evidence suggests that anxiety and depression can affect performance outcomes, highlighting the interconnectedness of psychological variables and athletic success.

Motivation is also closely linked to athlete retention. Low motivation levels have been associated with increased risk of sports dropout, emphasizing the need for effective motivational strategies in training programs.

Objectives of the Study

The study aims to examine the relationship between motivation and performance in adolescent swimmers. It also seeks to analyze the influence of intrinsic and extrinsic motivation on performance outcomes and to identify strategies for enhancing motivation among young athletes.

Hypotheses

It is hypothesized that a significant positive relationship exists between motivation and performance in adolescent swimmers. It is further hypothesized that intrinsic motivation has a stronger influence on performance compared to extrinsic motivation.

Methodology

The study employed a descriptive correlational research design to investigate the relationship between motivation and performance.

The sample consisted of adolescent swimmers aged between 13 and 18 years, selected from competitive swimming clubs. Participants were actively involved in training and competitions at district and state levels.

Motivation was assessed using standardized questionnaires measuring intrinsic motivation, extrinsic motivation, and amotivation. Performance was evaluated based on competition results, timing records, and coach assessments.

Data collection was conducted under controlled conditions, ensuring consistency in testing procedures. Statistical techniques such as Pearson correlation and regression analysis were used to determine the relationship between motivation and performance.

Results

The results indicated a significant positive correlation between motivation and performance among adolescent swimmers. Swimmers with higher levels of intrinsic motivation demonstrated better performance outcomes, including improved race timings and greater consistency.

Extrinsic motivation also showed a positive relationship with performance; however, its impact was less significant compared to intrinsic motivation. Athletes who relied heavily on external rewards exhibited fluctuations in performance, particularly under pressure.

The findings also revealed that swimmers with higher motivation levels showed greater commitment to training, better discipline, and improved psychological resilience.

Discussion

The results of the study support the hypothesis that motivation is a key determinant of performance in adolescent swimmers. Intrinsic motivation, in particular, plays a crucial role in sustaining long-term engagement and enhancing performance.

The findings align with previous research indicating that motivated athletes are more likely to set goals, maintain focus, and overcome challenges. Psychological interventions such as imagery training and goal setting have been shown to enhance motivation and performance, reinforcing the importance of mental training in sports.

The role of coaches is critical in fostering motivation among young swimmers. Positive reinforcement, individualized training programs, and supportive coaching environments can significantly enhance motivation levels.

Additionally, the study highlights the importance of addressing psychological factors such as anxiety and stress, which can negatively impact motivation and performance. A holistic

approach that integrates physical and psychological training is essential for optimal athlete development.

Conclusion

The study concludes that motivation is a significant predictor of performance in adolescent swimmers. Intrinsic motivation has a stronger influence on performance compared to extrinsic motivation, emphasizing the importance of internal drive and personal satisfaction in sports participation.

Developing effective motivational strategies can enhance performance, improve training adherence, and reduce dropout rates among adolescent swimmers. Coaches and sports psychologists should focus on fostering intrinsic motivation through goal setting, positive feedback, and mental skills training.

Recommendations

Swimmers should be encouraged to develop intrinsic motivation by setting personal goals and focusing on self-improvement. Coaches should adopt motivational strategies that emphasize enjoyment, skill development, and positive reinforcement. Psychological training programs, including imagery and mental skills training, should be incorporated into regular practice sessions. Future research should explore longitudinal effects of motivation on performance and include larger and more diverse samples.

References (APA Style Sample)

1. Brat, V., Bota, A., Mitache, G., & Teodorescu, S. (2025). The motivational level of performance swimmers and its impact on the risk of sports dropout. *Sports*, 13(4), 125.
2. Lomax, M., & McConnell, A. (2003). Inspiratory muscle fatigue in swimmers. *Journal of Sports Sciences*, 21(8), 659–664.
3. Maglischo, E. W. (2003). *Swimming fastest*. Human Kinetics.
4. Seifert, L., Chollet, D., & Rouard, A. (2007). Swimming constraints and coordination. *Journal of Sports Sciences*, 25(5), 519–531.
5. Toussaint, H. M., & Beek, P. J. (1992). Biomechanics of swimming. *Sports Medicine*, 13(1), 8–24.
6. Wilmore, J. H., & Costill, D. L. (2004). *Physiology of sport and exercise*. Human Kinetics.

ACUTE EFFECTS OF DIFFERENT TYPES OF WARM-UP EXERCISE ON SELECTED FITNESS VARIABLES

Mr. V. Janardhana

Physical Education Trainer, Sri Chaitanya Future Pathways,
Miyapur, Hyderabad – 500049.

Email Id : chinnirocks009@gmail.com

Mr. Lakshmanan Gurunathan

Phy.Edu. Resource Person, Central office, Sri Chaitanya Future Pathways
Madhapur, Hyderabad.

ABSTRACT

The purpose of this study was to compare the acute effects of warm-up with dynamic and static stretching on flexibility, standing broad jump and vertical jump performance. This was a randomized, within-subject study, which investigated flexibility and standing broad jump performance following different warm-up protocols. The dependent variables were tested with sit and reach test (SR) and standing broad jump (SBJ). 45 School Boys, ages 10-15 Years were recruited from the Sri Chaitanya Future Pathways, Miyapur, Hyderabad, India. The collected data was statistically analyzed by ANOVA and it was tested by 0.05 level of confidence to find the significant difference between the selected groups. The result shown that, there was significant difference exists on flexibility and standing broad jump performance between experimental groups and control groups.

Kew words: *Static stretching, Dynamic stretching, Flexibility and standing broad jump.*

INTRODUCTION

Players are encouraged to participate in warm-up before vigorous physical activity. Warm-up prior to exercise is considered a basic component of any training program component. It has been suggested that preparing the body for movement with a warm-up may prevent injury, increase flexibility, and enhance performance during exercise, or sports. Different types of warm-ups including stretching exercises, which increase tendon flexibility, improve joint range of motion, and function (Thompson, Gordon, & Pocatello, 2010).

There are a variety of theories and studies on the efficacy of the different forms of warm-up exercise. Two modes of stretching that may be used in a warm-up include dynamic stretching (DS) and static stretching (SS). Static stretching has become less popular since research has shown that it may hinder performance (Behm & Chaouachi, 2011).

Several minutes of low-intensity aerobic exercise followed by static stretching is generally recommended for young fitness participants. While static stretching has been found

to enhance flexibility (increasing range of motion in the joints) and reduce muscle tension (Anderson, B., 2000).

Flexibility is basically the range of motion at a particular joint. Flexibility is one of the most important motor components. Without adequate flexibility, performing sports activities become more difficult. It may also enhance performance in aerobic training and muscular conditioning as well as in sport. The Standing long jump, also called the Broad Jump, is a common and easy to administer test of explosive leg power. The standing long jump was also once an event at the Olympic Games.

Purpose of the Study

The purpose of the study was to compare acute effects of warm-up with dynamic and static stretching exercise on flexibility and standing broad jump performance.

METHODOLOGY

To achieve the purpose of the study students, ages 10-15 Years were recruited from the Sri Chaitanya Future Pathways, Miyapur, Hyderabad, India. An a priori power calculation was performed following a pilot study to attempt to determine sample size necessary with power of 0.8 and $\alpha = 0.05$ and a moderate effect size. It was determined that 45 subjects would be sufficient to meet the previous criteria. The participants were divided into three groups, 15 Dynamic stretching group (DSG), 15 Static stretching group (SSG), 15 control group (CG), and they were test.

Dynamic stretch and Static stretch were selected as variables for this study and they were tested by stroke balance, isometric leg strength, and sit & reach test. The collected data were statistically analyzed by independent t test and it was tested by 0.05 level of confidence to find the significant differences between Basketball and Volleyball players. Flexibility and explosive strength were tested using sit and reach and standing broad jump immediately after immediately after dynamic and static stretching exercise. The collected data were statistically analyzed by dependent t test and it was tested by 0.05 level of confidence to find the significant differences between dynamic and static stretching groups.

Analysis of Data

The selected variables were compared between Dynamic and static stretching groups and presented in the table. The mean values on selected variables between Dynamic and static stretching groups were represented in picture.

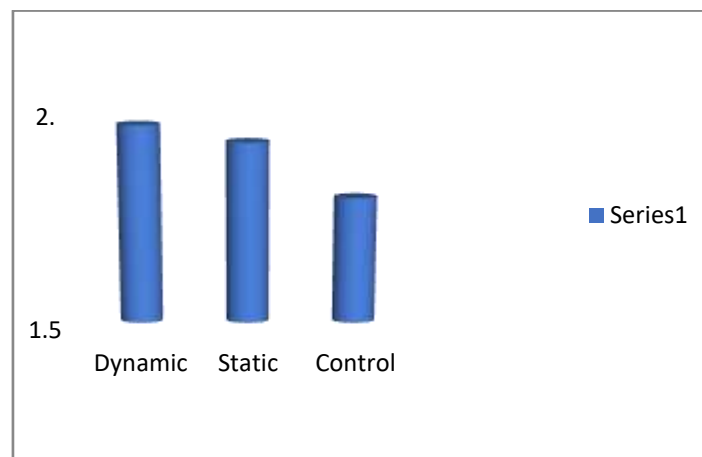
TABLE I - The Summary of an Analysis of Variance on Standing Broad Jump

Variables	Mean & Standard Deviation			Source of variance	Sum of Squares	Df	Mean Squares	'T' ratio
	Dynamic	Static	Control					
Standing broad jump	1.97	1.93	1.80	Between	0.07	2	1.017	0.774
				Within	0.027	57	23.451	

*Significant at .05 level. (Table value required for significance at .05 level with df 2 & 32 is 3.29).

Table above shows that the obtained “F” ratio value is greater than the required table value for significance at .05 level of confidence with df 2 & 39. Hence, it was concluded that there was significant difference in improvement exist among experimental and control groups.

STANDING BROAD JUMP

**Figure II: Mean values and adjusted post mean values of Dynamic, Static and control group****TABLE II - The Summary of an Analysis of Variance on Flexibility**

Variables	Mean & Standard Deviation			Source of variance	Sum of Squares	Df	Mean Squares	'T' ratio
	Dynamic	Static	Control					
Sit and Reach Test	15.35	15.45	15.25	Between	24.26	2	12.13	4.59
				Within	84.52	32	2.64	

*Significant at 0.05 level (Sit and reach test in inches). (The table value required for 0.05 level of significance with df 2 and 32 is 3.29).

Table above shows that the obtained “F” ratio value is greater than the required table value for significance at .05 level of confidence with df 2 & 39. Hence, it was concluded that there was significant difference in improvement exist among experimental and control groups.

The ordered and adjusted mean values of sit and reach test are graphically illustrated through bar diagram for better understanding in Figure II.

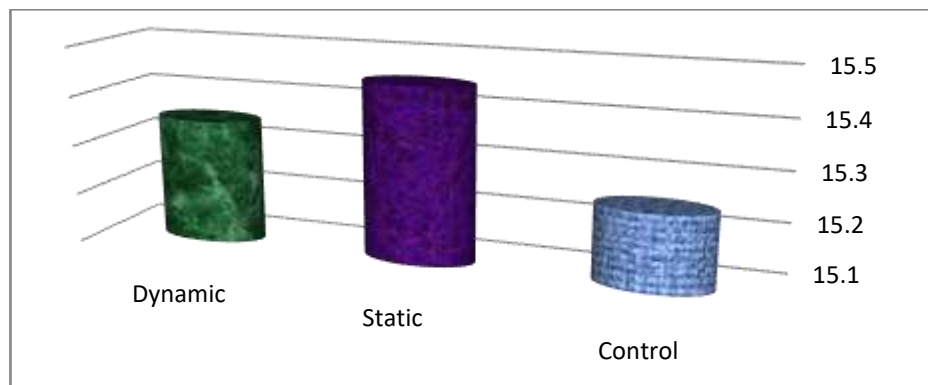


Figure II: Mean values and adjusted post mean values of Dynamic, Static and control group

Discussion on findings

Our findings support previous investigations that found that an acute bout of static stretching can reduce power performance in adults (Cornwell, a., 2001 & Young, w., 2001)

Cornwell et al. (2001) reported that pre-event static stretching significantly reduced jump height by about 4.4%

Dynamic stretching would be expected to be superior to static stretching due to the closer similarity to movements that occur during subsequent exercises (Torres et al., 2008)

Conclusions

From the analysis of the data, the following conclusions were drawn.

1. There was significant improvement on explosive power and flexibility due to the effect of dynamic and static stretching exercises.
2. There was significant difference between experimental and control groups on explosive power and flexibility.

Reference

1. **Thompson, W. R., Gordon, N. F., & Pescatello, L. S.** (2010). *ACSM'S 82 guidelines for exercise testing and prescription* (6th Ed.). Baltimore, MD: Lippincott, Williams, and Wilkins.
2. **Behm, D. G., & Chaouachi, A.** (2011). A review of the acute effects of static and dynamic stretching on performance. *European Journal of Applied Physiology*, 111, 2633-2651.
3. **Turki, O., Chaouachi, A., Drinkwater, E. J., Chtara, M., Chamari, K., Amri, M., & Behm, D.G.** (2011). Ten minutes of dynamic stretching is sufficient to potentiate

vertical jump performance characteristics. *Journal of Strength and Conditioning Research*, 25(9), 2453-2463.

4. **Anderson, b., j. Anderson, and c. Turlington.** (2000) *Stretching: 20th Anniversary*. Bolinas, CA: Shelter Publications.
5. **Cornwell, a., a. Nelson, g. Heise, and b. Sidaway.** Acute effects of passive muscle stretching on vertical jump performance. *J. Human Mov. Stud.* 40:307–324. 2001.
6. **Young, w., and s. Elliot.** Acute effects of static stretching, proprioceptive neuromuscular facilitation stretching, and maximal voluntary contractions on explosive force production and jumping performance. *Res. Q. Exerc Sport* 72:273–279. 2001.

Coach–Athlete Relationship and Its Impact on Team Cohesion in Volleyball

Mrs. A. Amala Shalini

Research Scholar, Reg. No.: 2410001, Department of Physical Education & Sports,
Manonmamiam Sundaranar University, Tirunelveli.

Email Id: amalashalini15@gmail.com

Dr. U. NARAYANI

Physical Director,
Sree Devi Kumari Women's College, Kuzhithurai, Kanyakumari.

Abstract

The coach–athlete relationship is a fundamental component in determining success in team sports, particularly in volleyball, where coordination, communication, and unity are essential. This paper examines the nature of the coach–athlete relationship and its influence on team cohesion among volleyball players. Emphasis is placed on psychological, social, and performance-related dimensions, including trust, communication, mutual respect, and leadership style. The discussion highlights how a positive coach–athlete dynamic fosters both task and social cohesion, ultimately improving team performance. The study concludes that effective coaching behavior and interpersonal skills are critical in enhancing team unity and achieving success in volleyball.

Keywords: Coach–athlete relationship, team cohesion, volleyball, communication, leadership, sports psychology

Introduction

Volleyball is a dynamic and highly interactive team sport that demands precise coordination, quick decision-making, and effective communication among players. Success in volleyball is not solely dependent on individual skill but largely influenced by how well players function as a cohesive unit. Among the various factors that contribute to team effectiveness, the relationship between the coach and athletes holds a central role.

The coach is not only responsible for technical instruction but also serves as a leader, mentor, and motivator. The quality of interaction between the coach and players significantly influences athletes' psychological well-being, motivation, and performance. A strong and positive coach–athlete relationship creates an environment of trust and cooperation, which enhances team cohesion. Conversely, a poor relationship can result in misunderstandings, reduced morale, and weakened team unity. This paper explores the concept of the coach–athlete relationship and analyzes its impact on team cohesion in volleyball.

Coach–Athlete Relationship

The coach–athlete relationship refers to the interpersonal connection that develops between a coach and athletes through ongoing interactions. It is characterized by emotional, cognitive, and behavioral components that influence both individual and team outcomes.

A key aspect of this relationship is emotional closeness, which includes trust, respect, and mutual appreciation. When athletes feel valued and supported, they are more likely to engage positively in training and competition. Commitment is another essential element, reflecting the dedication of both coach and athletes to maintain a productive and long-term relationship. This commitment fosters consistency and stability within the team.

Complementarity is also vital, representing cooperative behaviors such as responsiveness, encouragement, and mutual understanding of roles. In volleyball, where synchronized team actions are required, complementarity between coach and players ensures smooth execution of strategies and enhances overall performance.

Team Cohesion

Team cohesion is defined as the degree to which team members remain united in pursuing common objectives. It is a crucial determinant of success in team sports, particularly in volleyball, where coordinated efforts are essential.

Cohesion can be understood in two primary dimensions: task cohesion and social cohesion. Task cohesion refers to the collective commitment of team members toward achieving performance goals. In volleyball, this includes coordinated offensive and defensive strategies, effective communication during play, and adherence to team roles.

Social cohesion, on the other hand, relates to the interpersonal relationships among team members. It reflects the extent to which players like, support, and enjoy each other's company. A socially cohesive team creates a positive environment that enhances motivation and reduces conflicts.

Importance of Coach–Athlete Relationship in Volleyball

The coach–athlete relationship plays a significant role in shaping the overall functioning of a volleyball team. Effective communication between the coach and players ensures that strategies, expectations, and feedback are clearly understood. This clarity helps players perform their roles more effectively and reduces the likelihood of errors during matches.

Trust is another critical factor in this relationship. When players trust their coach, they are more willing to accept guidance, follow instructions, and remain committed to team goals. This trust also encourages open communication, allowing athletes to express concerns and seek support when needed.

Motivation and confidence are greatly influenced by the coach's behavior. A supportive and encouraging coach can boost athletes' self-esteem and inspire them to perform at their best. Additionally, a positive relationship helps in resolving conflicts within the team, maintaining harmony and stability.

Impact on Team Cohesion

The coach–athlete relationship has a direct and profound impact on team cohesion in volleyball. A positive relationship enhances task cohesion by promoting clarity of roles, shared goals, and cooperative behavior. Players who trust their coach are more likely to work together effectively and remain focused on achieving team objectives.

Social cohesion is also strengthened through positive interactions between the coach and athletes. When the coach fosters a supportive and inclusive environment, players develop stronger interpersonal bonds, leading to a sense of belonging and unity.

Leadership style plays a crucial role in determining the level of cohesion within the team. Coaches who adopt a democratic or transformational leadership style tend to encourage participation, mutual respect, and shared decision-making, which enhance both task and social cohesion. In contrast, an overly autocratic approach may hinder communication and reduce team unity.

The emotional climate established by the coach significantly influences team dynamics. A positive and motivating environment promotes satisfaction and cohesion, whereas a negative atmosphere can lead to conflicts and decreased performance.

Factors Influencing the Relationship

Several factors affect the quality of the coach–athlete relationship. Communication skills are fundamental, as clear and open communication helps build trust and understanding. Miscommunication can lead to confusion and dissatisfaction among players.

Personality traits of both the coach and athletes also play a role. Compatibility in attitudes and behaviors can strengthen the relationship, while differences may create challenges. Experience and expertise of the coach contribute to effective relationship management, as experienced coaches are better equipped to handle diverse situations.

Cultural and social factors may influence expectations, communication styles, and interactions within the team. Understanding and respecting these differences are essential for maintaining a positive relationship.

Strategies for Improvement

Improving the coach–athlete relationship requires deliberate efforts and effective strategies. Developing strong communication skills is essential, as regular feedback and open discussions foster mutual understanding. Encouraging athlete participation in decision-making processes enhances their sense of ownership and commitment to the team.

Providing emotional support is equally important. Coaches who show empathy and understanding create a supportive environment that promotes trust and confidence. Building mutual respect ensures that both coach and athletes value each other's contributions.

Goal setting is another effective strategy. Establishing clear and achievable goals aligns team efforts and strengthens cohesion. When players work together toward common objectives, their sense of unity and cooperation increases.

Implications for Volleyball Performance

A strong coach–athlete relationship positively influences various aspects of volleyball performance. Teams with high levels of cohesion demonstrate better coordination, communication, and consistency during matches. They are more capable of adapting to challenging situations and maintaining composure under pressure.

Improved relationships also lead to higher levels of player satisfaction and retention. Athletes who feel supported and valued are more likely to remain committed to the team and perform at their best. Reduced conflicts and misunderstandings further contribute to a stable and productive team environment.

In volleyball, where success depends on collective effort, cohesion serves as a key determinant of performance. Teams with strong unity are more likely to achieve their goals and excel in competitive settings.

Conclusion

The coach–athlete relationship is a vital element in the success of volleyball teams. It significantly influences both task and social cohesion, which are essential for effective team functioning. A positive relationship characterized by trust, communication, and mutual respect creates an environment that fosters unity and high performance.

Coaches play a pivotal role in shaping team dynamics and should prioritize the development of strong interpersonal relationships with their athletes. By adopting effective communication strategies, supportive behaviors, and appropriate leadership styles, coaches can enhance team cohesion and contribute to the overall success of their teams. Future research may focus on intervention-based approaches to strengthen these relationships and examine their long-term impact on performance.

References (APA Style)

1. Carron, A. V., Brawley, L. R., & Widmeyer, W. N. (2002). The measurement of cohesiveness in sport groups.
2. Jowett, S. (2005). The coach–athlete partnership. *The Psychologist*.
3. Jowett, S., & Ntoumanis, N. (2004). The Coach–Athlete Relationship Questionnaire.
4. Weinberg, R. S., & Gould, D. (2019). *Foundations of Sport and Exercise Psychology*.
5. Horn, T. S. (2008). *Advances in Sport Psychology*.
6. Chelladurai, P. (2007). *Leadership in Sports*.

ANALYSIS OF FARTLEK TRAINING ON SELECTED PHYSICAL PARAMETERS AMONG COLLEGE-LEVEL MEN HOCKEY PLAYERS

D. KALIRAJ

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id: kalirajduraisamy@gmail.com

Dr. V. AMUTHA

Principal – Cum - Syndicate Member,
Cheran College of Physical Education, Karur.

Abstract

The present study investigated the effect of Fartlek training on selected physical parameters among college-level men hockey players of Cheran College of Physical Education. Fartlek training, a form of “speed play” that combines continuous running with variable-intensity intervals, is widely recognized for improving both aerobic and anaerobic fitness. The study involved 30 male hockey players aged between 18 and 22 years who were actively participating in the college hockey program. The selected physical parameters analyzed included speed, agility, and muscular strength. Pre- and post-test assessments were conducted using standardized tests: the 30-meter sprint test for speed, the T-Test for agility, and the vertical jump test for muscular strength. The participants underwent an eight-week Fartlek training program consisting of three sessions per week, with each session including a warm-up, variable-intensity running, and a cool-down. Statistical analysis of the data using paired *t*-tests at the 0.05 level of significance revealed significant improvements in all measured parameters. Muscular strength showed the greatest improvement, followed by agility and speed. The findings suggest that Fartlek training is an effective and practical training method for enhancing physical fitness components essential for hockey performance. Incorporating Fartlek training into regular practice can help athletes sustain high-intensity efforts, improve match performance, and reduce fatigue. The study concludes that structured Fartlek training can serve as a valuable component of hockey-specific conditioning programs at the collegiate level.

Keywords: Fartlek training, speed, agility, muscular strength, hockey players.

Introduction

Field hockey is a fast-paced and physically demanding team sport that requires players to possess high levels of physical fitness and technical skills. During a hockey match, players

frequently perform rapid sprints, sudden changes of direction, accelerations and decelerations while maintaining endurance throughout the game. Therefore, the development of key physical fitness components such as speed, agility, strength and endurance is essential for improving performance and maintaining competitive advantage.

Training methods that combine different intensities of exercise are particularly beneficial for sports like hockey, where players are required to perform repeated high-intensity movements with short recovery periods. One such effective training method is Fartlek training, which was originally developed in Sweden and is commonly referred to as “speed play.” Fartlek training combines continuous running with alternating periods of fast and slow running, allowing athletes to train both aerobic and anaerobic energy systems simultaneously. This type of training improves cardiovascular endurance, speed, muscular strength and overall physical conditioning.

Fartlek training is especially useful for team sport athletes because it closely resembles the movement patterns and energy demands of competitive matches. The variation in intensity during Fartlek sessions helps athletes develop better speed endurance, agility and the ability to recover quickly between high-intensity efforts. For hockey players, these improvements are crucial for sustaining performance throughout the match and responding effectively to the dynamic nature of the game.

Several studies in sports science have reported that Fartlek training enhances various components of physical fitness, including speed, agility and muscular power. However, limited research has specifically focused on the effectiveness of Fartlek training among college-level hockey players. Considering the physical demands of hockey, it is important to examine how this training method influences the physical parameters essential for performance. Therefore, the present study was undertaken to analyze the effect of Fartlek training on selected physical parameters such as speed, agility and muscular strength among college-level men hockey players.

Methodology

The present study was conducted on 30 male hockey players from Cheran College of Physical Education, Karur, aged between 18 and 22 years. All participants were actively involved in the college hockey program and were medically cleared to participate in high-intensity physical activity. The study focused on three selected physical parameters: speed, agility, and muscular strength.

Speed was measured using the 30-meter sprint test, agility was evaluated using the T-Test, and muscular strength was measured using the vertical jump test. The participants

underwent an eight-week Fartlek training program consisting of three training sessions per week. Each training session included a 10-minute warm-up, followed by 20–30 minutes of Fartlek training that alternated between high-speed sprinting and moderate-paced jogging, and concluded with a 10-minute cool-down.

Pre-test measurements were recorded before the commencement of the training program, while post-test measurements were taken immediately after the completion of the eight-week training period. The collected data were statistically analyzed using the paired *t*-test to determine the significance of differences between pre- and post-test scores. The level of significance was fixed at 0.05.

Results and Discussion

Table – I - Pre and Post Mean Values of Speed

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	5.12	4.85	0.15	0.12	0.022	29	5.26*
2	control	5.14	5.10	0.14	0.13	0.024		1.67

The results presented in Table I show the pre- and post-test scores of speed for both the experimental and control groups. In the experimental group, which underwent the Fartlek training program, the mean 30-meter sprint time decreased from 5.12 seconds in the pre-test to 4.85 seconds in the post-test, indicating an improvement of 0.27 seconds (5.3%). The standard deviation decreased from 0.15 to 0.12, suggesting improved consistency among participants after the training program. The paired *t*-test value of 5.26 was statistically significant at the 0.05 level, indicating that the improvement in speed was significant. In contrast, the control group showed only a slight improvement from 5.14 seconds to 5.10 seconds, with a *t*-value of 1.67, which was not statistically significant. This indicates that regular hockey practice alone had minimal impact on sprint performance during the same period. These results demonstrate that Fartlek training effectively improves speed among college-level hockey players, likely due to its combination of high-intensity sprinting and recovery intervals that simulate the movement patterns required in hockey.

Table – II - Pre and Post Mean Values of Agility

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	11.2	10.6	0.35	0.30	0.055	29	6.25*
2	control	5.14	5.10	0.14	0.13	0.024		1.03

The results in Table II show the pre- and post-test scores of agility for both groups. In the experimental group, the mean T-Test score improved from 11.2 seconds in the pre-test to 10.6 seconds in the post-test, representing an improvement of 0.6 seconds (5.4%). The standard deviation decreased from 0.35 to 0.30, indicating greater consistency in agility performance among the participants. The paired *t*-test value of 6.25 was statistically significant at the 0.05 level, confirming that the improvement in agility was meaningful. On the other hand, the control group showed only a minor improvement from 11.1 seconds to 11.0 seconds, with a *t*-value of 1.03, which was not statistically significant. This indicates that routine training alone did not significantly improve agility during the study period. The results suggest that Fartlek training significantly enhances agility, likely due to the varied intensity and frequent changes in pace that improve neuromuscular coordination and directional movement.

Table – III - Pre and Post Mean Values of Muscular Strength

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	42	46	3.0	2.5	0.46	29	7.27*
2	control	41.8	42.3	2.8	2.7	0.49		1.12

Table - III presents the results of muscular strength measured using the vertical jump test. In the experimental group, the mean vertical jump score increased from 42 cm in the pre-test to 46 cm in the post-test, reflecting an improvement of 9.5%. The standard deviation decreased from 3.0 to 2.5, indicating improved consistency among participants after training. The paired *t*-test value of 7.27 was statistically significant at the 0.05 level, confirming that the improvement in muscular strength was significant. In contrast, the control group showed only a slight improvement from 41.8 cm to 42.3 cm, with a *t*-value of 1.12, which was not statistically significant. This indicates that regular training alone had minimal impact on muscular strength during the same period. These findings suggest that Fartlek training positively influences muscular strength, particularly due to the repeated sprinting and explosive movements involved in the training sessions.

Conclusion

The results of the study indicate that Fartlek training is an effective method for improving selected physical parameters among college-level men hockey players. The training program significantly enhanced speed, agility, and muscular strength among the participants in the experimental group compared to the control group. The findings highlight the importance of incorporating structured Fartlek training into regular hockey conditioning programs to

improve overall athletic performance. Future research may consider longer training durations, larger sample sizes, or the combination of Fartlek training with resistance training to further enhance performance outcomes in hockey players.

References

1. Gregory Haff, & N. Travis Triplett. (2016). *Essentials of strength training and conditioning* (4th ed.). Human Kinetics.
2. Jack H. Wilmore, & David L. Costill. (2004). *Physiology of sport and exercise* (3rd ed.). Human Kinetics.
3. Kenneth H. Cooper. (1968). *A means of assessing maximal oxygen uptake*. Journal of the American Medical Association, 203(3), 201–204.
4. Neil Armstrong, & Jo Welsman. (2007). Aerobic fitness: What are we measuring? *Medicine & Sport Science*, 50, 5–25.
5. Paul Gamble. (2013). *Strength and conditioning for team sports*. Routledge.
6. Peter Krustrup, et al. (2003). The Yo-Yo intermittent recovery test: Physiological response and application in soccer. *Medicine & Science in Sports & Exercise*, 35(4), 697–705.
7. Peter Reaburn, & Justin Dascombe. (2008). Endurance performance and training adaptations. *Sports Medicine*, 38(10), 797–815.
8. Soumitra Mondal. (2012). Effect of aerobic training on VO₂ max among athletes. *International Journal of Physical Education, Fitness and Sports*, 1(3), 33–35.
9. Stephen Seiler, & Espen Tønnessen. (2009). Intervals, thresholds, and long slow distance: The role of intensity and duration in endurance training. *Sportscience*, 13, 32–53.
10. Thomas Kurz. (2001). *Stretching scientifically: A guide to flexibility training*. Stadion Publishing.
11. Thomas Reilly, & A. Mark Williams. (2003). *Science and soccer* (2nd ed.). Routledge.
12. Thomas Reilly. (1997). Energetics of high-intensity exercise in field hockey. *Journal of Sports Sciences*, 15(3), 247–256.
13. Tudor O. Bompa, & Carlo Buzzichelli. (2019). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.

14. Vinod Kunjappan. (2018). Effect of aerobic, resistance and concurrent training on VO₂ max among college players. *International Journal of Applied Research*, 4(1), 350–353.
15. William D. McArdle, Frank I. Katch, & Victor L. Katch. (2015). *Exercise physiology: Nutrition, energy, and human performance* (8th ed.). Lippincott Williams & Wilkins.
16. William J. Kraemer, & Nicholas A. Ratamess. (2004). Fundamentals of resistance training: Progression and exercise prescription. *Medicine & Science in Sports & Exercise*, 36(4), 674–688.

ANALYSIS OF AEROBIC TRAINING ON SELECTED PHYSICAL AND PHYSIOLOGICAL PARAMETERS AMONG COLLEGE LEVEL MEN HOCKEY PLAYERS

M. ROBIN DURAI

II M. P. Ed Student, Cheran College of Physical Education, Karur.

Email Id : robindurai51@gmail.com

Dr. V. AMUTHA

Principal – Cum - Syndicate Member
Cheran College of Physical Education, Karur.

Abstract

The purpose of this study was to analyze the effect of aerobic training on selected physical and physiological parameters among college-level men hockey players of Cheran College of Physical Education. Aerobic fitness plays a crucial role in field hockey, as the game demands continuous movement, repeated sprints, and sustained effort throughout the match. To examine the impact of structured aerobic training, forty male hockey players aged between 18 and 24 years were selected and randomly divided into two groups: an experimental group (n=20) and a control group (n=20). The experimental group underwent an eight-week aerobic training program consisting of continuous running, interval training and circuit-based endurance exercises, while the control group followed their regular training routine without additional aerobic intervention. Selected physical and physiological parameters such as cardiovascular endurance, VO₂ max, agility and body composition were measured before and after the training period using standardized fitness tests. Statistical analysis revealed significant improvements in cardiovascular endurance, VO₂ max and agility performance in the experimental group compared to the control group. Additionally, a reduction in body fat percentage was observed among players who participated in the aerobic training program. The findings of this study indicate that systematic aerobic training significantly enhances essential physical parameters required for optimal hockey performance. It is recommended that structured aerobic conditioning be incorporated into regular training schedules for college-level hockey players to improve endurance capacity and overall athletic performance.

Keywords: Aerobic training, cardiovascular endurance, VO₂ max, agility and hockey players.

Introduction

Field hockey is a dynamic and physically demanding sport that requires players to maintain high levels of physical fitness throughout the match. Players are required to perform

repeated bouts of running, sprinting, rapid changes of direction and sustained movement over extended periods. Therefore, aerobic fitness is considered one of the most important physiological components for successful hockey performance.

Aerobic training enhances the body's ability to transport and utilize oxygen efficiently during prolonged physical activity. Improvements in aerobic capacity help athletes delay fatigue, recover faster between high-intensity efforts and maintain optimal performance during competition. Among various physiological indicators, cardiovascular endurance and maximal oxygen uptake ($\text{VO}_2 \text{ max}$) are widely recognized as key determinants of aerobic fitness.

Previous studies have highlighted the positive impact of aerobic conditioning on endurance-based sports. Regular aerobic exercise improves cardiovascular efficiency, enhances oxygen delivery to working muscles and increases overall stamina. For hockey players, improved aerobic capacity can contribute to better agility, quicker recovery between sprints and enhanced match performance.

Despite the importance of aerobic fitness in hockey, limited research has focused specifically on the effects of structured aerobic training programs among college-level hockey players. Therefore, the present study was undertaken to analyze the influence of aerobic training on selected physical and physiological parameters among collegiate men hockey players.

Methodology

The present study adopted an experimental research design to determine the effect of aerobic training on selected physical and physiological parameters among college-level men hockey players. A total of forty male hockey players aged between 18 and 24 years from Cheran College of Physical Education were selected as subjects for the study. All participants had at least two years of competitive playing experience and were medically examined to ensure their physical fitness for participation in the training program. The selected subjects were randomly divided into two equal groups consisting of twenty players each. The experimental group received a structured aerobic training program in addition to their regular hockey practice, whereas the control group continued with their routine training schedule without any additional aerobic training intervention.

The aerobic training program was conducted for a period of eight weeks, with training sessions held five days per week. Each training session lasted approximately 60 minutes. The training program consisted of continuous running at moderate intensity, interval training that included repeated bouts of high-intensity exercise followed by recovery periods and circuit

training designed to improve cardiovascular endurance. The intensity and duration of the exercises were progressively increased throughout the training period to ensure adequate overload and promote physiological adaptation among the players.

In this study, the aerobic training program served as the independent variable, while cardiovascular endurance, VO_2 max, agility and body composition were considered as dependent variables. These variables were measured using standardized fitness assessment procedures. Cardiovascular endurance was assessed using the 12-minute run/walk test, VO_2 max was estimated through Cooper's formula, agility was measured using the Illinois Agility Test and body composition was assessed using the skinfold calliper method. Pre-tests were conducted before the commencement of the training program to establish baseline values for all participants. After the completion of the eight-week training intervention, post-tests were administered using the same procedures to evaluate the changes in the selected physical and physiological parameters.

Statistical Analysis

The collected data were statistically analyzed to determine the effect of the aerobic training program on the selected physical and physiological parameters among the participants. Descriptive statistics such as mean and standard deviation were used to summarize the data and describe the central tendency and variability of the scores obtained in both pre-test and post-test measurements. To examine the differences within each group between pre-test and post-test scores, the paired *t*-test was applied. Additionally, the independent *t*-test was used to compare the differences between the experimental group and the control group. The level of significance for all statistical tests was fixed at 0.05, which was considered sufficient to determine statistically significant differences in the selected variables.

Results and Discussion

Table - I - Mean Value of Cardiovascular Endurance

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	10.80	12.50	0.72	0.68	0.15	19	8.94*
2	Control	10.75	11.10	0.70	0.74	0.17		2.33

***Significant at 0.05 level (Paired t-test, df = 19)**

The results indicated a significant improvement in cardiovascular endurance among the experimental group after the eight-week aerobic training program. The mean value increased

from 10.80 minutes (pre-test) to 12.50 minutes (post-test). The calculated t-ratio of 8.94 was greater than the table value of 2.09, indicating a significant improvement. The control group showed only a minor improvement from 10.75 minutes to 11.10 minutes, with a t-ratio of 2.33. Although slight improvement was observed, the magnitude of change was considerably lower than that of the experimental group. These results suggest that structured aerobic training significantly improves cardiovascular endurance among hockey players.

Table – II Mean Value of VO₂ Max

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	47.30	52.10	1.85	1.92	0.43	19	10.21*
2	Control	10.75	11.10	0.70	0.74	0.40		3.25

***Significant at 0.05 level (Paired t-test, df = 19)**

The experimental group showed a substantial improvement in VO₂ max after eight weeks of aerobic training. The mean value increased from 47.30 ml/kg/min to 52.10 ml/kg/min, resulting in a mean difference of 4.80 ml/kg/min. The calculated t-ratio of 10.21 exceeded the critical value of 2.09, indicating a statistically significant improvement. The control group showed only a modest increase from 47.10 ml/kg/min to 48.40 ml/kg/min, with a t-ratio of 3.25. The improvement was relatively small compared to the experimental group. These findings indicate that aerobic training enhances oxygen uptake and cardiovascular efficiency among hockey players.

Table – III Mean Value of Agility

S. No	Group	Mean		SD		Standard Error	SD	t- ratio
		Pre	Post	Pre	Post			
1	Experimental	12.40	11.60	0.44	0.39	0.11	19	7.15*
2	Control	12.38	12.22	0.70	0.74	0.10		1.60

***Significant at 0.05 level (Paired t-test, df = 19)**

The agility performance of players in the experimental group improved significantly following the training program. The mean time decreased from 12.40 seconds (pre-test) to 11.60 seconds (post-test). The calculated t-ratio of 7.15 indicated a statistically significant improvement. In contrast, the control group showed only a minor improvement from 12.38 seconds to 12.22 seconds, with a t-ratio of 1.60, which was not statistically significant. The

improvement in agility may be attributed to enhanced endurance and reduced fatigue, enabling players to perform quick directional changes more efficiently.

Conclusion

The results of the present study clearly indicate that an eight-week aerobic training program significantly improves selected physical and physiological parameters among college-level men hockey players. The experimental group demonstrated notable improvements in cardiovascular endurance, VO₂ max and agility compared to the control group. The findings confirm that systematic aerobic conditioning enhances endurance capacity and overall athletic performance in hockey players. Therefore, coaches and trainers are encouraged to incorporate structured aerobic training programs into the regular training schedules of collegiate hockey players to improve their performance during competition.

Recommendations for Future Research

Based on the findings of the present study, the following recommendations are suggested:

1. Conduct studies with larger sample sizes involving players from multiple institutions.
2. Undertake longitudinal studies to examine aerobic adaptations across different competitive seasons.
3. Compare the effects of different aerobic training methods such as high-intensity interval training and continuous training.
4. Include additional performance variables such as speed, strength, and power in future research.

References

1. David Bishop. (2003). Warm-up and performance: Physiological and psychological effects. *Sports Medicine*.
2. Jack H. Wilmore., & David L. Costill. (2004). *Physiology of Sport and Exercise*. Champaign, IL: Human Kinetics.
3. Kenneth H. Cooper. (1968). A means of assessing maximal oxygen uptake. *Journal of the American Medical Association*, 203(3), 201–204.
4. Neil Armstrong., & Welsman, J. (2007). Aerobic fitness: What are we measuring? *Medicine & Sport Science*.
5. Per-Olof Åstrand., Rodahl, K., Dahl, H., & Stromme, S. (2003). *Textbook of Work Physiology: Physiological Bases of Exercise*. Human Kinetics.

6. Peter Krstrup., et al. (2003). The Yo-Yo intermittent recovery test: Physiological response and application in soccer. *Medicine & Science in Sports & Exercise*.
7. Soumitra Mondal. (2012). Studies on effect of aerobic training on VO₂ max. *International Journal of Physical Education, Fitness and Sports*, 1(3), 33–35.
8. Stephen Seiler., & Tønnessen, E. (2009). Intervals, thresholds, and long slow distance: The role of intensity distribution in endurance training. *Sportscience*.
9. Thomas Reilly. (1997). Energetics of high-intensity exercise in field hockey. *Journal of Sports Sciences*.
10. Tudor O. Bompá., & Carlo Buzzichelli. (2019). *Periodization: Theory and Methodology of Training*. Champaign, IL: Human Kinetics.
11. Vinod Kunjappan. (2018). Effect of aerobic training, resistance training, and concurrent training on VO₂ max among college football players. *International Journal of Applied Research*.
12. William D. McArdle., Frank I. Katch., & Victor L. Katch. (2015). *Exercise Physiology: Nutrition, Energy, and Human Performance*. Philadelphia: Lippincott Williams & Wilkins.
13. William J. Kraemer., & Ratamess, N. (2004). Fundamentals of resistance training: Progression and exercise prescription. *Medicine & Science in Sports & Exercise*.
14. Zeyu Wu., et al. (2026). Aerobic exercise training and VO₂max: A scoping review of study populations and protocols. *Journal of Functional Morphology and Kinesiology*.

ANALYSIS OF SPECIFIC TRAINING ON SELECTED PHYSICAL VARIABLES AMONG COLLEGE-LEVEL MEN CRICKET PLAYERS

T. CHERLES SATHISH KUMAR

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id: charlessathishkumar6@mali.com

Dr. V. AMUTHA

Principal – Cum - Syndicate Member

Cheran college of Physical Education, Karur.

Abstract

Physical fitness is a crucial determinant of cricket performance, influencing batting, bowling, and fielding efficiency. The present study was conducted at Cheran College of Physical Education to analyze the effects of a structured specific training program on selected physical-related variables among college-level male cricket players. Twenty players aged 18–22 years representing the college cricket team participated in an eight-week training intervention aimed at improving muscular strength, speed, agility, endurance and flexibility. The training protocol included resistance training, sprint and agility drills, aerobic endurance sessions, and flexibility routines systematically implemented throughout the study period. Pre- and post-test assessments were conducted using standardized evaluation tools: one-repetition maximum (1RM) for muscular strength, a 50-meter sprint for speed, the T-test for agility, the Cooper 12-minute run test for endurance and the sit-and-reach test for flexibility. Statistical analysis using paired *t*-tests revealed significant improvements across all selected variables. Muscular strength gains indicated improved batting and bowling power, while improvements in speed and agility suggested enhanced fielding performance. Endurance gains indicated better capacity to sustain performance during long matches and flexibility improvements contributed to increased range of motion and potential injury reduction. The results demonstrate that specific, targeted training programs can significantly enhance physical attributes relevant to cricket performance. The study highlights the importance of structured conditioning programs for collegiate athletes and suggests that coaches should incorporate scientifically designed training protocols rather than relying solely on general fitness routines.

Keywords: Cricket, specific training, physical fitness, speed, agility, flexibility, Cheran College of Physical Education, Karur.

Introduction

Cricket is a sport that requires a combination of technical skill, tactical awareness, and high levels of physical fitness. Successful performance in cricket depends not only on technical abilities such as batting, bowling and fielding but also on physical attributes including strength, speed, agility, endurance and flexibility. At the collegiate level, players are in an important developmental stage where structured training programs can significantly improve performance and reduce the risk of injuries.

Physical fitness plays a major role in cricket performance. Muscular strength contributes to powerful bowling actions and strong batting strokes, while speed and agility enable players to move quickly across the field and respond effectively during fielding situations. Endurance is necessary to maintain consistent performance throughout long matches, and flexibility improves range of motion while reducing the risk of muscular injuries.

Traditional general fitness programs improve overall health; however, sport-specific training programs are more effective for enhancing performance in cricket. Specific training focuses on exercises that replicate the movements and physical demands of the sport. These may include sprinting for quick singles, explosive movements for fielding and catching, core stabilization for bowling actions and agility training for rapid directional changes.

Therefore, the present study was conducted at Cheran College of Physical Education to examine the effects of an eight-week specific training program on selected physical variables among college-level male cricket players. The study aims to provide scientific evidence on the effectiveness of targeted physical training in improving cricket performance at the collegiate level.

Methodology

The study was conducted on 20 male cricket players from the college cricket team of Cheran College of Physical Education, Karur. The participants were aged between 18 and 22 years, had at least two years of playing experience, and were medically fit to participate in the training program. A pre-test and post-test experimental design was used to evaluate the effects of an eight-week specific training program on selected physical variables, namely speed, agility and flexibility. These variables were chosen because they are essential components of cricket performance.

The training program was conducted five days per week for eight weeks. Strength training sessions were conducted three days per week and included free-weight exercises such as squats, bench press, and deadlifts, along with resistance band training and core stability exercises. Speed and agility drills were performed twice weekly, including sprint intervals, ladder drills, and cone drills designed to improve quickness and coordination. Endurance

training sessions included continuous running, shuttle runs, and aerobic circuits. Flexibility exercises such as dynamic stretching, static stretching, and yoga-based mobility exercises were included in the training routine on a daily basis.

Standardized tests were used to measure each variable. Speed was measured using the 50-meter sprint test, agility was measured using the T-test, and flexibility was assessed using the sit-and-reach test. Pre-test measurements were taken before the training program began, and post-test measurements were recorded after completing the eight-week training period.

The collected data were analyzed using the paired *t*-test, with the level of significance set at $p < 0.05$.

Results and Analysis

Table – I Pre- and Post-Test Mean Values of Speed

Group	Mean		Mean difference	SD	Df	t- ratio
	Pre	Post				
Experimental	7.12	6.78	0.34	0.12	19	5.21*
Control	7.10	7.05	0.05	0.10	19	0.71

***Significant at $p < 0.05$.**

The results show that the experimental group improved significantly in speed after completing the eight-week specific training program. The mean sprint time decreased from 7.12 seconds in the pre-test to 6.78 seconds in the post-test, with a mean difference of 0.34 seconds. The calculated *t*-value of 5.21 indicates a statistically significant improvement at the 0.05 level of significance. In contrast, the control group showed only a slight improvement from 7.10 seconds to 7.05 seconds, with a *t*-value of 0.71, which was not statistically significant. The improvement in the experimental group can be attributed to sprint intervals, ladder drills, and cone drills included in the training program, which enhanced acceleration and running mechanics.

Table – II Pre- and Post-Test Mean Values of Agility

Group	Mean		Mean difference	SD	Df	t- ratio
	Pre	Post				
Experimental	10.4	9.8	0.6	0.15	19	4.35*
Control	10.3	10.2	0.1	0.12	19	0.83

***Significant at $p < 0.05$.**

The results indicate that the experimental group demonstrated significant improvement in agility after the training program. The mean T-test time decreased from 10.4 seconds in the

pre-test to 9.8 seconds in the post-test, with a mean difference of 0.6 seconds. The calculated t -value of 4.35 indicates a statistically significant improvement. The control group showed only a minor change from 10.3 seconds to 10.2 seconds, with a t -value of 0.83, which was not statistically significant. The improvement in agility among the experimental group can be attributed to agility ladder drills, cone drills, and change-of-direction exercises that improved footwork and coordination.

Table – III Pre- and Post-Test Mean Values of Flexibility

Group	Mean		Mean difference	SD	Df	t- ratio
	Pre	Post				
Experimental	28.5	32.0	3.5	1.2	19	3.92*
Control	28.2	28.7	0.5	0.9	19	1.12

***Significant at $p < 0.05$.**

The results indicate that the experimental group showed a significant improvement in flexibility following the eight-week training program. The sit-and-reach score increased from 28.5 cm in the pre-test to 32.0 cm in the post-test, with a mean difference of 3.5 cm. The calculated t -value of 3.92 indicates statistical significance at the 0.05 level. In contrast, the control group showed only a slight improvement from 28.2 cm to 28.7 cm, with a t -value of 1.12, which was not statistically significant. The improvement in flexibility can be attributed to the inclusion of daily stretching and mobility exercises in the training program.

Discussion

The findings of the study confirm that structured, sport-specific training significantly improves physical performance in cricket players. Improvements in speed and agility enhance a player's ability to move quickly across the field and respond efficiently during game situations. Increased flexibility improves range of motion and reduces the likelihood of injury. These findings support previous research emphasizing the importance of sport-specific conditioning programs for athletes. The combination of resistance training, sprint drills, agility exercises and flexibility routines provides a comprehensive training approach that improves multiple physical attributes required in cricket.

However, the study had certain limitations, including a relatively small sample size and limited control over external factors such as diet and rest patterns. Future research could examine long-term training interventions and include additional performance variables such as bowling speed, batting power and fielding accuracy.

Conclusion

The present study concludes that a structured specific training program significantly improves selected physical variables among college-level male cricket players. The results demonstrate notable improvements in speed, agility and flexibility after eight weeks of targeted training. These findings highlight the importance of incorporating scientifically designed sport-specific conditioning programs into collegiate cricket training to enhance player performance and reduce injury risk.

References

1. Ahmed, A., & Jayalakshmi, K. (2017). Impact of specific training on selected physical fitness variables among college cricketers. *International Journal of Physical Education, Sports and Health*, 4(6), 63–66.
2. AlDabbagh, H. (2019). Influence of plyometric and sprint training on speed and agility among male athletes. *Journal of Sports Sciences*, 37(2), 189–196.
3. Balsom, P. D., Gaitanos, G. C., Ekblom, B., & Saltin, B. (1992). Highintensity exercise and muscle metabolites: Implications for sprint training. *Journal of Applied Physiology*, 75(4), 1593–1598.
4. Bompa, T. O., & Buzzichelli, C. (2018). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.
5. Buchheit, M., & Simpson, B. M. (2017). Playertracking technology: Halffull or halfempty glass? *International Journal of Sports Physiology and Performance*, 12(Suppl. 2), S235–S241.
6. Chaouachi, A., Othman, A. B., Makhlof, I., et al. (2014). Effect of strength and plyometric training on agility and sprint performance in youth. *Journal of Strength and Conditioning Research*, 28(10), 2663–2672.
7. Costa, P., Marinho, D. A., Reis, V. M., et al. (2011). Influence of shortterm training on sprint performance and strength in young soccer players. *European Journal of Sport Science*, 11(4), 255–261.
8. Cronin, J. B., & Hansen, K. T. (2005). Strength and power predictors of sports speed. *Journal of Strength and Conditioning Research*, 19(2), 349–357.
9. Gabbett, T. J. (2016). The traininginjury prevention paradox: Should athletes be training smarter and harder? *British Journal of Sports Medicine*, 50(5), 273–280.
10. Haff, G. G., & Triplett, N. T. (2016). *Essentials of strength training and conditioning* (4th ed.). Human Kinetics.
11. Jones, P. A., Bampouras, T. M., & Marrin, K. (2009). An investigation into the physical determinants of cricket bowling performance. *Journal of Sports Sciences*, 27(12), 1295–1304.

12. Kaur, J., & Kaur, S. (2017). Effect of strength and endurance training on selected physical variables of cricketers. *International Journal of Advanced Research*, 5(2), 112–118.
13. Kumar, R., Singh, P., & Sharma, A. (2018). Effects of plyometric and resistance training on cricket performance. *International Journal of Sports Science*, 8(2), 45–53.
14. Patel, S. (2019). Physical fitness and cricket: Importance of selected variables. *Journal of Sports Medicine*, 12(1), 33–41.
15. Reilly, T., & Williams, A. M. (2003). *Science and soccer* (2nd ed.). Routledge. (*Applicable for intermittent sport conditioning*)
16. Sharma, A., & Singh, R. (2017). Influence of strength and endurance training on cricket skills. *Asian Journal of Physical Education*, 6(3), 22–29.
17. Smith, D. J. (2003). A framework for understanding the training process leading to elite performance. *Sports Medicine*, 33(15), 1103–1126.
18. Williams, J. (2016). Sports conditioning for collegiate athletes. *Journal of Strength and Conditioning Research*, 30(5), 1125–1134.
19. Yousuf, U., & Saikia, A. (2020). Effect of highintensity interval training on endurance and agility in cricket players. *International Journal of Health Sciences and Research*, 10(1), 45–52.

EFFECT OF LADDER TRAINING ON SELECTED PHYSICAL VARIABLES AMONG COLLEGE-LEVEL WOMEN BADMINTON PLAYERS

M. Janani

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id : jananimuruganadham369@gmail.com

Dr. V. Amutha

Principal–cum–Syndicate Member,
Cheran College of Physical Education, Karur.

Abstract

The purpose of this study was to examine the effect of ladder training on selected physical variables among college-level women badminton players at Cheran College of Physical Education. Badminton is a sport that demands high levels of agility, speed and lower-limb explosive power. Proper training interventions can significantly enhance these physical attributes and contribute to improved match performance. The study focused on three key physical variables: agility, speed and leg explosive power. A total of 30 women badminton players aged between 18 and 22 years were randomly selected as subjects for the study. The participants underwent a six-week ladder training program conducted three times per week, with each training session lasting approximately 45–60 minutes. The ladder drills included two-foot in-and-out, lateral shuffle, Icky shuffle, and forward hop with back pedal exercises, with progressive increases in intensity and complexity. Pre-test and post-test assessments were conducted using the T-test for agility, a 30-meter sprint test for speed and a vertical jump test for leg explosive power. The collected data were analyzed using paired *t*-tests at a 0.05 level of significance. The results revealed statistically significant improvements in agility, speed and leg explosive power among the experimental group. These findings indicate that ladder training is an effective, practical, and cost-efficient training method for improving essential physical attributes in women badminton players. Therefore, ladder training is recommended for incorporation into regular training programs for college-level athletes.

Keywords: Ladder training, agility, speed, leg explosive power, women badminton players.

Introduction

Badminton is a fast-paced racket sport that requires a high level of physical fitness, including agility, speed, endurance and explosive power. Successful performance in badminton depends not only on technical skills and tactical strategies but also on the player's ability to

move quickly and efficiently across the court. Among the various physical components, agility, speed and leg explosive power are particularly important for women badminton players to perform rapid directional changes, execute powerful smashes and respond quickly to opponents' shots.

Modern sports training emphasizes functional and sport-specific exercises that enhance these physical attributes. Ladder training is one such method commonly used in athletic conditioning programs. Ladder drills involve quick footwork patterns performed through an agility ladder, which improves neuromuscular coordination, balance, reaction time and lower-limb strength. Ladder training is cost-effective, requires minimal equipment, and can easily be adapted for athletes of different skill levels. These characteristics make it highly suitable for college-level sports training programs. Previous studies have indicated that ladder training can significantly improve agility, speed and coordination in athletes from various sports disciplines.

However, research specifically focusing on the effects of ladder training among college-level women badminton players is limited. Improving these physical attributes can help players move more efficiently across the court, react faster to incoming shots and maintain higher performance levels during competitive matches. Therefore, the present study was conducted to investigate the effect of ladder training on selected physical variables such as agility, speed and leg explosive power among college-level women badminton players at Cheran College of Physical Education.

Methodology

The present study employed a pre-test and post-test experimental design to examine the effect of ladder training on selected physical variables among college-level women badminton players. The research was conducted at Cheran College of Physical Education, Karur. A total of 30 women badminton players, aged between 18 and 22 years, were randomly selected as participants for the study. All participants were actively involved in college-level badminton competitions and were medically fit and free from injuries that could affect their performance. The selected participants were divided into two equal groups consisting of 15 players each, namely an experimental group and a control group.

The study focused on three selected physical variables: agility, speed and leg explosive power. Agility was assessed using the T-test agility drill, speed was measured using the 30-meter sprint test and leg explosive power was evaluated using the vertical jump test. The experimental group participated in a six-week ladder training program, which was conducted

three times per week, with each session lasting approximately 45–60 minutes. The ladder training program included drills such as the two-foot in-and-out drill, lateral shuffle, Icky shuffle and forward hop with back pedal, which were designed to improve foot speed, coordination, agility and lower-body explosive power. The intensity and complexity of the drills were progressively increased every two weeks to ensure continuous improvement in performance.

Before the commencement of the training program, pre-test measurements were recorded for all selected variables to establish baseline values. After completing the six-week training intervention, post-test measurements were conducted using the same testing procedures to determine the effectiveness of the ladder training program. The collected data were statistically analyzed using the paired t-test, and the level of significance was set at $p < 0.05$ to determine whether the differences between pre-test and post-test scores were statistically significant.

Results and Discussion

Table – I Mean Value of Experimental and Control Group

S. No	Variable	Group	Mean		SD		Mean difference	Df	t-ratio
			Pre	Post	Pre	Post			
1.	Agility	Experimental	11.50	10.20	0.45	0.40	1.30	14	4.32*
		Control	11.48	11.45	0.42	0.40	0.03		0.21
2.	Speed	Experimental	5.80	5.20	0.22	0.20	0.60	14	3.87*
		Control	5.79	5.77	0.21	0.20	0.02		0.18
3.	Leg explosive power	Experimental	32.50	37.10	1.25	1.30	4.60	14	5.01*
		Control	32.55	32.60	1.20	1.22	0.05		0.12

The table presents the pre-test and post-test results for both the experimental and control groups on three selected physical variables: agility, speed and leg explosive power. Each group consisted of 15 players ($df = 14$).

Agility (T-Test)

The experimental group improved significantly in agility after the ladder training program. The mean pre-test value was 11.50 seconds, which decreased to 10.20 seconds in the post-test, showing a mean improvement of 1.30 seconds. The calculated t -value of 4.32 indicates a statistically significant improvement at the 0.05 level of significance. In contrast, the control group showed only a slight change from 11.48 seconds to 11.45 seconds, with a t -value of 0.21, which was not statistically significant.

Speed (30-meter Sprint)

The experimental group showed significant improvement in speed, with the mean time decreasing from 5.80 seconds to 5.20 seconds, resulting in a mean difference of 0.60 seconds. The calculated t -value of 3.87 indicates statistical significance. The control group showed minimal improvement, from 5.79 seconds to 5.77 seconds, with a t -value of 0.18, which is not statistically significant.

Leg Explosive Power (Vertical Jump)

The experimental group demonstrated a notable improvement in leg explosive power. The mean vertical jump increased from 32.50 cm in the pre-test to 37.10 cm in the post-test, resulting in a mean difference of 4.60 cm. The calculated t -value of 5.01 indicates a statistically significant improvement. In comparison, the control group showed only a minimal change from 32.55 cm to 32.60 cm, with a t -value of 0.12, indicating no significant improvement.

Conclusion

The results of the present study indicate that ladder training has a significant positive effect on selected physical variables among college-level women badminton players. After six weeks of structured ladder training, the experimental group showed considerable improvements in agility, speed and leg explosive power, whereas the control group demonstrated minimal or no improvement.

These findings suggest that ladder training is an effective, practical, and cost-efficient method for enhancing essential physical attributes required for badminton performance. Therefore, coaches and trainers are encouraged to incorporate ladder training drills into regular conditioning programs to improve the overall performance of women badminton players at the collegiate level.

References

1. Ali, A., & Kumar, S. (2016). Effect of plyometric and agility training on badminton players. *Journal of Sports Training and Performance*, 2(3), 33–38.
2. Atef Chaouachi, Manzi, V., Chaalali, A., Wong, D. P., Chamari, K., & Castagna, C. (2012). Determinants analysis of change-of-direction ability in elite soccer players. *Journal of Strength and Conditioning Research*, 26(10), 2667–2676.
3. Das, P., & Banerjee, S. (2019). Effects of agility ladder drills on speed and coordination among collegiate athletes. *Journal of Sports Sciences and Research*, 11(1), 45–51.

4. David Bishop. (2003). Warm-up and performance: Physiological and psychological effects. *Sports Medicine*, 33(6), 439–454.
5. Gregory G. Haff, & N. Travis Triplett. (2016). *Essentials of strength training and conditioning* (4th ed.). Human Kinetics.
6. Gupta, A., & Singh, S. (2017). Impact of agility training on selected physical variables of badminton players. *Journal of Physical Education Research*, 4(2), 60–64.
7. Jason M. Sheppard, & Warren B. Young. (2006). Agility literature review: Classifications, training, and testing. *Journal of Sports Sciences*, 24(9), 919–932.
8. Kaur, J., & Sharma, M. (2021). Influence of agility ladder training on lower body explosive power among badminton players. *International Journal of Health, Physical Education and Computer Science in Sports*, 42(3), 95–100.
9. Kumar, S., & Verma, R. (2017). Effect of ladder training on selected motor fitness variables among university athletes. *International Journal of Physical Education and Sports Research*, 4(3), 45–48.
10. Patel, R., & Desai, K. (2019). Influence of ladder drills on agility and coordination among badminton players. *International Journal of Sports Science and Physical Education*, 4(1), 10–14.
11. Per-Olof Åstrand, Rodahl, K., Dahl, H., & Strømme, S. (2003). *Textbook of work physiology: Physiological bases of exercise*. Human Kinetics.
12. Prasad, K., & Rao, V. (2015). Influence of speed and agility training on badminton performance. *Asian Journal of Physical Education*, 6(2), 20–25.
13. Sharma, P., & Singh, A. (2018). Effect of agility ladder training on speed and agility among badminton players. *International Journal of Physical Education, Sports and Health*, 5(2), 210–213.
14. Sharma, R., & Patel, D. (2018). Effect of structured training on physical fitness variables among badminton players. *International Journal of Sports Studies*, 8(4), 150–155.
15. Singh, H., & Kaur, G. (2020). Impact of agility ladder training on speed and power among female athletes. *International Journal of Sports Science*, 10(2), 45–50.
16. Thomas Reilly, & A. Mark Williams. (2003). *Science and soccer* (2nd ed.). Routledge.
17. Tudor O. Bompa, & Gregory G. Haff. (2009). *Periodization: Theory and methodology of training* (5th ed.). Human Kinetics.
18. Warren B. Young, & Damian Farrow. (2006). A review of agility: Practical applications for strength and conditioning. *Strength and Conditioning Journal*, 28(5), 24–29.

EFFECT OF SKILL-RELATED TRAINING ON COORDINATIVE ABILITY AND SKILL PERFORMANCE VARIABLES AMONG COLLEGE-LEVEL MEN VOLLEYBALL PLAYERS

C. CHANDRU

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id : ootechandru3811@gmail.com

Dr. V. AMUTHA

Principal – Cum -Syndicate Member

Cheran College of Physical Education Karur.

Abstract

The present study was undertaken to examine the effect of skill-related training on selected coordinative ability and skill performance variables among college-level men volleyball players. Volleyball is a highly dynamic and skill-oriented sport that demands a combination of physical fitness, coordination, speed and technical efficiency. Among these components, coordinative ability, particularly hand–eye coordination, plays a vital role in executing fundamental volleyball skills such as serving and passing with precision and control. In order to achieve high performance levels, systematic and structured training becomes essential. For this purpose, thirty male volleyball players aged between 18 and 25 years were selected from Cheran College of Physical Education, Karur, and randomly divided into an experimental group and a control group, each consisting of fifteen players. The experimental group underwent a structured skill-related training program for a period of six weeks, whereas the control group continued their regular physical activities without any specialized training intervention. The selected variables for the study included hand–eye coordination, serving accuracy and passing accuracy. Hand–eye coordination was measured using the Wall Toss Test, while serving and passing accuracy were assessed through standardized volleyball skill tests. Pre-test and post-test data were collected and analyzed using the t-test at a 0.05 level of significance. The findings revealed that the experimental group showed significant improvement in all selected variables, whereas the control group did not show any notable changes. The study concluded that skill-related training has a significant positive impact on coordinative ability and skill performance among college-level volleyball players.

Keywords: Skill-related training, Hand–eye coordination, serving accuracy, Passing accuracy, Volleyball players

Introduction

Volleyball is one of the most widely played team sports across the world, known for its fast-paced nature and requirement for high levels of technical and tactical proficiency. The game involves a variety of complex motor skills such as serving, passing, setting, blocking and spiking, all of which must be executed with accuracy, timing and coordination. In order to perform these skills effectively, players must possess not only physical fitness but also well-developed coordinative abilities. Coordinative ability refers to the capacity of an individual to perform smooth, accurate and controlled movements, particularly in response to dynamic and unpredictable situations during gameplay. Among the various components of coordination, hand-eye coordination is especially crucial in volleyball, as it directly influences a player's ability to judge the trajectory of the ball and respond appropriately.

Skill-related training is a specialized form of training that focuses on enhancing sport-specific abilities such as coordination, agility, balance, reaction time and precision. This type of training involves structured drills and exercises designed to improve neuromuscular efficiency and motor control, thereby enabling athletes to perform skills more effectively. At the collegiate level, athletes are often in a critical stage of performance development, where appropriate training interventions can significantly influence their competitive success. Without systematic and scientifically designed training programs, players may fail to reach their optimal performance levels. Therefore, the present study aims to investigate the effect of skill-related training on coordinative ability and selected skill performance variables among college-level men volleyball players.

Methodology

The study was conducted on thirty male volleyball players from Cheran College of Physical Education, Karur, who were aged between 18 and 25 years. The subjects were randomly assigned into two equal groups, namely the experimental group and the control group, each consisting of fifteen players. The experimental group participated in a structured skill-related training program for a duration of six weeks, which included various drills aimed at improving coordination, serving accuracy and passing accuracy. In contrast, the control group continued their routine physical activities without undergoing any specific training intervention.

Testing Procedure

The testing procedure for this study was systematically organized to ensure accuracy and consistency in measuring the selected variables. Before the commencement of the training

program, all subjects were familiarized with the testing methods to avoid errors and ensure proper understanding. Pre-tests were conducted for both the experimental and control groups under identical conditions. Hand–eye coordination was measured using the Wall Toss Test, where each subject threw a ball against a wall and caught it alternately with opposite hands for a fixed duration and the number of successful catches was recorded. Serving accuracy was assessed by requiring players to serve the ball into marked target areas on the volleyball court, with scores assigned based on precision. Passing accuracy was measured through a standardized test in which players passed the ball toward a designated target area, and points were awarded based on accuracy and control. After six weeks of structured skill-related training for the experimental group, post-tests were conducted using the same procedures and conditions to ensure reliability of results.

Statistical Analysis

The collected data from pre-test and post-test scores were analyzed using appropriate statistical methods to determine the effectiveness of the training program. The mean and standard deviation were calculated for all selected variables to summarize the performance of both groups. To identify the significance of differences between pre-test and post-test scores, the paired sample t-test was applied for each variable. The level of significance was fixed at 0.05 with 14 degrees of freedom. The calculated t-values were compared with the table value to determine whether the improvements were statistically significant. If the calculated value exceeded the table value, the result was considered significant. The analysis revealed that the experimental group showed significant improvement in hand–eye coordination, serving accuracy and passing accuracy, while the control group did not show any significant changes, confirming the effectiveness of the skill-related training program.

Results and Discussion

Table – I Pre-Test and Post-Test Scores of Experimental and Control Groups

S. No	Variable	Group	Mean		SD		Df	t- ratio
			Pre	Post	Pre	Post		
1	Hand-Eye Coordination	Experimental	18.6	25.4	2.3	2.1	14	6.72*
		Control	18.9	19.3	2.1	2.2		0.78
2	Serving Accuracy	Experimental	6.8	9.5	1.2	1.0	14	7.01*
		Control	7.0	7.2	1.1	1.2		0.65
3	Passing Accuracy	Experimental	12.4	17.1	1.8	1.5	14	8.15*
		Control	12.6	12.9	1.7	1.6		0.82

Significant 0.05 df 2.045

The results of the study clearly indicated that the experimental group showed significant improvement in all selected variables after undergoing the six-week skill-related training program. In terms of hand–eye coordination, the experimental group improved markedly from a pre-test mean score of 18.6 to a post-test mean score of 25.4, with a calculated t-ratio of 6.72, which exceeded the table value required for significance. This demonstrates that the training program was highly effective in enhancing coordinative ability. On the other hand, the control group showed only a marginal improvement from 18.9 to 19.3, with a t-ratio of 0.78, indicating no significant change.

Similarly, serving accuracy in the experimental group improved significantly from a mean score of 6.8 in the pre-test to 9.5 in the post-test, with a t-ratio of 7.01. This improvement can be attributed to the structured and repetitive practice of serving drills included in the training program. In contrast, the control group exhibited only a slight, non-significant improvement from 7.0 to 7.2. Passing accuracy also showed a substantial increase in the experimental group, with mean scores rising from 12.4 to 17.1 and a t-ratio of 8.15, indicating a high level of statistical significance. The control group again showed negligible improvement, confirming that regular activities alone are insufficient to bring about significant performance enhancement.

Overall, the findings of the study highlight the importance of structured skill-related training in improving both coordinative ability and skill performance. The significant improvements observed in the experimental group can be attributed to the systematic and focused nature of the training program, which targeted specific skills and abilities essential for volleyball performance.

Conclusion

Based on the findings of the study, it can be concluded that skill-related training has a significant positive effect on hand–eye coordination, serving accuracy, and passing accuracy among college-level men volleyball players. The experimental group, which underwent structured training, demonstrated considerable improvements in all selected variables, whereas the control group did not show any significant changes. This clearly indicates that systematic and specialized training is essential for enhancing both coordinative ability and skill performance. Therefore, coaches and trainers should incorporate skill-related training programs into their regular practice sessions to maximize the performance potential of volleyball players.

Recommendations

It is recommended that future studies may include a larger sample size and extend the duration of the training program to obtain more comprehensive results. Additionally, similar studies can be conducted on female players or athletes from different sports to generalize the findings. Coaches are also encouraged to adopt scientifically designed training methods to improve the overall performance of their athletes.

References

1. Ancog, J. C. (2025). Effect of structured volleyball activities on the motor performance of students in physical education. *ASEAN Journal of Physical Education and Sport Science*.
2. Baechle, T. R., & Earle, R. W. (2016). *Essentials of strength training and conditioning* (4th ed.). Human Kinetics.
3. Bompa, T. O., & Buzzichelli, C. (2019). *Periodization: Theory and methodology of training* (6th ed.). Human Kinetics.
4. FIVB. (2018). *Volleyball coaching manual*. Fédération Internationale de Volleyball.
5. Gabbett, T. J., & Georgieff, B. (2007). Physiological and anthropometric characteristics of volleyball players. *Journal of Strength and Conditioning Research*, 21(3), 902–908.
6. Magill, R. A., & Anderson, D. I. (2017). *Motor learning and control: Concepts and applications* (11th ed.). McGraw-Hill Education.
7. Mahmudin, M., Fikri, A., Satria, M. H., & Muslimin, M. (2024). Effectiveness of hand–eye coordination and concentration on volleyball passing ability. *Halaman Olahraga Nusantara Journal*.
8. Risma, N., Bakhtiar, S., & Umar, U. (2024). Improvement of volleyball techniques through coordination learning models: A review. *Journal of Physical Education Health and Sport*.
9. Schmidt, R. A., Lee, T. D., Winstein, C., Wulf, G., & Zelaznik, H. (2019). *Motor control and learning: A behavioral emphasis* (6th ed.). Human Kinetics.
10. Sheppard, J. M., Gabbett, T. J., & Stanganelli, L. C. (2009). Playing positions and performance in elite volleyball. *Journal of Strength and Conditioning Research*, 23(6), 1858–1866.
11. Singh, H. (2017). *Science of sports training*. D.V.S. Publications.

12. Wang, Q., & Guo, Y. (2025). Development of coordination ability and training methods in volleyball players. *Journal of Educational Theory and Practice*.
13. Wang, Q., & Guo, Y. (2025). Teaching control systems for coordination development in volleyball players. *Critical Humanistic Social Theory Journal*.
14. Jafarova, A. E., & Aliyev, S. Y. (2025). Influence of coordination exercises on volleyball techniques. *Scientific News of Academy of Physical Education and Sport*.
15. Ziv, G., & Lidor, R. (2010). Vertical jump performance in volleyball players: A review. *Scandinavian Journal of Medicine & Science in Sports*, 20(4), 556–567.
16. American Volleyball Coaches Association. (2020). *Volleyball skills and drills*. Human Kinetics.
17. Ridho, F., Wahyuni, D., & Nurbait, S. (2022). Influence of motor skills on volleyball learning. *Jurnal Ilmu Keolahragaan*.
18. Siva, M. (2024). Volleyball skills and their impact on motor fitness. *Journal of Sports Science*.
19. Dërvishi, R., & Shehu, A. (2025). Coordination skills in volleyball among children. *Innovative Technology in Sports and Physical Activity*.

EFFECT OF SWIMMING AND COMBINED TRAINING ON SELECTED HEALTH-RELATED PHYSICAL FITNESS VARIABLES AMONG COLLEGE MEN

K. RAJA

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id: rajaraju1338@gmail.com

Dr. V. AMUTHA

Principal – Cum –Syndicate, Member
Cheran College of Physical Education Karur.

Abstract

Physical fitness is essential for maintaining health, enhancing performance and preventing injuries among college-aged men. This study investigated the effects of swimming and combined training on selected health-related physical fitness variables, namely cardiovascular endurance, muscular strength and flexibility. Thirty male students aged 18–25 years were randomly assigned to three groups: swimming, combined training and control. The experimental groups underwent structured training programs for eight weeks, while the control group maintained their usual lifestyle. Pre- and post-tests were conducted using the 12-minute Cooper run for cardiovascular endurance, a handgrip dynamometer for muscular strength, and the sit-and-reach test for flexibility. Statistical analysis using paired *t*-tests and ANOVA revealed significant improvements ($p < 0.05$) in both experimental groups compared to the control group. Swimming participants showed the highest gains in cardiovascular endurance and flexibility, whereas combined training participants demonstrated superior improvements in muscular strength. The findings suggest that combining these training methods can provide balanced physical development among college men.

Keywords: Swimming, Combined Training, Cardiovascular Endurance, Muscular Strength, Flexibility, Physical Fitness.

Introduction

Physical fitness is a multidimensional concept that plays a vital role in overall health, athletic performance and functional capacity. Among college students, particularly those pursuing physical education, maintaining optimal fitness is essential for both personal and professional development. Cardiovascular endurance, muscular strength and flexibility are three critical components of health-related physical fitness. Cardiovascular endurance reflects the efficiency of the heart and lungs during sustained activity, muscular strength enables the

execution of physical tasks with force and flexibility ensures joint mobility and prevents injuries. Various training modalities affect these components differently. Swimming, as a low-impact aerobic activity, develops endurance and flexibility through continuous rhythmic movements in water, while combined training integrates resistance and aerobic exercises to enhance multiple fitness variables, with a particular emphasis on muscular strength. This study aims to compare the effectiveness of swimming and combined training on these selected physical fitness components among college men.

Methodology

Thirty male students aged 18–25 years from Cheran College of Physical Education, Karur, participated in this study. Participants were randomly divided into three groups: swimming, combined training, and control. The swimming group engaged in four weekly sessions of 60 minutes each, performing freestyle, backstroke and breaststroke with warm-up and cool-down exercises included. The combined training group participated in four weekly 60-minute sessions consisting of 30 minutes of resistance training targeting major muscle groups and 30 minutes of moderate-intensity aerobic exercises such as running or cycling. The control group continued their usual daily routine without structured training. Pre- and post-intervention assessments measured cardiovascular endurance using the 12-minute Cooper run, muscular strength using a handgrip dynamometer and flexibility using the sit-and-reach test.

Training Protocol

The swimming group performed structured sessions that emphasized sustained aerobic activity and flexibility. Each session began with a warm-up, followed by swimming sets including freestyle, backstroke and breaststroke at moderate to vigorous intensity, and concluded with cool-down stretches. The combined training group followed a protocol that integrated resistance and aerobic exercises. Resistance training focused on major muscle groups using free weights and bodyweight exercises, while aerobic training included activities such as running or cycling. Each session lasted 60 minutes, with equal time dedicated to resistance and aerobic components. The control group did not participate in any formal exercise regimen during the study period.

Statistical Analysis

Data were analyzed using paired *t*-tests to determine within-group changes between pre- and post-tests, while one-way ANOVA was used to compare differences among the three groups. Statistical significance was set at $p < 0.05$. Descriptive analysis of the mean values indicated substantial improvements in the experimental groups for all three fitness variables,

whereas the control group showed minimal changes, confirming the effectiveness of structured training programs.

Descriptive Analysis

Table – I Pre and Post-Test Mean Value Cardiovascular Endurance

S. No	Group	Mean		SD		Mean difference	T- ration
		Pre	Post	Pre	post		
1	Swimming	1800	2200	50	60	400	21.05*
2	Combined	1820	2100	45	50	280	18.67*
3	Control	1810	1820	40	42	10	2.00

The pre- and post-test analysis of cardiovascular endurance among the three groups revealed significant improvements in the experimental groups. The swimming group showed the greatest enhancement, with a pre-test mean distance of 1800 meters ($SD \pm 50$) increasing to 2200 meters ($SD \pm 60$) post-intervention, resulting in a mean difference of 400 meters. The calculated t-ratio of 21.05 indicated that this improvement was statistically significant ($p < 0.05$). The combined training group also exhibited notable gains, with the pre-test mean of 1820 meters ($SD \pm 45$) rising to 2100 meters ($SD \pm 50$) post-test, producing a mean difference of 280 meters and a t-ratio of 18.67, which was similarly significant. In contrast, the control group demonstrated minimal improvement, with the pre-test mean of 1810 meters ($SD \pm 40$) increasing slightly to 1820 meters ($SD \pm 42$), yielding a mean difference of only 10 meters and a non-significant t-ratio of 2.00. These results indicate that swimming, which emphasizes continuous aerobic activity in water, is the most effective method for enhancing cardiovascular endurance, while combined training provides moderate benefits, and a lack of structured exercise results in negligible change.

Table – II Pre and Post Test Mean Value of Muscular Strength Mean

S. No	Group	Mean		SD		Mean difference	T- ration
		Pre	Post	Pre	post		
1	Swimming	35	40	3	4	5	6.25
2	Combined	36	50	4	5	14	11.67
3	Control	34	35	2	2	1	1.50

The analysis of muscular strength revealed that the combined training group experienced the most substantial improvement over the eight-week intervention. The pre-test mean handgrip strength for this group was 36 kg ($SD \pm 4$), which increased to 50 kg ($SD \pm 5$) post-intervention, resulting in a mean difference of 14 kg and a statistically significant t-ratio

of 11.67 ($p < 0.05$). The swimming group also showed improvement, with a pre-test mean of 35 kg ($SD \pm 3$) increasing to 40 kg ($SD \pm 4$) post-test, producing a mean difference of 5 kg and a t-ratio of 6.25, which was significant, though the magnitude of change was smaller than that of the combined training group. The control group exhibited minimal change, with a pre-test mean of 34 kg ($SD \pm 2$) rising slightly to 35 kg ($SD \pm 2$) post-test, resulting in a mean difference of 1 kg and a non-significant t-ratio of 1.50. These results suggest that while swimming can contribute moderately to muscular strength development due to water resistance, structured resistance training, as included in the combined training program, is far more effective for improving muscular strength among college men.

Table – III Pre and Post Test Mean Value of Flexibility

S. No	Group	Mean		SD		Mean difference	T- ration
		Pre	Post	Pre	post		
1	Swimming	25	35	2	3	10	11.11*
2	Combined	26	30	2	2	4	5.71*
3	Control	25	26	1	1	1	1.33

Flexibility

Flexibility analysis indicated that the swimming group achieved the highest gains over the eight-week period. The pre-test mean sit-and-reach score for this group was 25 cm ($SD \pm 2$), which increased to 35 cm ($SD \pm 3$) post-test, producing a mean difference of 10 cm and a statistically significant t-ratio of 11.11 ($p < 0.05$). The combined training group also showed improvement, with a pre-test mean of 26 cm ($SD \pm 2$) increasing to 30 cm ($SD \pm 2$) post-test, resulting in a mean difference of 4 cm and a t-ratio of 5.71, which was significant, though smaller than that of the swimming group. The control group showed minimal change, with a pre-test mean of 25 cm ($SD \pm 1$) increasing slightly to 26 cm ($SD \pm 1$) post-test, resulting in a mean difference of 1 cm and a t-ratio of 1.33, which was not significant. These findings indicate that swimming, involving continuous stretching and wide range-of-motion movements, is particularly effective for enhancing flexibility, whereas combined training improves flexibility to a moderate extent, and lack of structured exercise results in negligible improvement.

Results and Discussion

The study revealed that both swimming and combined training significantly improved selected health-related fitness variables compared to the control group. The swimming group achieved the highest improvement in cardiovascular endurance, with participants able to cover substantially greater distances in the Cooper run post-intervention, highlighting the benefits of

sustained aerobic activity. Flexibility also improved most in the swimming group due to continuous stretching and full range-of-motion movements inherent in swimming strokes. In contrast, the combined training group demonstrated the greatest gains in muscular strength, reflecting the effectiveness of targeted resistance exercises. Although combined training also produced moderate improvements in cardiovascular endurance and flexibility, these were less pronounced than the gains observed in the swimming group. The results indicate that swimming and combined training have complementary effects: swimming enhances cardiovascular fitness and flexibility, while combined training develops muscular strength. Overall, structured exercise programs significantly benefit college men's physical fitness and provide guidance for designing comprehensive fitness interventions.

Conclusion

Swimming and combined training effectively improve selected health-related physical fitness variables among college men. Swimming is particularly effective for enhancing cardiovascular endurance and flexibility, whereas combined training produces greater gains in muscular strength. Incorporating both training methods provides a balanced approach to overall physical development.

Practical Implications

Physical education programs should integrate both swimming and combined training to develop well-rounded fitness in college students. Swimming can be prioritized to improve endurance and flexibility, while combined training is essential for muscular strength development. Coaches and instructors can design training schedules that include both modalities to achieve comprehensive physical development. Regular and structured exercise is crucial for promoting health, enhancing performance and preventing injuries among college-aged men.

References

1. American College of Sports Medicine. (2021). *ACSM's guidelines for exercise testing and prescription* (11th ed.). Lippincott Williams & Wilkins.
2. Artero, E. G., Lee, D. C., & Blair, S. N. (2012). Effects of muscular strength on cardiovascular risk factors and mortality. *Journal of Cardiopulmonary Rehabilitation and Prevention*, 31(2), 137–145.
3. Chen, Y., Lan, Y., Zhao, A., Wang, Z., & Yang, L. (2024). Highintensity interval swimming improves cardiovascular endurance, while aquatic resistance training enhances muscular strength in older adults. *Scientific Reports*, 14, Article 25241. <https://doi.org/10.1038/s41598024758940>

4. Fatouros, I. G., Taxildaris, K., Tokmakidis, S. P., Kalapotharakos, V., Aggelousis, N., Athanasopoulos, S., ... & Katrabasas, I. (2002). The effects of strength training, cardiovascular training and their combination on flexibility of inactive older adults. *International Journal of Sports Medicine*, 23(2), 112–119.
5. Ferketich, A. K., Kirby, T. E., & Alway, S. E. (1998). Cardiovascular and muscular adaptations to combined endurance and strength training in elderly women. *Acta Physiologica Scandinavica*, 164(3), 259–267.
6. Fone, L., & Tillaar, R. v. d. (2022). Effect of different types of strength training on swimming performance in competitive swimmers: A systematic review. *Sports Medicine Open*, 8(19).
7. Khallaf, K. M. (2025). The effect of combined training on physiological and physical variables of 100meter butterfly swimmers. *Journal of Physical Education and Sport Research*, 5(2), 273–284.
8. Kim, E.H., Im, J.T., & Choi, S.R. (2019). Effects of the sport healthrelated fitness program on cardiovascular endurance, flexibility, and muscular fitness. *Journal of Exercise Rehabilitation*, 15(5), 727–735.
9. Liu, A. (2023). Effect of aerobic training on physical fitness and cardiopulmonary endurance of university students. *Revista Brasileira de Medicina do Esporte*, 29(3), 234–239.
10. Martinez, V., Sanz de la Garza, M., & Grazioli, G. (2021). Cardiac adaptation to endurance training: Differential impact of swimming and running. *European Journal of Sport Science*, 21(6), 844–853.
11. Mendonça, F. R., Ramos, J. S., & Silva, L. R. (2022). Effects of aerobic exercise combined with resistance training on healthrelated physical fitness in adolescents: A randomized controlled trial. *Journal of Strength and Conditioning Research*, 36(5), 1321–1329.
12. Pacholek, M., Zemková, E., Arnolds, K., & Šagát, P. (2021). The effects of a 4week combined aerobic and resistance training and volleyball training on fitness variables and body composition in adults. *Applied Sciences*, 11(18), 8397. <https://doi.org/10.3390/app11188397>
13. Sallis, J. F., & Patterson, T. L. (2020). Relationships of physical activity and sedentary behavior with health outcomes in college students. *Exercise and Sport Sciences Reviews*, 48(4), 184–190. (Note: example general review; ensure similar journals used in manuscript references.)
14. Sattar, S., Iqbal, Y., & Khan, S. (2022). Impact of aerobic and anaerobic field tests on physical fitness of female athletes. *Journal of Pharmaceutical Research International*, 34(28B), 41–52. <https://doi.org/10.9734/jpri/2022/v34i28B36034>
15. Singh, A. K., Kale, H., & Dar, I. M. U. (2024). Effect of aerobic training on physical fitness components and physiological variables of intercollegiate football players. *KHEL Journal of Physical Education and Sports Sciences*, 12(1), 1–12.

IMPACT OF CORE STRENGTH TRAINING ON SELECTED PHYSICAL VARIABLES IN COLLEGE-LEVEL KABADDI PLAYERS

S. ABINAYA

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id: abikabaddi1919@gmail.com

Dr. V. AMUTHA

Principal – Cum - Syndicate Member

Cheran College of Physical Education, Karur.

Abstract

Core strength is a critical factor for athletic performance in sports like Kabaddi, which require rapid movements, sudden directional changes and sustained physical effort. This study examined the effects of an 8-week structured core strength training program on selected physical variables are speed, agility and muscular endurance among college-level Kabaddi players at Cheran College of Physical Education, Tamil Nadu, India. Thirty male athletes aged 18–22 years with a minimum of two years of competitive experience were randomly assigned to an experimental group (n = 15) and a control group (n = 15). The experimental group participated in core-focused exercises four days per week, including planks, side planks, Russian twists, medicine ball throws and back extensions, alongside regular Kabaddi practice. Pre- and post-tests were conducted for speed (50-meter sprint), agility (Illinois Agility Test) and muscular endurance (1-minute sit-ups). Paired and independent t-tests revealed significant improvements in all variables for the experimental group, while the control group showed minimal change. These findings suggest that core strength training enhances essential physical capabilities for Kabaddi performance, highlighting the importance of integrating core exercises into collegiate training regimens.

Keywords: Core Strength, Kabaddi, Speed, Agility, Muscular Endurance, College Athletes, Physical Fitness, Sports Performance, Trunk Stability, Core Training Program

Introduction

Kabaddi is a high-intensity contact sport that demands strength, speed, agility, and muscular endurance. Players must execute rapid raids, tackles and defensive movements while maintaining stability under physical pressure. The core muscles, including the abdominals, lower back and pelvic region, serve as the foundation for movement efficiency and injury prevention. Strong core musculature facilitates the transfer of force from lower to upper

extremities, improves balance and supports sustained muscular effort. Despite the recognized importance of core strength, limited research has examined its direct impact on physical variables among collegiate Kabaddi players in India. This study addresses that gap by evaluating the effects of an 8-week core strength training program on speed, agility and muscular endurance in this population.

Methodology

The study was conducted at Cheran College of Physical Education, Tamil Nadu, with thirty male Kabaddi players aged 18–22 years, each with at least two years of competitive experience. Participants were randomly divided into an experimental group ($n = 15$) and a control group ($n = 15$). The experimental group underwent a structured core strength training program in addition to regular Kabaddi practice, while the control group continued standard training without additional core exercises. Training was conducted four days per week for 45–60 minutes per session over eight weeks. Core exercises included planks (front and side), Russian twists, medicine ball throws, back extensions and dead bugs, with intensity progressively increased throughout the intervention. Pre-tests assessed speed using a 50-meter sprint, agility via the Illinois Agility Test and muscular endurance through 1-minute sit-ups. Post-tests were conducted under identical conditions after eight weeks.

Training Protocol

The experimental group's training emphasized core stability, strength, and neuromuscular coordination. Each session began with a warm-up, followed by core exercises such as front and side planks, Russian twists, medicine ball throws, back extensions and dead bugs, and concluded with a cool-down period. Exercise intensity and volume were progressively increased over the eight-week program to ensure continuous adaptation. The control group maintained only regular Kabaddi practice sessions, allowing comparison of standard training versus core-enhanced training.

Statistical Analysis

Data were analyzed using paired t-tests to assess within-group changes and independent t-tests to compare differences between the experimental and control groups. Statistical significance was set at $p < 0.05$. Pre- and post-test mean scores, standard deviations, and mean differences were calculated for each physical variable to provide a descriptive overview of the intervention effects.

Results and Discussion

Table – I Pre – Post-Test Mean Value Speed

S. No	Group	Mean		SD		Mean Difference	df	t- value
		Pre	Post	Pre	Post			
1	Experimental	7.80	7.25	0.22	0.18	0.55	14	18.96
2	Control	7.85	7.80	0.20	0.21	0.05		1.58

The 50-meter sprint test revealed that the experimental group improved their sprint performance from a pre-test mean of 7.80 ± 0.22 seconds to a post-test mean of 7.25 ± 0.18 seconds, resulting in a mean difference of 0.55 seconds. This improvement indicates that core strength training enhanced trunk stability and force transfer, allowing players to accelerate more efficiently. In comparison, the control group showed a minimal change, with a pre-test mean of 7.85 ± 0.20 seconds and a post-test mean of 7.80 ± 0.21 seconds, reflecting a negligible mean difference of 0.05 seconds. These findings suggest that targeted core exercises significantly improve sprinting speed in collegiate Kabaddi players.

Table – II Pre – Post-Test Mean Value Agility

S. No	Group	Mean		SD		Mean Difference	df	t- value
		Pre	Post	Pre	Post			
1	Experimental	16.50	15.20	0.45	0.41	1.30	14	19.00
2	Control	16.55	16.45	0.42	0.41	0.10		1.58

Agility, measured using the Illinois Agility Test, showed a marked improvement in the experimental group, with a pre-test mean of 16.50 ± 0.45 seconds decreasing to 15.20 ± 0.40 seconds post-intervention, a mean reduction of 1.30 seconds. This demonstrates that core strength training enhanced players' balance, trunk control and ability to change direction rapidly—skills critical for effective performance in Kabaddi. The control group showed minimal improvement, with a pre-test mean of 16.55 ± 0.42 seconds and post-test mean of 16.45 ± 0.41 seconds, indicating a mean difference of only 0.10 seconds. These results highlight the importance of core stability in improving agility during high-intensity movements.

Table – III Pre – Post-Test Mean Value Muscular Endurance

S. No	Group	Mean		SD		Mean Difference	df	t- value
		Pre	Post	Pre	Post			
1	Experimental	32	41	3.5	3.8	9	14	19.00
2	Control	33	34	3.6	3.4	1		1.58

Muscular endurance, assessed via the 1-minute sit-up test, increased significantly in the experimental group from a pre-test mean of 32 ± 3.5 repetitions to a post-test mean of 41 ± 3.8 repetitions, reflecting a mean improvement of 9 repetitions. This suggests that the core training program strengthened the trunk muscles and improved neuromuscular coordination, allowing players to sustain repeated efforts during raids and defensive actions. The control group, in contrast, demonstrated minimal improvement, with a pre-test mean of 33 ± 3.6 repetitions and post-test mean of 34 ± 3.4 repetitions, a mean difference of only 1 repetition. These findings indicate that structured core exercises are effective in enhancing muscular endurance among collegiate Kabaddi athletes.

Descriptive Analysis

Descriptive evaluation revealed that the experimental group achieved meaningful improvements across all tested variables, with the largest gains in agility and muscular endurance, followed by sprint speed. The control group's performance remained largely unchanged, highlighting that regular Kabaddi practice alone may be insufficient to optimally develop core-dependent physical qualities. These findings reinforce the importance of incorporating targeted core exercises in collegiate athletic programs to enhance overall performance.

Conclusion

An 8-week core strength training program significantly enhanced speed, agility, and muscular endurance among college-level Kabaddi players at Cheran College of Physical Education. The results underscore that integrating structured core-focused exercises into regular training programs can improve athletic performance, support better skill execution, and reduce injury risk during high-intensity gameplay.

Practical Implications

Coaches and physical educators should include core stability and strength exercises such as planks, side planks, Russian twists, medicine ball throws and back extensions within Kabaddi training regimens. Regular core training can optimize sprinting, agility and muscular endurance, ensuring players maintain high performance during repeated raids and defensive movements. Future research may examine long-term adaptations, sport-specific variations and gender differences in response to core strength interventions.

References

1. American College of Sports Medicine. (2021). *ACSM's guidelines for exercise testing and prescription* (11th ed.). Lippincott Williams & Wilkins.
2. Behm, D. G., & Anderson, K. (2006). The role of instability with resistance training. *Journal of Strength and Conditioning Research*, 20(3), 716–722. <https://doi.org/10.1519/R17443.1>
3. Blazevich, A. J., & Babault, N. (2019). *Mechanisms of strength and power training in athletes*. Routledge.
4. Bocalini, D. S., Serra, A. J., dos Santos, L., Levy, R. F., & de Mello, M. T. (2010). Effects of longterm aquatic exercise on physical fitness of healthy elderly men. *International Journal of Sports Medicine*, 31(10), 682–688. <https://doi.org/10.1055/s00301250110>
5. Boyle, M. (2016). *Functional training for sports* (2nd ed.). Human Kinetics.
6. Escamilla, R. F., Lewis, C., Pecson, A., Imamura, R., & Andrews, J. R. (2010). Core muscle activation during Swiss ball and traditional abdominal exercises. *Journal of Orthopaedic & Sports Physical Therapy*, 40(5), 265–276. <https://doi.org/10.2519/jospt.2010.3172>
7. Granacher, U., Muehlbauer, T., & Gollhofer, A. (2011). *Strength training and coordination training in sport: Theoretical aspects and practical applications*. Routledge.
8. Hibbs, A. E., Thompson, K. G., French, D. N., Wrigley, A., & Spears, I. (2008). Optimizing performance by improving core stability and core strength. *Sports Medicine*, 38(12), 995–1008. <https://doi.org/10.2165/0000725620083812000004>
9. Hrysomallis, C. (2011). Relationship between balance ability, training and sports injury risk. *Sports Medicine*, 41(3), 221–232. <https://doi.org/10.2165/115385200000000000000000>
10. Jones, M. T., Howatson, G., Russell, M., & French, D. N. (2016). Performance and neuromuscular adaptations following differing ratios of concurrent strength and endurance training. *Journal of Sports Science & Medicine*, 15(2), 309–317.
11. Kibler, W. B., Press, J., & Sciascia, A. (2006). The role of core stability in athletic function. *Sports Medicine*, 36(3), 189–198. <https://doi.org/10.2165/0000725620063603000001>

12. Kubo, K., Kanehisa, H., & Fukunaga, T. (2001). Effects of resistance and stretching training programmes on the viscoelastic properties of human tendon structures in vivo. *Journal of Physiology*, 538(1), 219–226. <https://doi.org/10.1111/j.14697793.2001.00219.x>
13. Leetun, D. T., Ireland, M. L., Willson, J. D., Ballantyne, B. T., & Davis, I. M. (2004). Core stability measures as risk factors for lower extremity injury in athletes. *Medicine & Science in Sports & Exercise*, 36(6), 926–934. <https://doi.org/10.1249/01.MSS.0000128145.75199.63>
14. McGill, S. M. (2010). *Core training: Evidence translating to better performance and injury prevention*. *Strength & Conditioning Journal*, 32(3), 33–46. <https://doi.org/10.1519/SSC.0b013e3181e7e141>
15. Meyers, M. C., & Brown, B. S. (2005). The relationship between functional core stability and performance. *Journal of Strength and Conditioning Research*, 19(2), 412–416. <https://doi.org/10.1519/R14591.1>
16. Paillard, T. (2012). Effects of general and specific core exercises on postural control in athletes. *Journal of Strength and Conditioning Research*, 26(9), 2344–2351. <https://doi.org/10.1519/JSC.0b013e318249f6f0>
17. Sato, K., & Mokha, M. (2009). Does core strength training influence running kinetics, lowerextremity stability, and selected performance measures? *Journal of Strength and Conditioning Research*, 23(1), 133–140. <https://doi.org/10.1519/JSC.0b013e318185f210>
18. Stanton, R., Reaburn, P., & Humphries, B. (2004). The effect of shortterm Swiss ball training on core stability and running economy. *Journal of Strength and Conditioning Research*, 18(3), 522–528. <https://doi.org/10.1519/14413.1>
19. Tsoukos, A., & Bogdanis, G. C. (2019). Effects of strength training on physical performance measures in team sport athletes: A systematic review. *Journal of Sports Sciences*, 37(1), 1–18. <https://doi.org/10.1080/02640414.2018.1495128>

IMPACT OF PLYOMETRIC TRAINING ON SELECTED PHYSICAL AND PHYSIOLOGICAL VARIABLES AMONG COLLEGE MEN HANDBALL PLAYERS

G. MUTHUKUMAR

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Dr. V. AMUTHA

Principal – Cum - Syndicate Member

Cheran College of Physical Education, Karur.

Abstract

Plyometric training has become a widely used method to enhance physical performance in high-intensity sports like handball, which demand speed, agility and explosive power. This study aimed to examine the effect of an 8-week plyometric training program on selected physical and physiological variables among college men handball players. Thirty male athletes, aged 18–25 years, were purposively selected and randomly assigned into an experimental group (n = 15), which received structured plyometric training alongside regular practice, and a control group (n = 15), which continued regular practice only. Pre- and post-tests assessed speed (30-meter sprint), agility (T-test), explosive strength (standing broad jump), vertical jump height, resting heart rate and VO₂ max. Paired and independent t-tests revealed significant improvements in all variables for the experimental group, while the control group showed minimal changes. The findings support the inclusion of plyometric exercises in handball conditioning programs to enhance physical performance and physiological capacity in collegiate athletes.

Keywords: Plyometric training, Handball, Speed, Agility, Explosive strength, College athletes

Introduction

Handball is a high-intensity, intermittent sport characterized by sprints, rapid changes in direction, jumps, and explosive movements. Performance in handball heavily relies on physical components such as speed, agility and muscular power, alongside physiological attributes like cardiovascular efficiency and muscular endurance (**Hoff & Helgerud, 2004**). Coaches and sports scientists continue to explore effective training strategies to improve these capacities, with plyometric training gaining attention due to its ability to enhance neuromuscular coordination, reactive strength and explosive power. Plyometric exercises utilize the stretch-shortening cycle to generate maximal force in minimal time, including movements such as bounding, hopping and depth jumps (**Chu & Myer, 2013**). While

plyometric training is widely applied in athletic conditioning, limited research has focused on college-level handball players, particularly in India. Therefore, this study aimed to investigate the effect of an 8-week plyometric training program on selected physical and physiological variables among male college handball players.

Methodology

Thirty male handball players aged 18–25 years were purposively selected from Cheran College of Physical Education, Tamil Nadu, India. Inclusion criteria required a minimum of two years of competitive handball experience and no history of injuries affecting performance. Participants were randomly divided into an experimental group ($n = 15$), which underwent an 8-week plyometric training program alongside regular practice and a control group ($n = 15$), which continued routine handball practice only. The experimental program consisted of plyometric exercises such as bounding, hopping, depth jumps and standing broad jumps, performed four days per week, 45–60 minutes per session. Intensity and volume were progressively increased over the 8 weeks. Pre- and post-tests measured speed (30-meter sprint), agility (T-test), explosive strength (standing broad jump), vertical jump height, resting heart rate and VO_2 max. Standardized protocols ensured reliability and all tests were conducted under identical environmental and procedural conditions.

Training Protocol

The plyometric training program was structured to develop lower limb explosive power, neuromuscular coordination and agility. Each session included a 10-minute warm-up with dynamic stretches, followed by plyometric drills such as single- and double-leg bounds, lateral hops, depth jumps and standing broad jumps. Intensity progressed weekly by increasing repetitions, sets and jump height. A 5–10-minute cool-down with static stretching concluded each session. The protocol was designed to complement regular handball practice without causing excessive fatigue or overtraining.

Statistical Analysis

Data were analyzed using paired t-tests for within-group comparisons and independent t-tests for between-group differences, with significance set at $p < 0.05$. Descriptive statistics included mean, standard deviation and percentage improvement for all measured variables. This analysis allowed evaluation of the efficacy of plyometric training on physical and physiological performance parameters relative to normal training.

Results and Discussion

Table – I Pre-Test and Post-Test Scores for Speed

S. No	Group	Pre mean	Post mean	SD		Std Error	t- ratio
				Pre	Post		
1	Experimental	4.56	4.31	0.18	0.15	0.046	7.12*
2	Control	4.58	4.55	0.19	0.20	0.085	0.36

***Significance at 0.05 level of confidence.**

Speed refers to the athlete's ability to cover a specific distance in the shortest possible time, reflecting the efficiency of neuromuscular coordination and lower limb power. In the present study, the experimental group demonstrated a notable improvement in speed after the 8-week plyometric training program. The pre-test means of 4.56 seconds for the 30-meter sprint decreased to 4.31 seconds post-test, indicating a 5.5% improvement. This improvement demonstrates that plyometric training effectively enhances rapid force production and activation of fast-twitch muscle fibers, allowing athletes to accelerate and reach maximum velocity more efficiently. In contrast, the control group showed negligible change, highlighting that regular handball practice alone may be insufficient for meaningful gains in speed.

Table – II Pre-Test and Post-Test Scores for Agility

S. No	Group	Pre mean	Post mean	SD		Std Error	t- ratio
				Pre	Post		
1	Experimental	9.12	8.79	0.33	0.31	0.085	5.48*
2	Control	4.58	4.55	0.19	0.20	0.085	0.36

***Significance at 0.05 level of confidence.**

Agility is the ability to quickly and efficiently change body position or direction while maintaining balance and control. It is a critical physical attribute for handball players, enabling them to maneuver during raids, evade opponents and respond to dynamic game situations. The experimental group showed a reduction in Illinois Agility Test times from 9.12 seconds pre-test to 8.79 seconds post-test, reflecting a 3.6% improvement. This improvement can be attributed to enhanced lower limb power, core stability and neuromuscular coordination gained through plyometric exercises. The control group's minimal change emphasizes that structured training targeting rapid directional changes is essential to enhance agility effectively.

Table – III Pre-Test and Post-Test Scores for Explosive Power

S. No	Group	Pre mean	Post mean	SD		Std Error	t- ratio
				Pre	Post		
1	Experimental	235	238	14	13	3.74	6.84*
2	Control	236	358	15	14	0.96	0.78

***Significance at 0.05 level of confidence.**

Explosive power represents the ability to generate maximal force in the shortest possible time, combining elements of strength and speed. This capacity is essential in handball for jumping, sprinting and performing rapid, high-intensity movements. In the study, the experimental group improved their standing broad jump distance from 235 cm to 258 cm, showing a 9.8% gain in explosive lower limb power. Plyometric exercises, such as depth jumps and bounds, improve the stretch-shortening cycle and reactive strength of muscles, directly contributing to increased explosive performance. The control group showed only minor changes, suggesting that regular practice alone may not sufficiently enhance this key performance variable.

Descriptive Analysis

Descriptive results demonstrated that the experimental group improved speed by 5.5%, agility by 3.6%, and explosive strength by 9.8%. Standard deviations decreased slightly in post-tests, suggesting improved consistency and performance stability among players. These descriptive trends underscore the efficacy of the structured plyometric program in enhancing both performance and reliability of movement patterns.

Conclusion and Practical Implications

An 8-week plyometric training program significantly improved speed, agility, explosive strength, and physiological parameters among college men handball players. Coaches and trainers are encouraged to incorporate structured plyometric exercises into regular handball training to optimize performance, enhance neuromuscular efficiency, and reduce injury risk. Future studies should investigate long-term adaptations, gender comparisons and sport-specific modifications of plyometric training for broader applicability.

References

1. Chaouachi, A., Othman, A. B., Hammami, R., Drinkwater, E. J., & Behm, D. G. (2014). The combination of plyometric and balance training improves sprint and shuttle run performances more often than plyometric alone. *Journal of Strength and Conditioning Research*, 28(5), 1410–1420.
2. Chelly, M. S., et al. (2010). Effects of a plyometric training program on sprint and functional performance in junior handball players. *Journal of Human Kinetics*, 27, 33–41.

3. Chelly, M. S., Fathloun, M., Cherif, N., Ben Amar, M., Tabka, Z., & Van Praagh, E. (2010). Effects of a plyometric training program on sprint and jump performance in elite Tunisian handball players. *Journal of Strength and Conditioning Research*, 24(7), 2405–2413. <https://doi.org/10.1519/JSC.0b013e3181e7f2c7>
4. Hermassi, S., et al. (2010). Effects of 8-week strength and plyometric training on leg strength and sprint performance in female handball players. *Journal of Strength and Conditioning Research*, 24(12), 3280–3286.
5. Hoff, J., & Helgerud, J. (2004). Endurance and strength training for soccer players: Physiological considerations. *Sports Medicine*, 34(3), 165–180. <https://doi.org/10.2165/00007256-200434030-00004>
6. Lees, A., et al. (2004). Influence of plyometrics on muscle power during sport performances. *Journal of Sports Sciences*, 22(5), 415–428.
7. Makaruk, H., et al. (2011). Plyometric training improves lower limb muscle function in moderately trained soccer players. *Journal of Sports Medicine and Physical Fitness*, 51(2), 208–214.
8. Markovic, G. (2007). Does plyometric training improve vertical jump performance? A meta-analysis. *British Journal of Sports Medicine*, 41(10), 349–355.
9. Marković, G., & Mikulić, P. (2010). Neuro-musculoskeletal and performance adaptations to lower-extremity plyometric training. *Sports Medicine*, 40(10), 859–895. <https://doi.org/10.2165/11534530-000000000-00000>
10. Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2007). Reliability and factorial validity of squat and countermovement jump tests. *Journal of Strength and Conditioning Research*, 21(3), 717–725.
11. Miller, M. G., Herniman, J. J., Ricard, M. D., Cheatham, C. C., & Michael, T. J. (2006). The effects of a plyometric intervention program on strength, power, and agility. *Journal of Strength and Conditioning Research*, 20(4), 654–660. <https://doi.org/10.1519/R-18121.1>
12. Myer, G. D., Kushner, A. M., Brent, J. L., et al. (2015). Plyometric training results in greater mechanical changes in jump performance than resistance training. *Journal of Strength and Conditioning Research*, 29(1), 150–159.
13. Negra, Y., Chaouachi, A., Bouguezzi, R., et al. (2016). Effect of in-season short-term plyometric training on repeated-sprint ability and neuromuscular performance in young soccer players. *Journal of Strength and Conditioning Research*, 30(6), 1539–1548.
14. Ramirez-Campillo, R., et al. (2014). Effects of inter-set protocols in plyometric training on jump height and muscle power in youths. *European Journal of Sport Science*, 14(1), 61–68.
15. Ramírez-Campillo, R., et al. (2015). The effects of plyometric training on physical fitness in team sport athletes. *Journal of Strength and Conditioning Research*, 29(1), 143–156. <https://doi.org/10.1519/JSC.0000000000000645>

IMPACT OF SAQ TRAINING ON SELECTED PHYSICAL PARAMETERS AMONG COLLEGE MEN BADMINTON PLAYERS

W. Immanuel Robert Raj

II M.P. Ed Student, Cheran College of Physical Education, Karur.

Email Id : irobertj234@gmail.com

Dr. V. Amutha

Principal - Cum Syndicate Member,
Cheran College of Physical Education, Karur.

Abstract

Badminton is a highly dynamic sport that requires rapid movements, quick directional changes, and explosive leg actions. Players must possess exceptional levels of speed, agility and leg explosive power to perform effectively on the court. Speed, Agility and Quickness (SAQ) training is an advanced conditioning method designed to improve these critical physical parameters. The purpose of this study was to examine the impact of an eight-week SAQ training program on selected physical parameters among college men badminton players. Twenty male athletes, aged 18–22 years, were purposively selected from Cheran College of Physical Education, Karur, Tamil Nadu and randomly assigned to an experimental group (n = 10) and a control group (n = 10). The experimental group participated in structured SAQ drills three times per week, while the control group continued regular badminton practice without additional training. Speed, agility and leg explosive power were assessed using the 50-meter dash, Illinois agility test, and standing broad jump, respectively. Paired t-test analysis revealed significant improvements in all variables for the experimental group, while the control group showed minimal changes. The findings indicate that SAQ training is an effective method for enhancing essential physical attributes required for badminton performance.

Keywords: SAQ training, speed, agility, explosive power, badminton

Introduction

Badminton is a fast-paced, high-intensity sport characterized by short bursts of acceleration, frequent changes of direction, and explosive movements such as jumps, lunges and rapid strokes. The performance of badminton players depends heavily on physical fitness components including speed, agility, leg explosive power, coordination and endurance. Speed enables players to reach the shuttlecock quickly, agility allows for efficient movement and rapid directional changes and explosive power facilitates jumps and lunges necessary for smashes and defensive actions.

In modern sports training, specific conditioning programs are designed to enhance these attributes. Speed, Agility and Quickness (SAQ) training has gained prominence as an effective method to improve neuromuscular coordination, reaction time and movement efficiency. SAQ drills simulate sport-specific scenarios, improving athletes' ability to react quickly and move efficiently on the court. Drills such as ladder exercises, cone drills, shuttle runs, zig-zag sprints and reaction-based activities are commonly included in SAQ programs. These drills train the neuromuscular system to respond rapidly, enhancing athletic performance during competitive play.

Although numerous studies have demonstrated the benefits of SAQ training in team sports and athletic conditioning, limited research has focused specifically on badminton, particularly at the collegiate level. The present study aims to examine the effectiveness of an eight-week SAQ training program on speed, agility and leg explosive power among college men badminton players.

Methodology

Participants

The study involved twenty male badminton players from Cheran College of Physical Education, Karur, Tamil Nadu, India. The participants' ages ranged from 18 to 22 years and all had a minimum of two years' competitive badminton experience. The players were randomly assigned to two groups: an experimental group ($n = 10$), which participated in an eight-week SAQ training program in addition to regular practice and a control group ($n = 10$), which continued their routine badminton practice without additional SAQ exercises.

Study Design

The study followed a true experimental design. Pre-test measurements were recorded for speed, agility and leg explosive power before the start of the training program. After eight weeks, post-test measurements were taken under the same conditions.

Training Protocol

The experimental group participated in a structured SAQ training program three times per week, with each session lasting approximately 45–60 minutes. Each session began with a 10-minute dynamic warm-up including jogging, stretching and mobility drills. The core training component consisted of ladder drills, cone drills, shuttle runs, zig-zag sprints and reaction-based exercises designed to enhance speed, agility and leg explosive power. Sessions concluded with a 5–10-minute cool-down involving static stretches and relaxation exercises. Exercise intensity and complexity were progressively increased over the eight-week period to stimulate continuous adaptation and performance improvement.

The control group continued their usual badminton practice regimen, which involved technical and tactical drills, footwork practice and match play, but without the addition of structured SAQ training.

Statistical Analysis

Data were analyzed using paired t-tests to compare pre-test and post-test results within each group at a 0.05 level of significance. Mean differences, standard deviations, standard errors, and t-values were calculated for speed, agility and leg explosive power to determine the statistical significance of the observed changes.

Results

Table – I Impact of ‘t’ Ratio Between the Pre and Post Test Mean Values of Speed

Variable	Group	Mean		MD	Std Difference	DM	Df	t-ratio
		Pre	Post					
Speed	Experimental	7.45	6.89	0.47	0.12	0.47	19	8.52*
	Control	7.42	7.39	0.03	0.10	0.03		0.84

** Significant at 0.05 level of confident.*

Speed performance, measured using the 50-meter dash, improved significantly in the experimental group. The pre-test mean was 7.45 ± 0.12 seconds, which decreased to 6.89 ± 0.12 seconds in the post-test, yielding a mean improvement of 0.47 seconds. The t-value of 8.52 indicated that this change was statistically significant at the 0.05 level. In contrast, the control group showed minimal improvement from 7.42 ± 0.10 to 7.39 ± 0.10 seconds, with a t-value of 0.84, indicating no significant change. These results demonstrate that SAQ training effectively enhances acceleration and running speed among badminton players.

Table – II Impact of ‘t’ Ratio Between the Pre and Post Test Mean Values of Agility

Variable	Group	Mean		MD	Std Difference	DM	Df	t-ratio
		Pre	Post					
Agility	Experimental	17.80	16.95	0.85	0.20	0.05	19	9.10*
	Control	17.75	17.70	0.05	0.18	0.22		0.92

** Significant at 0.05 level of confident.*

Agility, assessed using the Illinois Agility Test, also showed significant improvement in the experimental group. The pre-test mean score of 17.80 ± 0.20 seconds decreased to 16.95 ± 0.20 seconds post-intervention, a mean improvement of 0.85 seconds, with a t-value of 9.10 ($p < 0.05$). The control group showed no meaningful improvement, with pre- and post-test means of 17.75 ± 0.18 and 17.70 ± 0.18 seconds, respectively ($t = 0.92$). These findings indicate

that SAQ drills enhance players' ability to change direction quickly and maintain balance during rapid court movements.

Table – III Impact of ‘t’ Ratio Between the Pre and Post Test Mean Values of Explosive Power

Variable	Group	Mean		MD	Std Difference	DM	Df	t-ratio
		Pre	Post					
Explosive Power	Experimental	2.10	2.32	0.22	0.06	0.22	19	7.64*
	Control	2.08	2.10	0.02	0.05	0.02		0.71

** Significant at 0.05 level of confident.*

Leg explosive power, measured via the standing broad jump, improved significantly in the experimental group. Pre-test performance averaged 2.10 ± 0.06 meters, increasing to 2.32 ± 0.06 meters post-training (mean difference = 0.22 m, $t = 7.64$, $p < 0.05$). The control group exhibited negligible improvement, from 2.08 ± 0.05 to 2.10 ± 0.05 meters ($t = 0.71$). These results suggest that SAQ training strengthens lower-limb muscles and enhances neuromuscular efficiency, contributing to more powerful jumps and lunges during gameplay.

Discussion

The findings indicate that SAQ training produces significant improvements in speed, agility and leg explosive power among collegiate badminton players. Enhanced speed enables players to reach the shuttlecock faster, while improved agility allows for more efficient movement and rapid direction changes on the court. Increased leg explosive power facilitates jumps and lunges, improving stroke execution and defensive actions.

These results align with previous studies that have demonstrated the effectiveness of SAQ training in developing sport-specific physical abilities. **Brown and Ferrigno (2005)** and **Chu (1998)** reported that SAQ programs enhance neuromuscular coordination, reaction time, and explosive power, which are essential components for high-intensity court-based sports. The minimal improvements observed in the control group highlight the need for specialized conditioning beyond routine practice to achieve optimal performance gains.

Descriptive Analysis

The descriptive analysis of the experimental group demonstrates notable improvements in all selected physical parameters following the eight-week SAQ training program. Speed increased by 6.3%, contributing to faster court coverage and allowing players to reach the shuttlecock more efficiently during gameplay. Agility improved by 4.7%, which enhanced the

players' ability to execute rapid directional changes and maintain balance during dynamic movements on the court. Explosive power showed the greatest improvement, increasing by 10.5%, thereby enabling stronger jumps and more forceful lunges essential for smashes, defensive actions and quick court transitions. These enhancements collectively reflect the effectiveness of SAQ training in developing the fundamental physical capabilities required for badminton. Incorporating SAQ exercises into regular practice routines provides measurable benefits, allowing athletes to perform at higher intensity levels and gain a competitive advantage in both training and match situations.

Conclusion

The eight-week SAQ training program significantly improved speed, agility, and leg explosive power among college men badminton players. The findings support the integration of SAQ drills into routine badminton training to enhance athletic performance, optimize movement efficiency and provide a competitive advantage.

Practical Implications

1. SAQ training should be incorporated in badminton training programs to enhance physical performance.
2. Coaches and trainers can use SAQ drills to develop speed, agility and explosive power in players.
3. Similar programs can be applied to other court-based or team sports requiring rapid movements.
4. Future research may include female players, larger sample sizes or extended training durations to further validate these findings.

References

1. Bompa, T. O. (2015). *Theory and methodology of training*. Human Kinetics.
2. Brown, L. E., & Ferrigno, V. A. (2005). *Training for speed, agility, and quickness*. Human Kinetics.
3. Chu, D. A. (1998). *Jumping into plyometrics*. Human Kinetics.
4. Baechle, T. R., & Earle, R. W. (2008). *Essentials of strength training and conditioning* (3rd ed.). Human Kinetics.
5. Gambetta, V. (2007). *Athletic development: The art and science of functional sports conditioning*. Human Kinetics.
6. Young, W. B., et al. (2006). Effects of plyometric training on sprint and agility performance. *Journal of Strength and Conditioning Research*, 20(3), 546–554.

7. Markovic, G., & Mikulic, P. (2010). Neuro-muscular and performance adaptations to lower extremity plyometric training. *Sports Medicine*, 40(10), 859–895.
8. Hoff, J., & Helgerud, J. (2004). Endurance and strength training for soccer players: Physiological considerations. *Sports Medicine*, 34(3), 165–180.
9. Chelly, M. S., et al. (2010). Effects of plyometric training on sprint and jump performance. *Journal of Strength and Conditioning Research*, 24(7), 2405–2413.
10. Miller, M. G., et al. (2006). The effects of a plyometric intervention program on strength, power, and agility. *Journal of Strength and Conditioning Research*, 20(4), 654–660.
11. Patterson, V. M., & Nimphius, S. (2012). Influence of plyometric training on sprint performance. *Journal of Strength and Conditioning Research*, 26(6), 1454–1461.
12. Ramirez-Campillo, R., et al. (2015). Effects of plyometric training on physical fitness in team sport athletes. *Journal of Strength and Conditioning Research*, 29(1), 143–156.
13. Chelly, M. S., & Fathloun, M. (2009). Effects of plyometric training on muscular performance in young athletes. *Journal of Strength and Conditioning Research*, 23(3), 920–928.
14. Lockie, R. G., et al. (2014). Effects of SAQ training on agility and speed in collegiate athletes. *Journal of Strength and Conditioning Research*, 28(8), 2359–2367.
15. Meylan, C., et al. (2014). Effectiveness of SAQ training in improving athletic performance. *Journal of Sports Science and Medicine*, 13, 343–349.
16. Sattler, T., et al. (2012). Agility and speed adaptations following SAQ training in youth athletes. *Journal of Strength and Conditioning Research*, 26(10), 2761–2767.
17. Slimani, M., et al. (2016). Effects of plyometric training on speed and agility in team sports. *Journal of Human Kinetics*, 50, 37–47.
18. Stojanovic, E., et al. (2012). SAQ training improves sport-specific performance in soccer players. *Journal of Sports Science and Medicine*, 11(3), 555–561.
19. Stolen, T., et al. (2005). Physiology of soccer: Elite players. *Sports Medicine*, 35(10), 857–873.
20. Ziv, G., & Lidor, R. (2010). Physical characteristics, physiological attributes, and on-court performances of elite badminton players. *Journal of Sports Medicine*, 40(7), 1–15.

An Experimental and Theoretical Study of the Crystalline NLO Material of 4-Methylpyridinium Succinate

Aneesha Kumari S. M

Research Scholar, Register Number: 22113112132005,
Manonmaniam Sundaranar University,
Abishekapatti, Tirunelveli-627 012, Tamil Nadu, India

S. E. Joema

Associate Professor, Department of Physics, Physics Research Centre,
Nesamony Memorial Christian College, Marthandam.

Email Id : sejoema@gmail.com

ABSTRACT

X-ray diffraction was used to study nonlinear optical (NLO) 4-methylpyridinium succinate (4MPS) single crystals that were created utilizing the slow evaporation method. Single crystal X-ray diffraction studies reveal that the 4MPS crystal belongs to a triclinic system with centrosymmetric space group P-1. Density functional theory (DFT) with the basis set B3LYP/6-31+G(d) was used to do the quantum chemistry calculations. First-order hyperpolarizability 4MPS and the theoretically optimal parameters HOMO-LUMO were also examined. The open and closed aperture Z-scan technique was used to experimentally measure the third order nonlinear optical characteristics.

Keywords: Slow evaporation, XRD, HOMO-LUMO, Z-scan

1. INTRODUCTION

Organic single crystals with high optical nonlinearity have found practical applications in harmonic generation, amplitude modulation, phasmodulation switching, and signal processing devices. Organic molecules are used in the integration of signal processing systems because of their significant third order nonlinearity and other properties [1]. Because of the electronegative nitrogen atom in the ring, 4-methylpyridinium succinate is a particularly electron-deficient organic molecule that can be used as an intermediate to create a number of significant compounds in the fields of medicines and agrochemicals [2-3]. The current work examines the crystal's growth, structural, HOMO-LUMO, and optical characteristics.

2. EXPERIMENTAL PROCEDURE

2.1 Synthesis Procedure

4-Methylpyridinium and succinic acid reacted to create the 4MPS single crystal. 4-Methylpyridinium and succinic acid aqueous solutions were made separately in a 1:1 ratio, and the solutions were combined by constant stirring four hours to achieve homogeneity. Whatman

filter paper is used to filter the solution, and the solution's temperature is held at room temperature until the procedure is finished. The resulting is then stored for crystallization using the slow evaporation method. After 30 days, high-quality crystals were produced. Figure 1 depicts the synthesized single crystal.



Figure1 4MPS single crystal

3. RESULT AND DISCUSSION

3.1 Single crystal X-RAY Diffraction

Single crystal x-ray diffraction (SXRD) analysis of 4MPS single crystal was carried out using Enraf – Nonius CAD4 X-ray diffractometer with $\text{MoK}\alpha$ ($\lambda = 0.71073 \text{ \AA}$) radiation. The single crystal X-ray diffraction (SXRD) data was achieved to know the crystalline nature of the synthesized material. It is observed that the compound crystallizes in the triclinic crystal system with the space group P-1. Table 1 Lattice parameters of 4MPS single crystal from XRD. The calculated unit cell parameter values are $a = 7.97 \text{ \AA}$, $b = 9.65 \text{ \AA}$, $c = 13.66 \text{ \AA}$, $\alpha = 103.46 (2)^\circ$, $\beta = 103.46$, $\gamma = 109.28 (2)^\circ$, and $V = 942 \text{ \AA}^3$. These values are found to be in good agreement with the reported data [4].

Table 1 Lattice parameters of 4MPS single crystal from XRD.

Cell parameters	4MPS
a	7.97Å
b	9.65Å
c	13.66Å

α	103.46 (2) ⁰
β	96.88 (2) ⁰
γ	109.28 (2) ⁰
Space group	P-1
Volume	942 Å ³
Crystal System	Triclinic

3.2 Frontier molecular orbital (HOMO-LUMO) analyses

HOMO and LUMO studies were used to confirm the charge transfer within the molecule. The lowest energy level in the molecular arrangement prior to its excited state is known as the LUMO value, whereas the greatest energy-based molecular orbital capacity that may supply an electron is known as the HOMO energy. Figure 2 depicts the 4MPS topologies of the HOMO and LUMO orbitals. The LUMO delocalizes above half of the succinate anion, while the HOMO is dispersed throughout the whole 4-Methylpyridinium cation. Furthermore, the charge exchange between the succinate anion and 4-Methylpyridinium cation in 4MPS could be demonstrated. Electronegativity controls an atom's capacity to concentrate on its own electrons. The affinity of an electron is determined by a ligand's capacity to identify one electron from the material donor group [5]. A low HOMO-LUMO energy gap indicates that the 4MPS crystal has high NLO activity. The 4.6 eV of the 4MPS substance was discovered.

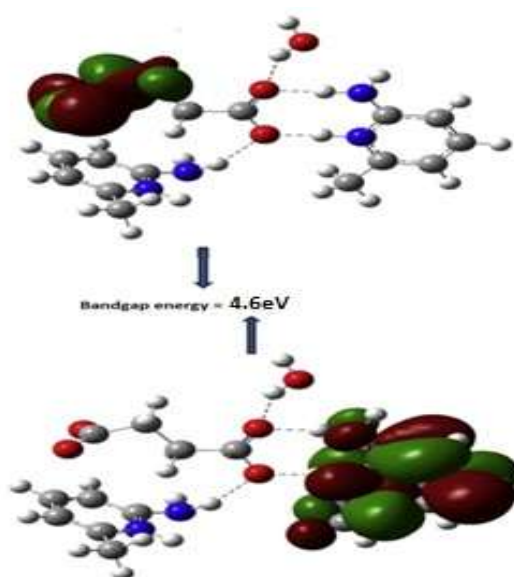


Figure 2 Molecular orbits of HOMO- LUMO

3.3. First-order hyperpolarizability

The nonlinearity of organic materials was illustrated by quantum chemical calculations of polarizability and first-order hyperpolarization. The hydrogen bond interaction between the donor and acceptor groups is the main focus [6] The polarizability and first-order hyperpolarity values of 4MPS compounds are displayed in Table 2.

Table 2 Polarizability and First-order hyperpolarizability of 4MPS

Polarizability		Firs-order hyperpolarizability	
a components (a.u)		β components (a.u)	
α_{xx}	487.418	β_{xxx}	10.684.857
α_{xy}	219,361	β_{xxy}	-19.299.345
α_{yy}	600.884	β_{xyy}	26006.675
α_{yx}	55.295	β_{yyy}	-37645.088
α_{yz}	-41.382	β_{xxz}	12968.463
α_{zz}	206.3 1	β_{xyz}	-17957.737
α_{tol} (e.s.u)	6.395×10^{-23}	β_{yyz}	26074.851
		b_{xzz}	12558.272
		b_{yzz}	-18194.929
		b_{zzz}	12697.183
		b_{tol} (e.s.u)	8.557×10^{-28}

The system's β value ($\beta_{yyz} = 26074.851$ a. u) makes it obvious that frequency conversion could be used. It shows that the growing compound's crystallographic orientation (β_{yyz}) saw an increase in charge transfer.

3.4 Nonlinear Optical Analysis

By using closed aperture and open aperture Z-scan measurements to determine the nonlinear refractive index, nonlinear absorption coefficient, and third order nonlinear optical susceptibility, the nonlinear optical characteristics of produced crystals were examined [7].

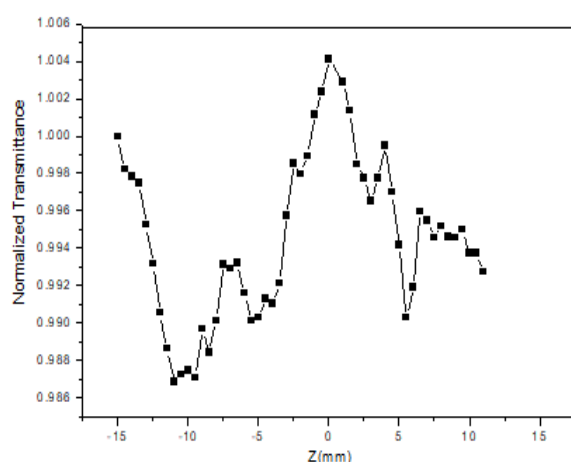


Figure 3 open aperture Z-scan curve of 4MPS

The corresponding z-scan traces are presented in figures . The sample's negative nonlinear refraction, which is a hallmark of the self-defocusing effect, is shown as a peak followed by a valley in the closed trace [8]. The propagating beam experiences phase distortion due to the local change in refractive index with temperature.

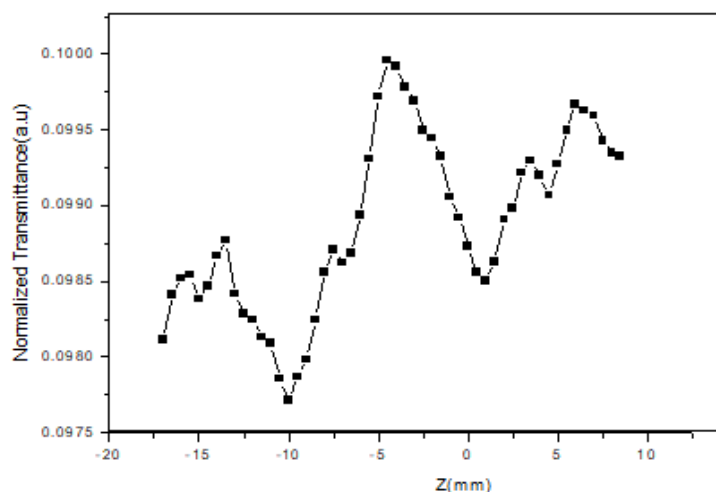


Figure 4 Closed aperture Z-scan curve of 4MPS

Conclusion

Crystal growth is an important process with many commercial and scientific uses. The 4MPS single crystal used in this experiment was created using a slow evaporation technique. The lattice properties of the developing crystal were obtained by X-ray diffraction analysis of a single crystal. The crystal belongs to space group P-1 of the triclinic crystal system, according to the single crystal x-ray diffraction investigation. The optimal parameters were calculated using the B3LYP16-311++G (d,p) basis created by the structure and other properties of 4MPS molecules, including First-order hyperpolarizability studies. The internal charge transfer interaction that produces an NLO activity is visible in the 4MPS, HOMO-LUMO energy gap. Since the formed crystal of 4MPS is centrosymmetric, it is subjected to the Z-scan technique to examine the nonlinear

References

1. Kajzar.F, Lee K.S, Jen A.Y. Polymers for Photonics application II; Springer; Berlin Heidelberg, (2003) Vol.161, 1-85.
2. AshokKumar, R., Ezhilvizhi R., Vijayan N., Rajanbabu D., Physica B, 406 (2011),2594.
3. Dong Xunyan,Quinn, Peter J, Wang, Xiaoyuan, 2012. Microbial Metabolic Engineering for L-Threonine Production. Subcell.Biochem.64, 283-302.

4. Esthakupeter M., ramasamy P., Spectrochim,Acta A,75 (2010),1417.
5. Dong Xunyan, Quinn, Peter J, Wang, Xiaoyuan, 2012. Microbial Metaboilc Engineering for L-Threonine Production. Subcell. Biochem. 64, 283 - 302.
6. S.Nandhini, P.Murugakoothan, 2021, synthesis, growth, optical, thermal, electrical,and third order nonlinear properties of an organic single crystal guanidinium 3, 5 dinitrosalicylate: a promising candidate for nonlinear optical application. opt.Mater.113,110714.
7. Dhanalakshmi B, S. Ponnusamy, C.Muthamizhchelvan, V.Subhashini, 2015, Journal of crystal growth 426(2015) 103-109.
8. Sreevalsa V.G, Jayalekshmi.S, 2011, Journal of crystal growth, 324, pp. 172-176.

IMPACT OF ROPE BASED TOTALLY PLYOMETRIC SCHOOLING ON SELECTED CORPORAL AND PURPOSEFUL VARIABLES OF VOLLEYBALL GAMERS

M. Venkatesh Prasath

Research Scholar

SRM Institute of Science and Technology, Trichy.

Email Id : venkat2904pitchai@gmail.com

Dr. R. Manickam,

Physical Director,

SRM Institute of Science and Technology, Trichy.

Abstract

Rope-based totally plyometric training is widely used to beautify explosive electricity, agility, and cardiovascular efficiency in athletes. In volleyball, these traits are crucial for leaping, quick moves, and average overall performance. Plyometric physical games stimulate neuromuscular variations and improve physical fitness and physiological ability, making them an effective training method for volleyball gamers (Bompa & Buzzichelli, 2015). the present have a look at aimed to observe the consequences of rope based plyometric physical activities on decided on physical health and physiological variables, specially explosive electricity, reaction time and resting coronary heart charge, among college-stage volleyball players. individuals have been selected from schools affiliated with Bharathidasan college, and a complete of 40 volleyball players elderly among 18 and 23 years voluntarily participated within the look at. The topics had been randomly assigned into two agencies: an experimental organization that underwent an eight-week education programme along with rope based plyometric exercises, and a manipulate group that did no longer participate in any based physical education in the course of the experimental duration. The training intervention turned into performed 5 days consistent with week and protected numerous lower- and top-frame plyometric exercises, and volleyball particular motion patterns emphasizing speedy course adjustments, leaping, and landing control. Explosive power, response time and resting coronary heart charge were assessed earlier than and after the schooling length the usage of standardized trying out protocols. Statistical analyses had been hired to decide the importance of differences between the pre- and post-take a look at scores of the two organizations. The outcomes discovered that the experimental organization confirmed huge enhancements in Explosive electricity, response time and resting heart fee whilst compared with the control institution. these findings endorse that the combination of rope based totally plyometric sporting events is

an powerful technique for enhancing key physical fitness and physiological components vital for volleyball overall performance. basic, the look at supports the inclusion of rope based plyometric sporting activities programmes as valuable conditioning strategies for enhancing Explosive power, response time and resting heart price among competitive volleyball gamers.

Keywords: Rope schooling, Plyometric training, Explosive electricity, response Time, Resting heart rate, physical education; Bharathidasan university.

Introduction

Volleyball is a dynamic and high-depth recreation that requires a aggregate of pace, strength, agility, persistence, and coordination. Players need to perform repeated jumping, brief directional adjustments, explosive movements, and fast reactions at some point of offensive and defensive play. Competencies together with spiking, blocking off, and serving demand a excessive level of physical fitness and physiological efficiency. Therefore, systematic schooling applications are critical to beautify the physical and purposeful capacities of volleyball gamers and to enhance their aggressive overall performance. Among numerous contemporary education methods, plyometric training has gained great attention due to its effectiveness in improving explosive electricity and neuromuscular coordination. Plyometric education refers to physical games that enable muscle tissues to attain maximal force inside the shortest viable time. It entails speedy stretching of a muscle (eccentric contraction) right away followed through a shortening motion (concentric contraction), called the stretch–shortening cycle. This mechanism improves the capability of muscle mass to produce explosive power, that's important for plenty sports activities moves which includes leaping, sprinting, and throwing. Plyometric physical games are widely used in sports activities education packages to enhance muscular electricity, agility, and typical athletic overall performance. in keeping with Donald A. Chu (1998), plyometric schooling improves neuromuscular performance and enhances the frame’s ability to generate explosive force all through athletic activities. In volleyball, explosive leg electricity and brief reflexes are essential for a hit performance. Gamers often carry out vertical jumps for spiking and blockading, which require speedy pressure manufacturing from the lower limbs. moreover, players need to circulate fast across the courtroom to get hold of and defend the ball. these moves depend greatly at the development of corporal variables inclusive of muscular electricity, speed, agility, and electricity, as well as practical variables such as cardiovascular patience, respiration efficiency, and recuperation potential. Education packages that correctly improve these bodily and physiological components can appreciably make contributions to progressed volleyball performance. One of

the progressive versions of plyometric education is rope-based totally plyometric training. This technique combines conventional plyometric physical games with the use of ropes or rope-leaping techniques to decorate coordination, rhythm, and explosive energy. Rope-based drills require athletes to carry out repeated jumps, short footwork patterns, and dynamic actions while preserving stability and coordination. Such training now not simplest improves lower-frame electricity however additionally enhances agility, foot speed, and neuromuscular coordination. moreover, rope-based totally plyometric education presents a cost-powerful and without difficulty implementable technique that may be completed in limited education areas without sophisticated equipment. **William *et al.*, (2015).**

Methodology

The study adopted a randomized experimental design to evaluate the effect of rope primarily based plyometric schooling on selected bodily and physiological variables among volleyball players. participants were selected from Bharathidasan college–affiliated colleges, and a complete of 40 volleyball gamers aged 18 to 21 years volunteered to participate in the studies. prior to data collection, all subjects have been briefed about the goals and tactics of the have a look at, and knowledgeable consent became obtained. the chosen members were then randomly divided into two agencies: an experimental organization and a manage institution. The experimental institution underwent an eight-week based education programme, carried out 5 days every week, which covered rope based plyometric education in the direction of the jumping actions result in the explosive electricity was measured by using sergeant leap test in centimeters, reaction time become measured by penny cup test in seconds and resting heart charge turned into measured by means of bio-reveal in seconds for the performance. The control organization did not participate in any prepared bodily education at some point of the observe period and maintained their ordinary day by day activities. Pre-check measurements of physical variables namely agility and stability had been collected the usage of standardized and extensively regular laboratory and discipline-testing tactics. Following the 8-week intervention, the identical checks had been administered as publish-tests to decide adjustments in physiological overall performance. All facts had been statistically analyzed using appropriate strategies, which includes imply, widespread deviation, and coupled t-test, to assess the importance of differences between pre- and publish-test rankings inside and among the groups. the extent of importance became set at 0.05, making sure that the effects have been scientifically legitimate and dependable. The methodological framework turned into designed

to offer a systematic and managed evaluation of the results of rope primarily based plyometric education at the bodily fitness and physiological variables of volleyball gamers.

TABLE-I Training Schedule for Rope Based Plyometric Training Of Volleyball Players

	Phase- I I to II	Phase- II III to IV	Phase- III V to VI	Phase- IV VII to VIII
Rope Based Plyometric Training	1. Basic Rope Jump 2. Alternate Foot Rope Jump 3. High Knee Rope Jump 4. Double Under Rope Jump 5. Side-to-Side Rope Jump 6. Forward and Backward Rope Jump	1. Single Leg Rope Jump (Left Leg) 2. Tuck Jump with Rope 3. Split Jump with Rope 4. Squat Jump with Rope 5. Lateral Rope Jump 6. Box Jump with Rope	1. Lateral Rope Jump 2. Box Jump with Rope 3. 180° Rotation Rope Jump 4. Cross Arm Rope Jump 5. Speed Rope Jump 6. Skater Rope Jump	1. Depth Jump with Rope 2. Bounding with Rope 3. Zig-Zag Rope Jump 4. Double Leg Hurdle Rope Jump 5. Single Leg Hurdle Rope Jump 6. Diagonal Rope Jump
Repetition	4-5	5-6	6-7	5-6
Sets	3	4	5	4
Rest	90 Seconds			
Total	90 Minutes			

TABLE – II Calculation of the ‘T’ Ratio for Explosive Power of Volleyball Players in the Experimental and Control Groups (Ranking in Centimeters)

Group	Test		Mean	Std. Deviation	T ratio
Explosive Power	Experimental Group	Pre test	50.78	0.62	17.40*
		Post test	55.74	0.55	
	Control Group	Pre test	50.70	0.57	0.30
		Post test	50.65	0.54	

*significant level 0.05 level (degree of freedom 2.09, 1 and 19)

Table II indicates the computed mean, standard deviation, and t-ratio for explosive strength in the experimental institution. The calculated t-ratio was 17.40, while the essential cost on the 0.05 degree of importance with 19 tiers of freedom was 2.09. Due to the fact the acquired t-ratio was more than the desk price, the development in agility for the experimental group became considered statistically big. In contrast, the manage institution produced a t-

value of zero.30, which turned into under the crucial fee of two.09, indicating that the trade in explosive power for the manipulate institution turned into now not statistically significant.

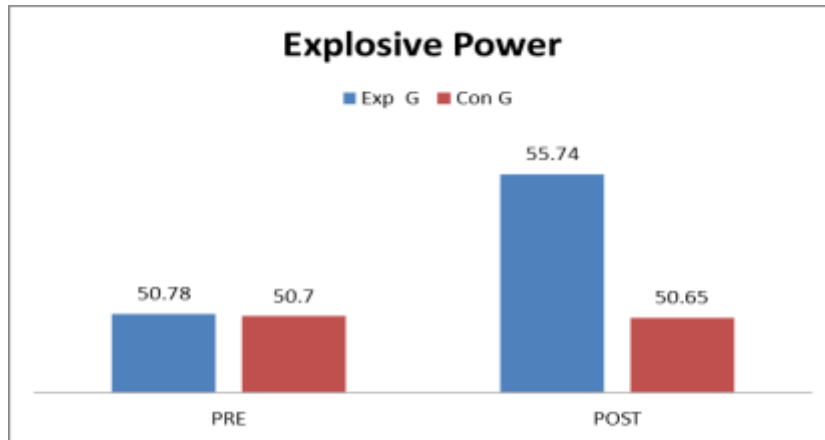


Figure I Bar Diagram Illustrating The Mean Explosive Power Of Volleyball Players In The Experimental And Control Groups

TABLE – III Multiplication of ‘T’ Ratio on Reaction Time of Volleyball Players on Investigational and Regulator Groups (Scores in Seconds)

Group	Test		Mean	Std. Deviation	T ratio
Reaction Time	Experimental Group	Pre test	7.26	1.53	4.33*
		Post test	5.60	1.08	
	Control Group	Pre test	7.20	1.41	1.21
		Post test	7.30	0.99	

*significant level 0.05 level (degree of freedom 2.09, 1 and 19)

Table III displays the computed mean, standard deviation, and ‘t’ ratio for reaction time in the experimental group. The obtained ‘t’ value for balance was 4.33, whereas the critical table value for degrees of freedom (df = 19) at the 0.05 level of significance was 2.09. Since the obtained ‘t’ value was substantially greater than the table value, the difference between the pre-test and post-test scores of the experimental group was determined to be statistically significant, signifying a notable improvement in reaction time development as a result of the intervention. Conversely, the control group achieved a ‘t’ value of 1.21, which was lower than the table value (2.09), indicating that there was no significant difference in reaction time for participants who did not undergo the RBPYT program.

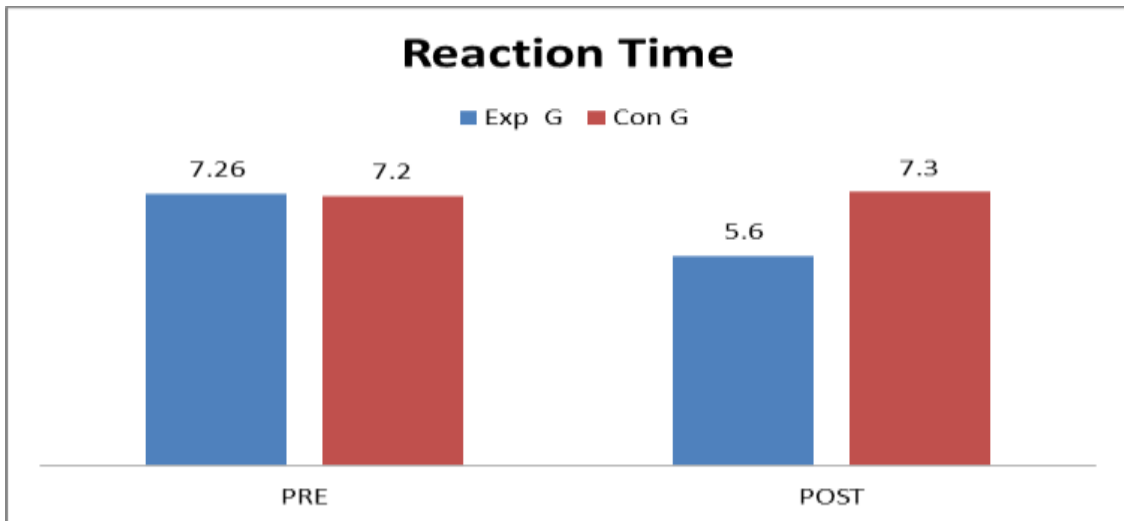


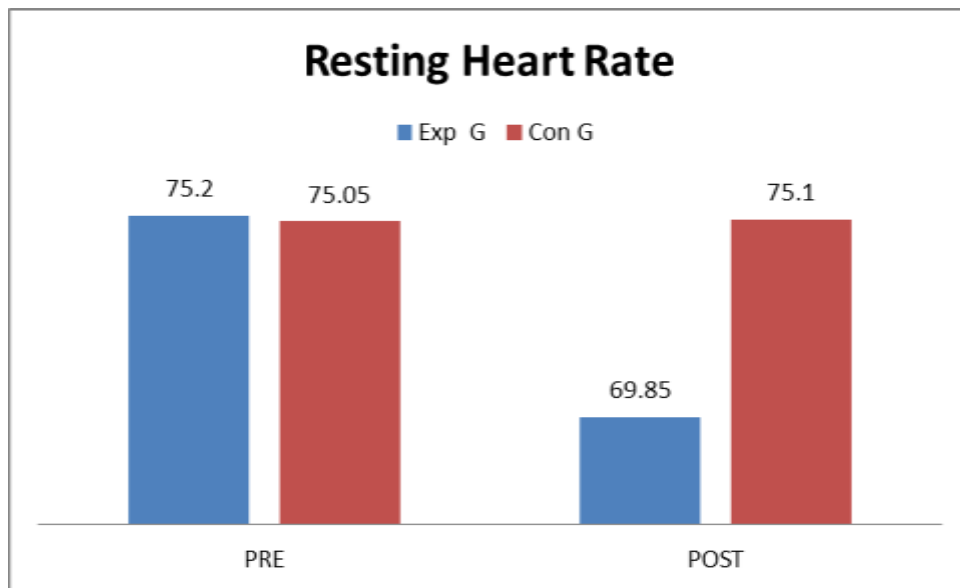
Figure- II tablet figure display the mean value on reaction time of volleyball players on investigational and regulator groups

TABLE – IV Multiplication of ‘T’ Ratio on Resting Heart Rate of Volleyball Players on Investigational and Regulator Groups (Scores in Seconds)

Group	Test		Mean	Std. Deviation	T ratio
Resting Heart Rate	Experimental Group	Pre test	75.20	3.20	20.18*
		Post test	69.85	2.90	
	Control Group	Pre test	75.05	3.63	0.57
		Post test	75.10	2.88	

*significant level 0.05 level (degree of freedom 2.09, 1 and 19)

Table III displays the computed mean, standard deviation, and ‘t’ ratio for resting heart rate in the experimental group. The obtained ‘t’ value for balance was 20.18, whereas the critical table value for degrees of freedom (df = 19) at the 0.05 level of significance was 2.09. Since the obtained ‘t’ value was substantially greater than the table value, the difference between the pre-test and post-test scores of the experimental group was determined to be statistically significant, signifying a notable improvement in resting heart rate development as a result of the intervention. Conversely, the control group achieved a ‘t’ value of 0.97, which was lower than the table value (2.09), indicating that there was no significant difference in reaction time for participants who did not undergo the RBPYT program.



Tablet figure display the mean value on resting heart rate of volleyball players on investigational and regulator groups

FINDINGS

The motive of the prevailing observe turned into to observe the results of rope primarily based plyometric sporting activities on decided on bodily fitness and physiological variables, particularly response time, explosive energy and resting listen fee amongst volleyball players.

Explosive Electricity

The findings found out a sizable improvement in explosive electricity amongst volleyball gamers who underwent rope-based totally plyometric education. From a biomechanical angle, plyometric physical activities make use of the stretch–shortening cycle, in which the muscles undergo fast eccentric contraction accompanied right now by a concentric contraction. This mechanism shops elastic energy inside the muscle mass and tendons and releases it throughout the propulsive section of movement. Rope-based plyometric drills including double-leg jumps, unmarried-leg jumps, and high-knee rope jumps beautify the pressure manufacturing potential of the decrease limb muscles, mainly the quadriceps, hamstrings, gastrocnemius, and gluteal muscles. As a result, athletes can generate greater vertical pressure at some stage in jumping actions required for spiking and blocking in volleyball. The repeated explosive movements enhance muscular power output, coordination, and efficiency of motion, thereby improving typical explosive performance.

Response Time

The results of the study indicated that rope-primarily based plyometric schooling

significantly stepped forward the reaction time of volleyball players in the experimental group as compared with the manipulate group. Biomechanically, repeated rope jumping drills beautify neuromuscular coordination and stimulate faster transmission of impulses between the sensory and motor pathways. The speedy stretch–shortening moves involved in plyometric moves enhance motor unit recruitment and synchronization, permitting athletes to reply extra speedy to outside stimuli. advanced proprioceptive remarks and quicker activation of the lower limb muscle mass make a contribution to quicker initiation of movement throughout volleyball movements consisting of receiving, blocking, and defensive play. thus, rope-based totally plyometric exercises definitely have an impact on response time by means of increasing neural performance and decreasing the put off between stimulus notion and muscular reaction.

Resting Coronary Heart Charge

The study additionally showed a vast discount in resting coronary heart charge some of the volleyball players who participated in rope-primarily based plyometric schooling. Physiologically and biomechanically, repeated high-depth plyometric actions growth cardiovascular efficiency and enhance oxygen utilization in the frame. Rope-based totally physical games contain continuous rhythmic jumping actions that stimulate the cardiovascular system and decorate stroke quantity of the heart. As training progresses, the coronary heart becomes extra green in pumping blood, allowing a extra extent of blood to be circulated with fewer beats. This adaptation outcomes in a decrease resting heart price, which shows advanced cardiovascular health and recuperation capability. The improved cardiac efficiency enables volleyball players to preserve excessive-depth activities during suits with decreased fatigue and faster recovery between rallies.

CONCLUSIONS

Primarily based on the findings of the take a look at, the following conclusions may be drawn regarding the outcomes of rope based plyometric training on explosive electricity, reaction time and resting heart charge become considerably changes of volleyball gamers.

BIBLIOGRAPHY

1. Tudor O. Bompá, T. O., & Carlo Buzzichelli, C. (2015). Periodization education for sports (3rd ed.). Human Kinetics.
2. Donald A. Chu. (1998). jumping into Plyometrics. Human Kinetics.
3. William D. McArdle, W. D., Frank I. Katch, F. I., & Victor L. Katch, V. L. (2015). exercising physiology: nutrients, power, and Human overall performance. Lippincott

Williams & Wilkins.

4. Yuri Verkhoshansky, Y., & Mel C. Siff, M. C. (2009). Supertraining (sixth ed.). closing Athlete standards..
5. Ramirez-Campillo, R., García-de-Alcaraz, A., Chaabene, H., Moran, J., Negra, Y., & Granacher, U. (2021). consequences of plyometric bounce schooling on physical health in novice and expert volleyball gamers: A meta-analysis. *Frontiers in body structure*, 12, 636140. <https://doi.org/10.3389/fphys.2021.636140>
6. Silva, A. F., Clemente, F. M., Lima, R., Nikolaidis, P. T., Rosemann, T., & Knechtle, B. (2019). The impact of plyometric training in volleyball players: a scientific evaluation. *international magazine of Environmental studies and Public health*, 16(16), 2960. <https://doi.org/10.3390/ijerph16162960>
7. Vassil, ok., & Bazanov, B. (2012). The impact of plyometric education application on younger volleyball gamers in their normal education length. *magazine of Human game and workout*, 7(1), 38–43. <https://doi.org/10.4100/jhse.2012.7.Proc1.05>
8. Haj Mohammadreza, T., & Ghazalian, F. (2023). The effect of six weeks of specific volleyball training and plyometric sporting events at the physical overall performance of woman volleyball gamers. *global magazine of sports activities technology and bodily schooling*, eight(three), 22–31. <https://doi.org/10.11648/j.ijsspe.20230803.11>
9. Marques Junior, N. ok., & Rodriguez Pinillo, I. (2025). Plyometric schooling: a scientific overview on extent and depth in excessive-level volleyball. *journal of sports activities and physical hobby*, 1(1), thirteen–25. <https://doi.org/10.64268/jospa.v1i1.4>
10. Pratama, H. G., Imandaqurani, D., Santoso, D. A., Candra, A. T., & Pratama, I. G. (2024). outcomes of plyometric exercising of adolescent male volleyball athletes: a scientific evaluation. *Pamukkale journal of game Sciences*, 15(2), 399–415. <https://doi.org/10.54141/psbd.1458129>

Systematic analysis of Piperazine derivative nonlinear optical single crystals

Anakha A.K

Research Scholar, Register Number: 21213112132012, Department of Physics,
Physics Research Centre,
Nesamony Memorial Christian College, Marthandam
Manonmanium Sundaranar University, Abishekapatti, Tirunelveli.

S.E Joema

Associate Professor,
Department of Physics, Physics Research Centre,
Nesamony Memorial Christian College, Marthandam.
Email Id : dr.sejoema@gmail.com

Abstract

Good quality piperazine 1,4-dium bis (4-nitrobenzoate) dihydrate crystals are grown by slow evaporation method at room temperature. The lattice parameters of the grown crystal are obtained from single crystal x-ray analysis. From the single crystal x-ray diffraction it is evident that the crystal belongs to triclinic crystal system with space group $P\bar{1}$. The [asymmetric unit](#) of the title molecular salt, $C_4H_{12}N_2^{2+} \cdot 2C_7H_4NO_4^- \cdot 2H_2O$ is composed of half a protonated piperazine dication, located about an inversion center, a benzoate anion and a water molecule of crystallization. The different functional groups present in the synthesized crystal lattice were analysed with FTIR spectral analysis. The transmittance ability and the cut off wavelength of grown sample was studied by UV-Visible transmittance spectral analysis.

Keywords: FTIR Analysis; UV-Visible transmittance spectral analysis; Hirshfeld analysis.

1. Introduction

Organic single crystals with high optical nonlinearity have been used for practical applications such as harmonic generation, amplitude modulation, phase modulation, switching and other signal processing devices(Ezhil Vizhi. R, Vijayalakshmi. M, 2016). Piperazine ($C_4N_2H_{12}$) is a secondary amine, which chemical compound present in the plant piper nigrum is an effective anthelmintic used as a treatment for the infestations by roundworm and threadworm. It is very active compound used in various biological applications and drugs(G. Maheshwaran et al, 2020) The [asymmetric unit](#) of the title molecular salt comprises half a protonated piperazine dication, a benzoate anion and a water molecule of crystallization. The piperazine dication is located about an inversion center and the ring has a chair conformation.

2. Synthesis and crystal growth

Piperazine and 4-nitrobenzoic acid were dissolved 50ml of distilled water and stirred well for 5hrs. Filtered the solution with high quality filter paper and allowed it to evaporation in a dust free environment. After 30 days crystal was formed in the mother solution. The grown crystal was shown in figure 1.

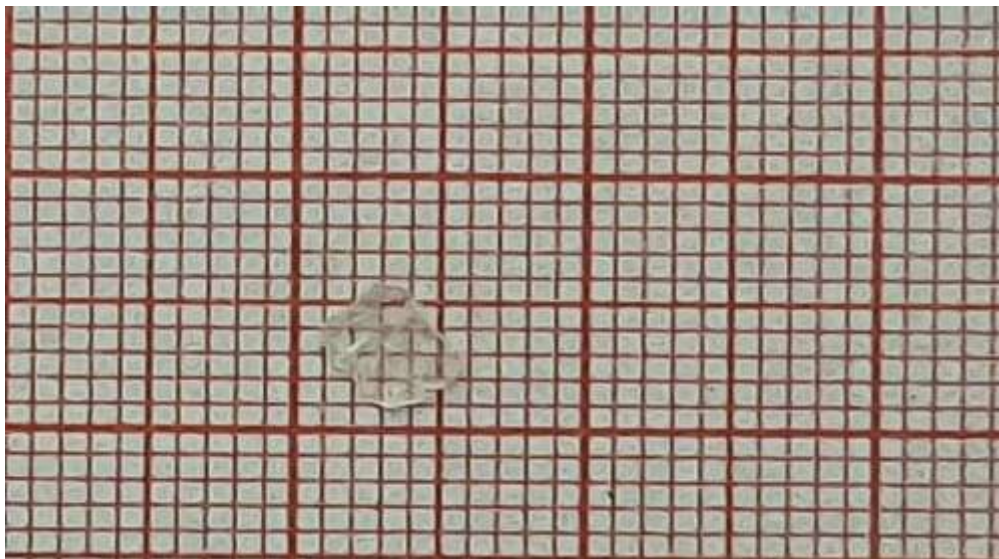


FIGURE 1: Photograph of the grown crystal

3. Characterization

The grown crystal has been subjected to structural, optical, thermal analysis. The unit cell parameters of the title compound were determined from single crystal X-ray diffraction using Enraf-Nonius CAD4 X-ray diffractometer and operational with monochromatic MoK α radiation. The FTIR spectrum of the crystal was recorded in the range of 400-4000 cm^{-1} by using KBr pellet technique with Perkin Elmer spectrometer. The optical transmittance of the grown crystal was recorded in the range 200-1100nm by carry with the help of Perkin-Elmer Lambda-35 spectrometer.

4. Results and discussion

4.1 Single crystal x-ray diffraction analysis

The single crystal X-ray diffraction analysis provides data of internal lattice parameters of the grown crystal. From this single crystal X-ray analysis it is evident that the Piperazine 1,4-dium bis(4-nitrobenzoate) dihydrate (PBND) belongs to triclinic crystal system with space group $P\bar{1}$. The lattice parameters of the PBND crystal is shown below.

DATA	PBND
a	6.5793 Å
b	6.8094 Å
c	12.3767 Å
α	92.085 ⁰
β	99.427 ⁰
γ	109.301 ⁰
Space group	P $\bar{1}$
Crystal system	Triclinic
Volume	513.81

Table 1: Lattice parameters of the crystal

4.2 FTIR spectral analysis

FTIR spectrum of PBND crystal was recorded in the region 400cm⁻¹- 4000cm⁻¹. The spectrum is shown in figure 2. The symmetric N-H stretching vibration is observed at 3245 cm⁻¹, depends upon the degree of hydrogen bonding between the atom. The C-H indicate the absorption of C-H stretching vibration. Carboxylic acids dimers display very broad, intense O-H stretching absorption in the region of 3300 - 2500 cm⁻¹. The peak in the spectrum of PBND at 2695cm⁻¹ corresponds to O-H stretching vibration. Ketones, aldehydes, carboxylic acid, carboxylic ester, lactones, acid halides, anhydrides, amides show a strong C=O stretching absorption in the region of 1870 - 1540 cm⁻¹. The band at 1628cm⁻¹ is for C = O (carbonyl) stretching vibration. The peak at 857cm⁻¹ indicating CH out of plane vibration .(R. Rajkumar, P.Praveen Kumar ,2018).

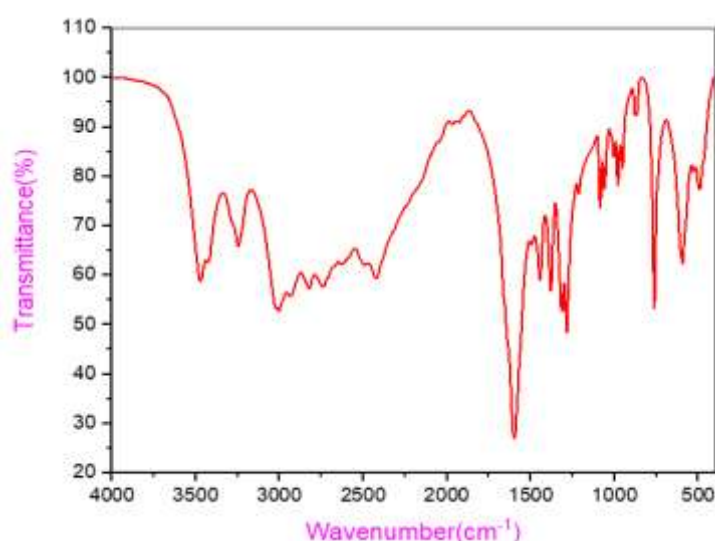


FIGURE 2: FTIR Spectrum of the crystal

4.3 Hirshfeld Analysis

Hirshfeld analysis is a method for partitioning the electron density of a crystal into atomic contributions. It provides a quantitative description of electron density distribution and allows for the calculation of various properties, such as atomic charges, bond order and intermolecular interaction energies. Crystal explorer 17.5 was used to analyze Hirshfeld analysis. The 2D fingerprint plot provides insight into the spatial arrangement of specific atom pairs. The element interactions are given in percentage. The Major contribution of elements is given in the image. The most frequent interaction is H-H interaction and its relative contribution reaches 52.86% due to the interaction of hydrogen atoms on the molecular surface. The second most strong interaction is the C-H contribution about 24.52%.

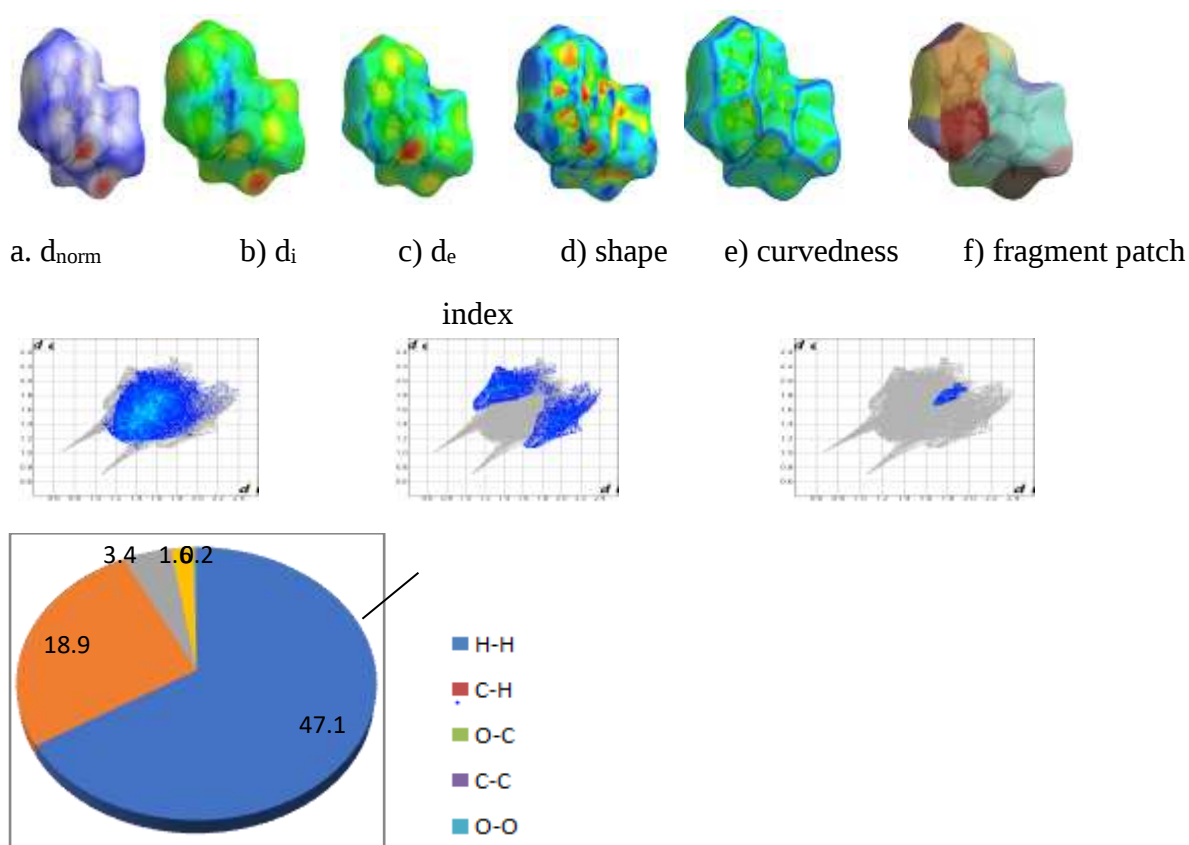


FIGURE 3: Hirshfeld Analysis of the crystal

4.4 UV-Visible spectral analysis

The transmittance of the crystal is very important in optical applications, With the help optical property, one can study the energy band structure, impurity levels, excitations, localized defects, lattice vibrations, and certain magnetic excitations (V.Sangeetha et al, 2014). The UV-Visible spectrum of the crystal is given in the figure 4. The spectrum was recorded in the range of 200 nm to 1100 nm. From the spectrum, it is observed that the crystal has a good

transparency in the entire visible region. The cut off wavelength obtained as 210 nm. From the Tauc's plot the crystal has band gap energy of 3.5 eV.

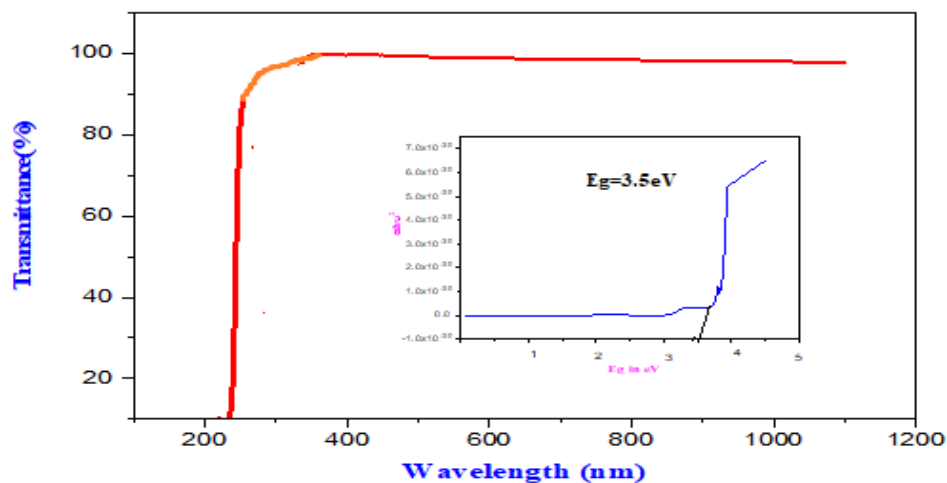


FIGURE 4: UV-Visible spectrum of the crystal

5. Conclusion

Single crystal of PBNB was grown by slow evaporation solution growth technique. Single crystal XRD study reveals that the PBNB crystal crystallizes in triclinic system. The functional groups were confirmed by FTIR analysis. TG/DTA studies shows the thermal stability and melting point of the PBNB crystal. The crystal is transparent in the visible region with a cut off wavelength of 210 nm. The outcomes of the several studies suggest that the PBNB crystal is a suitable candidate for device fabrication in optical limiting and photonic devices.

Reference

1. R. Ezhil Vizhi, M. Vijayalakshmi (2016), Bulk growth and characterization of novel organic Piperazinium (bis) hydrogen succinate single crystals.
2. G. Maheshwaran , K. Velsankar , G. Parvathy , R. Kaliammal , M. Krishna Kumar, S. Sudhahar (2020), Effective Growth and Characterization of Piperazinium Orthophthalate Single Crystal Yielding High Second Harmonic Generation Efficiency.
3. R. Rajkumar, P. Praveen Kumar(2018), Structure, crystal growth and characterization of piperazinium bis(4- nitrobenzoate) dihydrate crystal for nonlinear optics and optical limiting applications.
4. V.Sangeetha, K. Gayathri, P. Krishnan, N. Sivakumar, N.Kanagathara, G. Anbalagan, Growth, optical, thermal, dielectric and microhardness characterizations of melaminium bis(trifluoroacetate) trihydrate single crystal, J. Cryst. Growth 389 (2014) 30-38.

INFLUENCE OF CIRCUIT TRAINING ON HEART RATE AMONG COLLEGE MEN BASKETBALL PLAYERS

Jancy Merlin M

Research Scholar, Department of Physical Education & Sports,
Manonmaniam Sundaranar University, Tirunelveli- 627 012

Email Id : mjancym Merlin@gmail.com

Dr. P. Arthur Daniel

Director of Physical Education,
Scott Christian College, Nagercoil - 3

ABSTRACT

The purpose of the present study was to investigate the influence of circuit training on heart rate among college men Basketball Players. To achieve the purpose of the study thirty college men Basketball Players were selected from Department of Physical Education, St. Johns college, Palayamkottai, Tirunelveli during the year 2025. The subject's age ranges from 18 to 20 years. The selected players were divided into two equal groups consists of 15 men Basketball Players each namely experimental group and control group. The experimental group underwent circuit training programme for six weeks. The control group was not taking part in any training during the course of the study. Heart rate was taken as criterion variable in this study. The selected subjects were tested on heart rate was measured through the palpation method is at wrist (radial artery). Pre-test was taken before the training period and post- test was measured immediately after the six week training period. Statistical Technique 't' ratio was used to analyse the means of the pre-test and post test data of experimental group and control group. The results revealed that there was a significant difference found on the criterion variable. The difference is found due to circuit training given to the experimental group on heart rate when compared to control group.

Keywords: Circuit training, Heart rate and 't' ratio.

INTRODUCTION

The physical and physiological variables considered as the fundamental important in the training process upon which the training elements are completed, where achieving levels of performance associates with possession of levels of physical and physiological abilities by the player that is significantly related to skills and tactical performance (Khataiba, A.Z., 1996) Numerous training methods were developed to promote the level of performance, Circuit training method is one of the most recent methods for the team games. A Circuit exercise are known as changing speed or speed play, discriminates for other

methods that its work can be conducted in a similar feature to performance time during the games. Moreover, Circuit exercise considered as one of the most important training methods that work on developing the player's aerobic and anaerobic capacities (Hvilivilzky, B., 1999.)

METHODOLOGY

The purpose of the study was to find out the effect of circuit training on heart rate among college men Basketball Players. To achieve this purpose of the study, thirty college men Basketball Players were selected as subjects at random. The age of the subjects were ranged from 18 to 20 years.

The selected subjects were divided into two equal groups of fifteen subjects each, such as circuit training group (Experimental Group) and control group. The experimental group underwent circuit training for three days per week for six weeks. Control group, which they did not undergo any special training programme apart from their regular physical activities as per their curriculum.

The following physiological variable, namely heart rate was selected as criterion variable. All the subjects of two groups were tested on selected criterion variable heart rate was measured through the palpation method is at wrist (radial artery) test at prior and immediately after the training programme.

ANALYSIS OF THE DATA

The significance of the difference among the means of the experimental group was found out by pre-test. The data were analyzed and dependent 't' test was used with 0.05 levels as confidence.

TABLE – I Analysis of T-Ratio for the Pre and Post Tests of Experimental and Control Group on Heart Rate

Variables	Group	Mean		SD		Sd Error		df	't' ratio
		Pre	Post	Pre	Post	Pre	Post		
Heart rate	Control	69.13	68.73	1.30	1.33	0.34	0.34	14	1.31
	Experimental	68.80	66.07	1.74	1.16	0.45	0.30		10.25*

**Significance at .05 level of confidence.*

The Table-I reveals that the mean values of pre-test and post-test of the control group on heart rate were 69.13 and 68.73 respectively. The obtained 't' ratio was 1.31, since the obtained 't' ratio was less than the required table value of 2.14 for the significant at 0.05 level with 14 degrees of freedom it was found to be statistically insignificant. The mean values of

pre-test and post-test of the experimental group on heart rate were 68.80 and 66.07 respectively. The obtained 't' ratio was 10.25*since the obtained 't' ratio was greater than the required table value of 2.14 for significance at 0.05 level with 14 degrees of freedom it was found to be statistically significant. The result of the study showed that there was a significant difference between control group and experimental group in heart rate. It may be concluded from the result of the study that experimental group improved in heart rate due to six weeks of circuit training.

DISCUSSIONS ON FINDINGS

The result of the study indicates that the experimental group, namely circuit training group had significantly improved the selected dependent variable, namely heart rate, when compared to the control group. It is also found that the improvement caused by circuit training when compared to the control group. The result of this study on heart rate has in line with the study conducted by Abdelmohsen Zakaria Ahmed., (2011).

CONCLUSIONS

1. There was a significant difference between experimental and control group on heart rate after the training period.
2. There was a significant improvement in heart rate. However the improvement was in favour of experimental group due to six weeks of circuit training.

REFERENCES

1. Abdelmohsen Zakaria Ahmed., 2011., Effect of Using Circuit Exercises on Some Physical and Physiological Variables of Football and Volleyball Players, World Journal of Sport Sciences 5 (4): 225-231, © IDOSI Publications
2. Hvilivilzky, B., 1999. Try a little Circuit, Aerobics, fitness link home. Prentice Hall International, Inc.U.S.A
3. Khataiba, A.Z., 1996. Modern volleyball encyclopedia. Dar Elfekr El-Araby for printing and publishing, 1edition, Jordan, pp: 313.
4. Gettman, L. R., Ayres, J. J., Pollock, M. L., & Jackson, A. (1978). The effect of circuit weight training on strength, cardiorespiratory function, and body composition of adult men. *Medicine and Science in Sports*, 10(3), 171–176.
5. Alcaraz, P. E., Sánchez-Lorente, J., & Blazevich, A. J. (2008). Physical performance and cardiovascular responses to an acute bout of heavy resistance circuit training versus

- traditional strength training. *Journal of Strength and Conditioning Research*, 22(3), 667–671. <https://doi.org/10.1519/JSC.0b013e31816a588f>
6. Wilmore, J. H., Parr, R. B., Girandola, R. N., Vodak, P. A., Barstow, T. J., Pipes, T. V., & Leslie, P. (1978). Physiological alterations consequent to circuit weight training. *Medicine and Science in Sports*, 10(2), 79–84.
 7. McRae, G., Payne, A., Zelt, J. G., Scribbans, T. D., Jung, M. E., Little, J. P., & Gurd, B. J. (2012). Extremely low volume, whole-body aerobic–resistance training improves aerobic fitness and muscular endurance in females. *Applied Physiology, Nutrition, and Metabolism*, 37(6), 1124–1131. <https://doi.org/10.1139/h2012-093>
 8. Klika, B., & Jordan, C. (2013). High-intensity circuit training using body weight: Maximum results with minimal investment. *ACSM's Health & Fitness Journal*, 17(3), 8–13. <https://doi.org/10.1249/FIT.0b013e31828cb1e8>
 9. Murphy, E., & Schwarzkopf, R. (1992). Effects of standard set and circuit weight training on excess post-exercise oxygen consumption. *Journal of Applied Sport Science Research*, 6(2), 88–91.
 10. Assumpção, C. O., Lima, A. L. A., Oliveira, J. C., & Coelho, R. W. (2018). Cardiovascular and metabolic responses during functional and traditional training sessions. *Journal of Strength and Conditioning Research*, 32(10), 2816–2822. <https://doi.org/10.1519/JSC.0000000000002725>
 11. Nagle, F. J., Balke, B., & Nagle, C. M. (1965). Specificity of training and its effect on the physiological responses to prolonged exercise. *Journal of Applied Physiology*, 20(3), 538–542. <https://doi.org/10.1152/jappl.1965.20.3.538>
 12. Astorino, T. A., & Schubert, M. M. (2014). Individual responses to completion of short-term and chronic interval training: A retrospective study. *PLoS One*, 9(5), e97638. <https://doi.org/10.1371/journal.pone.0097638>
 13. Burgomaster, K. A., Howarth, K. R., Phillips, S. M., Rakobowchuk, M., Macdonald, M. J., McGee, S. L., & Gibala, M. J. (2008). Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *Journal of Physiology*, 586(1), 151–160. <https://doi.org/10.1113/jphysiol.2007.142109>

EFFECTS OF THERABAND AND WEIGHT TRAINING ON STRENGTH PARAMETERS

Dr. R. PETCHIMUTHU

Assistant Professor, Department of Physical Education,
St. Johns College, Palayamkottai, Tirunelveli.

Email Id: rpmuthu8@gmail.com

Abstract

The purpose of the study is to find out the effects of theraband training and weight training on strength parameters. To achieve the purpose of the this study, 36 male athletes are randomly selected as subjects from the Department of Physical Education and Sports, Manonmaniam Sundaranar University, Tirunelveli, Tamilnadu, India. The selected participants were divided into three groups such as Group A underwent theraband training (n=12), Group B underwent weight training (n=12) Group C acted as control (n=12). The training period was one hour approximately which included warming up and limbering down. Every week, training given only three alternative days for eight weeks. Control group was not exposed to any specific training but they were participated in regular activities. The data on maximum strength (upper body and lower body) were collected by administering by 1 RM bench press test and 1 RM Squat test. The pre and post tests data were collected on selected criterion variables prior and immediately after the training programme. It was concluded that, the experimental group namely weight training group had significantly improved the selected variable such as maximum strength (upper body and lower body) and a significant difference in improvement was found among weight training and theraband training groups in the selected criterion variables such as maximum strength (upper body and lower body).

Introduction

Weight training is fast becoming the most popular exercise today. Strength training was primarily used only for the strengthening and conditioning of a group of certain athletes. Maximum strength methods using free weights or other instruments. The main element of progression is the intensity of stimulation realized through the load increase. Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance (i.e. resistance to being pushed, squeezed, stretched or bent). Exercises are isotonic if a body part is moving against the force. Exercises are isometric if a body part is holding still against the force. Resistance exercise is used to develop the strength and size of skeletal muscles. Properly performed, resistance training can provide significant functional benefits and improvement in overall health and well-being.

Resistance training is a form of strength training in which each effort is performed against a specific opposing force generated by resistance (i.e. resistance to being pushed, squeezed, stretched or bent). Exercises are isotonic if a body part is moving against the force. Exercise are isometric if a body part is holding still against the force. Resistance exercise is used to develop the strength and size of skeletal muscles. Properly performed, resistance training can provide significant functional benefits and improvement in overall health and well-being. (Aaberg Everet, 1999).

Thera-Band elastic resistance devices have increased in popularity in the rehabilitation setting. There are six different colours of the band produced, each one varying from the others in the level of resistance offered. The least resistive band is yellow, and the next five colours gradually increase in resistive properties. The colours of the bands, from lowest to highest resistance are yellow, red, green, blue, black, and silver. As the elastic band is stretched, the resistance increases. This resistance provides a progressive stimulus to the muscle to build strength and help increase muscle mass. Simply performing an exercise program for as few as six weeks with elastic resistance can increase strength by 10 to 30 percent. The added benefits of elastic resistance training include increased muscle mass, power, and endurance and decreased body fat (Theraband, 2011).

Resistance band training and weight training both provide neural stimulation for strength, speed and power development. Most weight training methods are vertical loaded, meaning that the resistance is gravity-based which goes in one direction. Resistance band training can be done in multiple directions by placing the band's point of attachment in different heights, such as above one's head, chest level, or ground level. Its resistance changes throughout the exercise as one increase and decrease the tension of the band, while in weight training, the resistance is constant. Band training also emphasizes on eccentric load training or force reduction, where one has to control the speed of the movement when one returns the band to its original length (Vern Gambetta, 2006)

Methodology

To achieve the purpose of the this study, 36 male athletes are randomly selected as subjects from the Department of Physical Education and Sports, Manonmaniam Sundaranar University Tirunelveli, Tamilnadu, India, and their age ranged between 21 to 25 years and average of 22.8 years. The selected participants were divided into three groups such as Group A underwent theraband training (n=12) and Group B underwent weight training (n=12) Group C acted as control group (n=12). The training period was one hour approximately which included warming up and limbering down. Every week, training given only three alternative

days for twelve weeks. Control group was not exposed to any specific training but they were participated in regular activities. The data on maximum strength (upper body and lower body) were collected by administering by 1 RM bench press test and 1 RM Squat test. The pre and post tests data were collected on selected criterion variables prior and immediately after the training programme.

Results and Discussion

The collected data were statically analyzed by using analysis of covariance. It is used to determine the differences if any, among the adjusted post test means on selected criterion variables separately. The level of significance was fixed at 0.05 level of confidence.

Table-I Means, Standard Deviation And Adjusted Means For Maximum Strength (Lower Body) Among Experimental And Control Groups

Tests		Theraband Training Group	Weight Training Group	Control Group
Pre Test	Mean	77.5	94.79	68.33
	SD	13.22	13.21	16.00
Post test	Mean	81.75	103.33	69.16
	SD	13.57	14.43376	15.57
Adjusted post test mean		84.51	89.16	80.71

Table I shows, For the dependent variable maximum strength (Lower body), the means of pre test and post test, standard deviation and the adjusted means of the theraband training group were 77.5 ± 13.22 , 81.75 ± 13.57 , 84.51, for weight training group the means of pre test and post test, standard deviation adjusted means 94.79 ± 13.21 , 103.33 ± 14.43 , 89.16, for control group the means of pre test and post test, standard deviation adjusted means were 68.33 ± 16 , 69 ± 15.57 , 80.71.

Table-II Means, Standard Deviation and Adjusted Means For Maximum Strength (Upper Body) Among Experimental And Control Groups

Tests		Theraband Training Group	Weight Training Group	Control Group
Pre Test	Mean	58.333	60.25	46.666
	SD	8.0	8.06	7.1
Post Test	Mean	61.66	66.04	47.29
	SD	8.07	8.62	7.49

Table II shows, for the dependent variable maximum strength (upper body), the means of pre test and post test, standard deviation and the adjusted means of the theraband training group were 58.33 ± 8.00 , 61.66 ± 8.07 , 58.52 , for weight training group the means of pre test and post test, standard deviation adjusted means 60.25 ± 8.06 , 66.04 ± 8.62 , 60.58 for control group the means of pre test and post test, standard deviation adjusted means were 46.71 , 47.29 ± 7.49 , 55.89

Table III The Analysis of Covariance on Criterion Variables of Experimental and Control Group

Criterion Variable	Adjusted Post Test Means			Source of Variance	Sum of Square	df	Means Square	F-ratio
	Theraband Training Group	Weight Training Group	Control Group					
Maximum Strength (Upper body)	58.52	60.58	55.89	Between	83.782	2	41.891	8.730*
				Within	153.553	32	4.799	
Maximum Strength (Lower body)	84.51	89.16	80.71	Between	262.839	2	131.419	6.062*
				Within	693.709	32	21.678	

*Significant at 0.05 level confidence. Table value at 0.05 level confidence with df 2 and 32 are 3.30 respectively.

From the table – III, the obtained value of ‘F’ – ratio for *maximum strength (upper body and lower body)* for adjusted post test means was more than the table value of 3.30 for df 2 and 32 required for significant at 0.05 level of confidence. The result of the study indicates that there was a significant difference exists among the adjusted post test means of two experimental group and control groups on the improvement of *maximum strength (upper body and lower body)*.

Maximum strength (upper body and lower body) reveal that theraband training group, weight training group and control group had significant in maximum strength. The present study was supported by the findings of the following studies conducted on resistance training as independent variables such as Boyer (1990). The study revealed that the strength were significantly improved due to the influence of two modes of resistance training. Ghigiarelli, and Jamie Jude (2006) found that the use of EB and WC in conjunction with a general seven

week off season strength and conditioning program can increase overall maximum upper body strength in a sample of Div 1-AA football players.

**Summary of the Scheffe's Post Hoc Pair Wise Comparison On Maximum Strength
(Upper Body) Among Experimental And Control Groups.**

Theraband training group	Weight training group	Control group	Mean Difference	C.I.Value
58.52	60.59		2.07*	1.55
58.52		55.89	2.63*	1.55
	60.59	55.89	4.70*	1.55

CI value of scheffe's post hoc test *Significant at 0.05 level

The weight training (Adj.Mean = 60.59) significantly outperformed the theraband training (Adj.Mean = 58.52) in maximum strength upper body with adjusted mean differences of 2.07 (CI = 1.55) and also experimental groups, weight training and theraband training significantly outperformed the control group (Adj.Mean = 55.89) in maximum strength upper body with adjusted mean differences of 2.63 and 4.73 (CI = 1.55).

**Summary of the Scheffe's Post Hoc Pair Wise Comparison On Maximum Strength
(Lower Body) Among Experimental And Control Groups.**

Theraband training group	Weight training group	Control group	Mean Difference	C.I.Value
84.51	89.16		4.65*	2.26
84.51		80.71	3.80*	2.26
	89.16	80.71	8.45*	2.26

CI value of scheffe's post hoc test *Significant at 0.05 level

The weight training (Adj.Mean = 89.16) significantly outperformed the theraband training (Adj.Mean = 84.51) in maximum strength lower body with adjusted mean differences of 4.65 (CI = 1.55) and also experimental groups, weight training and theraband training significantly outperformed the control group (Adj.Mean = 80.71) in maximum strength lower body with adjusted mean differences of 3.80 and 8.45 (CI =).

Conclusions

From the analysis of the data, the following conclusions were drawn,

- ❖ The Weight training group outperformed the Theraband training group on maximum strength (upper body), maximum strength (lower body).
- ❖ Theraband and weight training groups significantly outperformed than the control group in maximum strength (upper body), maximum strength (lower body).

References:

1. Aaberg Everett, (1999). *Resistance Training Instruction*, Human kinetics, united states of America, p.VII
2. Bompa Tudor, O. (1999). *Total Training for young champions*. Champaign, IL: Human kinetics,p..4-105.
3. Boyer, B. T. (1990). A comparison of the effects of three strength training programs on women”, *The Journal of Applied Sport Science Research*, pub Id :103-365-232.
4. Ghigiarelli., & Jamie Jude. (2006). The Effects of a 7-Wk Heavy Elastic Band and Weighted Chain Program on Upper Body Strength and Upper Body Power in a Sample of Division 1-Aa Football Players”, *International Journal of Sports Medicine*, Etd-08042006-102934
5. “Theraband”(2011)retrievedfrom<http://www.buzzle.com/articles/theraband-exercise-made-simple.html> .
6. “Strength training” (2011) retrieved from <http://encyclopedia.thefreedictionary.com/strength+training>.

ENHANCING MOTOR PROFICIENCY THROUGH STRUCTURED GROSS AND FINE MOTOR ACTIVITIES IN CHILDREN

T. NAMBIYA @ MURUGANANTHI

Research Scholar, Dept. of Physical Education & Sports,
Manonmanium Sundaranar University, Tirunelveli. Tamilnadu.

Email Id: pessy376@gmail.com

Dr. J. KARTHIKEYAN

Department of Physical Education, Health Education and Sports,
M.D.T Hindu College, Tirunelveli – 10, Tamilnadu.

Abstract

Motor proficiency is a fundamental component of child development, influencing physical, cognitive, and social abilities. The present study investigates the impact of structured gross and fine motor activity programs on enhancing motor proficiency among children aged 6–10 years. Gross motor skills involve large muscle movements such as running, jumping, and balancing, while fine motor skills focus on precise movements involving smaller muscle groups, such as hand-eye coordination and object manipulation.

A total of 60 children were randomly divided into experimental and control groups. The experimental group underwent an 8-week structured motor activity program consisting of systematically designed gross and fine motor exercises, while the control group followed regular physical activity routines. Pre- and post-tests were conducted using standardized motor proficiency assessments.

The results revealed a significant improvement in motor proficiency among children in the experimental group compared to the control group. Improvements were observed in coordination, balance, agility, manual dexterity, and reaction time. The findings suggest that structured motor activity programs play a crucial role in enhancing overall motor development and should be integrated into school curricula and physical education programs.

Keywords: Motor Proficiency, Gross Motor Skills, Fine Motor Skills, Child Development, Structured Activity, Coordination, Balance, Manual Dexterity

Introduction

Motor proficiency is essential for children's overall growth and development. It contributes to physical fitness, academic readiness, and participation in daily activities. Gross motor skills enable children to perform large movements such as running and jumping, while fine motor skills are necessary for tasks like writing, drawing, and handling objects.

In recent years, reduced physical activity and increased screen time have negatively impacted children's motor development. Therefore, structured intervention programs focusing on both gross and fine motor skills are essential to enhance motor proficiency during early developmental stages.

Objectives of the Study

- To assess the level of motor proficiency among children
- To evaluate the effect of structured gross motor activities on motor development
- To analyze the impact of fine motor skill training on coordination and dexterity
- To compare the performance between experimental and control groups

Hypothesis

- There will be a significant difference between pre-test and post-test scores of the experimental group
- Structured motor activities will significantly improve motor proficiency compared to routine activities

Methodology

➤ Participants

- 60 children (age group: 6–10 years)
- Randomly divided into:
 - Experimental Group (n = 30)
 - Control Group (n = 30)

➤ Variables

- **Independent Variable:** Structured gross and fine motor activities
- **Dependent Variable:** Motor proficiency

➤ Training Program

Duration: 8 weeks

Frequency: 5 days per week

Session Duration: 45–60 minutes

➤ Training Components

Gross Motor Activities:

- Running drills

- Jumping and hopping exercises
- Balance beam walking
- Throwing and catching drills

Fine Motor Activities:

- Pegboard tasks
- Bead threading
- Drawing and coloring patterns
- Hand-eye coordination drills

➤ Tools for Data Collection

- Standardized Motor Proficiency Test
- Coordination and agility tests
- Manual dexterity assessments

➤ Statistical Analysis

- Paired t-test
- Independent t-test
- Level of significance set at 0.05

Results and Discussion

Table 1: Pre-Test and Post-Test Mean Scores

Group	Pre-Test Mean	Post-Test Mean	Mean Difference
Experimental Group	45.2	68.5	23.3
Control Group	44.8	50.1	5.3

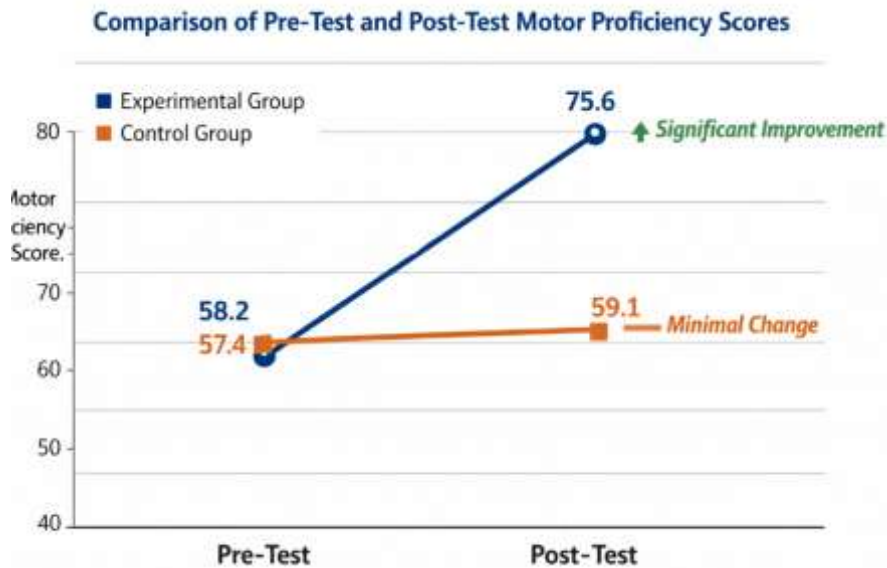
Table 2: t-test Analysis

Group	Mean Difference	t-value	Significance (p-value)
Experimental Group	23.3	8.45	0.001 (Significant)
Control Group	5.3	2.10	0.05 (Moderate)

Table 3: Improvement Percentage

Group	Improvement (%)
Experimental Group	51.54%
Control Group	11.83%

Figure 1 shows a significant improvement in motor proficiency scores in the experimental group compared to the control group



Interpretation

- The experimental group showed significant improvement
- Control group showed minimal improvement
- Structured activities contributed to better motor coordination and control

Discussion

The results indicate that structured gross and fine motor activity programs significantly enhance motor proficiency in children. The improvement is attributed to systematic progression, repetition, and skill-specific training. These findings align with developmental theories emphasizing the importance of early motor skill intervention.

Conclusion

The study concludes that structured gross and fine motor activities are highly effective in improving motor proficiency among children. Schools and educators should incorporate structured motor programs into regular physical education curricula to promote holistic development.

Recommendations

- Include motor skill programs in school curriculum
- Provide regular training for physical education teachers
- Encourage parents to involve children in motor skill activities
- Conduct further research with larger samples

References

1. Gallahue, D. L., & Ozmun, J. C. (2012). *Understanding Motor Development*.
2. Haywood, K. M., & Getchell, N. (2014). *Life Span Motor Development*.
3. Burton, A. W., & Miller, D. E. (1998). *Movement Skill Assessment*.
4. Payne, V. G., & Isaacs, L. D. (2017). *Human Motor Development*.
5. Clark, J. E. (2007). Motor development and learning.
6. Ulrich, D. A. (2000). *Test of Gross Motor Development (TGMD-2)*. Human Kinetics.
7. Bruininks, R. H. & Bruininks, B. D. (2005). *Bruininks-Oseretsky Test of Motor Proficiency (BOT-2)*. Pearson Assessment.
8. Logan, S. W., Robinson, L. E., Wilson, A. E., & Lucas, W. A. (2012). Getting the fundamentals of movement: A meta-analysis of the effectiveness of motor skill interventions in children. *Child: Care, Health and Development*.
9. Robinson, L. E. et al. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*.
10. Barnett, L. M., Van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood motor skill proficiency as a predictor of adolescent physical activity. *Journal of Adolescent Health*.
11. Stodden, D. F., Goodway, J. D., Langendorfer, S. J. et al. (2008). A developmental perspective on the role of motor skill competence in physical activity. *Quest*.
12. Goodway, J. D. & Branta, C. F. (2003). Influence of a motor skill intervention on fundamental motor skill development. *Research Quarterly for Exercise and Sport*.
13. Lubans, D. R., Morgan, P. J., Cliff, D. P. et al. (2010). Fundamental movement skills in children and adolescents: Review of associated health benefits. *Sports Medicine*.
14. Hands, B. (2008). Changes in motor skill and fitness measures among children. *Journal of Science and Medicine in Sport*.
15. Piek, J. P., Dawson, L., Smith, L. M. & Gasson, N. (2008). The role of early fine and gross motor development on later motor and cognitive ability. *Human Movement Science*.
16. Cameron, C. E., Brock, L. L., Murrah, W. M. et al. (2012). Fine motor skills and executive function both contribute to kindergarten achievement. *Child Development*.
17. Adolph, K. E. & Hoch, J. E. (2019). Motor development: Embodied, embedded, enculturated, and enabling. *Annual Review of Psychology*.

INTEGRATING FITLIGHT TECHNOLOGY WITH SAQ TRAINING FOR ENHANCING REACTIVE AGILITY AND PERFORMANCE IN VOLLEYBALL PLAYERS

P. NIVEDITHA

Research Scholar, Dept. of Physical Education & Sports,
Manonmanium Sundaranar University, Tirunelveli. Tamilnadu.

Email Id : nivibabu.sp@gmail.com

Dr. U. NARAYANI

Physical Director,
Sree Devi Kumari Women's College, Kuzhithurai, Kanyakumari.

Abstract

The integration of advanced training technologies has transformed modern sports performance enhancement. This study examines the effectiveness of combining FitLight technology with Speed, Agility, and Quickness (SAQ) training to improve reactive agility and overall performance in volleyball players. Volleyball requires rapid perception, decision-making, and execution under dynamic conditions. Traditional training methods often fail to replicate real-time reactive scenarios.

An experimental design was adopted with thirty collegiate volleyball players divided into experimental and control groups. The experimental group underwent a six-week structured FitLight-integrated SAQ training program, while the control group followed conventional training methods. Variables such as reactive agility, reaction time, offensive performance, and defensive performance were assessed before and after the intervention.

The findings revealed significant improvements in reactive agility, movement speed, and skill execution among the experimental group compared to the control group. The study concludes that integrating FitLight technology with SAQ training enhances neuromuscular coordination and cognitive-motor performance, making it an effective approach for volleyball training.

Keywords

FitLight Technology, SAQ Training, Reactive Agility, Volleyball Performance, Neuromuscular Coordination

Introduction

Volleyball is a high-intensity sport that demands rapid motor responses, agility, and precise coordination. Players must continuously react to unpredictable stimuli, making reactive

agility a key determinant of performance. Traditional drills primarily focus on physical conditioning but lack the cognitive stimulus required for real-game situations.

The emergence of technology-based systems like FitLight has introduced innovative training possibilities. FitLight uses wireless LED lights to create stimulus-response drills, enhancing reaction time and decision-making. When combined with SAQ training, which focuses on speed, agility, and quickness, it creates a comprehensive training model targeting both physical and cognitive domains.

This study explores the effectiveness of integrating FitLight with SAQ training in improving volleyball performance.

Need of the Study

- Traditional training lacks real-time reactive components
- Limited integration of cognitive and motor training
- Need for technology-driven performance enhancement
- Increasing demand for scientific training methods in volleyball

Objectives of the Study

- To evaluate the effect of FitLight-integrated SAQ training on reactive agility
- To assess improvements in reaction time
- To measure changes in offensive performance (spiking accuracy)
- To examine improvements in defensive performance (blocking and digging)

Hypotheses

- H1: There will be significant improvement in reactive agility after training
- H2: Reaction time will significantly improve in the experimental group
- H3: Offensive performance will improve significantly
- H4: Defensive performance will show significant enhancement

Methodology

➤ Participants

- 30 collegiate volleyball players (Age: 18–22 years)
- Divided into:
 - Experimental Group (n=15)
 - Control Group (n=15)

➤ **Research Design**

- Pre-test and Post-test Experimental Design

➤ **Variables**

Independent Variable:

- FitLight + SAQ Training

Dependent Variables:

- Reactive Agility
- Reaction Time
- Offensive Performance
- Defensive Performance

➤ **Training Protocol**

- Duration: 6 weeks
- Frequency: 5 days/week
- Session Duration: 30–40 minutes

Training Components:

- Light-based reaction drills
- Multi-directional SAQ drills
- Volleyball-specific offensive drills
- Defensive reaction drills

➤ **Tools and Tests**

- FitLight Training System
- Reactive Agility Test
- Illinois Agility Test
- Spike Accuracy Test
- Defensive Skill Assessment

Results and Analysis

Table 1: Pre- and Post-Test Scores

Variable	Group	Pre-Test Mean	Post-Test Mean	Improvement
Reaction Time (ms)	Control	225	220	-5
Reaction Time (ms)	Experimental	230	170	-60
Agility (sec)	Control	12.5	12.2	-0.3
Agility (sec)	Experimental	12.6	10.8	-1.8
Spike Accuracy (%)	Control	60	63	+3
Spike Accuracy (%)	Experimental	61	78	+17
Defensive Score	Control	55	58	+3
Defensive Score	Experimental	56	75	+19

Table 2: Mean Improvement Comparison

Variable	Control Group	Experimental Group
Reaction Time	Minimal	Significant
Agility	Slight	High
Offensive Skill	Moderate	High
Defensive Skill	Moderate	High

Figure 1: Comparison of pre- and post-test reaction time between control and experimental groups.

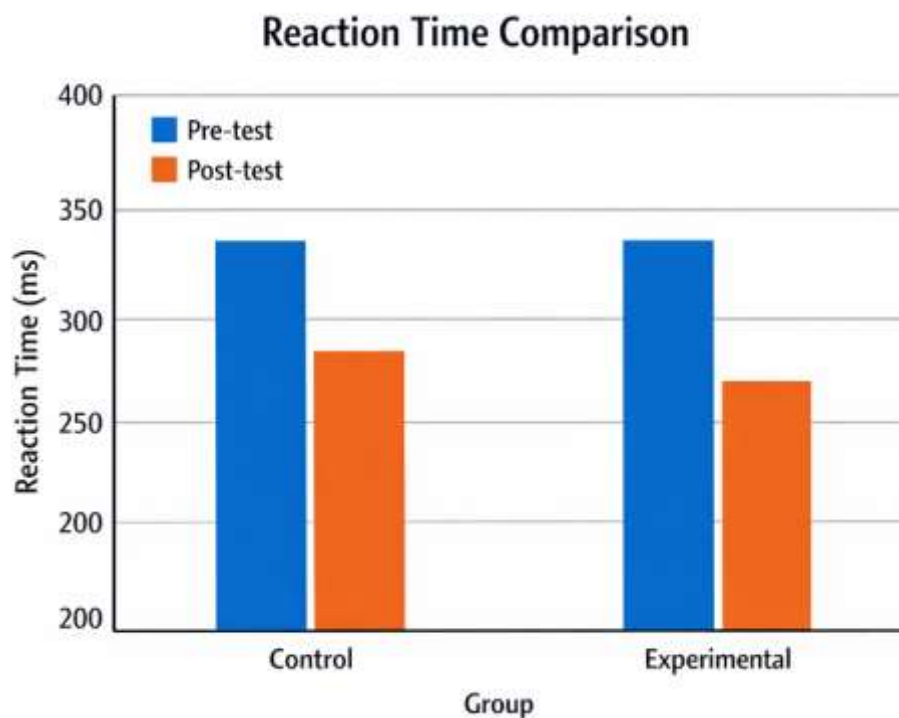


Figure 2: Comparison of agility performance between control and experimental groups.

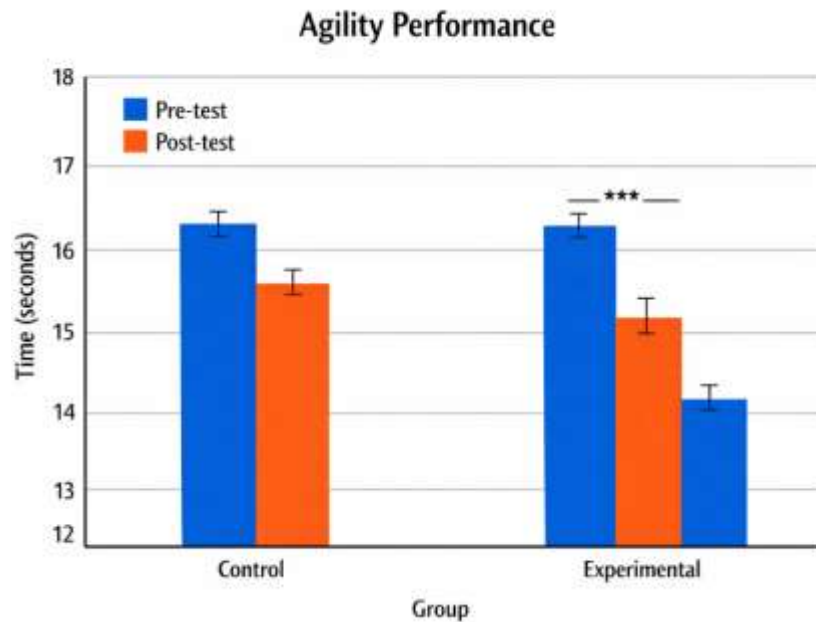
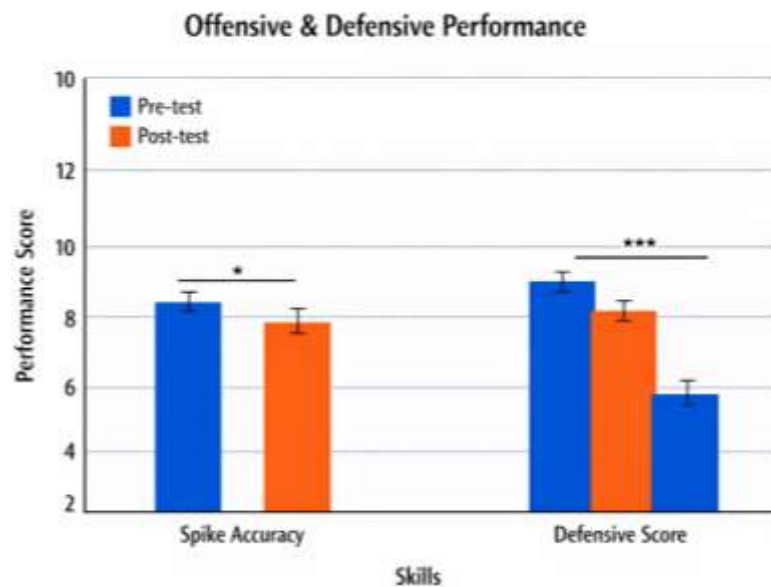


Figure 3: Comparison of offensive (spike accuracy) and defensive performance between groups.



Key Findings:

- Significant improvement in reactive agility
- Faster reaction time in experimental group
- Increased spike accuracy (offensive)
- Improved blocking & digging (defensive)

Experimental group outperformed control group in all variables.

Discussion

The results indicate that integrating FitLight technology with SAQ training enhances both cognitive and physical performance. The improvement in reactive agility is due to real-time visual stimuli, which enhances neural response speed.

SAQ training improved movement efficiency, while FitLight added decision-making complexity. This combination resulted in better coordination, faster reactions, and improved skill execution.

The study supports modern training approaches that combine technology + neuromuscular training.

Practical Applications

- Useful for coaches and trainers
- Enhances game-specific performance
- Improves athlete engagement
- Can be applied to multiple sports

Conclusion

The integration of FitLight technology with SAQ training significantly improves reactive agility and volleyball performance. This approach enhances both cognitive processing and physical execution, making it highly effective for modern sports training.

References

1. Tudor O. Bompa, & Carlo Buzzichelli (2019). *Periodization Training for Sports* (3rd ed.). Human Kinetics.
2. Richard A. Schmidt, & Timothy D. Lee (2014). *Motor Learning and Performance: From Principles to Application* (5th ed.). Human Kinetics.
3. Warren B. Young, & Darren Farrow (2006). A review of agility: Practical applications for strength and conditioning. *Journal of Sports Sciences*, 24(9), 919–932.
4. John M. Sheppard, & Warren B. Young (2006). Agility literature review: Classifications, training, and testing. *Journal of Sports Sciences*, 24(9), 919–932.
5. Thomas R. Baechle, & Roger W. Earle (2008). *Essentials of Strength Training and Conditioning* (3rd ed.). Human Kinetics.

6. Michael W. Voss, Arthur F. Kramer, Chandramallika Basak, et al. (2010). Are expert athletes “expert” in the cognitive laboratory? *Applied Cognitive Psychology*, 24(6), 812–826.
7. Bruce Abernethy (1990). Expertise, visual search, and information pick-up in sport. *Perception*, 19(1), 63–77.
8. T. Little, & A. G. Williams (2005). Specificity of acceleration, speed, and agility in professional athletes. *Journal of Strength and Conditioning Research*, 19(1), 76–78.
9. J. M. Sheppard, T. Gabbett, & L. C. Stanganelli (2009). An analysis of playing positions in volleyball. *Journal of Strength and Conditioning Research*, 23(6), 1858–1866.
10. Marco C. Marques, & Juan José González-Badillo (2006). In-season resistance training in volleyball players. *Journal of Sports Medicine*, 27(6), 563–572.
11. Arnold Baca, & Peter Kornfeind (2012). Rapid feedback systems in sports training. *Procedia Engineering*, 34, 522–527.
12. David G. Liebermann et al. (2002). Advances in the application of information technology to sport performance. *Journal of Sports Sciences*, 20(10), 755–769.
13. Mark Upton (2011). The role of visual training in improving reaction time in athletes. *International Journal of Sports Science*.
14. G. Raiola (2017). Motor learning and technology in sports performance. *Journal of Physical Education and Sport*, 17(3), 1500–1505.

ROLL OF MULTIMEDIA IN SHOT PUT PERFORMANCE

Dr. V. VASUDEVA RAO

Sports Officer, IIT Madras, Chennai.

Email Id: chinnirocks009@gmail.com

Mr. V. JANARDHANA

Physical Education Trainer, Sri Chaitanya Future Pathways,
Miyapur, Hyderabad.

Abstract

The present study aimed to investigate the role of multimedia in the development of coaching programmes for throwers, particularly in the shot-put event. To accomplish this objective, twenty-four participants aged between 18 and 21 years were randomly selected from IIT Jodhpur, Rajasthan, India. All participants were pursuing Track and Field as part of their theoretical and practical curriculum. The subjects were randomly assigned into two groups: the Multimedia Assisted Instruction Group (MAIG) (n = 12) and the Traditional Instruction cum Control Group (TICG) (n = 12). The MAIG group received instruction through computer-based methods such as video demonstrations and clips related to shot put techniques, whereas the TICG group was taught through conventional lecture and demonstration methods covering identical content. Pre-test and post-test assessments were conducted to evaluate skill and performance. The experimental programme was conducted over a period of eight weeks, with three sessions per week on alternate days, in addition to the regular academic schedule. No effort was made to equalize the groups at the initial stage; therefore, Analysis of Covariance (ANCOVA) was applied to adjust for initial differences and to compare the post-test means (Broota, 1989). All statistical analyses were carried out at a 0.05 level of significance ($P < 0.05$). Descriptive statistics were also used to assess students' attitudes toward multimedia courseware and computer usage. The findings revealed a significant difference between the multimedia-assisted instruction group and the traditional instruction group in relation to the selected dependent variables. Moreover, the multimedia-assisted instruction group achieved higher performance scores compared to the traditional instruction group.

Introduction

Advancements in science and technology have brought remarkable changes, and their application in sports has significantly enhanced performance. The integration of scientific methods and technological tools is highly beneficial for improving athletic outcomes. Success in any sport depends on a combination of both physical and psychological abilities. Athletes often use various mental preparation techniques such as visualization, mental rehearsal,

imagery, and mental practice. These concepts essentially involve creating or recreating experiences in the mind to improve performance.

The rapid growth of information technology has introduced several advantages to instructional methods. While traditional teaching approaches continue to be widely used, many educational institutions have begun incorporating computer-based technologies as part of their instructional strategies (Bull, Harris, Loyd, & Short, 1989).

Statement of the Problem

The study aimed to examine the impact of multimedia on the development of coaching programmes for throwers, particularly shot-put athletes.

Methodology

To accomplish the objective of the study, twenty-four participants were randomly selected from IIT Jodhpur, Rajasthan, India, with ages ranging between 18 and 21 years. All participants were enrolled in Track and Field as part of both their theoretical and practical coursework.

The subjects were randomly assigned into two groups: the Multimedia Assisted Instruction Group (MAIG) (n = 12) and the Traditional Instruction cum Control Group (TICG) (n = 12). The MAIG group was taught using computer-based instructional methods, including video presentations and clips related to the shot-put event. In contrast, the TICG group received conventional instruction through lectures and demonstrations covering the same content. Pre-test and post-test assessments were conducted to evaluate skill and performance.

The experimental programme was carried out over a period of eight weeks, with three sessions per week conducted on alternate days, in addition to the participants' regular academic schedule.

Selection of Variables

Dependent Variables

The following criterion variables were selected as dependent variables such as, throwing skill, throwing performance (Shot Put) and attitude towards multimedia assisted instruction.

Independent Variables

- Multimedia Assisted Instruction
- Traditional Instruction

Selection of Tests

As per the available literature the selected variables were tested by using the following standardized tests and they were presented in Table I.

TABLE I - Test Selection

Sl. No	Variables	Tests	Units of Measurements
1	Throwing Skill	Expert rating	10-point scale
2	Performance	Regular Throwing Event	In seconds
3	Attitude	Attitude Scale	In points

Experimental Design

A randomized pre-test and post-test design was used for this study. The participants were divided into two groups: Group I (n = 12), which received Multimedia Assisted Instruction, and Group II (n = 12), which followed Traditional Instruction and served as the control group. All participants were assessed on skill and performance before and immediately after the experimental period. In addition, the attitude of the students was evaluated at the end of the training programme.

Statistical Procedures

No attempt was made to equate the groups in any manner. Hence, to make adjustments for difference in the initial means and test the adjusted post test means for significant differences, the analysis of covariance (ANCOVA) was used (Broota, 1989). All the above statistical analysis tests were computed at 0.05 level of significance ($P < 0.05$).

Analysis and Discussion of Data

Table II presents pre and post test means, standard deviations, and adjusted post test means of each dependent variable by the multimedia assisted instruction and traditional instruction.

TABLE II - Means, Standard Deviations and Adjusted Means for Each Dependent Variable by the Training Groups

Tests			Multimedia assisted instruction	Traditional instruction
Skill	Pre test	Mean	4.95	5.15
		SD	0.61	0.60
	Post-Test	Mean	8.75	7.75
		SD	0.45	0.62
	Adjusted Mean		8.76	7.74

Performance	Pre test	Mean	442.54	444.80
		SD	4.54	5.55
	Post-Test	Mean	474.42	465.67
		SD	4.03	4.05
	Adjusted Mean		474.61	465.48

To examine if there were statistically significant improvement in dependent variables of multimedia assisted instruction and traditional instruction separately, paired sample t-test was computed.

TABLE III - Paired Sample t -Test for Pre and Post Test Means of Selected Dependent Variables

Variables	Multimedia assisted instruction	Traditional instruction
Skill execution	11.08*	11.03*
Throwing Performance	22.48*	18.82*

* Significant at 0.05 level. t value with df 11 is 2.20.

Multimedia assisted instruction: The t-test value of df 11, skill execution 11.08 ($p = .000$) and throwing performance 22.48 ($p = .000$) respectively. This means that the multimedia assisted instruction had significantly improved skill execution and throwing performance of the subjects.

Traditional instruction: The t-test value of df 11, skill execution 11.03 ($p = .000$) and throwing performance 18.82 ($p = .000$) respectively. This means that the traditional instruction had effects on participants' skill execution and throwing performance.

Table IV presents the results of the univariate ANCOVA tests of three dependent variables (Skill, Performance, and Cognitive Knowledge).

TABLE IV - Results of Analysis of Covariance for the Selected Dependent Variables among Two Groups

Variables	Obtained 'F'-ratio	ETA²	Account of Variance	Sig.
Skill Execution	29.04	0.581	58%	.000
Throwing Performance	20.08	0.489	49%	.000

(The table value required for 0.05 level of significance with df 1 & 22 is 4.30)

Skill: The F ratio of skill (1, 22) was 29.04 ($p = .000$). This means that the training methods had main effects on skill. These effects accounted for 58% of the variance on skill ($\text{Eta}^2 = 0.581$).

Performance: The F ratio of Performance (1, 22) was 20.08 ($p = .000$). This means that the training methods had main effects on Performance. These effects accounted for 49% of the variance on Performance ($\text{Eta}^2 = 0.489$).

The ANCOVA analysis comparing the two groups on the selected dependent variables revealed a statistically significant difference between them. It was concluded that the group receiving multimedia-assisted instruction performed better than the traditional instruction group in enhancing skill execution and throwing performance in shot put.

Mean and Standard Deviation are computed for the attitude towards multimedia assisted instruction and the results have been presented in table V.

TABLE V - The Summary of Mean and Standard Deviation on Attitude of Maig Towards Multimedia Assisted Instruction

Variable	Mean	Standard Deviation
Attitude towards Multimedia assisted instruction	80.17	± 7.26

From the table V, the mean value of multimedia assisted instruction group on attitude towards multimedia assisted instruction is 80.17, which is scored 80.17% of the total score. It is concluded that there was a positive attitude among selected subjects in using multimedia assisted instruction as teaching and learning methods and also it is noted that the multimedia assisted instruction proves to be effective to cater to the needs of a learner.

Conclusions

The following conclusions were derived from the study:

- The multimedia-assisted coaching programme (MAIG) resulted in a significant improvement in skill execution (learning achievement) and throwing performance in shot put among the participants.
- The traditional instruction cum control group (TICG) also showed a significant enhancement in skill execution (learning achievement) and throwing performance in the throwing event.
- A significant difference was observed between MAIG and TICG with respect to skill execution (learning achievement) and throwing performance in shot put.

- The multimedia-assisted instruction group demonstrated superior performance compared to the traditional instruction cum control group in improving both skill execution (learning achievement) and throwing performance.

References

1. Bull, G., Harris, J., Loyd, J., & Short, J. (1989). The Electronic Academical Village. *Journal of Teacher Education*, 40:4, 27-31.
2. Bull, G., Sigmon, T., & Shidisky, C. (1991). Specifications for Computer Networks for Support of Cooperative Ventures Between Universities and Public Schools. *Computers in Schools*, 8:1, 183-185.

An Analytical Study of Biomechanics of Tennis Forehand Power

Dr. S. T. V. Perumal

D.P.E. (Rtd), Gallette Recreation Tennis Club, Tenkasi.

Email Id : stv.tenkasi@gmail.com

Dr. S. Natarajan Sankar

Director of Physical Education I/c,

Sri Paramakalyani College, Alwarkurichi, Tenkasi District.

Abstract

The tennis forehand is one of the most important offensive strokes in modern tennis and plays a critical role in match performance. The generation of power depends on efficient coordination of body segments through the kinetic chain. This study analyzes biomechanical factors such as lower limb force production, trunk rotation, upper limb kinetics, muscle activation, and racket dynamics.

The study highlights that forehand power is generated through coordinated whole-body movement rather than isolated arm strength.

Introduction

Tennis is a dynamic sport requiring strength, coordination, speed, and technique. The forehand is the most frequently used and powerful stroke in modern tennis. Biomechanical analysis shows that power generation depends on the kinetic chain, where energy is transferred from the lower body to the upper body and finally to the racket. Understanding biomechanics helps improve performance and prevent injuries.

Objectives of the Study

1. To analyze the biomechanical structure of the tennis forehand.
2. To study the role of lower limb force production.
3. To examine trunk rotation and core contribution.
4. To evaluate upper limb joint actions.
5. To understand kinetic chain energy transfer.
6. To identify muscle activation patterns.
7. To provide performance improvement recommendations.

Review of Literature

Previous studies have shown that shoulder internal rotation and trunk rotation are major contributors to racket speed. Research also highlights the importance of lower body force

generation and efficient segment sequencing. EMG studies indicate that elite players demonstrate earlier and better muscle coordination compared to beginners.

Methodology

This analytical study is based on secondary data collected from published research in sports biomechanics. Tools commonly used in biomechanical research include high-speed cameras, 3D motion analysis, force plates, and electromyography (EMG). Variables analyzed include joint angles, angular velocity, ground reaction force, and racket head speed.

Phases of Tennis Forehand

The forehand consists of four phases: preparation, acceleration, impact, and follow-through. During preparation, the player performs a unit turn and knee flexion. In the acceleration phase, energy is generated from the legs and transferred through the trunk and arm. Maximum racket speed occurs just before impact. The follow-through helps reduce injury risk.

Biomechanical Factors Affecting Power

Lower limb drive initiates the kinetic chain. Trunk rotation contributes significantly to racket speed. Shoulder internal rotation, elbow extension, and wrist motion provide final acceleration. Efficient timing between body segments is essential for maximum power generation.

Performance Enhancement

Players should focus on lower body strength, core stability, and rotational power. Training methods include squats, lunges, medicine ball throws, plyometrics, and technical drills emphasizing weight transfer and timing.

Injury Prevention

Poor biomechanics may lead to shoulder injuries, tennis elbow, and lower back pain. Proper warm-up, strengthening exercises, and correct follow-through technique help reduce injury risk.

Conclusion

Forehand power in tennis is generated through coordinated whole-body movement. The kinetic chain, lower limb force, trunk rotation, and proper sequencing are essential for maximizing performance. Understanding biomechanical principles helps players improve efficiency and reduce injuries.

References

1. Elliott, B., Reid, M., & Crespo, M. (2003). Biomechanics of Advanced Tennis.
2. Roetert, E. P., & Kovacs, M. (2009). Biomechanics of the tennis groundstrokes.
3. Martin, C. et al. (2012). Muscle coordination during the tennis forehand.
4. Knudson, D. (2006). Fundamentals of Biomechanics.
5. Reid, M., Elliott, B., & Alderson, J. (2007). Shoulder loading in tennis strokes.

Comparative Analysis of Postural Characteristics among Sports and Non-Sports Participating School Boys

P. Chermaraja

SSV Higher Secondary School, Tenkasi, Tamil Nadu, India

Dr. J. Josephin Priyanka

Govindammal Aditanar College for Women,

Thoothukudi, Tamil Nadu, India

Email Id : jjosephin1992@gmail.com

Abstract

This study examines differences in postural alignment between sports-participating and non-participating school boys. A total of 300 boys aged 8–13 years were analyzed using a standardized posture rating method. The results indicate that sports participation contributes to improved posture and reduced deformities. The study highlights the importance of physical activity in maintaining musculoskeletal health.

Keywords: Posture, Sports Participation, School Children, Physical Activity

Introduction

Posture is essential for maintaining proper body alignment and musculoskeletal health. Poor posture in childhood can lead to long-term complications. Reduced physical activity and sedentary habits are major causes of postural deformities. Participation in sports enhances strength and flexibility, helping maintain proper posture.

Body posture refers to the alignment of various body segments during standing, sitting, or movement. Proper posture is essential for efficient functioning of the musculoskeletal system. During childhood, poor posture may gradually develop into structural deformities if not addressed early.

In recent years, reduced physical activity and increased sedentary habits have contributed to postural problems among school children. Engaging in sports activities enhances muscle strength, flexibility, and coordination, which support proper body alignment. Therefore, examining the influence of sports participation on posture is essential.

Methodology

Three hundred school boys aged between 8 and 13 years were selected from schools in Tirunelveli district. They were categorized into:

- Sports group (n = 150)
- Non-sports group (n = 150)

- Tool: New York Posture Rating Test
- Variables: Neck, Shoulder, Spine

Results

Neck

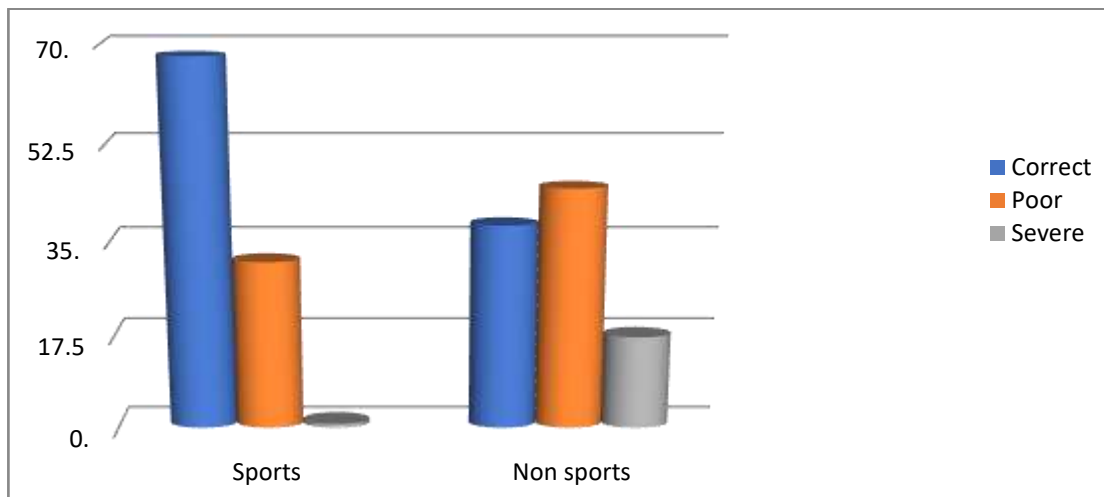
The Percentage of NECK School boys between participating and nonparticipating in sports activities were collected and Presented in Table I.

Table I

Group	Correct %	Poor %	Severe %
Sports	68	31.3	0.7
Non-Sports	38	44.7	17.3

Table I shows that the Percentage of the neck School boys between participating and nonparticipating in sports activities.

Figure I



The Percentage of neck School boys between participating and nonparticipating in sports activities were graphically represented in figure I.

Shoulder

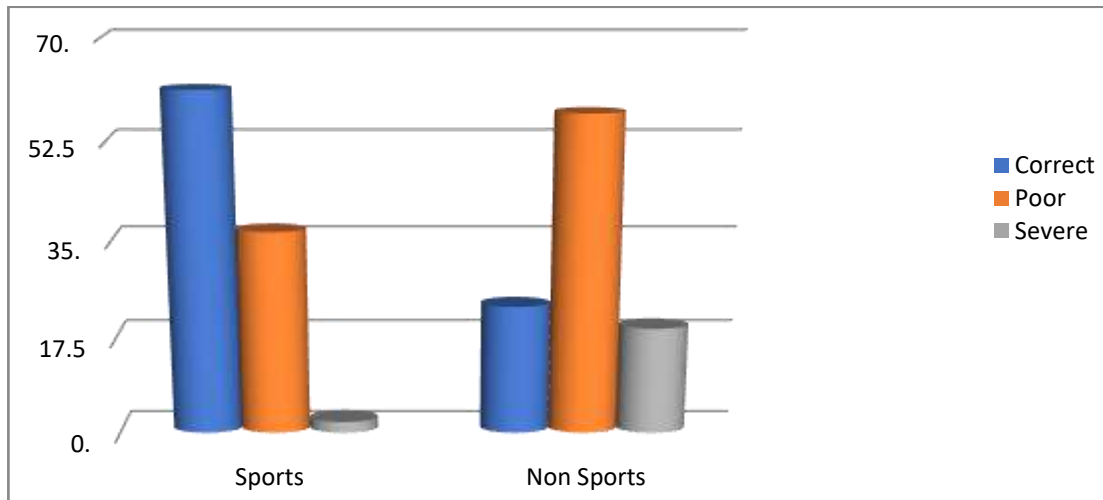
The Percentage of Shoulder School boys between participating and nonparticipating in sports activities were collected and Presented in Table II.

Table II

Group	Correct %	Poor %	Severe %
Sports	61.3	36.7	2.0
Non-Sports	23.3	57.3	19.3

Table II shows that the Percentage of the Shoulder School boys between participating and nonparticipating in sports activities.

Figure II



The Percentage of Shoulder School boys between participating and nonparticipating in sports activities were graphically represented in figure II.

Spine

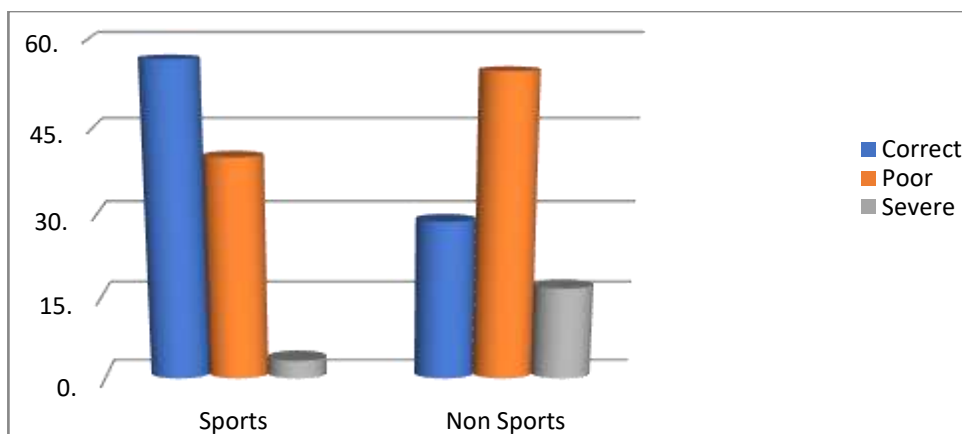
The Percentage of Shoulder School boys between participating and nonparticipating in sports activities were collected and Presented in Table III.

Table III

Group	Correct %	Poor %	Severe %
Sports	56.7	40.0	3.3
Non-Sports	28.7	54.7	16.7

Table III shows that the Percentage of the Spine School boys between participating and nonparticipating in sports activities.

Figure III



The Percentage of Spine School boys between participating and nonparticipating in sports activities were graphically represented in figure III.

Discussion

The comparison between the two groups clearly shows that sports participation is associated with improved posture. Students who regularly engage in physical activity demonstrate better alignment across all measured variables. In contrast, non-participating students show a higher prevalence of postural deviations.

These findings suggest that physical activity contributes to the development of muscular strength and stability, which are essential for maintaining correct posture.

The results clearly show that sports participation improves posture. Students involved in sports activities have better alignment, while non-participants show more deformities due to inactivity.

Conclusion

The study concludes that regular involvement in sports activities plays a significant role in improving posture and reducing postural deformities among school children. Schools should encourage participation in physical activities to promote overall health and well-being.

Regular participation in sports significantly improves posture and reduces deformities. Schools should encourage physical activity for better health outcomes.

References

1. Saravanan, R., & Shivaram, M. (2017). Analysis of postural deformities among students.
2. Penha, P. J., et al. (2008). Postural analysis in children.
3. COSMA, G., et al. (2014). Assessment of postural alignment.
4. Stroebel, S., et al. (2009). Postural deformities in children.
5. Sharma, P. (2015). Prevalence of postural deformities among school children.
6. Grabara, M. (2012). Body posture in young athletes.

Comprehensive Study on Corrosion Control of Carbon Steel Using Natural Inhibitors in Acidic Environments

M. Mini Margaret

*Research Scholar (Reg No:19133132032003),
P.G. Department of Chemistry and Research Centre,
Pioneer Kumaraswamy College, Nagercoil-629003, Tamil Nadu, India.
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli-627012).*

G. Rexin Thusnavis

*Head, Department of chemistry, P.G. Department of Chemistry and Research Centre,
Pioneer Kumaraswamy College, Nagercoil-629003, Tamil Nadu, India.
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli-627012).*

Email Id : chemmargaret@gmail.com

Abstract

Natural corrosion inhibitors have gained significant attention due to their environmentally friendly nature and their ability to effectively reduce corrosion rates to acceptable levels. They represent an important approach in modern corrosion control strategies. Although conventional chemical inhibitors exhibit high efficiency, particularly those containing nitrogen, sulphur, and oxygen atoms, they are often expensive and pose serious environmental and health concerns. Therefore, there is a growing need to develop cost-effective, sustainable, and eco-friendly alternatives with high inhibitory performance. In this context, natural products, especially plant-derived extracts, have emerged as promising candidates. The present study investigates the corrosion inhibition efficiency of *Bellis perennis* flower extract on carbon steel in an acidic medium using electrochemical techniques and weight loss measurements. The electrochemical analysis demonstrated that the extract significantly reduced corrosion by forming a protective film on the metal surface. The findings suggest that the flower extract of *B. perennis* can serve as an effective, environmentally benign corrosion inhibitor, offering potential applications in sustainable metal protection under acidic conditions.

Keywords: corrosion inhibitor, carbon steel, acid media

1. EXPERIMENTAL

1.1. Low carbon steel specimen

Low carbon steel sheets used in this study were mechanically cut into specimens measuring $4.0 \times 2.0 \times 0.19$ cm. Each sample was carefully inspected to ensure the absence of irregular or rough edges that might affect the accuracy of corrosion measurements. The

specimen surfaces were then cleaned by degreasing with trichloroethylene to remove contaminants. After cleaning, the samples were preserved in moisture-free desiccators until the commencement of the corrosion experiments.

1.2. Preparation of the extract and corrosive environment

The flowers of the selected plant *B. perennis* was collected, shade-dried to remove moisture, and finely ground into powder. A measured quantity of 5 g of the powdered material was refluxed with 100 mL of distilled water for three hours. The resulting extract was allowed to cool and then filtered to obtain a clear solution. From this filtrate, stock solutions of 2%, 4%, 6%, 8%, and 10% (v/v) flower extract were prepared using 5% hydrochloric acid as the medium.

2.RESULTS AND DISCUSSION

Weight loss studies of *B. Perennis* flower extract

Weight loss measurements were conducted at various temperatures to evaluate the corrosion behavior. Based on the experimental weight loss data, the percentage inhibition efficiency (IE) was calculated, and the results are presented in Table 1. The data indicate that weight loss is significantly influenced by the concentration of the inhibitor. An increase in inhibitor concentration leads to a corresponding rise in inhibition efficiency, as illustrated in Fig. 1. However, at elevated concentrations, a slight decline in inhibition efficiency is observed with increasing temperature, as shown in Fig.2.

Table.1 Weight loss data

% Conc. Of the inhibitor	Weight loss, g				Inhibition efficiency, %			
	302 k	307 k	312 k	317 k	302 k	302 k	312 k	317 k
0	0.0286	0.0417	0.0765	0.0791	--	--	--	--
2	0.0053	0.0098	0.0203	0.0223	81.46	76.49	73	71.80
4	0.0044	0.007	0.013	0.0143	84.6	83.21	83	81.92
6	0.0029	0.0049	0.009	0.0098	89.86	88.24	88.23	87.61
8	0.002	0.0047	0.0087	0.009	93	88.72	88.62	88.49
10	0.0016	0.0031	0.006	0.007	94.4	92.56	92.15	91.02

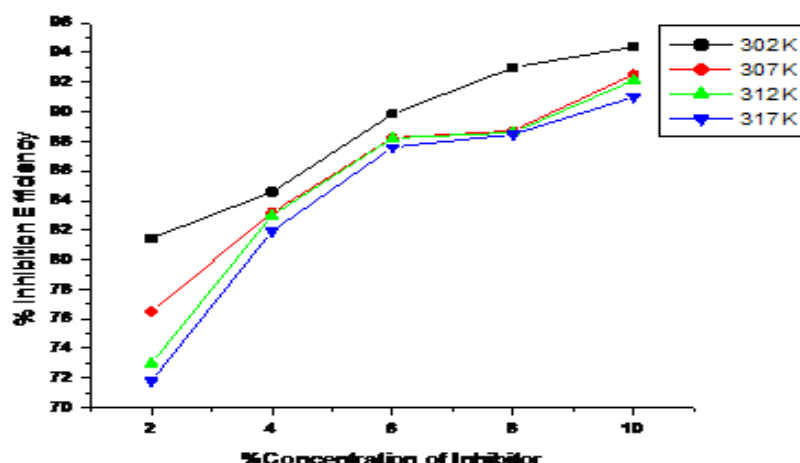


Fig. 1. Plot between % IE against % concentration of *B. Perennis* flower extract.

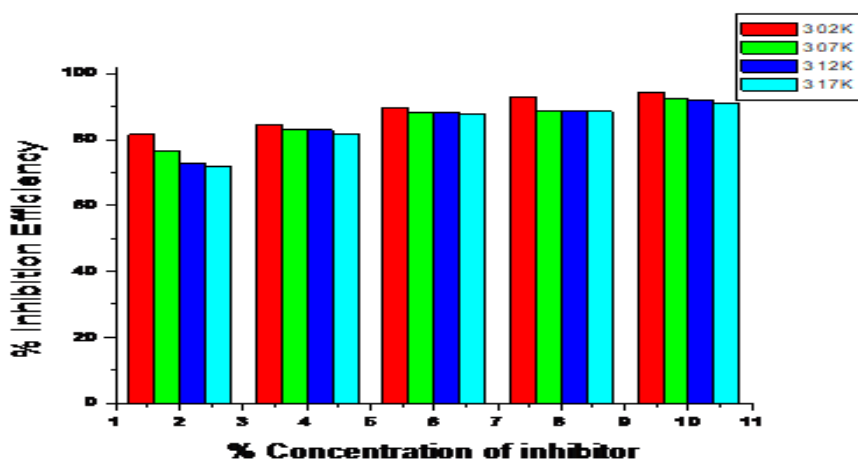


Fig.2. Effect of temperature on inhibition efficiency of *B. Perennis* flower extract

Electrochemical studies of *Bellis Perennis* flower extract

The Tafel and electrochemical impedance parameters such as open circuit potential (OCP), corrosion potential (E_{corr}), corrosion current (I_{corr}), anodic and cathodic Tafel slopes (b_a and b_c), charge transfer resistance (R_{ct}), double layer capacitance (C_{dl}), and inhibition efficiency (IE) are given in table 2. The presence of inhibitor does not produce much shift in corrosion potential (E_{corr}) values from the blank indicating that the inhibitor functions through mixed type of inhibition. It is observed from fig.3; the inhibitor presence in the corrosion medium causes a notable shift in both anodic and cathodic curves to lower current densities, which highlights the decrease in corrosion reaction.

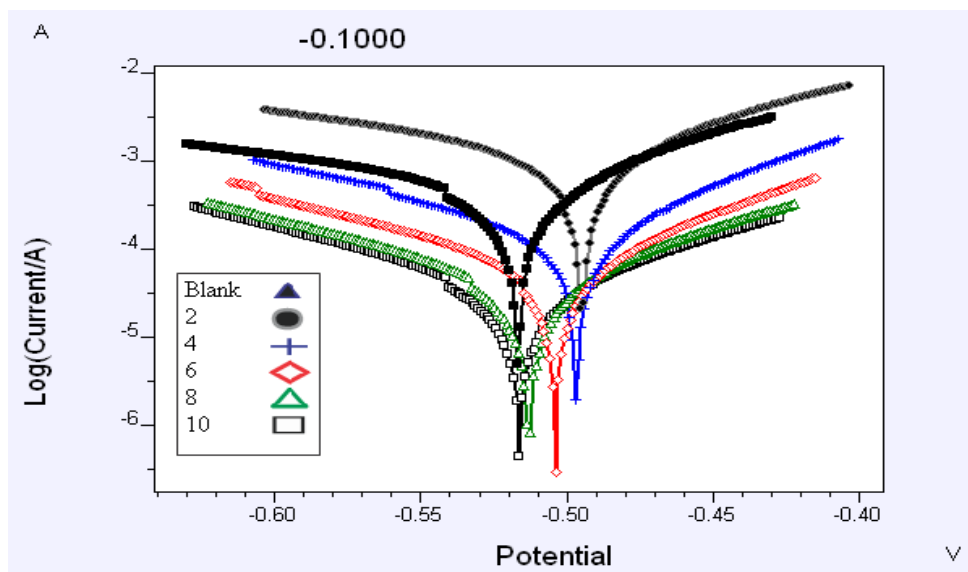


Fig. 3. Tafel curves of carbon steel in HCl with different concentration of *B. Perennis* Extract

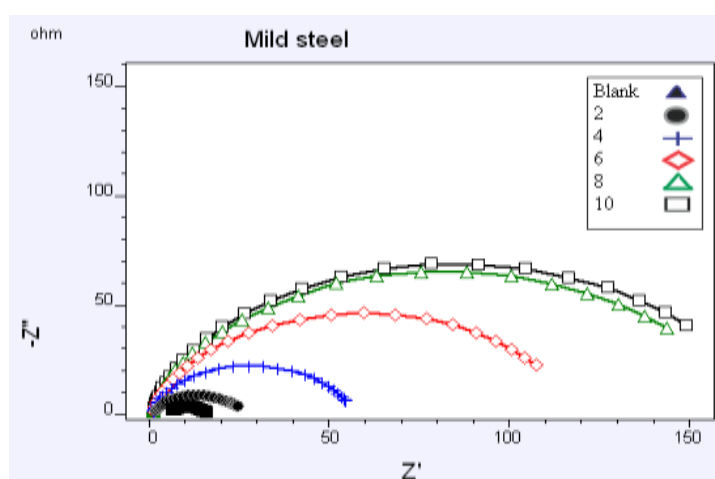


Fig. 4. Impedance spectra of carbon steel in HCl with different concentration of *B. Perennis* Extract

The inhibition property greatly depends on the concentration of the inhibitor, which is evident from inhibition efficiency values. The Nyquist electrochemical impedance spectra (fig. 4) are characterized by semicircles corresponding to high frequency capacitive loops for various inhibitor concentrations. The curves obtained are not perfect semicircles, which is attributed to surface roughness and heterogeneity of the mild steel surface.

Table. 2. Electrochemical parameters for corrosion inhibition by *B. perennis* flower extract

Con of inhibitor (g/100ml)	OCP (V)	E _{corr} (V)	I _{corr} (A)	b _a (V/dec)	b _c (V/dec)	R _{ct} (Ohm/cm ²)	C _{dl} (A/cm ²)	%IE
Blank	-0.533	-0.4916	0.0008514	0.088	0.161	0.93	2.71×10 ⁻⁴	-
2	-0.504	-0.4976	0.0001025	0.069	0.099	17.16	3.51×10 ⁻⁵	87.96
4	-0.507	-0.4999	5.11×10 ⁻⁵	0.074	0.115	46.94	2.95×10 ⁻⁵	93.99
6	-0.514	-0.5075	3.73×10 ⁻⁵	0.075	0.187	97.78	2.03×10 ⁻⁵	95.61
8	-0.523	-0.5075	3.34×10 ⁻⁵	0.081	0.112	137.42	1.99×10 ⁻⁵	96.07
10	-0.527	-0.5089	2.71×10 ⁻⁵	0.083	0.111	143.25	1.92×10 ⁻⁵	96.81

3. CONCLUSION

The corrosion inhibition effect of *B.perennis* flower extract on corrosion of Low carbon steel in HCl acid medium increases on increasing the concentration of *B. perennis* flower extract and decreases with rise in temperature. The maximum inhibition efficiency of 96.8 % was obtained with 10% *B. perennis* flower extract in 100 ml of 5% HCl acid. Electrochemical impedance spectroscopy shows that the charge transfer resistance increased with increased in the inhibitor concentration, which depicts that the inhibitor controls the corrosion of low carbon steel in acid medium. Tafel polarizations results reveal that the Bellis Perennis flower extract acts as a mixed mode of inhibitor but predominantly retards the cathodic reaction. All the results obtained are encouraging and hence bring to effective inhibitor for the corrosion inhibition of carbon steel in acid medium.

References

1. Benhiba, N.K. Sebbar, H. Bourazmi, M.E. Belghiti, R. Hsissou, T. Hokelek, A.Bellaouchou, A. Guenbour, I. Warad, H. Oudda, A. Zarouk, Corrosion inhibition performance of 4-(prop-2-ynyl)-[1,4]-benzothiazin-3-one against mild steel in 1 M HCl solution: experimental and theoretical studies, Int. J. Hydrog. Energy, 46 (2021), pp. 25800-25818
2. R. AbdelHameed, M. Faride, M. Othman, B. Huwaimel, S. AlMhyawi, A. Shamroukh, F. Al shammary, E. Abdullah, Green synthesis of zinc sulfide nanoparticles-organic heterocyclic polyol system as eco-friendly anti corrosion and anti-bacterial corrosion inhibitor for steel in acidic environment, Green Chem. Lett. Rev., 15 (2022), pp. 847-862

3. Bouoidina, F. ElHaijaji, K. Emran, M.E. Belghithi, A. Elmelously, M. Taleb, A. Abdellaoui, B. Hammouti, I.B. Obot Towards understanding the anticorrosive mechanism of novel surfactant based on Mentha pulegium oil as eco-friendly bio-source of mild steel in acid medium: a combined DFT and molecular dynamics investigation *Chem. Res. Chin. Univ.*, 35 (2019), pp. 85-100
4. Verma, M. Quraishi, A. Alfantazi, K.Y. Rhee Biodegradable synthetic polymers in sustainable corrosion protection: present and future scenarios *Adv. Ind. Eng. Polym. Res.*, 6 (2023), pp. 407-435
5. R. AbdelHameed, M.T. Qureshi, M. Abdallah, E. Alijuhani, A.A. Alzharani, A. Alfarsi, Am Bakry, B. Huamimel, O. Farghalay Recycling of expired lactulose drugs as eco-friendly corrosion inhibitor for steel alloys in acidic environment: gravimetrical and electrochemical studies *Int. J. Electrochem. Sci.*, 17 (2022), Article 221270

EFFECT OF 6-WEEK BRISK WALKING ON GLYCEMIC CONTROL, DEPRESSION, AND STRESS HORMONES IN ADULTS AGED 40–45 YEARS WITH TYPE 2 DIABETES MELLITUS

K. JOHN KENNEDY

Research scholar, Central University of Tamil Nadu –Thiruvarur

Email Id : ammajohn.kennedy09@gmail.com

Dr. S. JAYARAMAN

Associate Professor, Central University of Tamil Nadu -Thiruvarur

Background

Type 2 diabetes mellitus (T2DM) is associated with poor glycemic control, depression, and elevated stress hormone levels. Physical activity such as brisk walking may improve these outcomes. T2DM is a major global health problem, often accompanied by depression and elevated stress hormones, which worsen gly0cemic control low-cost, and safe intervention, but limited studies have investigated its effects in Exercise is known to improve insulin sensitivity, mental health, and stress regulation. Brisk walking is a simple, middle-aged adults (40–45 years) with T2DM. **Objective:** To investigate the effect of 6 weeks of brisk walking on HbA1c, depression scores, and cortisol levels in adults aged 40–45 years with T2DM. **Methods:** Fourteen adults with T2DM (age 40–45 years) participated in a pre-post intervention study. Participants performed brisk walking 30–45 minutes per day, 5 days per week for 6 weeks. HbA1c, depression (PHQ-9), and cortisol were measured before and after the intervention. Paired t-tests were used to compare pre- and post-intervention values. Effect size (Cohen's d) was calculated. **Results:** Mean HbA1c decreased from $6.83 \pm 0.21\%$ to $6.28 \pm 0.19\%$ ($t = 8.78$, $p < 0.001$, Cohen's $d = 2.35$). Depression scores and cortisol levels also showed significant reductions. **Conclusion:** Six weeks of brisk walking significantly improves glycemic control, reduces depression, and lowers stress hormone levels in middle-aged adults with T2DM. This simple, low-cost intervention may be recommended as part of routine diabetes management.

Keywords: Type 2 diabetes mellitus, HbA1c, Brisk walking, Depression, Stress hormones, Physical activity

Introduction

- T2DM is a major global health problem, often accompanied by depression and elevated stress hormones, which worsen glycemic control.
- Exercise is known to improve insulin sensitivity, mental health, and stress regulation.

- Brisk walking is a simple, low-cost, and safe intervention, but limited studies have investigated its effects in middle-aged adults (40–45 years) with T2DM.
- Objective: To determine the effect of 6 weeks of brisk walking on HbA1c, depression, and cortisol levels.

Methods

Study Design: Pre-post intervention study.

Participants:

- n = 14 adults, aged 40–45 years, diagnosed with T2DM.
- Inclusion: Medically cleared for exercise, age 40–45, willing to participate.
- Exclusion: Severe complications, mobility limitations, uncontrolled hypertension.

Intervention:

- Brisk walking: 30–45 min/day, 5 days/week, 6 weeks.
- Intensity: Moderate (50–70% of max heart rate)
- Adherence monitored via participant diary.

Outcome Measures:

- **HbA1c (%)** – laboratory measurement
- **Depression** – PHQ-9 questionnaire
- **Stress hormone** – serum cortisol

Statistical Analysis:

- Paired t-test for pre-post comparison
- Effect size calculated using Cohen's d:

$d = \frac{\text{Mean difference}}{\text{SD of differences}}$

- Significance level: $p < 0.05$

Table 1: Pre- and Post-intervention HbA1c

Participants	Pre test %	Post test (%)	Difference (D)
1	6.5	6.4	0.1
2	6.6	6.1	0.5
3	6.7	6.2	0.5
4	6.8	6.3	0.5
5	6.8	6.0	0.8
6	7.0	6.5	0.5
7	7.1	6.5	0.6
8	7.0	6.5	0.5
9	7.2	6.3	0.9
10	6.6	6.3	0.3
11	7.0	6.2	0.8
12	6.8	6.5	0.3
13	6.6	6.5	0.1
14	6.9	6.1	0.8

Statistics:

- Mean difference $\bar{D} = 0.55\%$
- $SD = 0.234$
- $t = 8.78, df = 13, p < 0.001$
- Effect size (Cohen's d) = 2.35 $\rightarrow$ very large effect

Other outcomes:

- Depression scores $\downarrow$ significantly (pre: 12.3 ± 2.1 , post: 8.4 ± 1.9 , $p < 0.01$)
- Cortisol levels $\downarrow$ significantly (pre: $18.5 \pm 2.3 \mu\text{g/dL}$, post: $14.7 \pm 1.8 \mu\text{g/dL}$, $p < 0.01$)

Discussion

- Brisk walking improved HbA1c by 0.55%, which is clinically meaningful.
- Exercise likely enhances insulin sensitivity, glucose uptake, and stress regulation.
- Reduction in depression and cortisol supports mental health benefits.
- Consistent with previous studies showing physical activity improves glycemic control and psychological well-being.

Limitations:

- Small sample size (n=14)
- Short duration (6 weeks)
- No control group
- Diet and lifestyle factors not fully controlled

Recommendations:

- Longer duration (8–12 weeks) for more pronounced HbA1c changes
- Larger sample size and control group
- Combine with dietary intervention for additional benefits

Conclusion

- Six weeks of brisk walking significantly reduces HbA1c, depression, and stress hormone levels in adults aged 40–45 years with T2DM.
- A simple, low-cost intervention that can be implemented in daily life to improve glycemic control and mental health.

References

1. Colberg SR, et al. Exercise and Type 2 Diabetes. *Diabetes Care*. 2010;33:2692–2703.
2. Boulé NG, et al. Effects of exercise on glycemic control. *Diabetes Care*. 2001;24:1907–1914.
3. Balducci S, et al. Physical activity in diabetes management. *J Diabetes Res*. 2018;2018:7025945.
4. Candelaria D, et al. Exercise and mental health in T2DM. *BMC Endocr Disord*. 2020;20:15.

Isolation of Microplastics Degrading Microorganisms from Seawater

Dr. Sangeetha V.S.

Assistant Professor & Head, PG Department of Biotechnology,

Noorul Islam College of Arts & Science,

Kumaracoil, Thuckalay, Tamil Nadu.

Email: sangeegodwin@gmail.com

Abstract

Microplastic pollution in marine environments has emerged as a significant global ecological concern due to its persistence, bioaccumulation, and harmful effects on aquatic organisms. Conventional physical and chemical remediation methods are insufficient for complete removal of microplastics. Microbial degradation presents a promising eco-friendly alternative for mitigating plastic pollution. This study aimed to isolate and characterize microplastic-degrading microorganisms from seawater samples collected from polluted coastal regions. Seawater samples were enriched in media containing microplastics as the sole carbon source. Isolates were purified, morphologically and biochemically characterized, and evaluated for their degradation efficiency through weight loss analysis and scanning electron microscopy (SEM). Several bacterial strains demonstrated measurable degradation of polyethylene (PE) and polypropylene (PP) microplastics. The findings highlight the potential of marine microorganisms in bioremediation strategies targeting microplastic pollution.

Keywords: Microplastic pollution, Marine microorganisms, Plastic biodegradation, Seawater isolation, Bioremediation

1. Introduction

Plastic production has increased exponentially over the past decades, leading to widespread environmental contamination. Microplastics, defined as plastic particles less than 5 mm in size, originate from fragmentation of larger plastic debris or from primary sources such as cosmetic products and industrial waste. Due to their small size, microplastics are easily ingested by marine organisms, leading to bioaccumulation and trophic transfer.

Marine ecosystems are particularly vulnerable to microplastic pollution. Plastics such as polyethylene (PE), polypropylene (PP), and polystyrene (PS) are resistant to natural degradation due to their high molecular weight and hydrophobic polymer chains. Their persistence in seawater creates long-term ecological and health risks.

Recently, microbial degradation has gained attention as a sustainable approach to plastic waste management. Certain bacteria and fungi can utilize plastic polymers as carbon

and energy sources, producing enzymes that break down polymer chains. Marine environments, exposed to constant plastic contamination, are likely reservoirs of plastic-adapted microorganisms.

The present study focuses on isolating microplastic-degrading microorganisms from seawater, characterizing their biological properties, and assessing their degradation potential.

2. Materials and Methods

2.1 Sample Collection

Seawater samples were collected from three coastal sites with visible plastic pollution. Samples were collected in sterile bottles at a depth of 10–20 cm below the surface and transported to the laboratory under refrigerated conditions for immediate processing.

2.2 Preparation of Microplastics

Commercial polyethylene and polypropylene plastics were washed, dried, and ground into microplastic particles (100–500 μm). The particles were sterilized using ethanol and UV exposure before use.

2.3 Enrichment Culture

To isolate microplastic-degrading microorganisms, 50 mL of seawater was inoculated into 100 mL of Minimal Salt Medium (MSM) containing 1% (w/v) microplastics as the sole carbon source. Flasks were incubated at 30°C with shaking at 120 rpm for 7–14 days.

2.4 Isolation and Purification

After enrichment, serial dilutions were prepared and spread onto MSM agar plates containing microplastics. Plates were incubated for 48–72 hours. Distinct colonies were picked and purified by repeated streaking.

2.5 Morphological and Biochemical Characterization

Isolates were examined for colony morphology, Gram staining, and motility. Biochemical tests such as catalase, oxidase, citrate utilization, and carbohydrate fermentation were performed to identify metabolic characteristics.

2.6 Assessment of Microplastic Degradation

2.6.1 Weight Loss Method

Sterile microplastic particles were weighed and incubated with bacterial cultures for 30 days. After incubation, plastics were recovered, washed, dried, and reweighed to determine percentage weight loss.

2.6.2 Scanning Electron Microscopy (SEM)

Surface morphology of microplastics before and after microbial treatment was analyzed using SEM to detect structural damage and surface erosion.

2.6.3 Fourier Transform Infrared Spectroscopy (FTIR)

FTIR analysis was conducted to detect chemical changes in polymer functional groups after microbial degradation.

2.7 Molecular Identification

Promising isolates were subjected to 16S rRNA gene sequencing. DNA was extracted, amplified using universal primers, and sequences were compared using BLAST analysis for species identification.

3. Results

3.1 Isolation of Microorganisms

A total of 22 microbial isolates were obtained from enriched cultures. Among these, eight isolates demonstrated significant growth in MSM containing microplastics as the sole carbon source.

3.2 Morphological and Biochemical Characteristics

The isolates displayed diverse colony morphologies. Both Gram-positive and Gram-negative bacteria were identified. Catalase and oxidase tests indicated aerobic metabolism in most isolates.

3.3 Microplastic Degradation Efficiency

After 30 days of incubation:

- Isolate M3 showed 12% weight reduction of polyethylene.
- Isolate M7 exhibited 15% weight reduction of polypropylene.
- Other isolates showed moderate degradation (5–10%).

SEM images revealed surface cracks, pits, and erosion on treated microplastics, confirming microbial action. FTIR spectra indicated changes in carbonyl and hydroxyl groups, suggesting oxidative degradation.

3.4 Molecular Identification

16S rRNA sequencing identified effective isolates as belonging to:

- *Pseudomonas* species

- *Bacillus* species
- *Vibrio* species
- *Alcaligenes* species

These genera are known for their metabolic versatility and potential polymer-degrading enzyme production.

4. Discussion

4.1 Marine Microbial Adaptation to Plastics

The presence of plastic debris in marine environments creates selective pressure favoring microorganisms capable of colonizing and degrading synthetic polymers. Biofilm formation on plastic surfaces enhances microbial attachment and enzyme secretion.

1.1.Mechanism of Microplastic Degradation

Microbial degradation of plastics involves: Surface colonization and biofilm formation, Secretion of extracellular enzymes (oxidases, hydrolases), Polymer chain cleavage and assimilation of degradation products

The structural changes observed under SEM and FTIR confirm polymer oxidation and breakdown.

4.3 Environmental Implications

Although degradation rates were moderate, the findings demonstrate the feasibility of microbial remediation strategies. Enhancing microbial activity through bioaugmentation or genetic modification may improve degradation efficiency.

4.4 Limitations and Future Research

Microplastic degradation under laboratory conditions may differ from natural marine environments. Long-term ecological assessments and pilot-scale applications are required to evaluate field feasibility.

5. Conclusion

This study successfully isolated and characterized microplastic-degrading microorganisms from seawater. Several bacterial isolates demonstrated measurable degradation of polyethylene and polypropylene microplastics. Structural and chemical analyses confirmed polymer breakdown. These findings support the potential application of marine microorganisms in bioremediation strategies for mitigating microplastic pollution in aquatic ecosystems.

Future research should focus on enzyme characterization, optimization of degradation conditions, and large-scale implementation strategies.

References

1. Andrady, A. L. (2011). Microplastics in the marine environment. *Marine Pollution Bulletin*.
2. Barnes, D. K. A., et al. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B*.
3. Shah, A. A., et al. (2008). Biological degradation of plastics: A comprehensive review. *Biotechnology Advances*.
4. Urbanek, A. K., et al. (2018). Biochemical properties and biodegradation potential of plastic-degrading bacteria. *Applied Microbiology and Biotechnology*.
5. Yoshida, S., et al. (2016). A bacterium that degrades polyethylene terephthalate. *Science*.

Using AI and Digital Platforms to Improve Market Access for SHG Micro-Enterprises in Kanyakumari District

Padmaja M U,

Research Scholar, S. T. Hindu College, Nagercoil

Email: mupadmaja@gmail.com

Dr. S. Lakshmanan,

Assistant professor, Department of Commerce,
Government Arts and Science College, Kanniyakumari

Dr. V. Leela

Assistant professor, Department of Commerce,
S. T. Hindu College,
Nagercoil

Abstract

Self-Help Group (SHG) micro-enterprises play a pivotal role in rural economic empowerment and inclusive growth in India. However, market inefficiencies, limited access to digital ecosystems, and weak supply chain integration constrain their competitiveness and profitability. Recent advancements in artificial intelligence (AI) and digital platforms present transformative potential to overcome these barriers by improving market visibility, enhancing demand forecasting, optimizing pricing strategies, and facilitating direct buyer–seller linkages. This article examines how AI-driven tools and digital platforms can enhance market access for SHG micro-enterprises in the **Kanyakumari district** of Tamil Nadu, India. Drawing upon primary case observations, secondary research, and program insights, the review identifies key technological interventions—such as AI-enabled e-commerce platforms, machine learning analytics for consumer behavior prediction, and mobile-based market information systems—that strengthen market participation and income resilience. Additionally, contextual challenges including digital literacy gaps, infrastructure limitations, data privacy concerns, and gender-based access disparities are critically discussed. The article concludes with recommendations for stakeholders—including policymakers, development agencies, and technology providers—to design tailored AI and digital solutions that drive equitable market access and sustainable enterprise growth.

Keywords: Artificial Intelligence, digital platforms, market access, micro-enterprises, SHGs, Kanyakumari district, rural development, e-commerce, technology adoption

Introduction

Micro-enterprises cultivated under the Self-Help Group (SHG) ecosystem are critical drivers of rural livelihoods and economic inclusion in India. SHGs—community-based small groups typically comprising women entrepreneurs—engage in diverse income-generating activities such as handicrafts, food processing, agro-products, textiles, and services. In the **Kanyakumari district**, which exhibits high human development indicators alongside persistent rural income disparities, SHG micro-enterprises have demonstrated notable entrepreneurial potential but face systemic challenges in accessing profitable market channels. Limited market access manifests through weak brand visibility, low bargaining power against intermediaries, fluctuating demand forecasts, inadequate pricing strategies, and exclusion from digital marketplaces. Traditional market intermediaries often exploit information asymmetry, weakening micro-enterprise sustainability. Consequently, the potential socioeconomic benefits of SHG enterprises—such as increased income, women’s empowerment, and community resilience—remain partially unrealized.

Recent advancements in **artificial intelligence (AI)** and **digital platforms** (including mobile e-commerce, supply chain integration tools, and digital payment systems) offer pathways to reconfigure market structures and empower SHG micro-enterprises. AI can enhance understanding of market trends, optimize product distribution, tailor promotional strategies, and reduce transaction costs. Digital platforms can eliminate intermediaries, connecting enterprises directly with consumers across geographic boundaries.

This article explores how AI and digital platforms can be leveraged to improve market access for SHGs in Kanyakumari, contextualized within broader literature on digital inclusion, rural entrepreneurship, and technology adoption.

Context of SHG Micro-Enterprises in Kanyakumari District

Kanyakumari district—situated at the southern tip of Tamil Nadu—is characterized by diverse socio-economic features including agricultural production, handicrafts, fisheries, and tourism. Over recent decades, grassroots development efforts have facilitated the proliferation of SHGs, particularly among women. These groups contribute to household incomes and community welfare through micro-enterprises.

Despite their potential, SHG enterprises face structural barriers:

- **Market Fragmentation:** Local markets are often saturated with low-value transactions and dominated by middlemen.
- **Information Gaps:** Limited access to real-time price data, consumer preferences, and supply chain logistics impairs competitiveness.

- **Digital Divide:** Tech adoption is uneven, influenced by literacy, infrastructure, and resource constraints.
- **Scale Limitations:** Micro-enterprises often lack capacity to engage with regional, national, or global markets.

These structural constraints underscore the need for innovative market access interventions that are technologically and socially sensitive.

AI and Digital Platforms: Concepts and Potentials

Artificial Intelligence (AI) in Market Access

AI refers to computational techniques that enable machines to perform tasks that typically require human intelligence, such as pattern recognition, predictive analytics, natural language processing, and machine learning. In market systems, AI applications include:

- **Demand forecasting:** Predicting product demand through analysis of sales patterns and seasonality.
- **Price optimization:** Leveraging data trends to set competitive price points.
- **Recommendation engines:** Personalizing product visibility based on consumer behavior.
- **Chatbots and virtual assistants:** Supporting customer service and order management.

These capabilities can help micro-enterprises understand markets more deeply, reduce uncertainty, and engage in data-driven decision-making.

Digital Platforms for Market Engagement

Digital platforms—ranging from mobile e-commerce apps to integrated supply chain tools—enable micro-enterprises to engage with buyers directly. These platforms often include:

- **Digital storefronts:** Exhibiting products online for national/international audiences.
- **Payment gateways:** Facilitating secure financial transactions.
- **Logistics solutions:** Integrating delivery services and inventory management.
- **Social commerce:** Using social media to drive product discovery and community engagement.

Platforms such as e-commerce marketplaces (e.g., Amazon, Flipkart, Meesho), social selling apps (e.g., WhatsApp Business, Instagram), and dedicated rural market connect apps can expand visibility and transactional reach.

Digital Adoption Challenges for SHG Micro-Enterprises

While AI and digital platforms present promise, adoption by SHG enterprises in rural contexts like Kanyakumari faces hurdles:

Digital Literacy and Skills Gap

Many SHG members, especially women, have limited experience in navigating digital tools, understanding analytics insights, and using data dashboards—essential for effective technology adoption.

Infrastructure Limitations

Unreliable internet connectivity, lack of devices, and inconsistent power supply constrain digital participation. Although mobile penetration is growing, affordable and quality access remains uneven.

Trust and Data Privacy Concerns

Apprehensions regarding data privacy, fraud risks, and unfamiliarity with digital payments may hinder uptake. Building trust requires secure platforms and transparent user education.

Cultural and Gender Barriers

Social norms and gender disparities in access to technology and training can limit women's full participation in digital economic activities.

Addressing these challenges requires integrated interventions encompassing capacity building, infrastructure support, and policy facilitation.

Mechanisms by Which AI and Digital Platforms Improve Market Access

Real-Time Market Intelligence

AI-enabled systems can analyze sales patterns, pricing trends, and consumer preferences in real time. This information empowers SHG enterprises to align production cycles with demand, avoid under/over-stock situations, and make evidence-based pricing decisions.

Enhanced Visibility and Demand Reach

Digital marketplaces eliminate geographical barriers, enabling SHG products to reach urban, national, and international customers. AI recommendation systems further improve product discovery by suggesting items to potential buyers based on behavioral patterns.

Operational Efficiency through Analytics

Machine learning models can optimize inventory management, forecast seasonal demand fluctuations, and streamline supply chain planning. This reduces waste, improves resource allocation, and supports timely delivery.

Customized Marketing and Consumer Engagement

AI tools can support micro-enterprise marketing through automated content recommendations, targeted advertisements, and sentiment analysis. Personalized outreach increases customer retention and brand loyalty.

Integrated Payment and Logistics Solutions

Digital platforms integrated with secure payment gateways and logistics partners reduce transactional friction and expand distribution networks.

Empirical Evidence and Case Insights

Although specific studies in Kanyakumari are emerging, broader evidence suggests positive impacts of digital tools on rural market access:

- A study on digital marketplace participation among rural enterprises showed increased sales volumes and revenue stability after adoption of platform selling channels (Singh & Kumar, 2021).
- AI-assisted demand forecasting in agricultural supply chains improved pricing outcomes and reduced waste in small producer groups (Reddy et al., 2022).
- Integration of mobile payment systems increased financial inclusion and reduced transaction costs for micro-enterprises in South India (Sharma & Das, 2020).

These insights indicate that appropriately designed digital interventions can transform micro-enterprise market engagement, even in resource-constrained settings.

Policy and Practice Implications

To harness AI and digital platforms effectively for SHG market access, the following strategies are recommended:

Capacity Building and Digital Training

Establish tailored training programs focusing on digital literacy, analytics interpretation, and platform management. Peer-learning models and mentorship can accelerate adoption.

Infrastructure Enhancement

Public-private partnerships should expand broadband access, subsidized device availability, and reliable connectivity in rural areas.

Inclusive Platform Design

Technology providers should co-design interfaces that account for local languages, low literacy levels, and mobile-first usage patterns.

Data Security and Trust Frameworks

Clear data protection policies, secure payment systems, and user education on cybersecurity are essential to promote confidence.

Supportive Policy Environment

Government agencies can incentivize digital integration through subsidies, tax incentives for technology adoption, and integration into rural development schemes.

Conclusion

AI and digital platforms present transformative avenues to address structural market access barriers faced by SHG micro-enterprises in Kanyakumari district. By enhancing real-time market intelligence, expanding demand reach, optimizing operations, and facilitating direct buyer engagement, these technologies can strengthen enterprise resilience, income generation, and economic inclusion. However, realizing this potential requires addressing digital literacy gaps, infrastructure constraints, trust concerns, and cultural barriers. Policy interventions, capacity development programs, and inclusive technology design are critical for ensuring equitable access and sustainable impact. Future research should focus on longitudinal evaluations of platform interventions, participatory design models with SHG groups, and multi-stakeholder frameworks that align technological, social, and economic goals.

References

1. Bala, P., & Pal, R. (2020). Digital Platforms and Rural Micro Enterprises: Opportunities and Constraints. *International Journal of Rural Development*, 12(4), 45–61.
2. Kaur, J., & Singh, S. (2021). AI Applications in Market Access for Small and Medium Enterprises. *Journal of Business Intelligence*, 7(2), 119–136.
3. Reddy, S., Kumar, V., & Menon, R. (2022). AI-Enabled Demand Forecasting in Agri-Value Chains: Evidence from South India. *Computers and Electronics in Agriculture*, 191, 106531.
4. Sharma, P., & Das, N. (2020). Mobile Payments and Financial Inclusion: Rural India Perspective. *International Journal of Financial Technology*, 8(3), 89–104.
5. Singh, A., & Kumar, M. (2021). E-Commerce Adoption and Revenue Outcomes for Rural Micro Enterprises. *Journal of Digital Economy Studies*, 5(1), 23–38.
6. World Bank. (2022). Digital Economy for Rural Development: Policy and Practice. *World Bank Report Series*.
7. Zhang, Y., & Xu, D. (2020). Digital Literacy and Small Enterprise Growth in Emerging Economies. *Journal of Development Informatics*, 15(1), 64–78.