Emerging Trends in Applied Research

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Chapter - 1

Methodology of Language Teaching: A Comprehensive Review

Vemuganti Sreehari and Dumpala Nirmala Devi

Abstract

This research work aims to provide a comprehensive review of the methodology of language teaching. Language teaching methodologies play a crucial role in shaping effective language learning experiences for students. This work explores various approaches and techniques employed in language teaching, highlighting their theoretical foundations, practical applications, and potential benefits and challenges. The review encompasses both traditional and modern methodologies, encompassing grammar-translation, audio-lingual, communicative, task-based, and content-based approaches, among others. Furthermore, the work discusses recent advancements in technology and their integration into language teaching. By examining the strengths and limitations of different methodologies, this research aims to contribute to the ongoing discussion on effective language teaching practices.

Keywords: Language teaching methodologies, language acquisition, second language acquisition

1. Introduction

Language teaching methodologies have evolved over the years, influenced by changing theories of language acquisition, advances in technology, and the recognition of the importance of effective communication skills in a globalized world. The field of language teaching has moved away from traditional rote memorization and grammar-focused approaches towards more learner-centered, communicative, and task-based methods. In the past, language teaching primarily revolved around the Grammar-Translation Method, which emphasized the memorization of grammar rules and the translation of texts. This approach was criticized for its limited focus on practical communication skills and the lack of meaningful interaction in the target language. The emergence of the Direct

Method challenged the Grammar-Translation Method by emphasizing direct immersion in the target language and avoiding the use of the learners' native language. The Audio-Lingual Method, influenced by behaviorist theories, further emphasized repetitive drills and pattern practice to reinforce language structures. However, in the 1970s and 1980s, a shift occurred towards communicative approaches to language teaching. Communicative Language Teaching (CLT) aimed to develop learners' ability to communicate fluently and effectively in real-life situations. This approach emphasized the importance of meaningful interaction, authentic materials, and task-based activities. In recent years, technological advancements have significantly influenced language teaching methodologies. Computer-Assisted Language Learning (CALL) and Mobile-Assisted Language Learning (MALL) have opened up new possibilities for interactive and personalized learning experiences. Virtual reality and augmented reality have also been integrated into language teaching to create immersive environments for language practice. Blended learning, combining face-to-face instruction with online components, has gained popularity in language teaching. This approach allows for flexibility, individualization, and increased access to resources.

2. Objectives of language teaching

To provide a comprehensive overview of traditional and modern language teaching methodologies: The paper aims to explore the historical development and evolution of language teaching methodologies, including traditional approaches such as Grammar-Translation, Audio-Lingual, and Direct Method, as well as communicative approaches like Communicative Language Teaching (CLT), Task-Based Language Teaching (TBLT), and Content-Based Language Teaching (CBLT). It also aims to cover recent trends, including the integration of technology, blended learning, and innovative approaches.

To examine the theoretical foundations of different methodologies: The paper seeks to delve into the underlying theoretical principles and assumptions that shape each language teaching methodology. By discussing the theoretical frameworks, it aims to provide a deeper understanding of how these methodologies approach language acquisition, learning processes, and the role of communication in language teaching.

To explore the practical applications and techniques associated with each methodology: The research paper aims to discuss the practical aspects of implementing various language teaching methodologies. It will examine the instructional techniques, classroom activities, materials, and assessment methods associated with each approach, providing insights into how

educators can effectively apply these methodologies in different language learning contexts.

To assess the benefits and challenges of different methodologies: The paper aims to critically evaluate the strengths and limitations of each language teaching methodology. By examining the potential advantages and challenges associated with each approach, it seeks to provide educators with a balanced understanding of the methodologies' efficacy and suitability for different learners, language goals, and instructional settings.

To discuss the integration of technology in language teaching: The research paper intends to explore the role of technology in language teaching, including computer-assisted language learning (CALL), mobile-assisted language learning (MALL), virtual reality, and augmented reality. It aims to discuss the benefits, challenges, and potential implications of technology-enhanced language teaching and the ways in which it can be effectively integrated into language classrooms.

To provide insights for language teaching practice and future research: By synthesizing the findings and discussions, the paper aims to offer practical insights and recommendations for language educators. It aims to inform instructional decision-making and curriculum development, as well as highlight areas that require further research and exploration to advance the field of language teaching.

3. Scope and Significance

Scope

Language teaching methodologies: The paper will cover a wide range of language teaching methodologies, encompassing both traditional and modern approaches. It will include methodologies such as Grammar-Translation, Audio-Lingual, Communicative Language Teaching (CLT), Task-Based Language Teaching (TBLT), Content-Based Language Teaching (CBLT), and others. The scope will also extend to the integration of technology, blended learning, and emerging trends in language teaching.

Theoretical foundations: The research paper will explore the theoretical underpinnings of various methodologies, examining the linguistic, cognitive, sociocultural, and psychological theories that inform language teaching practices.

Practical applications: The paper will discuss the practical implementation of different methodologies, including instructional techniques, classroom activities, materials, and assessment methods

associated with each approach. It will provide examples and insights into how educators can apply these methodologies in diverse language learning contexts.

Technology in language teaching: The scope of the paper will include the integration of technology in language teaching, exploring the use of computer-assisted language learning (CALL), mobile-assisted language learning (MALL), virtual reality, augmented reality, and other technological tools and platforms.

Significance

Guidance for language educators: The research paper aims to provide language educators with a comprehensive review of language teaching methodologies. By examining the strengths, limitations, and practical applications of different approaches, the paper will offer insights and guidance for educators in making informed decisions about instructional strategies, materials and assessment methods.

Enhanced language learning outcomes: The research paper intends to contribute to the improvement of language learning outcomes by promoting effective teaching practices. By examining various methodologies and their potential benefits, educators can tailor their approaches to meet the specific needs and goals of their learners, ultimately enhancing language proficiency and communication skills.

Informing curriculum development: The findings and discussions in the paper can inform curriculum developers and instructional designers in creating language teaching materials and programs. By understanding the theoretical foundations and practical applications of different methodologies, curriculum developers can design curricula that align with current language teaching approaches and promote effective language learning experiences.

Advancing Research and Discussion: The research paper aims to contribute to the ongoing research and discussion on language teaching methodologies. By reviewing the existing literature and synthesizing the findings, the paper will identify gaps, challenges, and future research directions, encouraging further exploration and advancements in the field.

4. Traditional approaches to language teaching

Traditional approaches to language teaching have historically been influential in shaping language education, although they have been subject to criticism and have evolved over time. The following traditional approaches are commonly discussed:

Grammar-Translation method

The Grammar-Translation Method emphasizes the memorization of grammar rules and the translation of texts between the target language and the learners' native language. This approach focuses on the explicit teaching of grammatical structures and vocabulary through deductive reasoning. It emphasizes reading and writing skills more than oral communication and places a significant emphasis on accuracy rather than fluency.

Direct method

The Direct Method aims to immerse learners in the target language from the beginning of their language learning journey. It emphasizes the use of the target language exclusively during instruction, avoiding translation or the use of learners' native language. This approach focuses on developing learners' oral communication skills through authentic and meaningful interactions, employing visual aids, gestures, and demonstrations to support comprehension.

Audio-Lingual method

The Audio-Lingual Method, influenced by structural linguistics and behaviorist psychology, emphasizes the repetition and practice of language patterns and dialogues. This approach relies heavily on drilling and repetition exercises to develop learners' habit formation and automaticity in using grammatical structures and vocabulary. It focuses on listening and speaking skills and uses dialogues to teach language structures and functional expressions.

Cognitive approach

The Cognitive Approach to language teaching emerged in response to behaviorist approaches. It focuses on the mental processes involved in language acquisition and emphasizes the role of learners' cognitive abilities, such as memory, attention, and problem-solving skills. This approach incorporates meaningful and interactive activities to promote comprehension, critical thinking, and the application of language in authentic contexts.

While traditional approaches have contributed to language teaching practices, they have faced criticism for their limited focus on meaningful communication, lack of learner engagement, and overemphasis on grammar and translation. They often neglect the development of speaking and listening skills, which are crucial for effective communication. Over time, these traditional approaches have been supplemented or replaced by more

communicative and learner-centered methodologies, which aim to create dynamic and interactive language learning experiences.

5. Technology-Enhanced language teaching

Technology has significantly impacted language teaching, providing new opportunities for interactive and engaging learning experiences. Here are some key aspects of technology-enhanced language teaching:

Computer-Assisted Language Learning (CALL)

CALL refers to the use of computers and digital technologies to support language learning. It encompasses various software, applications, and online resources designed specifically for language education. CALL offers interactive exercises, multimedia materials, language tutorials and virtual language practice environments. Learners can access language learning platforms, online dictionaries, grammar checkers, and language exchange platforms, among other resources, to enhance their language skills.

Mobile-Assisted Language Learning (MALL)

MALL takes advantage of mobile devices, such as smartphones and tablets, to facilitate language learning. Mobile apps and platforms provide learners with on-the-go access to language resources, interactive exercises, vocabulary flashcards, language games, and audio/video materials. MALL enables learners to practice listening, speaking, reading, and writing skills through mobile applications and engage in language learning anytime and anywhere.

Virtual Reality (VR) and Augmented Reality (AR)

VR and AR technologies offer immersive and interactive language learning experiences. VR creates simulated environments where learners can practice language skills in realistic scenarios, such as virtual language exchanges, cultural simulations, or virtual field trips. AR overlays digital information onto the real world, allowing learners to interact with digital content while engaging in language tasks. Both VR and AR provide opportunities for authentic language practice and cultural exploration.

Online language learning platforms

Online language learning platforms offer structured language courses, interactive lessons, and personalized learning experiences. These platforms often include features like video lessons, interactive exercises, progress tracking, and social learning communities. Learners can engage in self-paced learning, receive immediate feedback and interact with other learners and instructors through discussion forums and video conferencing tools.

Digital language assessment

Technology has also revolutionized language assessment. Online platforms and tools provide automated assessment of language skills, such as reading, listening and grammar proficiency. Computerized adaptive testing adjusts the difficulty level of questions based on learners' responses, providing more accurate and personalized assessment results. Additionally, speech recognition software enables automated assessment of speaking and pronunciation skills.

The integration of technology in language teaching offers several benefits, including increased learner engagement, personalized learning experiences, immediate feedback, access to authentic resources, and enhanced interactivity. However, challenges such as the digital divide, technical issues, and the need for teacher training and digital literacy skills must be considered to ensure equitable and effective implementation of technology-enhanced language teaching.

6. Current Trends and Innovations

Current trends and innovations in language teaching reflect the evolving needs of learners and the advancements in technology. Here are some notable trends and innovations in the field:

Flipped classroom

The flipped classroom model involves learners accessing instructional content, such as video lectures or reading materials, outside of class time. Classroom time is then dedicated to interactive activities, discussions, and collaborative tasks that promote deeper understanding and application of the language. The flipped classroom approach allows for more student-centered and active learning experiences.

Gamification in language teaching

Gamification involves incorporating game elements and mechanics into language learning activities to increase learner motivation and engagement. Language learning apps and platforms use gamified features, such as badges, leaderboards, rewards, and challenges, to create a more interactive and enjoyable learning environment. Gamification can promote healthy competition, goal setting, and progress tracking, making language learning more engaging and motivating for learners.

Corpus linguistics and data-driven learning

Corpus linguistics refers to the study and analysis of large collections of language data. In language teaching, corpus linguistics is used to provide

learners with authentic examples of language usage and to explore patterns and structures in real-world language data. Data-driven learning approaches utilize corpus-based resources and tools to enhance learners' understanding of vocabulary, grammar, and collocations, enabling them to make informed language choices.

Content and Language Integrated Learning (CLIL)

CLIL involves teaching academic content, such as science or history, through the medium of a second or foreign language. This approach combines language learning and subject matter instruction, allowing learners to develop both language proficiency and disciplinary knowledge simultaneously. CLIL fosters interdisciplinary learning, language acquisition and cognitive skills development.

Multimodal approaches

Multimodal approaches integrate multiple modes of communication, such as text, images, audio and video, to enhance language learning. Learners engage with various multimedia resources, authentic materials, and digital tools to develop multiple language skills and literacies. Multimodal approaches acknowledge the importance of visual and auditory elements in language learning and cater to learners' diverse learning styles and preferences.

Online collaborative learning

Online collaborative learning platforms and tools enable learners to engage in collaborative language learning activities, irrespective of geographical barriers. Learners can interact, collaborate, and co-create language projects, participate in virtual language exchanges, and engage in online discussions and group work. Online collaborative learning promotes intercultural communication, peer interaction, and the development of digital literacy skills.

These trends and innovations in language teaching reflect the integration of technology, learner-centered approaches, and the recognition of the importance of authentic and meaningful language use. They aim to enhance learner engagement, interactivity, and language learning outcomes in diverse educational contexts.

Conclusion

In conclusion, the research work on the methodology of language teaching provides a comprehensive overview of traditional and modern approaches, examines their theoretical foundations, explores practical

applications, and discusses the integration of technology. By considering these methodologies and innovations, language educators can make informed decisions about instructional strategies, materials, and assessment methods, ultimately enhancing language learning outcomes and preparing learners for effective communication in a globalized world.

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Chapter - 2
नियोजन काल के अंतर्गत डेयरी विकास कार्यक्रम

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Chapter - 2

नियोजन काल के अंतर्गत डेयरी विकास कार्यक्रम

डॉ कामरान हुसैन खाँ

सारांश

भारतवर्ष में रहने वाले अधिकांश लोगों का जीवन आज से नहीं वरन शताब्दियों से कृषि पर आधारित है। आज भी 60% से अधिक लोग कृषि एवं सम्बन्धित क्रियाकलापों के माध्यम से अपनी जीविका चलाते हैं। यह विदित है कि ग्रामीण क्षेत्रों में कृषकों को खेती. की कटाई एवं बुआई के समय में ही रोजगार के सुअवसर प्राप्त होते हैं तथा इसके अतिरिक्त समय में ग्रामीण श्रम शक्ति प्रायः बेरोजगार हो जाती है। अतः इस विषम परिस्थिति में पशुपालन एवं दुग्ध व्यवसाय को एक महत्वपूर्ण सहायक व्यवसाय के रूप में अपनाना लाभप्रद है। राष्ट्रीय कृषि आयोग (1971) की अन्तरिम रिपोर्ट से यह स्पष्ट है कि डेयरी विकास का प्रसार प्रभाव कृषि विकास को अतिरिक्त लाभ प्रदान करता है। डेयरी क्रियाओं के माध्यम से ग्रामीण क्षेत्रों में आर्थिक एवं सामाजिक परिवर्तन लाया जा सकता है। कृषि के सर्वांगीण विकास एवं ग्रामीण क्षेत्र में समृद्धि के लिए अच्छे कार्य करने वाले तथा अधिक दुधारू पशुओं की देश में विशेष आवश्यकता है। भारत में विश्व की कुल पशु संख्या के 15% पशु हैं तथा पशु संख्या की दृष्टि से भारत का विश्व में प्रथम स्थान है। एक अनुमान के अनुसार स्वतन्त्रता के समय देश में 28.50 करोड़ पशु थे जिनकी संख्या पशुगणना के अनुसार 1996 में बढ़कर 44.2 करोड हो गयी। वर्ष 1996 की पशुगणना के अनुसार भारत में गाय, भैंस, ऊँट, बकरी आदि की संख्या विश्व की कुल संख्या का क्रमशः 14.8, 52.6, 7.9 एवं 4.3 प्रतिशत थी जो वर्ष 2019 की पशुगणना के अनुसार बढ़कर क्रमशः 15.9, 55.2, 8.4 एवं 7.5 हो गई। गाय एवं भैंसों की संख्या में भारत का विश्व में प्रथम स्थान है। इसी प्रकार सम्पूर्ण पशुधन की दृष्टि से भी भारत का विश्व में प्रथम स्थान है एवं विश्व का एक तिहाई दुग्ध भारत में उत्पन्न होता है।

मुख्य शब्दः पशुपालन, डेयरी विकास, पंचवर्षीय योजनाएं, दुग्ध उत्पादन

भारत में स्वतंत्रता से पूर्व डेयरी विकास क्षेत्र को महत्वपूर्ण स्थान प्राप्त नहीं था, परंतु स्वतंत्रता के पश्चात यह अनुभव किया गया कि इस क्षेत्र का विकास केवल राष्ट्रीय स्वास्थ्य निर्माण में ही नहीं बल्कि आय एवं रोजगार सृजन में भी

महत्वपूर्ण भूमिका हो सकती है। ग्रामीण विकास में पशुपालन एवं डेयरी विकास की सशक्त भूमिका है तथा किन्ही भी परिस्थितियों में इन्हें एक दूसरे से पृथक नहीं किया जा सकता है। अच्छी खेती तथा अच्छे स्वास्थ्य के लिए अच्छे बैल तथा बढ़िया किस्म के दुधारू पशुओं की विशेष आवश्यकता होती है। दुधारू पशुओं से अच्छा दूध प्राप्त होता है। दूध ही एक ऐसा पदार्थ है जो अपने आप में एक पूर्ण आहार है अर्थात् दूध में भोजन के सभी आवश्यक तत्व पाए जाते हैं।

प्रथम एवं द्वितीय पंचवर्षीय योजनाओं में दुधारू पशुओं की संख्या में वृद्धि, उचित स्वास्थ्य सुधार, पशु पोषण, नस्ल सुधार, वैज्ञानिक प्रबन्धन आदि पक्षों में सुधार कर के दुग्ध उत्पादन में सुधार करने पर बल दिया गया। इन उद्देश्यों को प्राप्त करने के लिए की–विलेज स्कीम, गो–सदन कार्यक्रम एवं गोशाला विकास कार्यक्रम को क्रियान्वित किया गया था। प्रथम योजना में 'ग्राम समूह योजना' (1951–52) के अंतर्गत देश में अच्छे गुणवत्ता वाले सांडों की समस्या के समाधान हेतु उपाये किए गए थे। द्वितयी योजना में "गोसदन कार्यक्रम (1959)" को क्रियान्वित किया गया था। गोसदन का निर्माण गावों से बाहर जंगलों में किया जाता है जिसमें अनुत्पादक एवं बेकार पशुओं को रखा जाता है । गोशाला योजना भारत में पिछले 200 वर्षों से कार्यरत थी तथा इसे पशु प्रजनन एवं दुग्ध उत्पादक केंद्रों के रूप में प्रयोग किया जाता था। गोशालाओं का पशु विकास एवं दुग्ध उत्पादन के क्षेत्र में कोई विशेष सार्थक भूमिका न होने के कारण इस योजना को 1969 में समाप्त कर दिया गया था।

शोध प्रोत्साहन एवं प्रशिक्षण कार्यक्रमों के क्रियान्वयन के उद्देश्य से भारतीय डेयरी शोध संस्थान का नवीन नामकरण 'राष्ट्रीय डेयरी शोध संस्थान'(NDRI) के रूप में किया गया तथा वर्ष 1955 में इस संस्थान को बेंगलोर से हस्तांतरित कर के करनाल में स्थापित किया गया। दक्षिण भारत में NDRI के क्षेत्रीय कार्यालय की स्थापना बेंगलोर में की गयी थी। इसके पश्चात दो अन्य कार्यालयों की स्थापना मुंबई तथा कोलकाता में की गयी।

डेयरी उद्धोग के संतुलित विकास के लिए दुग्ध एवं दुग्ध उत्पादों को संगठित विपणन व्यवस्था के महत्व को स्वीकार किया गया ताकि दुग्ध उत्पादकों को उनके दुग्ध एवं दुग्ध उत्पादों का उचित मूल्य प्राप्त हो सके। परिणामस्वरूप तरल दुग्ध क्रांति का निर्माण, दुग्ध कार्यक्रम एवं प्रमुख नगरों एवं कस्बों में दुग्ध उत्पादों के उद्योगो की स्थापना पर विशेष ध्यान दिया गया। तृतीय पंचवर्षीय योजना में 23 तरल दुग्ध प्लांट, 4 दुग्ध उत्पादों की फैक्ट्री, 27 पायलट स्कीम तथा 3 क्रीम निकालने वाली फैक्ट्री का श्री गणेश किया गया। डेयरी क्षेत्र की तकनीकी सुविधाओं क विस्तार के उद्देश्य से 1965 में राष्ट्रीय डेयरी विकास बोर्ड (NDDB) की स्थापना आनंद (गुजरात) में की गयी । देश में आनंद पद्धति पर कार्यरत

ग्रामीण दुग्ध सहकारी समितियों को इसके माध्यम से तकनीकी सुविधाओं को उपलब्ध कराया जाने लगा।

यह अनुभव किया गया की पिछली विभिन्न योजनाओं में किया गया पशुधन विकास कार्यक्रमों का डेयरी क्षेत्र पर अनुकूल प्रभाव नहीं पड़ा। अतः दुग्ध आपूर्ति में वृद्धि करने के उद्देश्य से तृतीय पंचवर्षीय योजना के अन्तिम मध्य भाग में एक नवीन पशुधन विकास कार्यक्रम सघन पशु विकास परियोजना (ICDP 1965–66) को लागू किया गया। इस योजना के अंतर्गत समितियों को कृत्रिम वीर्यदान सुविधा, बांझपन निवारण, गाय के संकर प्रजनन में जर्सी तथा फ्रीजियन साँडो का उपयोग, मुर्रा तथा सुरति भैंसों का देशी भैंसों के साथ प्रजनन, सचल पशु चिकित्सा सुविधा, संतुलित पशु आहार, अमूल दान का वितरण,पशु आहार दो दलीय हरे चारे के उत्पादन को प्रोत्साहन आदि बिंदुओं पर विशेष ध्यान दिया गया था ताकि 50 वर्ष की समयावधि में 30% दुग्ध उत्पादन में वृद्धि को सुनिश्चित किया जा सके।

तृतीय पंचवर्षीय योजना क पश्चात तीन वर्षीय योजनाओं के प्रथम चरण में 1967 में पूना में भारतीय एग्रो इण्डस्ट्रीज फाउन्डेशन' (वायफ) प्रतिष्ठान की स्थापना ग्रामीण क्षेत्रों में रहने वाले निर्धन कृषको को पशुधन एवं दुग्ध व्यवसाय के माध्यम से रोजगार के अवसर उपलब्ध कराने के उद्देश्य से की गयी। इस प्रतिष्ठान द्वारा देश में 700 पशु प्रजनन केन्द्र स्थापित करके 7 राज्यों के 10 हजार गाँवों में लगभग 8 लाख परिवारों को इस योजना के अन्तर्गत आच्छादित किया गया है। इन केन्द्रों के माध्यम से गाय, भैंस के हिमीकृत वीर्यदान की सुविधा उपलब्ध कराई जा रही है।

चतुर्थ पंचवर्षीय योजना से डेयरी विकास कार्यक्रमों के बहुउद्देशीय स्वरूप को स्वीकार किया गया। तरल दुग्ध उत्पादन वृद्धि, दुग्ध उपार्जन, दुग्ध प्रसंस्करण, दुग्ध एवं दुग्ध उत्पादों की संगठित विपणन व्यवस्था को क्रियान्वित किया गया। यद्यपि डेयरी विकास कार्यक्रम के माध्यम से निर्धन ग्रामीणों की आर्थिक स्थिति में सुधार लाने में लघु कृषक विकास (SFDA) सीमान्त कृषक एवं कृषि श्रमिक विकास एजेन्सी योजना (MFAL). जनजाति क्षेत्र विकास कार्यक्रम (TADP) सूखा आशंकित क्षेत्र कार्यक्रम (DPAP) आदि कार्यक्रमों की भी सशक्त भूमिका रही है।

भारत सरकार द्वारा चतुर्थ पंचवर्षीय योजना में दुग्ध सहकारिताओं पर आधारित डेयरी विकास योजना के कार्य संचालन का दायित्व राष्ट्रीय डेरी विकास बोर्ड (NDDB) को सौपा गया। इस बोर्ड द्वारा अमूल की सफलता पर आधारित एक संगठन विकसित किया गया जिसे 'आनंद पद्धति का नाम दिया गया। इस योजना में बोर्ड द्वारा विश्व की सबसे बड़ी डेयरी विकास योजना ऑपरेशन फ्लड योजना–1 (1970) प्रारम्भ की गयी। बोर्ड को वित्तीय एवं व्यापारिक क्रियाओं के लिए भारत सरकार अधिकृत मान्यता न प्रदान होने के कारण आपरेशन फ्लड–1 के व्यावसायिक कार्यों के सहयोग देने हेतु भारत सरकार द्वारा 1970 में भारतीय डेयरी

निगम (IDC) की स्थापना की गयी। संगठित दुग्ध प्रसंस्करण (प्रोसेसिंग) एवं दुग्ध विपणन के लक्ष्यों को प्राप्त करने के उद्देश्य से विभिन्न प्रदेशों में प्रादेशिक डेयरी कारपोरेशनों एवं फेडरेशनों की आधारशिला रखी गयी।

पाँचवी पंचवर्षीय योजना' में लघु एवं सीमान्त कृषकों तथा कृषिगत श्रमिको के आर्थिक एवं सामाजिक उत्थान में डेयरी को आर्थिक व्यवसाय के रूप में महत्व प्रदान किया गया। इस सन्दर्भ में इन कृषक वर्गों को पशुनस्ल सुधार, दुग्ध एवं दुग्ध उत्पादों के उचित मूल्यों के लिए विभिन्न सुविधाएँ प्रदान करने का प्रावधान था। इस योजना में सरकार द्वारा विशेष पशुधन उत्पादन कार्यक्रम (1975) क्रियान्वित किया गया था।

छठीं पंचवर्षीय योजना के अन्तर्गत देश में दुग्ध सहकारिताओं की प्रोन्नति पर आधारित एकीकृत क्षेत्र विकास दृष्टिकोण को अपनाने पर बल दिया गया। पशु–पोषण, पशु प्रजनन, पशु प्रबन्धन तथा पशु स्वास्थ्य के लिए विभिन्न उन्नत तकनीकियों को क्रियान्वित करने पर विशेष बल दिया गया था ताकि पशु उत्पादकता एवं दुग्ध उत्पादन में वृद्धि हो सके। इस योजना के अन्तर्गत आपरेशन फ्लड–11 (1979–80) लागू किया गया जिसका प्रमुख उद्देश्य देश के 1980 के दशक में दुग्ध तथा दुग्ध पदार्थों की माँग के अनुसार दुग्ध की आपूर्ति को सुनिश्चित किया जा सके। जिन प्रदेशों एवं क्षेत्रों में आपरेशन फ्लड–।। क्रियान्वित नही था वहाँ पर इस योजना के समान एक अन्य योजना (नान–आपरेशन फ्लड योजना) के क्रियान्वयन की भारत सरकार ने स्वीकृति प्रदान की थी। इस योजना के अन्तर्गत दुधारू पशुओं के क्रय हेतु ऋण प्रदान कर निर्धनता की रेखा से नीचे जीवनयापन करने वाले सीमान्त, लघु एवं भूमिहीन श्रमिकों को स्वरोजगार उपलब्ध कराने हेतु व्यवस्था की गयी थी।

इसी योजनाकाल में स्पेशल कम्पोनेन्ट प्लान' (1982–83) प्रारम्भ की गयी थी। इस परियोजना का उद्देश्य दुग्धशाला विकास कार्यक्रमों के अन्तर्गत अनुसूचित जातियों को दुग्ध उत्पादक सदस्य बनाकर उनकी आय में वृद्धि करना ताकि उनको निर्धनता रेखा से ऊपर उठाकर उनकी आर्थिक स्थिति में सुधार लाने का प्रावधान था। अनुसूचित जातियों को वित्तीय सहायता प्रदान करने के उद्देश्य से अनुसूचित जाति/जनजाति निगम स्थापित किया गया।

छठी पंचवर्षीय योजना के उपरान्त अन्य योजनाओं में डेयरी विकास कार्यक्रमों की सशक्त भूमिका रही है। सातवीं योजना में भारत सरकार द्वारा क्रियान्वित "भ्रूण प्रत्यारोपण कार्यक्रम (1987) पशु प्रजनन क्षेत्र में एक अद्वितीय उपलब्धि थी। इसके अन्तर्गत केवल उत्पादक एवं श्रेष्ठ नस्ल की गायों का ही चयन किया जाता है तथा भ्रूण प्रत्यारोपण द्वारा एक वर्ष में 5–10 उन्नतशील नस्ल की संततियाँ प्राप्त की जा सकती हैं। वर्तमान समय में देश के लगभग सभी राज्यों में इसे अपनाने पर विशेष ध्यान दिया जा रहा है।

गुजरात की अमूल डेयरी की सफलता एवं अनुभव पर विकसित आनंद पद्धति को मूल आधार मानकर देश में आपरेशन फ्लड योजना को क्रियान्वित किया गया। ग्रामीण क्षेत्रों में इस योजना से प्राप्त होने वाले लाभों को और अधिक प्रभावी एवं गतिशील बनाने के उद्देश्य से भारत सरकार द्वारा "डेयरी प्रौद्योगिकी मिशन" (1988) का गठन किया गया। इसके अन्तर्गत देश के दुग्ध विकास, पशुधन विकास, ग्राम्य विकास आदि विभागों के पास उपलब्ध भौतिक एवं वित्तीय संसाधनों का अधिकतम उपयोग करके देश के दुग्ध उत्पादन में वृद्धि की रणनीति अपनायी गयी।

इसी योजनाकाल में आपरेशन फ्लड–II योजना के शेष अपूर्ण लक्ष्यों को पूर्ण करने तथा राज्यों में गठित सहकारी डेयरी फेडेरेशनों के ढाँचे को सुदृढ करने के उद्देश्य से आपरेशन फ्लड–III (1989) को क्रियान्वित किया गया। साथ ही साथ OF–III योजना में राष्ट्रीय डेयरी विकास बोर्ड द्वारा अधिकांश कार्यकलाप विभिन्न राज्यों के सहकारी डेरी फेडरेशनों को हस्तान्तरित किए गये

महिलाओं की आर्थिक स्थिति में सुधार एवं अन्य लोकतान्त्रिक संगठनों में उनकी भूमिका एवं भागीदारी सुनिश्चित करने के उद्देश्य से आठवीं पंचवर्षीय योजना के अन्तर्गत "महिला डेयरी परियोजना" (1991–92) प्रारम्भ की गयी थी। इस परियोजना का प्रमुख उद्देश्य महिलाओं को महिला दुग्ध समितियों के माध्यम से दुग्ध व्यवसाय से जोड़कर उन्हें आर्थिक रूप से आत्मनिर्भर एवं सुदृढ करना था।

इसी योजना काल में एक अन्य योजना वर्ष (1991–92) में दीनदयाल विकास योजना को प्रारम्भ किया गया था जिसका बाद में नामकरण "सघन मिनी डेयरी परियोजना" कर दिया गया। इस योजना में दो या चार दुधारू पशुओं के क्रय हेतु बैंक ऋण एवं अनुदान का प्रावधान किया गया। इसे चार प्रमुख चरणों में क्रियान्वित किया गया है। चतुर्थ चरण (2000 के बाद) के अन्तर्गत यह परियोजना अम्बेडकर विशेष रोजगार योजना के अन्तर्गत क्रियान्वित है। इसी योजना के अन्तर्गत "सेन्ट्रल सेक्टर योजना (1994–95) में सरकार के सहयोग से उत्तर प्रदेश के बुन्देलखण्ड तराई एवं पूर्वाचल के जनपदों में क्रियान्वित है। आठवीं योजना काल में ग्रामीण क्षेत्रों में परिवार नियोजन एवं स्वास्थ्य शिक्षा को प्रोत्साहित करने के उद्देश्य से 'सिफ्सा परियोजना (1993–94) दुग्ध सहकारिताओं के माध्यम से क्रियान्वित की गयी थी। यह परियोजना देश के सभी राज्यों में 5–10 वर्षो क लिए लागू की गयी थी तथा महिला डेयरी परियोजना के अभिन्न अंग के रूप में कार्यरत थी।

नवीं पंचवर्षीय योजना के अन्तिम वर्ष में भारत सरकार द्वारा स्पेशल कम्पोनेंट प्लान के अधीन दुग्ध उत्पादक अम्बेडकर ग्राम्य विकास योजना (2001–2002) प्रारम्भ की गयी थी। इस योजना के अन्तर्गत अम्बेडकर ग्रामों में निवास करने वाले अनुसूचित जाति एवं जनजातियों के सदस्यों को दुग्ध समितियों से प्रत्यक्ष रूप से जोड़ा गया।

इसी प्रकार सेन्ट्रल सेक्टर स्कीम के अन्तर्गत नॉन आपरेशन फ्लड परियोजना के रूप में एकीकृत दुग्धशाला विकास परियोजना (2001–2002) उत्तर प्रदेश के चार जनपदों– रामपुर, बरेली, पीलीभीत एवं शाहजहाँपुर में क्रियान्वित की गयी है जिसका कार्यकाल पाँच वर्ष (2001–2006) तक के लिए अनुमोदित था। इस परियोजना का प्रमुख उद्देश्य भूमिहीन एवं सीमान्त कृषक परिवारों को डेयरी क्षेत्र में प्रत्यक्ष रूप से जोड़ना ताकि दुग्ध समितियों के माध्यम से दुग्ध उत्पादन क्षमता एवं उनकी आय में वृद्धि सम्भव हो सके।

भारतीय योजनाओं में प्रमुख डेयरी विकास कार्यक्रमों की संक्षिप्त रूपरेखा निम्नलिखित हैः–

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छठी योजना

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ग्यारहवीं योजना

राष्ट्रीय कृषि विकास कार्यक्रम।

मवेशी और भैंस प्रजनन के लिए राष्ट्रीय परियोजना।

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Chapter - 3
अद्भुत फसल क्विनोआ के पोषण संबंधी पहलू

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Chapter - 3

अद्भुत फसल क्विनोआ के पोषण संबंधी पहलू

रमनदीप सिंह और अनुभव

सारांश

क्विनोआ को छद्म अनाज की फसल के रूप में जाना जाता है, जिसमे स्टार्च डाइकोटाइलडोनस बीज के साथ चौड़ी पत्ती होती है और इसलिए यह अनाज नहीं होता है। परन्तु यह अनाज खाद्य पदार्थों की तरह प्रयोग में लिया जाता है, तथा यह खाद्य उद्योग के लिए एक महत्वपूर्ण घटक स्त्रोत भी है। क्विनोआ विभिन्न कृषि पारिस्थितिक क्षेत्रों में पाया जा सकता है, यह बहुत गर्म या ठंडे जलवायु में अनूकूल बना लेता है। यह–4 डिग्री सेल्सियस से 38 डिग्री सेल्सियस के तापमान में जीवित रह सकता है। क्विनोआ की खेती के लिए सापेक्षिक आर्द्रता 40 प्रतिशत से 88 प्रतिशत के बीच होती है। यह एक अत्यधिक जल कुशलता वाला पौधा है। यह मिट्टी की नमी की कमी के प्रति सहनशील और प्रतिरोधी है। इसकी पर्याप्त उपज के लिए आवश्यक औसत वर्षा 100 से 200 मिमी है। इस तरह के गुणो वाले क्विनोआ को पफ्स, आटा, पास्ता, फ्लेक्स, एनर्जी बार इत्यादि जैसे कई उत्पादों को प्राप्त करने के लिए कच्चे माल के रूप में उपयोग में लाया जाता सकता है। क्विनोआ सीलिएक रोगियों के लिए एक आकर्षक ग्लूटेन रहित खाद्य के रूप में उपलब्ध है, और आहार में क्विनोआ को शामिल करना उच्च प्रोटीन और साथ ही सभी बुनियादी अमीनो एसिड को खाने के लिए एक अच्छा तरीका हो सकता है।

क्विनोआ में असंतृप्त लिपिड, फाइबर, जटिल शर्करा और अन्य लाभकारी मिश्रण भी होते हैं, उदाहरण के लिए इसका उपयोग टाइप 2 मधुमेह को नियंत्रित करने में मदद करने के लिए किया जा सकता है।

प्रस्तावना

क्विनोआ को छद्म अनाज की फसल के रूप में जाना जाता है, जिसमे स्टार्च डाइकोटाइलडोनस बीज के साथ चौड़ी पत्ती होती है और इसलिए यह अनाज नहीं होता है। परन्तु यह अनाज खाद्य पदार्थों की तरह प्रयोग में लिया जाता है, तथा यह खाद्य उद्योग के लिए एक महत्वपूर्ण घटक स्त्रोत भी है। भारत में, इसे नकदी फसल के रूप में जाना जाता है। क्विनोआ विटामिन और खनिज से भरपूर होते है। इसमें भरपूर पोषण है तथा इसे अनाज का राजा भी कहा जाता है। क्विनोआ को विशेष औषधीय महत्व है यह प्रकृति में गलूटिन मुक्त होने और एंटीआक्सीडेंट होने के

कारण अधिक उपयोगी है। पहले यह लेटिन अमेरिका में पूर्व कोलंबियाई संस्कृति की मुख्य फसल थी, लेकिन बाद में स्पेनियों के आने के बाद इसकी खेती लगभग समाप्त हो गई थी।

क्विनोआ विभिन्न कृषि पारिस्थितिक क्षेत्रों में पाया जा सकता है, यह बहुत गर्म या ठंडे जलवायु में अनूकूल बना लेता है। इसे गर्म रेगिस्तान के साथ–साथ शुष्क जलवायु में भी उगाया जा सकता है। यह –4 डिग्री सेल्सियस से 38 डिग्री सेल्सियस के तापमान में जीवित रह सकता है। क्विनोआ की खेती के लिए सापेक्षिक आर्द्रता 40 प्रतिशत से 88 प्रतिशत के बीच होती है। यह मिट्टी की नमी की कमी के प्रति सहनशील और प्रतिरोधी है। इसकी पर्याप्त उपज के लिए आवश्यक औसत वर्षा 100 से 200 मिमी है। इसे बलुई दोमट मिट्टी में उगाया जा सकता है।

क्विनोआ 5000 से 7000 साल पहले बोलीविया और पेरू के एंडन क्षेत्र में उगाया जाता था। चूंकि यह मानव पोषण की गंभीर समस्या को हल करने का सबसे अच्छा विकल्प है, इसलिए इसे 1996 में एफ.ए.ओ. द्वारा मानवता की सबसे आशाजनक फसल में एक माना गया था। नासा ने इसे सी.ई.एल.एस.एस. (नियंत्रित पारिस्थितिक जीवन समर्थन प्रणाली) में भी शामिल किया है, क्योकि यह समृद्ध प्रोटीन आहार है और इसमें पर्याप्त मात्रा में खनिज होते है। यह उन्हें लंबी अवधि की यात्रा और प्रोटीन के पर्याप्त सेवन के लिए भोजन की समस्या को हल करने में मदद करता है। फसल की इतनी महत्वपूर्ण क्षमता के कारण, संयुक्त राष्ट्र ने 2013 को इंटरनेशनल ईयर ऑफ क्विनोआ घोषित किया।

इस तरह के गुणो वाले क्विनोआ को पफ्स, आटा, पास्ता, फ्लेक्स, एनर्जी बार इत्यादि जैसे कई उत्पादों को प्राप्त करने के लिए कच्चे माल के रूप में उपयोग में लाया जाता सकता है। हालाँकि इसका उपयोग थ्क्वनोआ तेल, स्टार्च, सैपोनिन, प्रोटीन सांद्रता आदि के निष्कर्षण उत्पादों के उत्पादन के लिए किया जा रहा है, जिसमें उन्नत तकनीक और मशीनरी की आवश्यकता होती है। इन उत्पादों का अच्छा आर्थिक मूल्य है, क्योंकि उनके पास न केवल खाद्य मूल्य है, बल्कि एंटी आक्सीडेंट, रोगाणुरोधी जैसे कई गुण भी है, जिसके कारण सौंदर्य प्रसाधन, दवा और रासायनिक उद्योगों जैसे उद्योग में इसकी बहुत मांग है।

ऐतिहासिक पृष्ठभूमि और भौगोलिक वितरण

जैकबसेन (2003) के अनुसार क्विनोआ एक प्राचीन फसल है, और एंडियन क्षेत्र की सबसे पुरानी फसल भी है जिसकी खेती 5000 से 7000 साल पहले भी की जाती थी। पूर्वी–कोलंबियाई संस्कृतियों में इसकी व्यापक रूप से एंडियन क्षेत्र में खेती की जाती थी और इसके अनाज का उपयोग उच्च ऊंचाई वाले क्षेत्रों में आहार के रूप में किया जाता है। जहाँ जलवायु शुष्क होती है और तापमान लगभग 12 डिग्री सेल्सियस रहता है। हांलाकि यह स्थानीय प्रजाति है लेकिन क्विनोआ के पेरिकार्प में सैपोनिन होता है, जो स्वाद में कड़वा होता है। इसलिए सेवन करने से पहले सैपोनिन

को हटाना आवश्यक होता है (मुजिका, 1992; हेइसर और नेल्सन, 1974)। स्पेनिश विजय की शुरूआत और जौ और गेहूं (मुजिका, 1992; जेकबसेन और स्टोलन, 1993) जैसे अनाज के साथ इस फसल का हाशियाकरण और प्रतिस्थापन हुआ और क्विनोआ को बदल दिया गया और कई आर्थिक ओर सामाजिक कारणों से शहरी आबादी इसकी खेती समाप्त हो गई। लेकिन इस फसल की खेती अभी भी एडियन लोगों (रिसी, 1997) द्वारा कि जाती है। 80 के दशक के दौरान एंडियन लोगो ने यूरोप जैसे आर्थिक रूप से विकसित देशों मे क्विनोआ को भोजन के रूप में पेश करके आर्थिक विकास का एक नया तरीका आजमाया जो अतंतः उनके बाजार को बढाता है और पारंपरिक खेती की फसल से क्विनोआ को निर्यात वस्तु के रूप में स्थापित करने मदद करता है।

खाद्य सुरक्षा और संप्रभुता में थ्क्वनोआ का सभावित योगदान

क्विनोआ में पोषण, आनुवांशिक व्यवहार्यता, प्रतिकूल जलवायु और मिट्टी की स्थिति के अनुकूल और कम लागत मूल्य जैसे गुण होते है, जिससे इस फसल में खाद्य सुरक्षा और संप्रभुता में योगदान करने की अपार क्षमता होती है। क्विनोआ आंतरिक उत्कृष्ट विशेषताओं वाला एक अनाज है। क्विनोआ रेगिस्तान, गर्म और शुष्क जलवायु के अनुकूल है। प्रतिकुल जलवायु और मिट्टी की परिस्थितियों के अनुकूल होने की अपनी क्षमता के कारण, जहां अन्य फसलें उगने में असमर्थ है, समुद्र तल से 4000 मीटर (उच्च एंडियन पठार, सलारे एंडियन पठार, आंतरिक एंडियन घाटियों) की ऊंचाई पर फसल प्राप्त की जा सकती है। सीमित खाद्य उत्पादन वाले देशों मे क्विनोआ अनाज फसलों का सबसे अच्छा विकल्प है। थ्क्वनोआ विभिन्न देशों में खाद्य सुरक्षा में योगदान देता है क्योकि इसमें प्रतिकुल परिस्थितियों में उत्पादन की उच्च क्षमता है (विल्सनए 1985)।

इसका कृषि में बहुत महत्व है क्योकिं इसमें पाया जाने वाला सैपोनिन एक प्राकृतिक कीटनाशक के रूप में मदद करता है और कई जैव कीटनाशकों में कच्चे माल के रूप में उपयोग में लिया जाता है।

मुख्य रूप में अच्छी गुणवला वाले प्रोटीन की उच्च सामग्री के कारण क्विनोआ उच्च पोषण तत्व वाला एक संपूर्ण भोजन है। प्रोटीन सामग्री के अलावा, इसमें लिपिड, स्टार्च, खनिज और सैपोनिन जैसे कई अन्य तत्व होते हैं, इसमें विटामिन बी, ई और सी जैसे विटामिन भी होते है। बोलिविया और पेरू दुनिया भर में 88 प्रतिशत उत्पादन के साथ क्विनोआ के सबसे बड़े निर्यातक हैं। इसके बाद संयुक्त राज्य अमेरिका 6 प्रतिशत (ब्रेनेस, 2001) के साथ है। अर्जेटीना में उत्पादन आमतौर पर घरेलू खपत के लिए बीज या आटे के रूप में उपयोग किया जाता है।

उद्देश्य

क्विनोआ के पोषण संबंधी पहलू, उपयोग और भविष्य के पहलुओं का अध्ययन करना।

कार्यप्रणाली

यह पेंपर सेकेंडरी डेटा पर आधारित है। यह जानकारी विभिन्न माध्यमिक स्त्रोतों जैसे पत्रिकाओं, शोधपत्र आदि के लिए गई थी।

क्विनोआ के रासायनिक और पोषण गुण

तालिका संख्या 1: क्विनोआ बीज की रासायनिक संरचना

ऊर्जा मूल्य	क्विनोआ	गेहूं	चावल	मक्का
किलोकैलारी/100 ग्राम	350.00	309.00	353.00	338.00
प्रोटीन/ 100 ग्राम	13.81	11.50	7.40	9.20
वसा/100 ग्राम	5.01	2.00	2.20	3.80
कार्बोहाड्रेट / 100 ग्राम	59.74	59.40	74.60	65.20
कैल्शियम मिलीग्राम / 100 ग्राम	66.60	43.70	23.00	15.00
फास्फोरस मिलीग्राम / 100 ग्राम	408.30	406.00	325.00	256.20
मैग्नीशियम मिलीग्राम /100 ग्राम	204.20	147.00	157.20	120.00
पोटेशियम मिलीग्राम / 100 ग्राम	1040.0	502.00	150.00	330.00
आर्यन मिलीग्राम / 100 ग्राम	10.90	3.30	2.60	.
मैंगनीज मिलीग्राम /100 ग्राम	2.47	3.40	1.10	0.48
जस्ता मिलीग्राम/100 ग्राम	7.47	4.10	.	2.50

(स्त्रोतः शर्मा वी., 2015)

तालिका संख्या 2: अन्य खाद्य सामग्री की तुलना में क्वीनोआ की पोषण संरचना (प्रतिशत)

अवयव (प्रतिशत)	क्विनोआ	मांस	अंडे	पनीर	गाय का दुध
प्रोटीन	13.00	30.00	14.00	18.00	3.50
वसा	6.10	50.00	3.20	.	3.50
कार्बोहाड्रेट	71.00	—	—	—	—
शकर	—	—	—	—	4.70
आर्यन	5.20	2.20	3.20	.	2.50
कैलोरी/100 ग्राम	350.00	431.00	200.00	2400	60.00

स्त्रोतः ऐग्रीफूड रिपोर्ट, 2009, एम.डी.आर.टी. बोलिविया

भोजन में क्विनोआ का प्रयोग

क्विनोआ एक अत्यधिक पौष्टिक भोजन है यह संयुक्त राष्ट्र के खाद्य और कृषि संगठन (एफएओ) द्वारा इस फसल के पोषण मूल्य की तुलना सूखे दूध से की गई है। इसका उपयोग आटा, सूप, नाश्ता अनाज और बियर बनाने के लिए किया जाता

है। संयुक्त राज्य अमेरिका में बेचे जाने वाले अधिकांश क्विनोआ को साबुत अनाज के रूप में बेचा जाता है जिसे चावल के रूप में अलग से पकाया जाता है। क्विनोआ आटा एक स्टार्च एक्सटेंडर के रूप में काम करता है इसे बिस्कुट, ब्रेड और प्रोसेस्ड फूड बनाने में गेहूं के आटे या अनाज, या मकई के भोजन के साथ मिलाया जाता है। कंकोला क्विनोआ की एक मीठी किस्म है, जिसका उपयोग भोजन के रूप में किया जाता है, मुख्यतः गेहूं और चावल की तरह, क्विनोआ में सैपोनिन होता है जो कड़वा स्वाद देता है, और इसे भोजन के उपयोग से पहले डी–हलिंग की आवश्यकता होती है ताकि कड़वे और पोषण–विरोधी कारकों को दूर किया जा सके। क्विनोआ के उबले हुए बीजों को चावल की जगह पर खाया जा सकता है, या सूप को गाढ़ा करने के लिए या दलिया के रूप में या गर्म नाश्ते के अनाज के रूप में इस्तेमाल किया जा सकता है। हरे अंकुरित अंकुरित क्विनोआ बीज को सलाद में मिला सकते हैं। पॉपकॉर्न की तरह क्विनोआ सीड पॉप भी बनाया जा सकता है।

क्विनोआ के औद्योगिक उपयोग

क्विनोआ को सब्जियों के साथ जोड़ा जा सकता है, उदाहरण के लिए, आहार की गुणवत्ता बढ़ाने के लिए, विशेष रूप से नवजात बच्चों और बच्चों के लिए स्कूल के नाश्ते के लिए चौड़ी बीन्स और किडनी बीन्स। वैसे ही संसाधित और अर्ध–तैयार खाद्य पदार्थ उपलब्ध हैं, लेकिन ये ज्यादातर आबादी के एक बड़े हिस्से के लिए अधिक महंगे और अनुचित रूप से महंगे हैं।

इस तरह की अर्ध–तैयार वस्तुओं में ''जई'' शामिल होता है जो खाने के लिए तैयार किया जाता है और अधिकांश भाग नाश्ते में खर्च किया जाता है। इनमें फूला हुआ, दानेदार, कटा हुआ, नष्ट और गर्म अनाज शामिल होता है जिसमें उपयोग से पहले एक गर्म तरल पदार्थ शामिल किया जाता है। इसी तरह पुनर्गठित बाल आहार हैं।

सभी उद्देश्यों और उद्देश्यों के लिए सभी आटा उद्योग वस्तुओं का उत्पादन क्विनोआ साबुत अनाज और आटे का उपयोग करके किया जा सकता है। एंडियन जिले में और कहीं और प्रारंभिक ने 10, 15, 20 और 40ः क्विनोआ आटे को ब्रेड में, नूडल्स में 40ः प्रतिशत तक, वाइप केक में 60 प्रतिशत तक और 70 प्रतिशत तक शामिल करने की संभावना का प्रदर्शन किया है। आटा व्यवसाय में एक पूरक आहार के रूप में क्विनोआ का उपयोग करने का मूल पसंदीदा दृष्टिकोण यह है कि यह दुनिया भर में ग्लूटेन के बिना मांग के विकास की देखभाल करने में सक्षम बनाता है।

वर्तमान में उच्च प्रोटीन सामग्री के साथ उत्कृष्ट भोजन की आवश्यकता है। 45ः प्रतिशत तक प्रोटीन युक्त क्विनोआ बीज के प्रारंभिक जीव में प्रोटीन को स्थानांतरित किया जाता है। प्रारंभिक जीव को बीज के किसी भी अवशेष से अलग किया जा सकता है और केंद्रित फ्रेम में फिर सीधे बच्चों के भोजन से जोड़ा जा सकता है,

उदाहरण के लिए कुपोषित युवाओं को तेजी से पौष्टिक स्वास्थ्य प्राप्त करने में मदद करना, या इसे बहुत अच्छी तरह से मिश्रित किया जा सकता है वयस्कों के लिए आहार संबंधी सहायता की आवश्यकता वाले व्यंजन, उदाहरण के लिए, गर्भवती महिलाएं।

पशुओं का चारा

पूरे पौधे का उपयोग हरे चारे के रूप में किया जाता है। फसल के अवशेषों का उपयोग मवेशियों, भेड़, सूअर, घोड़ों और मुर्गे को खिलाने के लिए भी किया जाता है।

औषधीय उपयोग

उच्च स्वस्थ सम्मान, चिकित्सीय गुण, और क्विनोआ की लस मुक्त प्रकृति बच्चों, बुजुर्गों, कुलीन प्रतियोगियों, लैक्टोज के बड़े खरीदारों, ऑस्टियोपोरोसिस–इच्छुक महिलाओं, और लोहे की कमी, मधुमेह वाले व्यक्तियों सहित कुछ खतरनाक दुकानदार आबादी को लाभान्वित कर सकती है। डिस्लिपिडेमिया, भारीपन, या सीलिएक बीमारी (भार्गव, एट आल, 2006 वेगा–गैल्वेज, एट आल, 2010)। इस तथ्य के बावजूद कि क्विनोआ की पुनर्स्थापना क्षमता पर प्राणी और मानव नैदानिक प्रारंभिक मात्रा सीमित है, कुछ परीक्षण क्विनोआ के उपयोग से संबंधित विभिन्न लाभों को प्रदर्शित करते हैं।

क्विनोआ के पत्तों, तनों और अनाजों का उपयोग पुनर्स्थापनात्मक उद्देश्यों के लिए किया जाता हैः घावों को ठीक करना, सूजन कम करना, पीड़ा (दांत दर्द) को कम करना और मूत्र पथ को साफ करना। उनका उपयोग हड्डी की सेटिंग, आंतरिक जल निकासी और खौफनाक क्रॉली एंटी–एजेंट के रूप में भी किया जाता है।

ब्रिटनी एट आल, (2015) के नेतृत्व में क्विनोआ के कल्याण सम्मान और उपयोगितावादी जीविका सुधार में प्रगति पर एक जांच की गई थी। चार नैदानिक शोधों में यह प्रदर्शित किया गया है कि क्विनोआ अनुपूरण लोगों में चयापचय, हृदय और जठरांत्र संबंधी स्वास्थ्य पर भारी, लाभकारी परिणामों को लागू करता है। बहरहाल, यह पाया गया कि विश्वव्यापी मानव स्वास्थ्य और पोषण की प्रगति में क्विनोआ के काम को कारगर बनाने के लिए तार्किक, कृषि और विकास के क्षेत्रों में बड़ी मुश्किलें और खुलेपन बने हुए हैं।

क्विनोआ के भविष्य के पहलू

इंका साम्राज्य में प्राचीन काल से क्विनोआ की पौष्टिकता को जाना जाता है। इन दिनों, क्विनोआ को दुनिया भर में हर जगह इसके अच्छे लाभों के लिए, और इसके प्रोटीन, खनिज और विटामिन पदार्थ के लिए माना जाता है। पौष्टिक आचरण में क्विनोआ की भूमिका निभाने वाले राष्ट्रों के साथ–साथ निर्मित दुनिया में भी महत्व को रेखांकित किया गया है। एंडियन देशों में, क्विनोआ की पैदावार बाद में उनकी

अर्थव्यवस्थाओं में एक महत्वपूर्ण भूमिका निभा सकती है, इसके अतिरिक्त, क्विनोआ एक महत्वपूर्ण उत्पाद हो सकता है जिसका उपयोग प्रांतीय छोटे जिलों में खाने की व्यवस्था के पूरक के लिए किया जाता है, जहां जीवन शक्ति प्रोटीन अस्वस्थता निर्माण करने वाले राष्ट्रों में निवासियों की संख्या के एक बड़े हिस्से को प्रभावित करती है। क्विनोआ, ''मदर ग्रेन'' के रूप में, निर्मित दुनिया में एक रंगीन और ठोस पुनर्खोज की बात करता है (वेलेंसिया–कैमोरो 2003)। एंडियन क्षेत्र के देशों में जर्मप्लाज्म का जमावड़ा होना चाहिए। पौधे की मोटाई, संभावित विकास, फीनोलॉजी, आकृति विज्ञान, शारीरिक विकास, उपज और खरपतवार नियंत्रण सहित कृषि अनुसंधान किया जाना चाहिए। इसके अतिरिक्त संयुक्त राज्य अमेरिका और यूरोप में ''क्विनोआ के नए घरों'' के लिए विभिन्न किस्मों के लचीलेपन की जांच आवश्यक है। क्विनोआ को विशेष रूप से भारत के लिए 'कम उपयोग' नाम दिया जा सकता है, क्योंकि इसकी व्यापक बहुमुखी प्रतिभा, जंगलीपन और अधिक, स्वस्थ प्रबलता के बावजूद, इसकी व्यावसायिक क्षमता अनदेखा रह गई है। भारत में, आबादी के एक बड़े हिस्से के पास प्रोटीन युक्त आहार की बहुत कम पहुंच है, क्योंकि चावल और गेहूं प्रमुख पोषक फसलें हैं। क्विनोआ का अत्यधिक प्रोटीनयुक्त अनाज इस स्थान में खाने को कम समायोजित कर सकता है और भारत में गरीब आबादी के बीच 'शांत भूख' से लड़ने में महत्वपूर्ण भूमिका निभा सकता है, जिनके पास प्रोटीन युक्त आहार आहार तक बहुत कम पहुंच है। इसके अलावा, उन्नत प्रगति और विभिन्न क्षेत्रों के साथ संबंध, आइटम उन्नति और प्रचार के समान, व्यवसाय को अलग–अलग अनुप्रयोगों के लिए अपनी क्षमता का दोहन करने के लिए सशक्त करेगा।

निष्कर्ष

क्विनोआ जैसे छद्म अनाज का उपयोग अनुसंधान के एक आशाजनक क्षेत्र की बात करता है, क्योंकि इसका उपयोग विशिष्ट मैक्रोमोलेक्यूल्स और फाइटोकेमिकल्स के प्रवेश को बढ़ा सकता है जिन्हें मानव कल्याण के लिए मूल्यवान माना जाता है। क्विनोआ सीलिएक रोगियों के लिए उपलब्ध एक आकर्षक, बिना ग्लूटेन ऐच्छिक है, और आहार में क्विनोआ को शामिल करना उच्च कार्बनिक सम्मान प्रोटीन और साथ ही सभी जैवउपलब्ध बुनियादी अमीनो एसिड, कुछ ऐसा जो कभी–कभी अन्य अनाज खाने के लिए एक अच्छा तरीका हो सकता है। क्विनोआ में असंतृप्त लिपिड, फाइबर, जटिल शर्करा और अन्य लाभकारी मिश्रण भी होते हैं, उदाहरण के लिए, बीटाइन, और इसका उपयोग उपापचय जोखिम कारक प्रोफाइल को बढ़ाने और टाइप –2 मधुमेह को नियंत्रित करने में मदद करने के लिए किया जा सकता है। क्विनोआ कुछ अन्य पुनर्स्थापनात्मक कठिनाइयों के लिए मूल्यवान हो सकता है, उदाहरण के लिए, बीमारी, वजन और डिस्लिपिडेमिया। इसके अलावा, क्विनोआ, एक पौधे के पोषण के रूप में, कार्बन और पानी के पोषण प्रिंट के साथ अत्यधिक किफायती है, जो मांस की तुलना में 30 से 60 गुना कम है।

इसके अलावा, क्विनोआ अनाज में काउंटर आहार कारक बिना किसी खिंचाव के निष्क्रिय हो सकते हैं या सुरक्षित भलाई के स्तर तक कम हो सकते हैं जब इस जीविका की आधुनिक हैंडलिंग या पारिवारिक इकाई व्यवस्था के लिए उपयुक्त तरीकों का उपयोग किया जाता है। पाक अनुप्रयोगों के संबंध में, साबुत अनाज द्वारा परिष्कृत आटे का प्रतिस्थापन, उदाहरण के लिए, क्विनोआ कुछ कठिनाइयाँ पैदा करता है, जिन्हें ऑर्गेनोलेप्टिक गुणों में परिवर्तन को शामिल करते हुए किया जाना चाहिए।

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Chapter - 4
Subaltern Historiography in India

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Chapter - 4

Subaltern Historiography in India

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Abstract

In India, subaltern historiography is a revolutionary and empowering method of studying the past. It challenges prevailing historical narratives that silence the voices and experiences of underprivileged communities, including Dalits, indigenous peoples, women, and peasants. Subaltern historiography provides a more inclusive and thorough knowledge of India's past by emphasizing these underrepresented viewpoints. This essay analyzes the advantages and disadvantages of this method, highlighting its benefits for exposing subaltern agencies, reinterpreting power relationships, and utilizing non-conventional sources. But issues with essentialism, the exclusion of powerful actors, methodological difficulties, the essentialization of postcolonial identity, the narrow focus on economic issues, gender, international contexts, and representation call for careful thought. Subaltern historiography can continue to be a key player in altering historical research and advancing historical justice by responding to these criticisms.

Keywords: Dalits, historiography, non-traditional, caste, colonial

Introduction

A revolutionary and uplifting method of studying the past, subaltern historiography in India aims to elucidate the histories of marginalized and oppressed communities that have historically been kept silent or obscured by dominant narratives. Subaltern historiography, a term taken from Antonio Gramsci's writings to refer to the socially and economically marginalized, was developed in the 1980s by the eminent Indian historian Ranajit Guha. It challenges traditional historical narratives that frequently concentrate on the deeds of ruling elites, colonial powers, and dominant social classes while ignoring the experiences and agency of the subaltern. The importance of subaltern historiography can be attributed to its goal of presenting a more thorough and complex view of India's past by bridging the gaps in traditional historiography. Subaltern historiography shifts focus to the lives of common

people, peasants, tribal communities, women, and other oppressed groups while mainstream history may offer a top-down perspective on major political events, battles and the lives of rulers. It highlights the significance of grassroots movements, regular resistance and subaltern communities' collaborative efforts to control their futures. Subaltern historiography's dependence on the "history from below" technique is one of its key features. This strategy makes use of non-conventional historical sources, including folklore, oral traditions, music, regional mythologies, and other indigenous knowledge systems. These resources allow historians to reconstruct the history of the subaltern from their viewpoints rather than through the eyes of the ruling classes and provide insightful accounts of their everyday lives. Subaltern historiography confronts the prejudices present in official documents and colonial archives accomplishing this.

The criticism of colonial historiography, which was frequently closely tied to imperial goals and reaffirmed orientalist notions of Indians as docile and backward people, has also been greatly aided by subaltern historiography. This method challenges the idea of a one-sided narrative of colonial control and reveals the nuanced relationships between the rulers and the ruled by emphasizing the resistance movements and agency of subaltern communities during colonial rule. Additionally, caste- and gender-based structures in Indian society have been reexamined as a result of subaltern historiography. It explores the histories of women and Dalits (formerly known as untouchables), highlighting their contributions and ongoing battles to regain their identities and agency. There have been issues with subaltern studies as a historiographical framework. According to some academics, this can lead to romanticizing or idealizing the subaltern and can obscure the inherent conflicts and difficulties that exist within these groups. Others contend that concentrating only on the underprivileged risks omitting the larger socioeconomic and political environment in which these groups operated. This chapter aims to list the positive and negative aspects of this school of historiography.

Subalterns of prominence and their works

1) **Ranajit Guha:** Ranajit Guha, who was born in 1923, is frequently referred to as the founder of subaltern studies and a significant contributor to the growth of subaltern historiography. Guha, born in Kolkata, studied history at the University of Calcutta before going to the University of Oxford to get his doctorate. In his seminal book "Elementary Aspects of Peasant Insurgency in Colonial India" (1983), he questioned traditional historiography, which

predominantly examined the Indian liberation fight from the viewpoint of the nationalist elite. Guha instead focused on the peasant uprisings and movements throughout the colonial era, notably those in the 19th century. Guha maintained that rather than being passive targets of oppression, peasants were active participants in the struggle against colonial rule and the exploitation-promoting practices of the landed gentry. By adopting the term from the writings of the Italian Marxist Antonio Gramsci, he created the term "subaltern" to describe these oppressed people. Guha's writings highlighted the necessity to study history "from below," reconstructing the experiences of the lower classes utilizing out-of-the-ordinary materials like oral traditions, folk melodies, and local tales. Guha co-founded the Subaltern Studies group in 1982 with other like-minded historians in addition to his seminal work. The group produced several significant books that were essential to the development of Subaltern Studies. Guha's efforts have had a significant impact on Indian historical studies, he passed away in 2015 after a glorious career.

2) **Gyanendra Pandey:** A renowned anthropologist and historian well known for his important contributions to subaltern studies. He was born in India in 1942 and pursued higher education in the US, where he worked in a variety of academic fields. The interconnections of culture, society, and history are frequently explored in Pandey's work, with a focus on topics relating to nationalism, identity politics, and communalism in colonial and post-colonial India. Pandey explores the development of communal identities under British colonial authority in his seminal work "The Construction of Communalism in Colonial North India" (1990). He disputes the idea that communalism was a fundamental or inevitable force, claiming that it was a result of particular social and historical circumstances. The significance of comprehending communalism at the grassroots level is emphasized in Pandey's work. He has also investigated the politics of memory and representation as a result of his interaction with the complexity of Indian society. Pandey investigates the various ways that the partition of India in 1947 has been remembered and commemorated in his 2001 book "Remembering Partition: Violence, Nationalism, and History in India". He draws attention to the omissions and exclusions in official narratives and emphasizes the importance of taking into account the experiences of the lower classes, who frequently got lost in history.

3) **Shahid Amin:** Another renowned historian affiliated with subaltern studies; Shahid Amin was born in 1938. He was educated at Cambridge University and Aligarh Muslim University after being born in Aligarh, India. The social and cultural history of contemporary India receives the majority of Amin's attention. Amin examines the historical memory and representations of the Chauri Chaura incident that took place in 1922 in his book "Event, Metaphor, Memory: Chauri Chaura, 1922-1992" (1995). Chauri Chaura's initially peaceful protests during Mahatma Gandhi's non-cooperation movement became violent, killing police officers. Gandhi responded by halting the movement against cooperation. Amin looks at how this incident has been remembered and perceived over the years to show how it has continued to influence subaltern groups' collective consciousness. The significance of local viewpoints and the many ways that historical events are perceived and remembered by various social groups are both highlighted by Amin's work. He draws emphasis on the agency, lived experiences, and impact on molding the historical memory of the subaltern classes.

4) **Dipesh Chakravarty:** Dipesh Chakrabarty, a prominent postcolonial historian, and leader in the subject of subaltern studies, was born in 1948. Chakrabarty, who was raised in Kolkata, completed his higher education in both India and the US. His writing focuses mostly on colonialism, modernism, and historical disparity issues. Chakrabarty critically investigates the Eurocentric nature of much of modern historical thought in his ground-breaking book, "Provincializing Europe: Postcolonial Thought and Historical Difference" (2000). He contends that non-Western nations' historical experiences have frequently been disregarded or dismissed as simple copies of Western history. Instead of rejecting Western philosophy, Chakrabarty advocates "provincializing" Europe to make room for the uniqueness of non-Western histories and experiences. Chakrabarty's involvement with subaltern studies includes a critique of the Eurocentrism present in historical accounts as well as a plea for a more inclusive and pluralistic approach to the study of history. He highlights the significance of acknowledging the agency and historical contributions of underrepresented people, and he calls on historians to look beyond Eurocentric paradigms.

5) **Parth Chatterjee:** Renowned political scientist and historian Partha Chatterjee has made substantial contributions to knowledge of nationalism and the postcolonial state in India. He was born in Calcutta in 1947 and earned his degrees from the Universities of Rochester and Chicago. The conceptions of nationhood and nationalism in colonial India are critically examined by Chatterjee in his influential book, "Nationalist Thought and the Colonial World: A Derivative Discourse?" (1986). He contends that the colonial encounter played a major role in the development of Indian nationalism as a derivative of European political thinking. According to Chatterjee, the nationalist elite frequently imitated the hierarchical and exclusive systems of the colonial state while vying for independence. This realization enables a nuanced comprehension of how nationalism's aim and the aspirations of oppressed people interacted. Chatterjee's work has affected discussions of nationalism and identity politics as well as the growth of postcolonial philosophy. His involvement in subaltern studies has made it possible to examine Indian nationalism's complexity and the ways that marginalized groups have negotiated their identities inside the nation-state in greater detail.

6) **Gayatri Spivak:** Gayatri Chakravorty Spivak, also referred to as Gayatri Spivak, is a well-known academic, literary critic, and proponent of postcolonial theory. Spivak, who was born in 1942 in Calcutta (now Kolkata), India, has significantly influenced several academic fields, such as literary theory, feminism, postcolonial studies, and cultural studies. Education and Academic Career: Gayatri Spivak completed her undergraduate studies in English literature at the University of Calcutta. Later, she relocated to the US and continued her education at Cornell University, where she earned a master's degree in comparative and English literature. Spivak later finished her Ph.D. at Cornell, where she concentrated on the writings of British novelist Thomas Carlyle from the 19th century. The most significant contributions made by Spivak are in the area of postcolonial theory, where she has tackled difficult issues like power, representation, and subaltern. She has made a significant contribution to postcolonial discourse by criticizing academics' Eurocentric viewpoints. The 1988 article "Can the Subaltern Speak?" is one of her key pieces. The representation of oppressed and marginalized groups, notably women, within the framework of colonial and postcolonial discourses, is critically examined by Spivak in this

essay. She contends that dominant narratives frequently stifle and obscure the voices of the subaltern, especially subaltern women. Additionally, Spivak examines the difficulties of speaking for the oppressed and criticizes the propensity of thinkers and academics to advocate for underrepresented groups without actually comprehending their circumstances. Spivak has worked on cultural studies and feminist theory in addition to her contributions to postcolonial theory. The interaction of gender, race, and class in the context of globalization and postcolonial countries is a topic on which she has written extensively. In her work, Spivak has also delved into the field of cultural studies, where she has investigated the connections between power, identity, and culture. Her analysis of how dominating cultures form and impact representations of the subaltern has been further enhanced by her work with cultural studies. In addition to teaching, Spivak has been active in advocacy throughout her academic career. She has worked as a professor at several notable universities, including the University of California, Berkeley, Columbia University, and the University of Chicago. Her multidisciplinary approach to teaching, which incorporates political theory, literature, and philosophy, has earned her praise. Spivak has been a vocal supporter of social justice and human rights causes outside of the classroom. She has taken part in campaigns promoting the rights of LGBTQ+ people, women, and the global economy. The scholastic endeavors and intellectual contributions of Spivak have received widespread acclaim. For her work, she has won various distinctions and prizes, including the 2012 Kyoto Prize in Arts and Philosophy. One of the most prominent international honors given in acknowledgment of outstanding contributions to societal improvement is the Kyoto Prize.

Merits

In India, subaltern historiography has become a revolutionary and powerful method of studying the past. It questions conventional historical narratives that frequently exclude the perspectives and experiences of peasants, tribal communities, Dalits (formerly known as untouchables), women, and other underprivileged groups in favor of focusing on the deeds of ruling elites and dominating classes.

Some of its merits are-

1) **Centering marginalized voices:** The dedication of subaltern historiography to elevating the voices of underrepresented communities is one of its greatest strengths. Traditional historiography frequently gave the ruling class's and the elites' viewpoints preference, especially during colonial times. Subaltern groups' pasts were either discounted as unimportant or completely forgotten. By emphasizing the agency, struggles, and accomplishments of individuals who were traditionally silenced, subaltern history confronts this bias. Historians can present a more complete and fair picture of India's past by allowing the subaltern a voice. With this strategy, the experiences of Dalits, tribal groups, women, and peasants are not marginalized but rather become essential elements of the historical narrative.
2) **Rethinking power and resistance:** A fresh examination of power relationships and resistance in Indian history has been sparked by contemporary historiography. Traditionally taught histories frequently presented colonial rule as an oppressive force that Indians were powerless to resist. However, subaltern historiography paints a more nuanced picture, showing that these populations actively challenged colonial power and oppressive regimes. Historians can comprehend how oppressed populations exercised their agency and opposed oppressive structures by examining grassroots movements, uprisings, and regular acts of defiance. This reconsideration of power and resistance rejects the Eurocentric idea of subaltern passivity and emphasizes the role of agency and self-determination in determining the course of history.
3) **Use of non-traditional sources:** The use of unconventional sources for historical investigation is encouraged by subaltern historiography. Subaltern historiography aims to investigate alternative sources such as oral traditions, folk songs, myths, and local narratives, whereas traditional history largely focuses on official records, government documents, and written accounts by elites. These unconventional sources offer perceptions of the cultural practices, life experiences, and beliefs of underprivileged communities. Using these various sources, historians can create a more vivid and accurate portrait of the past that reflects the goals and viewpoints of individuals whose voices have been silenced in the past.

4) **Critique of dominant narratives:** Subaltern historiography is essential for challenging conventional historical interpretations and raising issues about the biases ingrained in the process of creating history. The limitations of conventional historiography are highlighted, revealing the omissions and silences that have sustained prevailing power structures. This critical evaluation helps us understand historical players and events in a more complex way. It encourages historians and scholars to approach their work with a self-reflective mindset, questioning how their work could uphold current structures or obscure the experiences of particular populations.

5) **Empowering marginalized communities:** For disadvantaged groups, subaltern historiography can be uplifting since it recognizes their hardships and historical contributions. Subaltern groups' agency and resiliency are acknowledged, which promotes a sense of pride and identity in these communities. Given that it dispels unfavorable assumptions and preconceptions about excluded people, historical visibility can be a potent weapon for social empowerment. In addition, by exposing past examples of resistance and resiliency, subaltern history can serve as an inspiration for present social movements and mobilizations.

6) **Decolonizing historical narratives:** The goal of subaltern historiography is to liberate the history of India from colonial and Eurocentric frames, which is in line with the larger decolonization process. This method encourages more inclusive and varied historiography by undermining the authority of Western knowledge production and questioning the colonial gaze. Subaltern historiography supports a decolonized historical narrative that challenges the dominance of Western epistemologies and engages with the complexity and diversity of India's past by recognizing subaltern voices and experiences.

7) **Reinterpretation of national identity:** Indian nationalism and identity have also been reexamined in light of subaltern historiography. The diversity of cultures, languages, and experiences within India was frequently erased in traditional nationalist narratives, which generally offered a homogenized and unified picture of Indian identity. Subaltern historiography resists this homogenizing approach and advances a more pluralistic vision of Indian identity by interacting with the history of underprivileged communities. As part of the complex tapestry of Indian history and

culture, it recognizes the diversity of identities and narratives that have shaped it.

8) **Inclusive social history:** The importance of social history, which examines the lives of common people, their difficulties daily, and the nuanced interactions they have within their communities, is highlighted by subaltern historiography. This method offers a counterpoint to political history, which frequently concentrates on the deeds of ruling elites and the state. Historians can learn more about the socioeconomic factors, cultural norms, and social dynamics that influenced subaltern societies' experiences by examining their daily lives. A more comprehensive understanding of Indian society and its diversified population is provided by this inclusive social history.

9) **Contributions to global scholarship:** A significant contribution to international study has also come from the development of Subaltern historiography in India. Historiographical approaches in other regions of the world, particularly in postcolonial contexts, have been impacted by their emphasis on marginalized communities, resistance, and non-traditional sources. Subaltern historiography has motivated academics to reconsider their methodology, embrace many viewpoints and address concerns of representation and power in the creation of historical knowledge by challenging the prevailing paradigms of historical study.

India's subaltern historiography has many advantages that make it a transformative and worthwhile method of studying the past. This method provides a more comprehensive and nuanced perspective of India's history by emphasizing the voices and experiences of oppressed populations, rethinking power and resistance and employing non-traditional sources. It supports underrepresented groups, refutes mainstream narratives and advances the larger goal of decolonizing historical knowledge. The focus on social history in subaltern historiography and its worldwide ramifications further emphasize its significance in altering historical research and fostering a more inclusive and varied view of India's rich and complicated past.

Critique of subalterns

Even though subaltern historiography has significantly improved how we view Indian history, it is not without criticism. We shall examine the criticisms of Subaltern historiography in this essay, emphasizing the difficulties and constraints this methodology faces, some of which are as follows.

1) **Essentialism and generalization:** The tendency of subaltern historiography to distill and generalize the experiences of various subaltern groups is one of the main criticisms thrown at it. Although the strategy tries to elevate and center the perspectives of those who have been excluded, it runs the risk of homogenizing their experiences and ignoring internal tensions and diversity within these communities. In contrast to the intricacies and diversity seen within these societies, subaltern historiography frequently depicts subaltern groups as cohesive entities with a shared history. Subaltern historiography, for instance, can treat the Dalits as a single category with a shared historical narrative even though distinct caste groups within the Dalits may have diverse historical trajectories. Such essentialism can result in exaggerations and oversimplifications, which can undermine a nuanced comprehension of the many subaltern populations' lived realities.
2) **Neglecting dominant actors:** Some claim that subaltern historiography occasionally ignores the influence of dominant institutions and actors on historical events. While it is important to elevate the voices of the oppressed, focusing solely on the marginalized may obscure the nature of power and how elites have sustained hegemony. Understanding these interactions is crucial for a thorough explanation of the past since interactions between dominant and subaltern groups frequently impact historical events. Subaltern historiography may unintentionally perpetuate a binary interpretation of history that pits the oppressed against the oppressors by ignoring the role of dominating actors. The intricacies of power relationships and the interaction between dominant and subaltern groups in determining historical outcomes should be acknowledged through a more sophisticated approach.
3) **Challenges in methodology:** Another criticism of subaltern historiography focuses on the methodological difficulties in obtaining non-conventional materials, like oral histories and folktales. Although evaluating and interpreting these sources might be subjective and vulnerable to biases, they do offer insightful information on the lives of subaltern cultures. For instance, memory lapses and reinterpretations may occur with oral traditions over time. For historians, it might be difficult to rely on oral testimonies without supporting evidence from written records. Furthermore, it may be difficult for academics to comprehend historical situations properly

in the absence of written records from subaltern views. Historians need to evaluate the drawbacks and dangers of utilizing alternative sources in their study.

4) **Essentialization of postcolonial identity:** According to critics, subaltern historiography can essentialize postcolonial identities by depicting them as intrinsically opposed to the colonial past. A sole focus on resistance, however, can restrict our understanding of postcolonial identities, even though it is crucial to acknowledge the agency and resistance of subaltern groups against colonial oppression. In actuality, interactions between colonial and indigenous influences frequently shape postcolonial identities. These identities could be complex and composite, combining aspects of collaboration and opposition to colonial processes. Subaltern history may ignore the subtleties of identity development and the ways that groups constructed their identities within the colonial and postcolonial setting by essentializing postcolonial identities as fundamentally antagonistic.

5) **Less focus on economic aspects:** Critics have noted that subaltern historiography frequently ignores the economic realities of subaltern lives in favor of focusing more on cultural and social components. The conditions of marginalized populations were frequently greatly influenced by economic considerations; therefore, a more thorough examination should take into account their economic struggles, exploitations, and interactions with markets and labor relations. The economic aspects of subaltern existence, such as the effects of colonial economic policies on peasant communities, the exploitative practices of landlords, and the economic implications of resistance movements, could be explored in subaltern historiography. Examining the interactions between economic, social, and cultural variables that shaped subaltern histories is essential to developing a comprehensive understanding of subaltern experiences.

6) **Essentialism and Gender:** Critics have also called attention to issues with gender-related essentialism in Subaltern history. Although the strategy intends to offer a voice to underprivileged women, there is a chance that it will reinforce preconceived notions and beliefs about the uniformity of their experiences. including any other group, subaltern women have a variety of identities, and their experiences are influenced by overlapping elements including caste, class, and area. Subaltern historiography should be careful to avoid

categorizing subaltern women as a single group. Instead, it ought to explore how complicated gender identities are in underprivileged groups and how they interact with other social categories to influence historical events.

7) **Lack of engagement with global contexts:** Critics contend that Subaltern historiography occasionally fails to interact with broad historical settings enough. Although it has contributed to the critique of Eurocentric viewpoints, a more sophisticated strategy should take into account the interplay between regional and international influences. Exploring the links between India and other regions of the world and taking into account the larger forces influencing historical changes may be beneficial for gaining a more complete grasp of subaltern experiences. Subaltern historiography can provide a more thorough account of how colonialism, imperialism, and globalization impacted the experiences of marginalized populations by placing subaltern history within global contexts. The agency of subaltern groups and their responses to shifting global dynamics can be better understood by understanding these global interactions.

8) **Limited representation:** The difficulties of depiction are a subject for another criticism of Subaltern historiography. Although the method aims to elevate the voices of the subaltern, it is challenging to correctly convey their experiences without applying prejudices or judgments from the outside. When engaging in subaltern historiography, historians must balance their moral need to accurately reflect subaltern tales with an awareness of their interpretive limitations. Since there is a chance of distorting or misappropriating subaltern voices, historians must carefully explore the best ways to accurately portray the experiences of oppressed populations.

In India, subaltern historiography has come a long way in opposing historical canons and elevating the voices of oppressed groups. To critically engage with its shortcomings and criticisms, though, is imperative. The need for a more nuanced engagement with global contexts and representation, as well as the issues of essentialism, neglect of dominant actors, methodological difficulties, essentialization of postcolonial identity, and gender, all call for careful consideration. By addressing these criticisms, the field of Subaltern historiography can be enriched and the historical experiences of India can be better understood overall. A more inclusive and responsible historiography that reflects the diverse and complicated nature of India's past may develop as historians continue to investigate the complexity of subaltern histories.

However, to avoid the traps of essentialism and ensure a more nuanced and inclusive depiction of the histories of oppressed populations, subaltern historiography needs constant reflection and critical interaction.

Conclusion

Finally, subaltern historiography has become a revolutionary and liberating method of studying the past in India. It challenges the prevailing historical narratives that have long suppressed the voices and experiences of underprivileged populations, including peasants, tribal tribes, Dalits, women, and other outcasts. Subaltern historiography has significantly contributed to reinventing Indian history by emphasizing these underrepresented views, providing a more inclusive and thorough understanding of the country's past. The dedication of Subaltern historiography to elevating the voices of the subaltern is one of its greatest strengths. The agency, tenacity, and contributions of marginalized communities in influencing historical events and processes have been highlighted through this methodology. Historians have learned more about the intricate processes that have molded India's history through studying grassroots movements, commonplace acts of resistance and the coordinated efforts of underprivileged groups. Additionally, traditional ideas of power and resistance in India's historical narrative are questioned by subaltern historiography. It exposes how communities of the underclass actively resisted colonial control and exploitative structures, moving beyond the binary of oppressor and oppressed. History has been reinterpreted "from below," allowing historians to better understand the agency and self-determination of marginalized communities. The method's focus on non-conventional sources, such as oral traditions, folk songs, and local narratives, has improved historical research by revealing details about the cultural practices and life experiences of people who were previously marginalized. Subaltern historiography has portrayed the past more vividly and authentically by combining these various sources, reflecting the concerns and viewpoints of individuals whose voices were once silenced. Subaltern historiography has been criticized, though. The approach, according to some opponents, runs the risk of essentializing and summing up the experiences of many subaltern communities. By concentrating on similarities, it can miss internal disputes and differences within these communities, which could result in misunderstandings and oversimplifications. To avoid essentialism, one must use a nuanced approach that recognizes the variety of experiences found in subaltern cultures. Moreover, a thorough knowledge of historical events may be constrained by the omission of dominating individuals and institutions in Subaltern historiography. A solely oppressed-centered perspective may

ignore the dynamics of power and the means through which elites sustained hegemony. An examination of the interactions between dominant and subaltern groups from a more balanced perspective can help us analyze historical results in more detail. Potential restrictions also come from methodological difficulties with obtaining non-traditional sources, like oral traditions. To make sure that their research is supported by thorough and critical analysis, historians must address the subjectivity and biases inherent in interpreting these sources. Despite these criticisms, Subaltern historiography continues to be a vital method for altering historical viewpoints and fostering a more inclusive knowledge of India's past. It gives oppressed groups more clout by acknowledging their efforts and historical contributions. Subaltern historiography has widened the scope of historical inquiry by questioning prevailing narratives and interacting with alternative sources, as well as by contributing to the larger initiative of decolonizing historical knowledge. Historians working on subaltern historiography must take a reflective, sensitive, and inclusive approach to their research to answer the criticisms. A constant exchange of ideas between academics from diverse fields can advance the subject and promote a greater understanding of the complexity of India's historical experiences.

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Chapter - 5
The Vedas, Upanishads and Dharmashashtra: Understanding Ancient Hindu Texts through Artificial Intelligence

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Chapter - 5

The Vedas, Upanishads and Dharmashashtra: Understanding Ancient Hindu Texts through Artificial Intelligence

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Abstract

The Vedas, Upanishads and Dharmashastras are three ancient Hindu writings that are explored and understood using artificial intelligence (AI) in this study work. These ancient sacred texts, which include profound spiritual knowledge, moral guidance and intellectual understandings, have influenced India's culture and religion. But for academics and seekers looking to better understand their teachings, the complexity of their antiquated language, dense symbolism, and diverse philosophical notions has presented difficulties. This research study explores how AI can be a revolutionary tool in revealing the eternal knowledge concealed inside these ancient books by utilizing AI's strengths in natural language processing, semantic analysis, and contextual comprehension. The Vedas and the Upanishads' metaphysical truths are now more understandable and accessible to modern audiences thanks to AI's ability to comprehend their cryptic language.

Keywords: Vedas, Upanishads, Dharmashashtra, artificial intelligence, Hindu

Introduction

The Vedas, Upanishads and Dharmashastras, which make up the ancient Hindu scriptures, are some of the most deep and significant works in human history. They stand for the core of Hindu philosophy, spirituality and morality, which have influenced millions of people for thousands of years. Although scholars, priests, and philosophers have loved and studied the wisdom found in these ancient books for many years, the development of artificial intelligence (AI) has opened up new possibilities for a deeper understanding and study. The Vedas, the earliest Hindu writings, are a collection of proverbs and hymns written in Vedic Sanskrit. The Rigveda, the Yajurveda, the Samaveda, and the Atharvaveda are the four main texts that make up the Vedas, which are said to have been divinely revealed. Each Veda has a specific

function and contains a wealth of information on a variety of topics, such as rites, metaphysics, astronomy, linguistics, and cosmology. The Vedas' ancient language and intricate symbolic representations constitute one of their biggest obstacles to comprehension. However, natural language processing (NLP) methods driven by AI have demonstrated encouraging results in understanding these complex documents. In order to better understand the Vedas and shed light on them, researchers have been able to train AI models on enormous databases of Vedic Sanskrit and its interpretations.

The Upanishads, a philosophical continuation of the Vedas, explore profound spiritual ideas and make an effort to provide basic explanations for what existence, consciousness and the supreme reality (Brahman) are. These writings, which are regarded as embodying the core of Vedic philosophy, provide those seeking spiritual awakening and self-realization with a clear path. Deeper insights hidden within the Upanishads have been revealed thanks to AI-driven semantic analysis and pattern recognition. AI algorithms have permitted a deeper investigation of the interrelated themes prevalent across these texts by comparing and cross-referencing various translations and commentary. With the help of this multidisciplinary method, academics can close the knowledge gap between the Upanishadic teachings and modern understanding. The Dharmashastras are a massive collection of books that serve as both a personal and societal rule of ethics and morality. These texts cover a wide range of topics, including dharma (social obligations), family, law, government and other aspects of daily life. Some of the well-known Dharmashastras are the Manusmriti, Yajnavalkya Smriti and Narada Smriti.

It can be challenging to interpret and apply the Dharmashastras' teachings to the intricacies of the contemporary world. However, AI presents a rare chance to draw the guiding ideas and values from these historic works and apply them to moral conundrums in the modern world. AI can help in the creation of morally sound decision-making systems by evaluating large datasets of linked ethical conversations and utilizing machine learning methods. Natural language processing, machine learning, and artificial intelligence have completely changed how we study historical texts. AI algorithms are able to identify patterns, contextualize meanings, and even make comparisons between seemingly unrelated ideas in a variety of texts through the use of extensive data analysis. Semantic Analysis: Researchers may analyze the complex language of the Vedas, Upanishads, and Dharmashastras using AI-powered semantic analysis to help them extract the philosophical, spiritual, and ethical core of the texts. This method contributes to a piece of more comprehensive knowledge. Cross-References and

Comparisons: AI is capable of processing enormous amounts of related texts, commentary, and interpretations from various eras and places with efficiency.

This makes it possible for academics to analyze and cross-reference various theories, interpretations, and linguistic developments, resulting in more thorough and accurate assessments of the scriptures. Preservation and Translation: With the aid of artificial intelligence, it is now easier to preserve and translate historic works into contemporary tongues. Ancient manuscripts can now be digitized and translated thanks to cutting-edge optical character recognition (OCR) and machine translation techniques, opening up these hallowed texts to a wider audience. Understanding in Context: To comprehend ancient works, one must take into account the historical and cultural settings in which they were written. AI's capacity to analyze huge historical databases enables a more thorough understanding of the situation. The Vedas, Upanishads and Dharmashastras are significant collections of prehistoric Hindu knowledge that cover spirituality, philosophy, and moral instruction. Artificial intelligence has created new opportunities for comprehending and enjoying this old literature through its strengths in natural language processing, semantic analysis, and historical contextualization. Scholars and seekers can obtain deeper insights into the timeless knowledge contained within these holy texts by utilizing AI's analytical power, helping to build a peaceful link between the past and the present for future generations.

Understanding Vedas with the help of artificial intelligence

The Vedas, frequently regarded as the earliest Hindu sacred books, are a veritable gold mine of knowledge and wisdom that have taught people how to live their lives for thousands of years. The Vedas are a collection of hymns, rituals, and philosophical truths written in Vedic Sanskrit and handed down orally over the ages. The Rigveda, Yajurveda, Samaveda and Atharvaveda are the four main writings that make up the Vedas, which are the cornerstone of Hindu philosophy, spirituality and cosmology. The Vedas are highly esteemed, yet due to their antiquated language, symbolic phrases, and intricate metaphors, understanding them can be difficult. Because of this, conventional research and interpretation can demand years of commitment and experience from academics and clergy. The development of artificial intelligence (AI), however, has opened up new possibilities for deciphering the riddles contained within the Vedas, allowing researchers and seekers to obtain a deeper understanding of its profound teachings. The goal of the AI subfield known as Natural Language Processing (NLP) is to make it possible for machines to comprehend and process human language. Researchers can decipher the underlying meaning of the hymns and verses in Vedic Sanskrit texts by using

NLP techniques, which provide important insights into the philosophical and spiritual aspects of the Vedas.

The interconnected themes and ideas offered throughout several hymns can be better-understood thanks to NLP algorithms that can spot patterns and correlations in the Vedic texts. Furthermore, sentiment analysis can help distinguish between invocations, petitions, and philosophical speculations, giving a thorough perspective of the Vedas' complex character. With the help of AI, researchers may interpret the Vedas by examining extensive historical records. Researchers can better grasp the societal and cultural conditions in which the Vedas were created by comparing ancient writings and historical accounts. Scholars may determine historical occurrences, geographic influences, and dominant ideas that influenced the hymns and ceremonies included in the Vedas because of AI's capacity to analyze massive volumes of data effectively. This contextualization enhances interpretation by allowing for a fuller understanding of ancient India's social structure and how it influenced Vedic thought. The Vedas use complex metaphors and symbolic language that call for expert interpretation to reveal their vast meanings. Decoding symbolic terms and revealing the layers of meaning buried within the hymns is made possible by AI-powered semantic analysis.

The Vedas include essential ideas and archetypal representations that can be highlighted by machine learning algorithms by identifying repeated themes and symbolic patterns. This symbolic interpretation makes it easier to delve deeper into the texts' metaphysical truths and cosmic principles. Preserving and translating old manuscripts is one of the main difficulties in studying the Vedas. Through the use of optical character recognition (OCR) and image processing techniques, artificial intelligence (AI) is a key component in the digitization and restoration of fading Vedic writings.

AI facilitates the preservation of these priceless materials for future generations by digitizing old handwritten manuscripts. The Vedas are also translated into various languages with the help of machine translation algorithms, making this profound knowledge more widely available. Comparative analysis and cross-referencing of numerous Vedic texts and comments are now possible thanks to AI's capacity for processing enormous datasets and spotting patterns. Scholars can develop a thorough understanding of the various intricacies of Vedic teachings by examining various interpretations and geographical differences. Cross-referencing also aids in bridging disparate schools of thought, illuminating shared underlying ideas, and developing a more comprehensive comprehension of the Vedas. The Vedas contain a vast store of spiritual, intellectual, and ethical wisdom that has

inspired and led humanity for millennia. Scholars and seekers can embark on an exploratory voyage to find the wisdom jewels buried inside these ancient writings with the help of artificial intelligence. We can delve deeper into the Vedas' substance thanks to AI-powered natural language processing, semantic analysis, contextualization, symbolic decoding, and preservation approaches. A greater appreciation and understanding of the profound lessons that have formed the spiritual fabric of humanity for millennia are made possible by the harmonious synergy between ancient knowledge and contemporary technology that is created by the merger of AI and Vedic studies.

New perspectives on Dharmashahstra through ai

Ancient Hindu books known as the Dharmashastras include ethical and moral rules that serve as a guide for both people and society. These writings, together with the Vedas and Upanishads, are fundamental to Hindu philosophy and direct people toward the path of morality (dharma). The Dharmashastras are essential resources for comprehending the societal norms and ethical principles of ancient India since they cover a wide range of topics, including law, governance, family life, social responsibilities, and personal conduct. The Dharmashastras are thought to have been composed over several centuries by sages and jurists, and they have their origins in the Vedic tradition. The Yajnavalkya Smriti, the Narada Smriti, and the Manusmriti (Laws of Manu) are some of the most well-known Dharmashastras. These works each present a distinctive viewpoint on dharma, expressing the sociopolitical setting and philosophical preferences of their different authors.

The Dharmashastras are based on the idea of dharma, which includes morality, obligation, and good behavior. Dharma is frequently referred to as the moral law that upholds the cosmos and preserves social harmony. The Dharmashastras outline each person's obligations and liabilities according to their age, gender, caste and employment, preserving social balance and order. The caste structure and social hierarchy that were prominent in ancient India are reflected in the Dharmashastras. These texts emphasize the value of cooperation and mutual respect among members of society even as they acknowledge the distinct duties and responsibilities of various castes. AI can shed light on the geographical and historical setting in which the caste system emerged as well as its applicability to and ramifications for modern society. The Dharmashastras have legal and juridical features, providing rules for resolving conflicts, punishing criminals, and upholding justice's basic principles.

Using AI, it is possible to compare several Dharmashastras and their legal provisions, exposing differences in how justice is administered in various geographical areas and throughout history. The Dharmashastras also provide insight into women's rights and gender roles in ancient India. While some books highlight the significance of women's responsibilities in society and the family, others could impose constraints. Researchers can recognize subtleties in women's representation and ascertain the underlying sentiments on gender in ancient Hindu society by using AI-driven sentiment analysis. Although the Dharmashastras provide insightful analysis of traditional ethical and moral principles, applying them in contemporary contexts can be difficult due to shifts in societal structures and cultural conventions. By assisting in the reinterpretation and application of the ethical ideas outlined in classical classics to modern circumstances, AI can significantly contribute to closing this gap.

The extensive corpus of Dharmashastras can be interpreted and organized with the use of AI-powered text analysis. AI algorithms can provide a thorough overview of the essential ethical concepts and values defended by these ancient books by spotting recurrent patterns, themes, and phrases. Researchers may gain a deeper knowledge of the Dharmashastras' historical setting thanks to AI. Researchers might learn more about the sociopolitical environment and cultural forces that influenced these ethical principles by examining comparable historical databases and cross-referencing other contemporary writings. Comparative investigation of numerous Dharmashastras can be facilitated by AI, enabling academics to spot overlaps and differences in ethical precepts among distinct scriptures. This method can reveal the dharma's capacity for change and adaptability over time. AI is a useful tool for resolving current ethical conundrums because of its capacity to process enormous amounts of data and understand complex scenarios.

AI can help people and politicians make informed and morally sound decisions by relying on the ethical ideas of the Dharmashastras and fusing them with contemporary ethical frameworks. By examining the ideas and viewpoints of the general public from a variety of sources, AI can establish a forum for open discourse and discussion on ethical concerns. This may provide a deeper comprehension of ethical issues, enabling a more inclusive and well-informed method of approaching ethical decision-making. The ethical and moral precepts that have governed Hindu society for ages are revealed in the Dharmashastras in a way that is timeless. Scholars and individuals can obtain a fresh perspective on these old books with the help of artificial intelligence, contextualizing their lessons in the modern era. The

Dharmashastras are now useful resources for contemporary ethical discourse and decision-making thanks to AI-driven textual analysis, contextualization, and ethical investigation. By bridging the gap between conventional ideas and ancient wisdom.

Upanishads

The philosophical underpinnings of Vedic thinking and spirituality are found in the Upanishads, a collection of historic Hindu texts. These books on the essence of reality and other significant metaphysical ideas were written in Sanskrit. The Upanishads, commonly referred to as Vedanta (the end of the Vedas), are regarded as the core of Hindu philosophy and are a completion of Vedic knowledge. The Upanishads have inspired seekers and thinkers for hundreds of years with their deep lessons on self-realization and the ultimate reality (Brahman). Between 800 and 500 BCE, during the late Vedic era, the Upanishads first appeared. There are, according to estimates by scholars, around 200 Upanishads, but only about 13 major ones are regarded as the most significant and well-researched. The Brihadaranyaka, Chandogya, Katha, Mandukya, and Taittiriya Upanishads are among those that are of particular significance. The majority of the Upanishads are composed as dialogues between instructors (gurus) and their students (shishyas), sharing profound spiritual truths through dialogue, meditation, and introspection. The core message of the Upanishads is centered on Brahman and Atman, the supreme reality or cosmic essence that is independent of all forms and characteristics. The everlasting, constant, and limitless source of existence is known as Brahman. On the other side, Atman is the unique self or soul that is the same as Brahman. The Upanishads claim that the secret to achieving spiritual emancipation (moksha) is realizing this identity.

The term "maya" describes the phenomenal world's illusory qualities, which conceal reality's actual essence. In order to recognize the unity of Atman and Brahman, the Upanishads emphasize the necessity of overcoming maya and achieving true knowledge (jnana). Karma and Reincarnation: The Upanishads explain the idea of karma or the rule of cause and consequence. Understanding the intricacies and philosophical ideas concealed in the Upanishads requires the use of AI-powered semantic analysis. Artificial intelligence (AI) systems can find recurrent patterns, philosophical ideas and linguistic idioms by analyzing the enormous corpus of Upanishadic writings. comprehending these ancient works' contexts is essential to comprehend their deeper meanings and how they apply to different situations. The Upanishads are frequently linked together and include recurring themes and ideas. Cross-referencing several Upanishads can help scholars find similarities, spot differences in philosophical ideas and resolve apparent inconsistencies.

The uniqueness and universality of Upanishadic thinking can be further highlighted by comparison with other philosophical systems. Finding the logical connections between distinct Upanishadic teachings can be made easier with the help of AI's capacity for processing intricate philosophical arguments and inference. AI can assist in building a comprehensive comprehension of the Upanishads' philosophical framework by examining the texts' logical coherence. For the purpose of communicating their profound ideas, the Upanishads frequently use symbolism and allegory. AI's capacity for pattern recognition can help interpret the symbolic representations and uncover deeper layers of meaning that are encoded in the texts. The Upanishads are a powerful example of the philosophical breadth and spiritual profundity of classical India. Scholars and seekers can get new insights into these ancient books with the use of artificial intelligence, revealing the everlasting truths they contain. With the use of AI-driven semantic analysis, cross-referencing, philosophical inference, and symbolic representation, we can more easily and appreciatively navigate the huge Upanishads' environment. AI can act as a link between traditional knowledge and the current desire for self-realization by applying Upanishadic ideas to contemporary problems. The emphasis on self-realization and the interdependence of all beings in the Upanishads can serve as a paradigm for AI-based ethical decision-making. AI can encourage decisions that put compassion, harmony, and ecological sustainability first by adopting Upanishadic ideas. Utilizing AI's ability to support spiritual activities can help people better understand Upanishadic ideas and accelerate their spiritual development.

Conclusion

The Vedas, Upanishads, and Dharmashastras, which are regarded as the founding texts of Hinduism, provide a tremendous storehouse of knowledge, spiritual insight, and moral instruction that has influenced India's cultural landscape for thousands of years. It has long been a difficult undertaking to delve into these ancient texts and comprehend their profound teachings; it calls for a high level of skill and years of devoted study from both experts and seekers. However, new frontiers in the study of these holy texts have opened up with the development of artificial intelligence (AI) and its potent applications in natural language processing, semantic analysis, and contextual comprehension. The goal of this study article was to explore the ways in which AI might provide a fresh perspective on the Vedas, Upanishads, and Dharmashastras. The mysterious Vedic language has been made more understandable with AI-powered natural language processing, allowing

academics to explore the deeper meanings and relationships between hymns and verses. Semantic analysis and pattern recognition have made it easier to comprehend the writings' intricate symbolism and allegorical depictions.

AI has offered crucial contextualization by analysing enormous historical records, revealing the social environment and cultural influences that shaped these ancient scriptures. As a result, we now appreciate the Vedas' tremendous insights into cosmology, rites, and philosophical concepts even more. The Upanishads, which discuss profound metaphysical ideas and self-realization, have also been made easier to understand through semantic analysis and contextual understanding by AI. AI has filled in holes in philosophical theory by using cross-referencing and comparative analysis, providing a greater understanding of the interconnection and universality of Upanishadic teachings. The Upanishads' contemporary relevance is highlighted by AI, encouraging the incorporation of these spiritual teachings into practices like meditation, mindfulness, and moral decision-making. The powers of AI have also shed light on the Dharmashastras as moral and ethical rules. Artificial intelligence (AI) has revealed the complex social order and moral obligations embedded in ancient scriptures through language analysis and pattern identification.

AI has revealed variances in ethical concepts across locations and historical periods by comparing several Dharmashastras. Furthermore, the Dharmashastras continue to be relevant in directing ethical concerns in modern society as shown by AI's capacity to apply their ethical wisdom in contemporary circumstances, including AI-based ethical decision-making models and venues for open ethical conversation. The intersection of AI and classical Hindu scriptures offers a symbiotic relationship, beautifully fusing the knowledge of the past with the transformational force of contemporary technology, as this article has emphasized. The Vedas, Upanishads, and Dharmashastras have become more accessible to scholars, seekers, and a global audience because to AI's ability to process enormous volumes of data, spot patterns and expose hidden meanings. In order to provide a thorough comprehension of the ancient Hindu scriptures, AI transcends cultural and temporal boundaries by revealing the timeless wisdom hidden within these works. In conclusion, a new chapter in the study of the Vedas, Upanishads, and Dharmashastras has been opened by the merger of AI and these ancient Hindu texts. We now have a deeper knowledge of the philosophical, spiritual, and ethical components of these ancient books thanks to AI's capabilities in natural language processing, semantic analysis, and contextualization. AI acts as a link between the knowledge of the past and the difficulties of the present

by offering a fresh perspective on these old books, showing the road to higher spiritual awareness and moral living in a world that is changing quickly. The convergence of AI with ancient Hindu texts holds the potential of a harmonic coalescence between tradition and innovation, paving the path for a new era as technology and human intellect continue to advance.

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Chapter - 6
Effects of Variable Viscosity and Thermal Conductivity on MHD Micropolar Fluid past a Stretching Sheet in Presence of Chemical Reaction and Heat Source

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Chapter - 6

Effects of Variable Viscosity and Thermal Conductivity on MHD Micropolar Fluid past a Stretching Sheet in Presence of Chemical Reaction and Heat Source

Keshab Borah, Dr. Jadav Konch and Animesh Phukan

Abstract

This research explores the impact of combined variable viscosity and thermal conductivity, along with chemical reactions on the boundary layer of MHD micropolar fluid flow over a stretching sheet. Using similarity transformation, the governing partial differential equations are converted into a set of coupled ordinary differential equations. The governing equations of the flow problem are numerically solved using MATLAB programming codes. The codes are specifically designed to implement the fourth-order Runge-Kutta method combined with the shooting technique. The results are presented graphically to interpret the various physical parameters of the problem

Keywords: Chemical reaction, micropolar fluid, stretching sheet, variable viscosity, variable thermal conductivity

1. Introduction

There are numerous available research studies that focus on the analysis of boundary layer flow of micropolar fluid over a stretching sheet. This is because the flow and heat transfer characteristics of micropolar fluids hold significant importance in engineering applications. For example, boundary layer flow of micropolar fluid over a stretching sheet is crucial in the design of processing materials used in various applications such as polymeric fluids, food products and slurries.

Micropolar fluids are a type of fluid that possesses a microstructure. They are categorized as fluids with a non-symmetric stress tensor. The pioneering work on the theory of micropolar fluids was carried out several years ago by Eringen [1, 2]. By utilizing this theory, numerous researchers have developed mathematical models for many non-Newtonian fluids in cases where the classical Navier-Stokes theory is inadequate. These fluids serve as

mathematical models for studying complex and complicated fluid motions, including suspension solutions, blood rheology, and colloidal fluids. Micropolar fluids can be found in a wide range of systems such as polymeric fluids, fluid suspensions, animal blood, liquid crystals, colloidal fluids, and dust-filled clouds [3,4].

Ziaul Haque *et al.* [5] conducted a study on the behaviors of micropolar fluids in the context of steady magnetohydrodynamic (MHD) free convection flow, considering the effects of viscous dissipation and Joule heating. Siva Reddy and Shamshuddin [6] investigated a problem related to the MHD flow of heat and mass transfer in a micropolar fluid. Their study considered the influence of both viscous dissipation and chemical reaction on the system. Mishra and Jena [7] conducted a numerical examination of the solution for boundary flow, taking into account the influence of viscous dissipation.

The investigation of flow and heat transfer resulting from stretching surfaces is of great importance in various industrial and engineering applications. Examples of such processes include the aerodynamic extrusion of plastic sheets, wire drawing, glass fiber production, paper production, and hot rolling. The initial groundwork on steady boundary layer flow of an incompressible viscous fluid induced by a linearly stretching sheet was conducted by Crane [8]. Gupta and Gupta [9] further expanded on this research by incorporating heat and mass transfer effects on a stretching sheet with suction or blowing. These studies have contributed to our understanding of the behavior and characteristics of fluid flow and heat transfer in these industrial processes.

The analysis of heat and mass transfer coupled with chemical reactions and heat generation/absorption in boundary layer flow holds significant practical importance, particularly in chemical processes and hydrometallurgical industries. This research area finds applications in various fields, including food processing, ceramics manufacturing, and polymer production. Studies conducted by Das [10] and Mishra *et al.* [11] have contributed to advancing our understanding of these complex processes and their relevance in industrial applications.

In the previously discussed flow problems, it was assumed that the thermophysical properties of the fluid, including viscosity and thermal conductivity, remains constant. However, it is observed that these properties can actually vary with changes in temperature. To accurately model the flow and heat transfer phenomena, it becomes crucial to take into account the temperature-dependent variation of fluid viscosity. The effects of variable viscosity on convective heat transfer along a vertical surface in a porous

medium were investigated by Lai and Kulacki [12]. Pop *et al*. [13] conducted a study on the influence of variable viscosity on laminar boundary layer flow and heat transfer over a continuously moving flat plate. The objective was to investigate how changes in viscosity affect the flow and heat transfer characteristics in this scenario. El-Aziz [14] conducted a study on the flow, heat and mass transfer properties of a viscous electrically conducting fluid. The fluid considered in the study exhibited temperature-dependent viscosity and thermal conductivity. The fluid flow occurred past a continuously stretching surface, and the analysis took into consideration the influence of Ohmic heating. Additionally, significant research has been conducted by Pantokratoras [15] and Mukhopadhyay [16] regarding the effects of variable viscosity on flow and heat transfer over a stretching sheet under various physical conditions.

Recently the impact of chemical reaction on a micropolar fluid flowing past a stretching sheet has been studied by Jena Pattanik *et al*. [17]. Inspired by the previously conducted studies, we have examine the influence of various parameters on the micropolar fluid flow past over a stretching sheet by considering the effects of variable viscosity and variable thermal conductivity on the flow behavior.

This study mainly focuses on investigating the influence of variable viscosity and thermal conductivity on the behavior of a MHD micropolar fluid flowing past a stretching sheet. By considering the variation of viscosity and thermal conductivity with temperature, as proposed by Lai and Kulacki [12] and Choudhury and Hazarika [18] and employing similarity transformations, the governing partial differential equations of motion are transformed into ordinary differential equations. The resulting problem is then solved numerically using the shooting technique. This approach allows for the determination of the desired solutions and provides insights into the behavior of the system under consideration.

2. Mathematical formulation of the problem

The sheet is being stretched at a velocity of $u_w = bx$. The ambient temperature is uniformly denoted as T_∞. The flow is assumed to be constant. A transverse magnetic field with a strength of B_0 is applied in the positive *y*-direction, which is perpendicular to the surface. The *x*-axis is aligned with the stretching direction of the sheet, while the *y*-axis is perpendicular to it. The governing flow equations, along with their respective boundary conditions, can be expressed as follows:

Continuity Equation:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0 \tag{1}$$

Momentum Equation:

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=\frac{1}{\rho}\frac{\partial}{\partial y}\left\{(\mu+\kappa)\frac{\partial u}{\partial y}\right\}+\frac{\kappa}{\rho}\frac{\partial N}{\partial y}-\left(\frac{\sigma B^2}{\rho}+\frac{\upsilon}{k_p'}\right)u+g\beta_T(T-T_\infty)+g\beta_C(C-C_\infty) \tag{2}$$

Angular momentum Equation:

$$u\frac{\partial N}{\partial x}+v\frac{\partial N}{\partial y}=\frac{\Omega}{\rho j}\frac{\partial^2 N}{\partial y^2}-\frac{\kappa}{\rho j}\left(2N+\frac{\partial u}{\partial y}\right) \tag{3}$$

Energy Equation:

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\frac{1}{\rho C_P}\frac{\partial}{\partial y}\left(k\frac{\partial T}{\partial y}\right)+\left(\frac{\mu+\kappa}{\rho C_P}\right)\left(\frac{\partial u}{\partial y}\right)^2-\frac{1}{\rho C_P}\frac{16\sigma^* T_\infty^3}{3k^*}\frac{\partial^2 T}{\partial y^2}+S'(T-T_\infty) \tag{4}$$

Concentration Equation:

$$u\frac{\partial C}{\partial x}+v\frac{\partial C}{\partial y}=\frac{1}{Sc}\frac{\partial}{\partial y}\left(\upsilon\frac{\partial C}{\partial y}\right)-k_c'(C-C_\infty) \tag{5}$$

The corresponding boundary conditions are

$$\left.\begin{aligned} &u=u_w,\ v=0,\ N=-n\frac{\partial u}{\partial y},\ T=T_w,\ C=C_w \ \text{ at } y=0\\ &u\to 0,\ N\to 0,\ T\to T_\infty,\ C\to C_\infty \ \text{ as } y\to\infty \end{aligned}\right\} \tag{6}$$

Using Rosseland approximation for radiation, we have

$$q_r=-\frac{4\sigma^*}{3k^*}\frac{\partial T^4}{\partial y} \text{ and } T^4=4T_\infty^3 T-3T_\infty^4 \tag{7}$$

Equation (4) reduced to

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\frac{1}{\rho C_P}\frac{\partial}{\partial y}\left(k\frac{\partial T}{\partial y}\right)+\left(\frac{\mu+\kappa}{\rho C_P}\right)\left(\frac{\partial u}{\partial y}\right)^2-\frac{1}{\rho C_P}\frac{16\sigma^* T_\infty^3}{3k^*}\frac{\partial^2 T}{\partial y^2}+S'(T-T_\infty) \tag{8}$$

Where u and v are the velocity components along x and y axis respectively, υ is the kinematic viscosity, κ is the vortex viscosity, $j=\frac{\upsilon x}{u_w}=\frac{\upsilon}{b}$ is the micro-inertia density that specify the length of the

reference, k is the thermal conductivity, N is the microrotation or angular velocity, γ is the spin-gradient viscosity and is given by [19] $\gamma = \left(\mu + \frac{\kappa}{2}\right) j$

We introduced the following similarity transformation and non dimensionless function as follows

$$\eta = \sqrt{\frac{b}{\upsilon}} y, \quad f(\eta) = \frac{\psi}{x\sqrt{b\upsilon}}, \quad g(\eta) = \sqrt{\frac{\upsilon}{b}} \frac{N}{bx}, \quad \theta(\eta) = \frac{T - T_\infty}{T_w - T_\infty},$$

$$\phi(\eta) = \frac{C - C_\infty}{C_w - C_\infty} \tag{9}$$

Using the relation $u = \frac{\partial \psi}{\partial y}$ and $v = -\frac{\partial \psi}{\partial x}$, where ψ is the stream function, we get

$u = xbf'(\eta)$ and $v = -\sqrt{b\upsilon}\, f(\eta)$.

According to Lai and Kulacki [12]

$$\frac{1}{\mu} = \frac{1}{\mu_\infty}\left[1 + \gamma\left(T - T_\infty\right)\right] \text{ Or } \frac{1}{\mu} = a\left(T - T_r\right) \tag{10}$$

According to Choudhury and Hazarika [18]

$$\frac{1}{k} = \frac{1}{k_\infty}\left[1 + \xi\left(T - T_\infty\right)\right] \text{ Or } \frac{1}{k} = b\left(T - T_e\right) \tag{11}$$

Where $a = \frac{\gamma}{\mu_\infty}$, $T_r = T_\infty - \frac{1}{\gamma}$, $b = \frac{\xi}{k_\infty}$ and $T_e = T_\infty - \frac{1}{\xi}$ are constant.

Under the above substitution, equation (1) is identically satisfied and equation (2), (3), (8) and (5) reduces to the following ordinary differential equations-

$$\left(\beta - \frac{\theta_r}{\theta - \theta_r}\right) f''' + ff'' - (f')^2 + \frac{\theta_r}{(\theta - \theta_r)^2} f''\theta' + \beta g' - \left(M + \frac{1}{K_p}\right) f' + \lambda_1 \theta + \lambda_1 \phi = 0 \tag{12}$$

$$\left(\frac{1}{2}\beta-\frac{\theta_r}{\theta-\theta_r}\right)g''+f\,g'-g\,f'+\frac{\theta_r}{(\theta-\theta_r)^2}g'\theta'-\beta(2g+f'')=0 \quad (13)$$

$$\left(N_r-\frac{\theta_e}{\theta-\theta_e}\right)\theta''+\frac{\theta_e}{(\theta-\theta_e)^2}(\theta')^2-\Pr\left[f\theta'+\left(\beta-\frac{\theta_r}{\theta-\theta_r}\right)Ec(f'')^2+S\theta\right]=0 \quad (14)$$

$$\left(\frac{\theta_r}{\theta-\theta_r}\right)\phi''-Sc\;f\,\phi'-\frac{\theta_r}{(\theta-\theta_r)^2}\phi'\theta'+Sc\,Kc\,\phi=0 \quad (15)$$

And the corresponding boundary condition (6) changes to

$$\left.\begin{aligned} &f(\eta)=0,\ f'(\eta)=1, g(\eta)=-n\,f''(\eta), \theta(\eta)=1, \phi(\eta)=1 \ \text{at}\ \eta=0\\ &f'(\eta)=0,\ g(\eta)=0,\ \theta(\eta)=0,\ \phi(\eta)=0 \qquad \text{at}\ \eta\to\infty \end{aligned}\right\} \quad (16)$$

The non-dimensional parameter in equation (13)-(16) are defined as

$$\beta=\frac{\kappa}{\mu},\quad \lambda_1=\frac{g\beta_T(T_w-T_\infty)}{b^2x},\quad \lambda_2=\frac{g\beta_C(C_w-C_\infty)}{b^2x},\quad M=\frac{\sigma B_0^2}{\rho b},$$

$$K_p=\frac{k_p'b}{\upsilon},\quad N_r=\frac{16T_\infty^3\sigma^*}{3k^*\kappa},\quad \Pr=\frac{\mu C_p}{k},\quad Ec=\frac{u_w^2}{C_P(T_w-T_\infty)},\quad S=\frac{S'}{a},$$

$$Sc=\frac{\upsilon}{D},\ Kc=\frac{k_0'}{a},\ \theta_r=\frac{T_r-T_\infty}{T_w-T_\infty},\ \theta_e=\frac{T_e-T_\infty}{T_w-T_\infty}$$

Where β is the material parameter, λ_1 is the thermal Richardson number, λ_2 is the solutal Richardson number, M is the magnetic parameter, K_p is the dimensionless porosity parameter, N_r is the radiation parameter, $\Pr$ is the Prandtl number, Ec is the Eckert number, S is the heat source parameter, Sc is the Schmidt number, Kc is the chemical reaction parameter, θ_r and θ_e are dimensionless form of viscosity and thermal conductivity parameters.

3. Results and discussion

The equations (12)-(15) and the corresponding boundary conditions (16) are solved by utilizing the fourth-order Runge-Kutta method in combination with the shooting technique by developing MATLAB programming code. The effect of various parameters on the velocity, micro-rotation (angular velocity), temperature and concentration profile are depicted in figures (1)-(22).

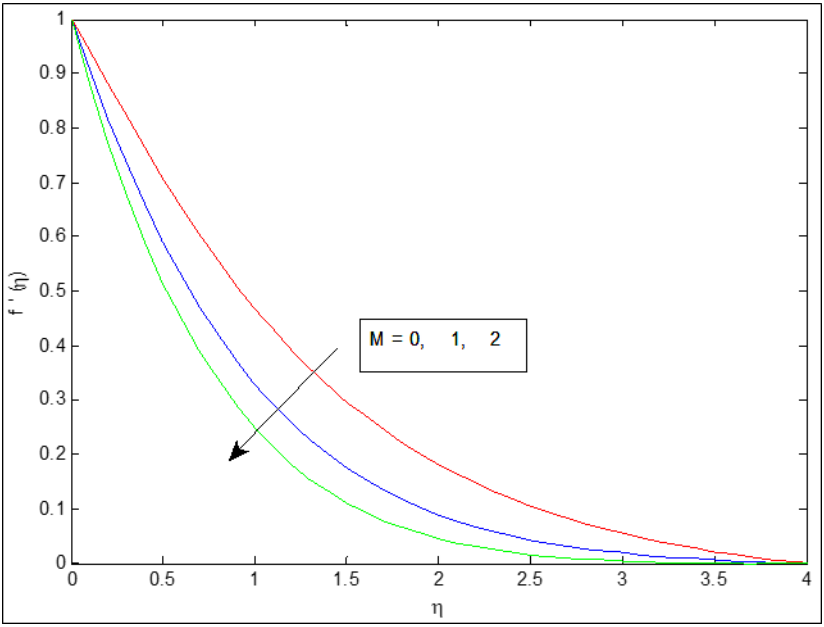

Fig 1: Velocity profile for different *M*

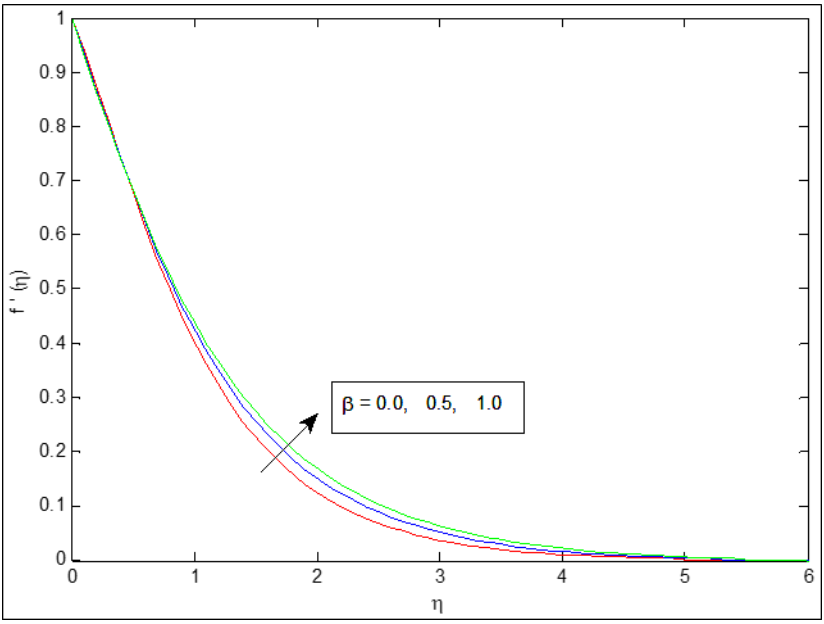

Fig 2: Velocity profile for different β

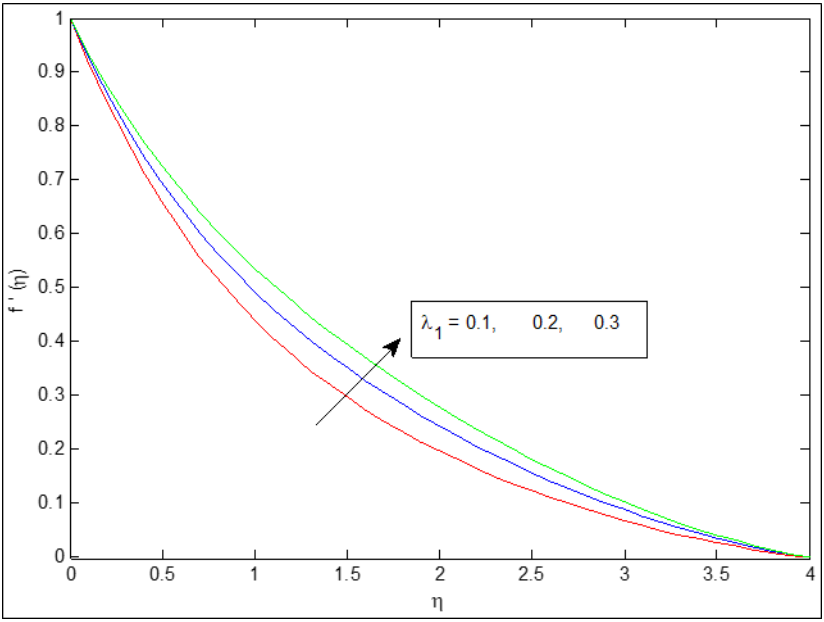

Fig 3: Velocity profile for different λ_1

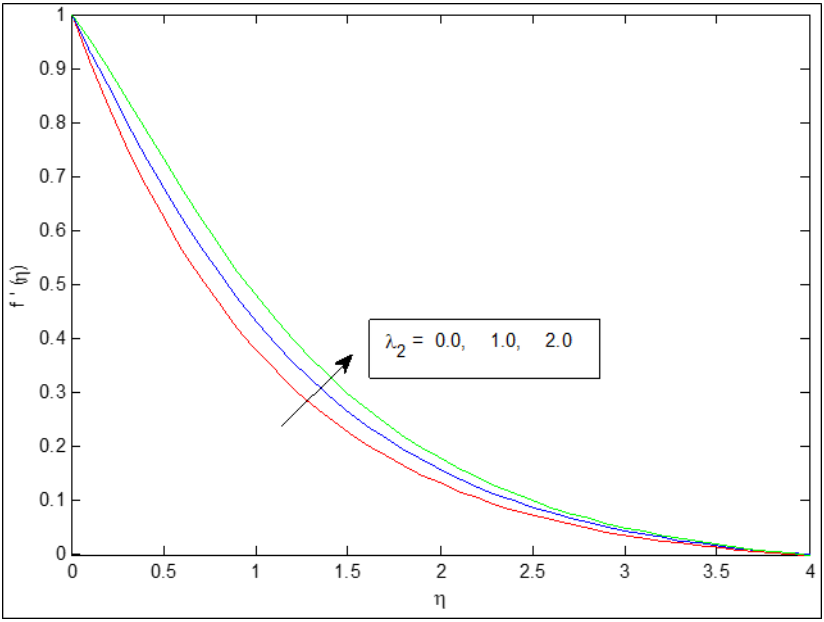

Fig 4: Velocity profile for different λ_2

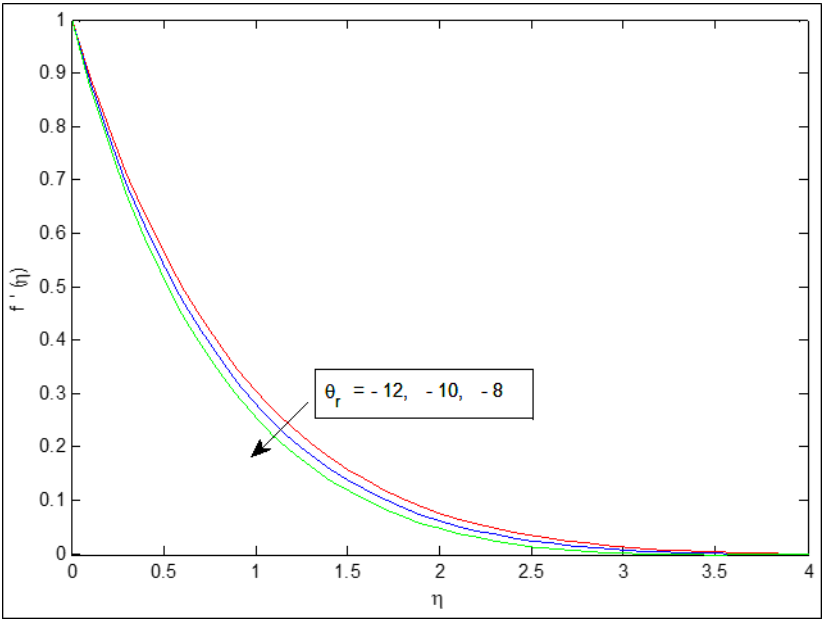

Fig 5: Velocity profile for different θ_r

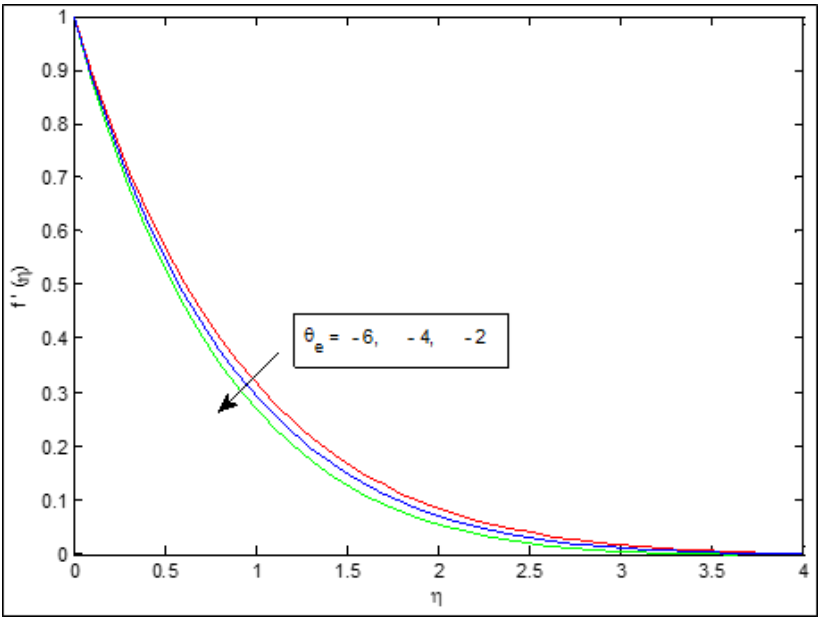

Fig 6: Velocity profile for different θ_e

Figures (1)-(6) illustrates the changes in the dimensionless velocity distribution for various parameters, including the Magnetic parameter *M*, material parameter β, thermal Richardson number λ_1, solutal Richardson number λ_2, viscosity parameter θ_r and thermal conductivity parameter θ_e. From figure 1, it is observed that with the increasing values of *M*, the velocity profile decreases. Figure 2 illustrates the effect of β on velocity profile. It is observed that fluid velocity increases with the increasing values of β. Figure 3 and 4 shows the effect of thermal Richardson number λ_1 and solutal Richardson number λ_2 on velocity profile. It is observed that fluid velocity increases with the increasing values of λ_1 and λ_2. Figure 5 and 6 shows the effect of viscosity parameter θ_r and thermal conductivity parameter θ_e on velocity profile. It is observed that fluid velocity decreases with increasing values of θ_r and θ_e.

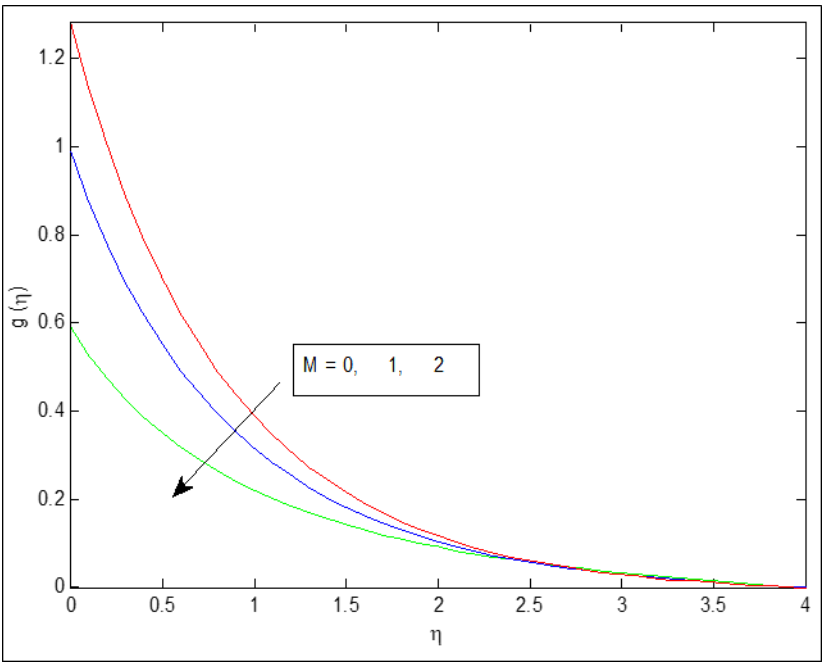

Fig 7: Angular velocity profile for different *M*

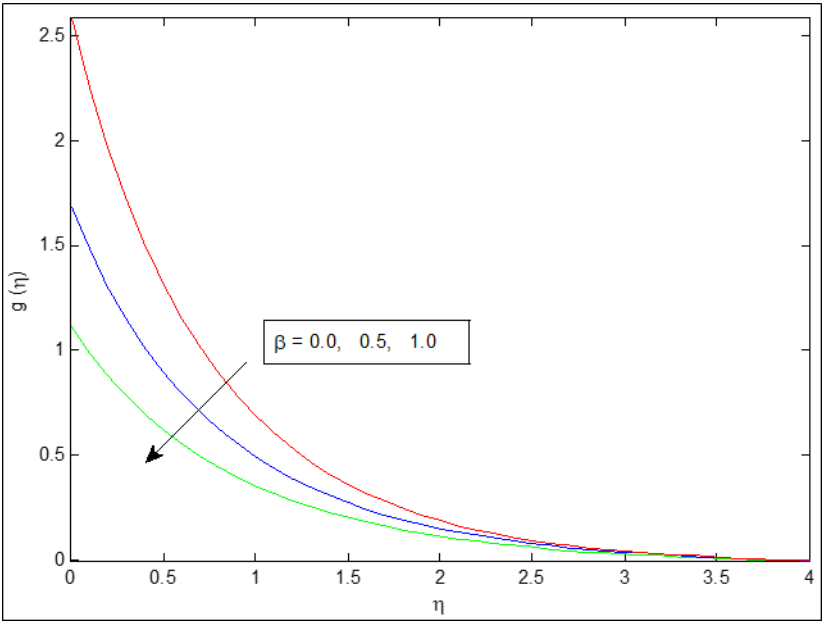

Fig 8: Angular velocity profile for different β

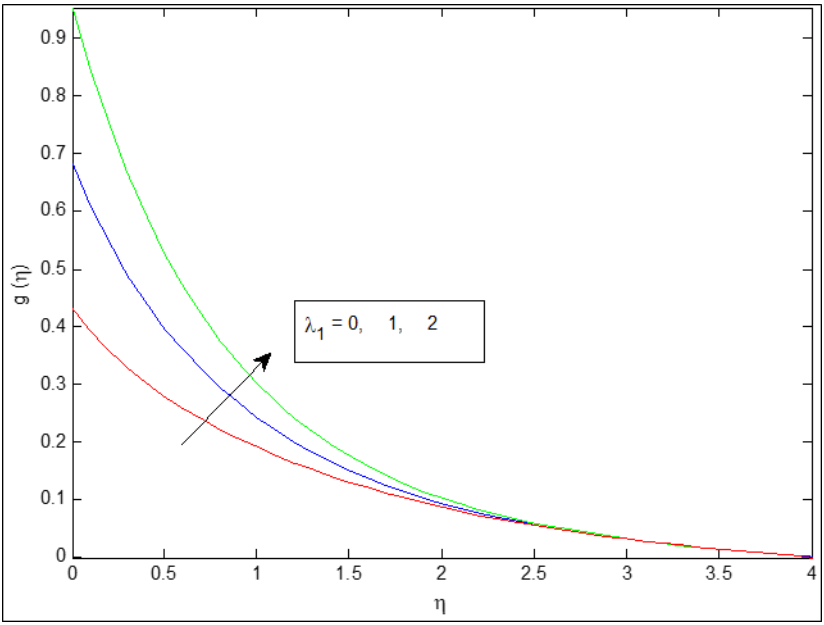

Fig 9: Angular velocity profile for different λ_1

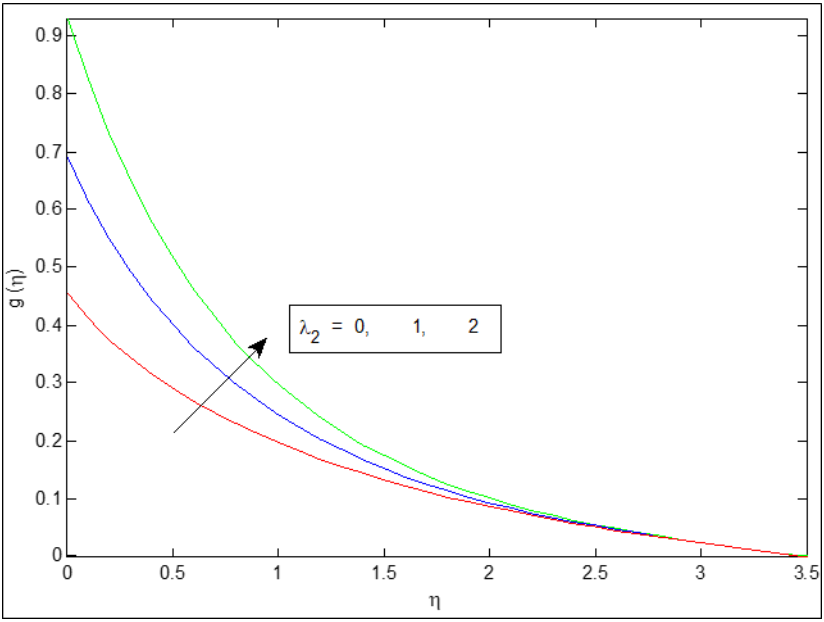

Fig 10: Angular velocity profile for different λ_2

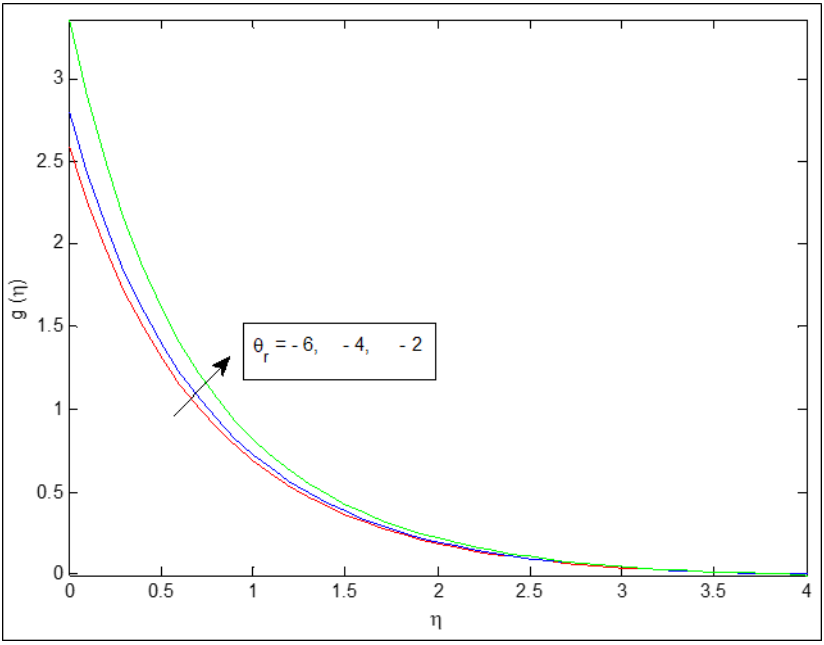

Fig 11: Angular velocity profile for different θ_r

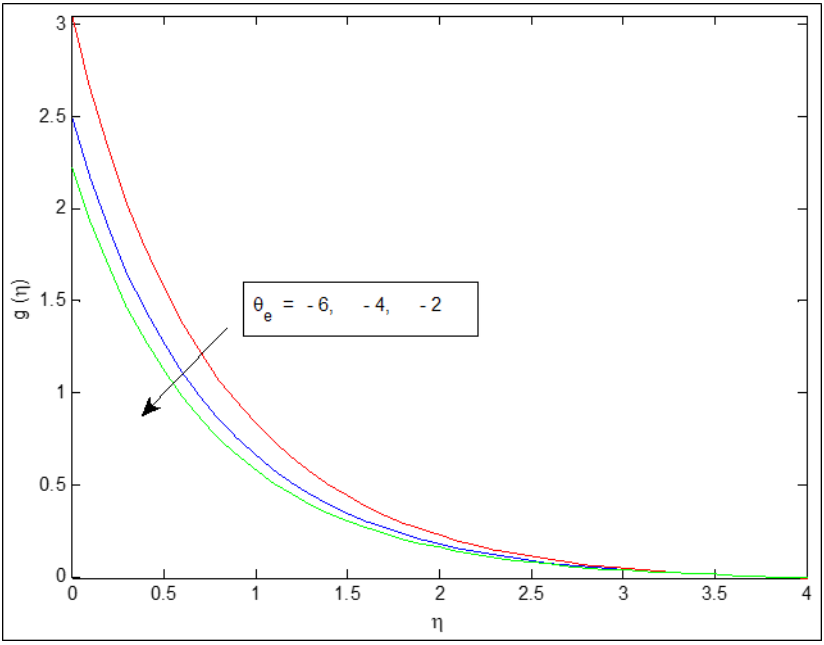

Fig 12: Angular velocity profile for different θ_e

Figures (7)-(12) illustrates the changes in the dimensionless angular velocity distribution for various parameters, including the Magnetic parameter *M*, material parameter β, thermal Richardson number λ_1, solutal Richardson number λ_2, viscosity parameter θ_r and thermal conductivity parameter θ_e. Figures 7 and 8 shows the effect of *M* and β on angular velocity profile. It is found that the angular velocity profile decreases with the increasing values of *M* and β. Figures 9 and 10 shows the effect of thermal Richardson number λ_1 and solutal Richardson number λ_2 on angular velocity profile. It is observed that angular velocity increases with the increasing values of λ_1 and λ_2. Figures 11 and 12 shows the effect of viscosity parameter θ_r and thermal conductivity parameter θ_e on angular velocity profile. It is observed that fluid angular velocity increases with increasing values of θ_r whereas opposite result is seen for θ_e.

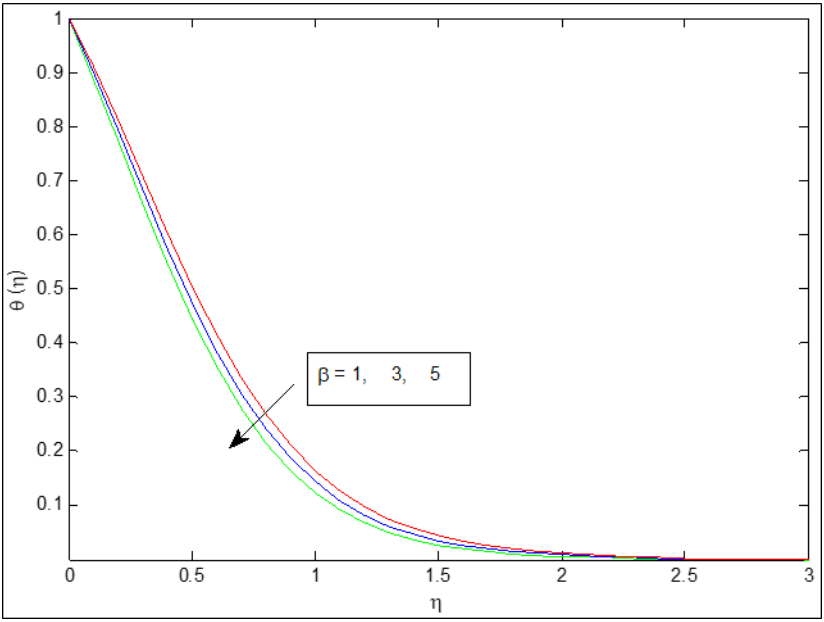

Fig 13: Temperature profile for different β

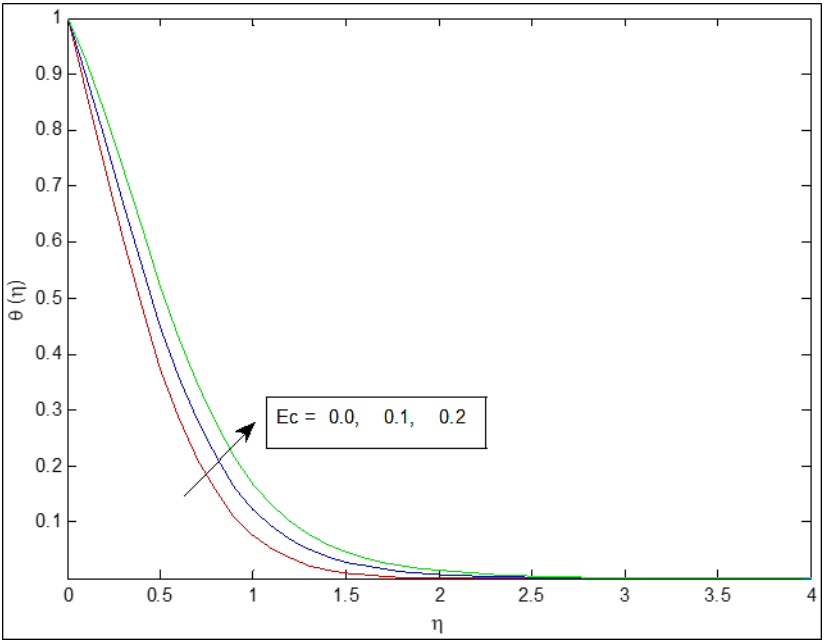

Fig 14: Temperature profile for different *Ec*

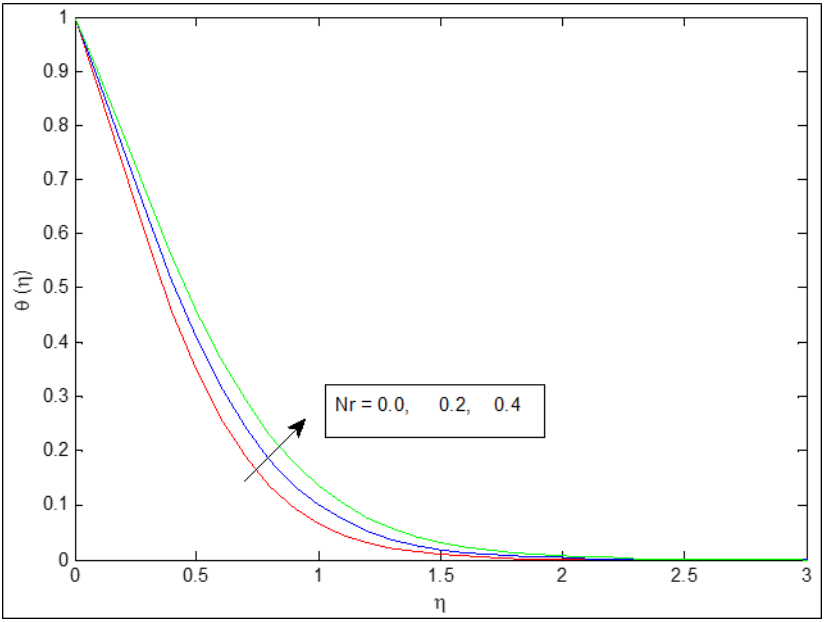

Fig 15: Temperature profile for different Nr

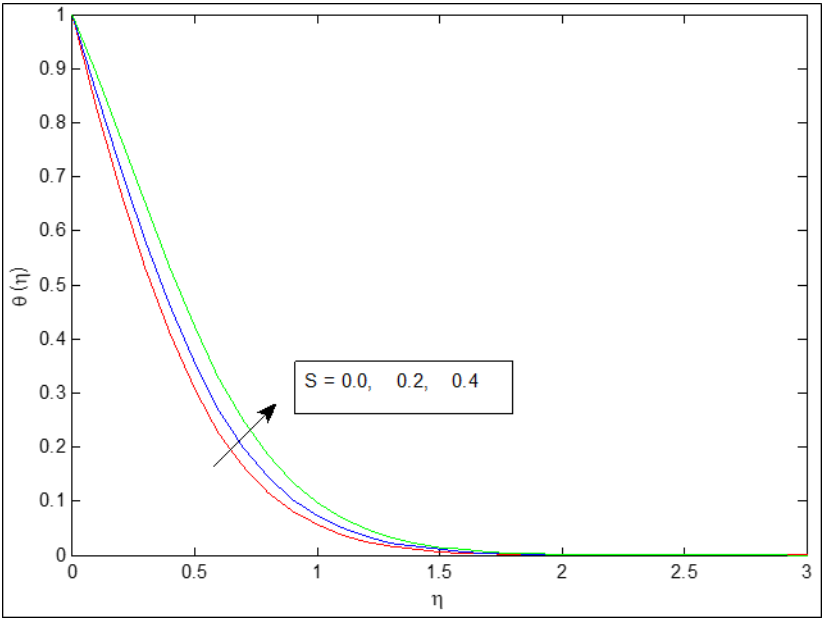

Fig 16: Temperature profile for different S

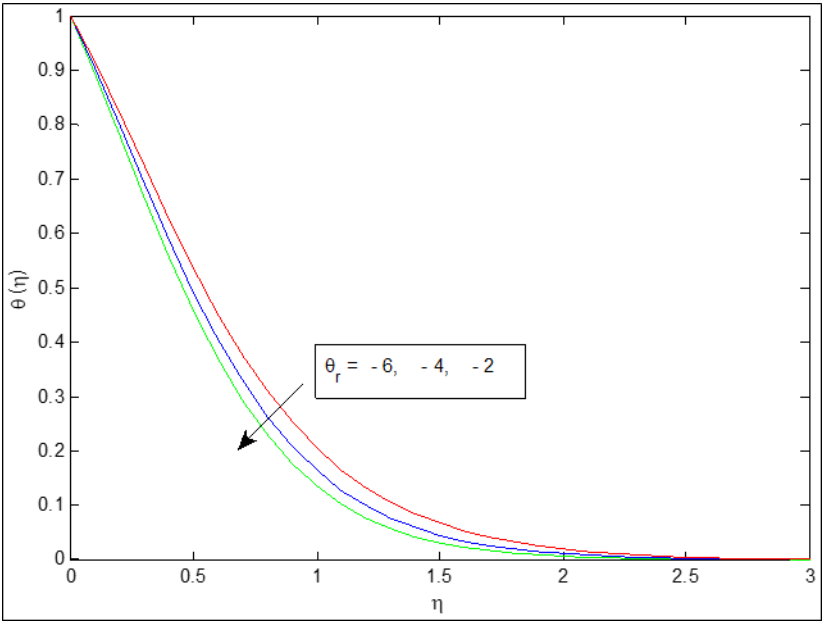

Fig 17: Temperature profile for different θ_r

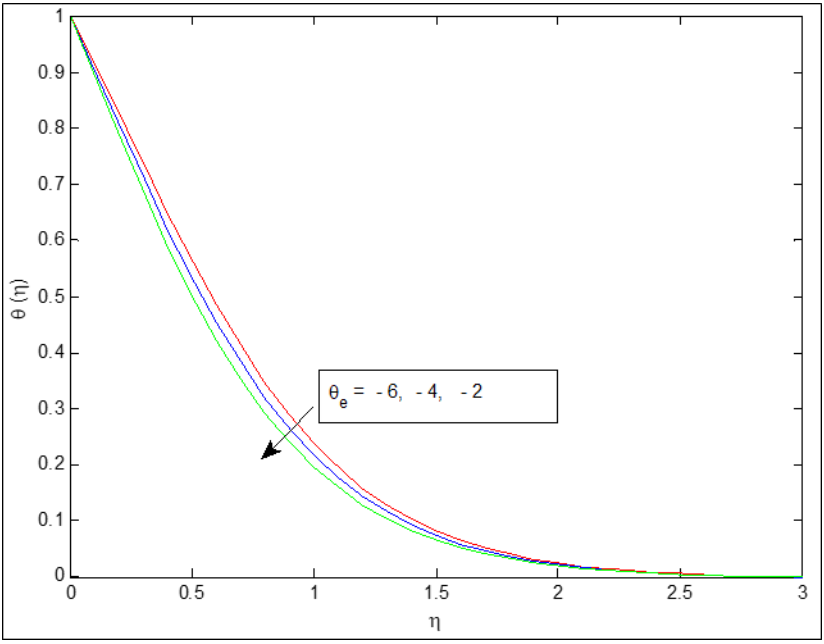

Fig 18: Temperature profile for different θ_e

Figures (13)-(18) illustrates the changes in the dimensionless temperature distribution for various parameters, including material parameter β, Eckert number *Ec*, radiation parameter Nr, heat source parameter *S*, viscosity parameter θ_r and thermal conductivity parameter θ_e. Figure 7 shows the effect of β on temperature profile. It is found that the fluid temperature decreases with the increasing values of β. Figures 14 to 16 shows the effect Eckert number *Ec*, radiation parameter *Nr*, heat source parameter *S* on temperature profile. It is observed that fluid temperature increases with the increasing values of *Ec*, *Nr* and *S*. Figures 17 and 18 shows the effect of viscosity parameter θ_r and thermal conductivity parameter θ_e on temperature profile. It is observed that fluid temperature decreases with increasing values of θ_r and θ_e.

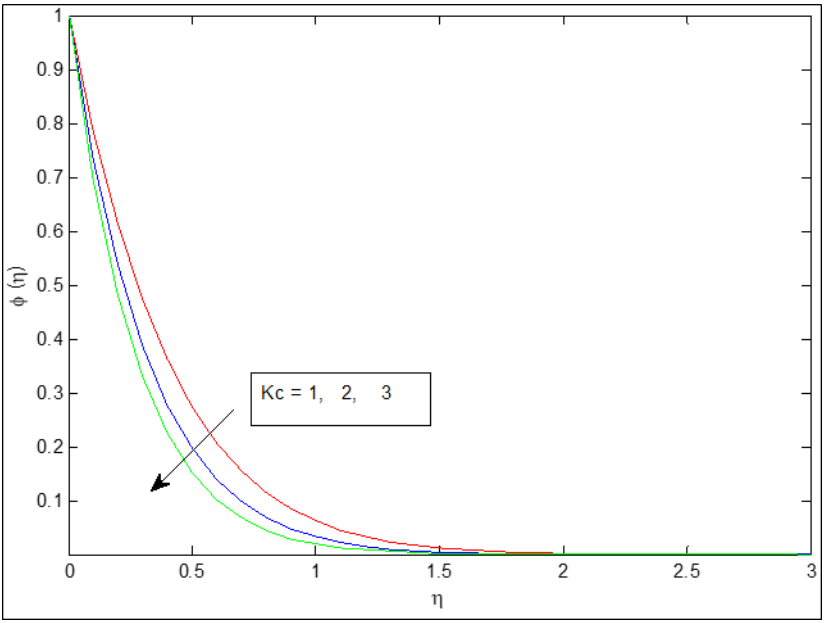

Fig 19: Concentration profile for different *Kc*

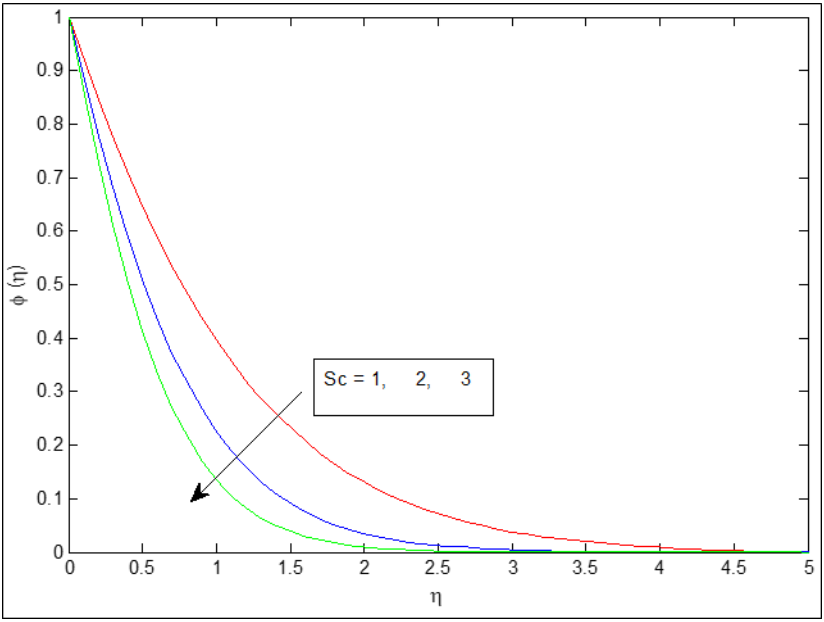

Fig 20: Concentration profile for different *Sc*

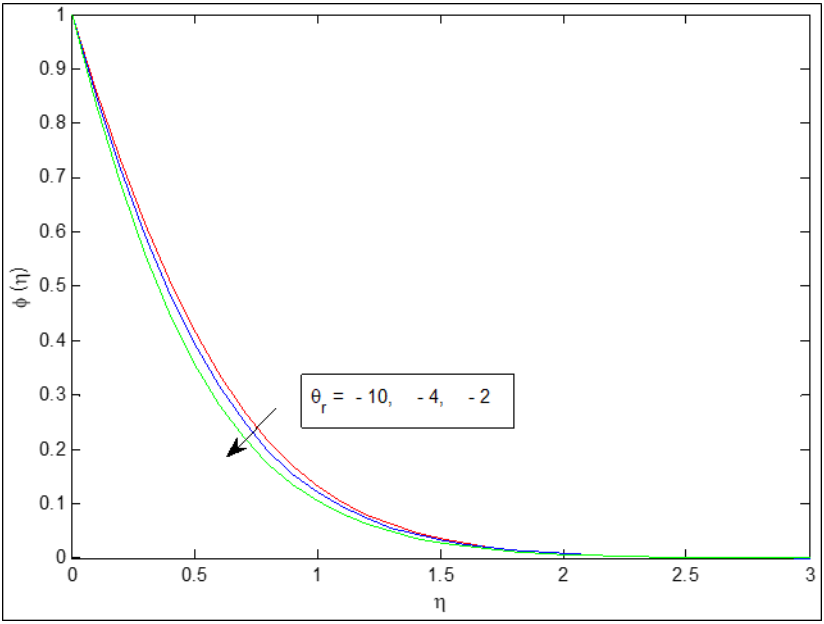

Fig 21: Concentration profile for different θ_r

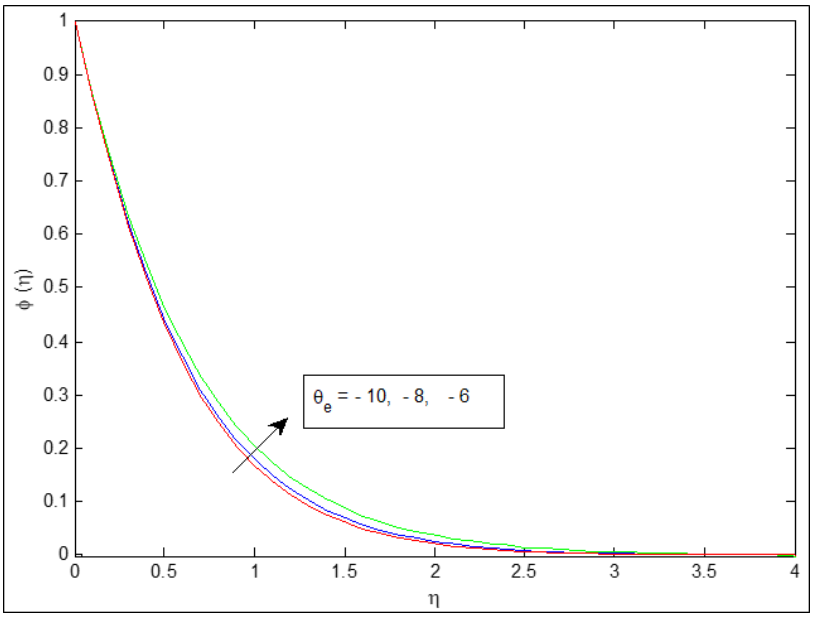

Fig 22: Concentration profile for different θ_e

Figures (19)-(22) illustrates the changes in the dimensionless concentration distribution for various parameters, including chemical reaction parameter *Kc*, Schmidt number *Sc*, viscosity parameter θ_r and thermal conductivity parameter θ_e. Figures 19 to 21 shows the effect of *Kc*, *Sc* and θ_r on concentration profile. It is observed that fluid concentration decreases with the increasing values of *Kc*, *Sc* and θ_r. Figure 22 shows the effect of thermal conductivity parameter θ_e on concentration profile. It is observed that fluid concentration increases with increasing values of θ_e.

4. Conclusions

The current study has yielded the following valuable observations:

- The fluid velocity increases with both Richardson numbers and the material parameter. However, it decreases for increasing values of the magnetic field parameter, thermal conductivity parameter and viscosity parameter.
- The angular velocity profile increases for both Richardson numbers and the viscosity parameter. However, it decreases for increasing

values of the material parameter, thermal conductivity parameter, and magnetic field parameter.

- The dimensionless fluid temperature increases with increasing Eckert number, radiation parameter, and heat source parameters. However, it decreases with increasing material parameter, thermal conductivity parameter and viscosity parameter.
- As the viscosity parameter, Schmidt number, and chemical reaction parameter increase, the concentration decreases. On the other hand, the concentration increases with thermal conductivity parameter.

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Chapter - 7
Artificial Intelligence: A State of the Art

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Chapter - 7

Artificial Intelligence: A State of the Art

Satyendra Singh Sachan and Meghna Verma

Abstract

AI is a technique where teaching computers, robots are operated by a computer or a piece of soft ware to think critically muck like an intelligent person good. The field of science that focus on assisting machines in resolving complex issues in a way which is more predilected to that of a human. Most of the cases are associated with taking traits from human intelligence and using them, the goal behind the creation of AI was to imbue machines with intelligence that could be compared to and given valued by human beings. This science has been found on field such as computer science and biology, psychology, mathematics and engineering. Concept of computer abilities analogous to human intelligence such as learning, problem solving and reasoning is a key concern of AI.

Keywords: Artificial intelligence, terminology of artificial intelligece, artificial intelligence issues, artificial intelligence terminology

Artificial intelligence: A Brief Overview

- Artificial intelligence is "the science and engineering of making intelligent machines, especially intelligent computer programs," according to John McCarthy, the father of the field.
- Artificial intelligence is a technique for teaching a computer, a robot that is operated by a computer, or a piece of software to think critically, much like an intelligent person would.
- Artificial intelligence (AI) is a field of science that focuses on assisting machines in solving complex issues in a way that is more akin to that of a human.
- The study of how the human brain works, as well as how people learn, make decisions, and collaborate when attempting to solve an issue, is the first step in developing intelligent software and systems.
- In most cases, this entails taking traits from human intellect and using them.

Philosophy of AI:

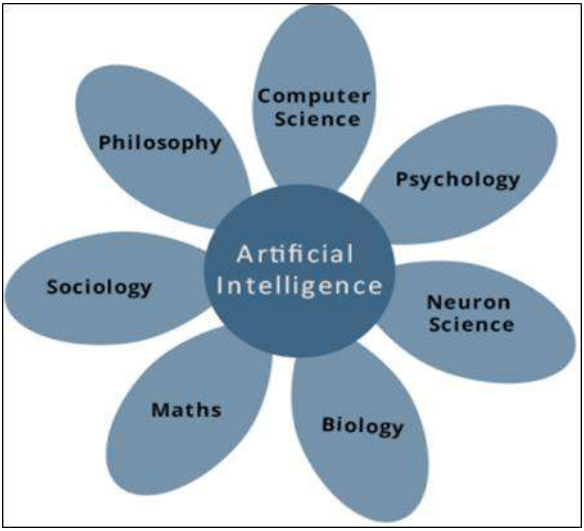
- Human curiosity led him to question, "Can a machine think and behave like humans do?" while utilizing the power of computer systems.
- The goal behind the creation of AI was to imbue machines with intelligence that is comparable to and valued highly by humans.

AI's main objectives are to:

- Develop expert systems, or machines that can advise their users and behave intelligently.
- To Implement Human Intelligence in Machines: Developing apparatuses that comprehend, consider, pick up knowledge, and act in human-like ways.

AI's contribution is:

A science and technology called artificial intelligence is founded on fields like computer science, biology, psychology, linguistics, mathematics, and engineering. The creation of computer abilities akin to human intelligence, such as learning, problem-solving, and reasoning, is a key focus of AI.



Both without and with AI, programming

The following are some differences between writing without and with AI:

Programming Without AI	Programming With AI
Without AI, a computer program can resolve the particular problems it is designed to address.	AI-enhanced computer programs are capable of providing general solutions to problems.
The program's layout changes when it is modified.	By combining knowledge from very independent sources, AI programs can take in new changes. Therefore, you can change even a tiny bit of program material without affecting its overall structure.
Modification takes time and effort. It might result in a negative impact on the initiative.	Modifying a software quickly and easily.

AI's importance

- **Game Playing:** For a few hundred dollars, you can purchase chess playing robots that can compete at the master level. Although they contain some AI, they primarily use brute force computation to perform well against humans by looking at millions of positions. It takes the ability to look at 200 million locations per second to defeat a world champion using brute force and well-known trustworthy heuristics.

Voice recognition

Computer voice recognition became useful for a few specific uses in the 1990s.Thus United Airlines has replaced its keyboard tree for flight details by a system using speech recognition of flight numbers and city names. It is very practical.

Natural language processing

You can communicate with a machine that can comprehend human-spoken natural language.

Expert systems

Some apps combine hardware, software, and specialized data to convey reasoning and advice. They offer customers explanations and guidance.

Vision systems

These systems interpret, grasp, and process computer-generated visual data. A spy plane, for instance, captures images that are used to create maps

or spatial data for the regions.

Clinical expert systems are used by doctors to identify patients.

Police use computer software that can identify the face of criminal with the stored portrait made by forensic artist.

Handwriting Recognition

Software that reads handwritten text on paper or on a computer using a stylus is known as handwriting recognition. In order to create editable text, it can identify the letter shapes.

AI Methodology

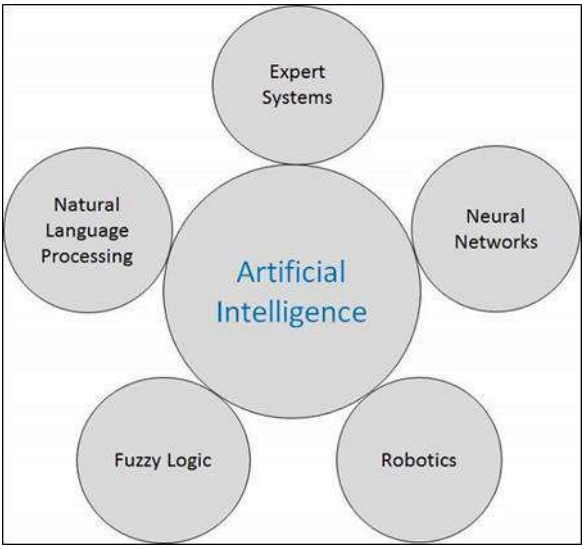
The goal of an AI technique is to efficiently organize and use information so that:

- It should be perceptible to the people who provide it.
- It should be simple to modify to fix mistakes.
- Despite being insufficient or incorrect, it should be helpful in many circumstances.

AI methods increase the speed at which a complex program is executed.

AI research topics include

Artificial intelligence encompasses a vast range of topics. As we move forward, we take into account the widely prevalent and thriving research fields in the field of AI:



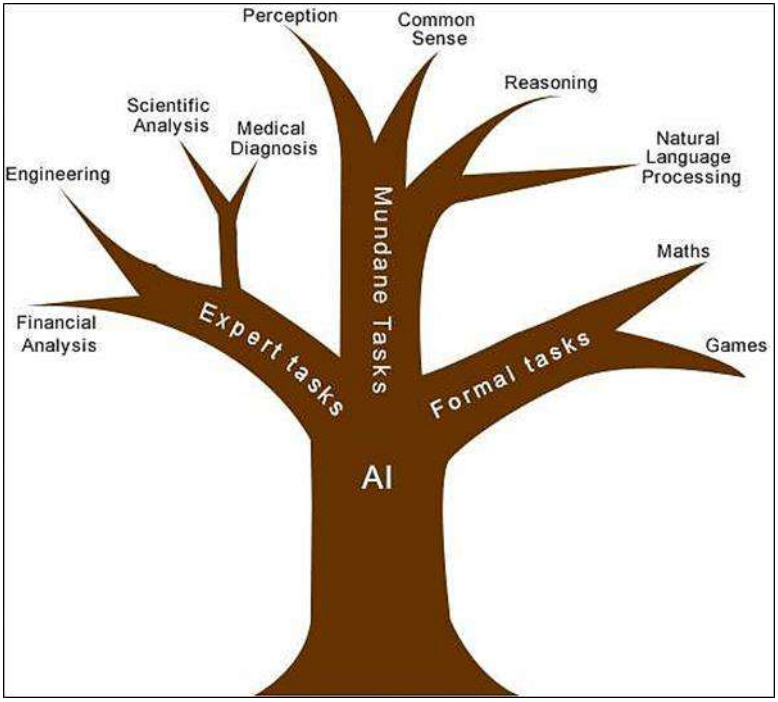
Applications in real life of research fields

There are a wide range of uses for AI that benefit regular individuals in their daily lives:

Sr. No.	Research Area
1.	**Expert Systems** Examples include clinical tools and flight tracking systems.
2.	**Natural Language Processing** Examples include speech recognition, the Google Now feature and automatic voice output
3.	**Neural Networks** Examples include face recognition, character recognition and handwriting recognition systems.
4.	**Robotics** Industrial robots, for instance, can move objects, apply paint, check for accuracy, drill holes, clean surfaces, coat objects, and .carve objects.
5.	**Fuzzy Logic** Examples: Consumer electronics, automobiles, etc.

AI task classification

The domain of AI is classified into Formal tasks, Mundane job, and expert tasks.



Task Domains of Artificial Intelligence		
Mundane (Ordinary) Tasks	**Formal Tasks**	**Expert Tasks**
• Perception • Computer Vision • Speech and voice	• Mathematics • Geometry • Logic • Integration and • Differentiation	• Engineering • Fault finding • Manufacturing • Monitoring
Natural Language Processing • Understanding • Language Generation • Language Translation	**Games** • Go • Chess • (Deep Blue) • Checkers	**Scientific Analysis**
Common Sense	Verification	Financial Analysis

AI issues

AI is developing with such an incredible speed, sometimes it seems magical. Researchers and developers share the belief that AI may become so powerful that it will be challenging for people to control.

Humans created AI systems by infusing them with as much intelligence as they could, which now threatens the very existence of humans.

Threat to privacy

Theoretically, each email and phone conversation could be understood by an AI program that can recognize speech and comprehend natural language.

Threat to human dignity

AI systems have already started replacing the human beings in few industries. It shouldn't take the place of people in professions like nursing, surgery, judging, or law enforcement where they hold dignified positions that are related to ethics.

Threat to safety

Safety Risk Self-improving AI systems have the potential to grow so powerful that they are very difficult to stop from achieving their objectives, which may have unintended consequences.

AI Terminology

Term	Meaning
Agent	Agents, also known as assistants, brokers, bots, droids, intelligent agents, and software agents, are systems or software

	programs that are capable of autonomous, purposeful, and reasoning directed towards one or more goals.
Autonomous Robot	Robot capable of controlling itself without outside assistance or influence.
Backward Chaining	Working backward to determine the cause or reason for a problem.
Blackboard	The memory inside the computer is what is used for inter-expert system contact.
Environment	It is the area of the real or virtual universe that the agent inhabits.
Forward Chaining	Approach to moving toward a conclusion or solution to an issue.
Heuristics	It is information that has been gained through experimentation, evaluations, and trial-and-error.
Knowledge Engineering	Obtaining information from other resources and human experts.
Percepts	It is the manner in which the agent receives environmental data.
Pruning	Ignoring pointless and useless factors in AI systems.
Rule	It is a way for expert systems to describe knowledge bases. It is in the shape of IF-THEN-ELSE.
Shell	A shell is a piece of software that aids in creating an expert system's knowledge store, inference engine, and user interface.
Task	It is the goal the agent is tries to accomplish.
Turing Test	a test created by Allan Turing to measure a machine's intellect in comparison to human intelligence.

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Chapter - 8
Job Stress Symptoms and How to Ease the Stress

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Chapter - 8

Job Stress Symptoms and How to Ease the Stress

Dr. Anil Kisan Bade

Abstract

Job stress comes in different forms and affects your mind and body in different ways. Small things can make you feel stressed. Major stress comes from having too much or not enough work or doing work that doesn't satisfy you. Conflicts with your boss, coworkers, or customers are other major causes of stress.

First, identify what's creating stress at work. Maybe it's lack of control over your job. Or maybe it's worry about losing your job or how you are doing at work. You might feel stress because you're unable to express your thoughts and ideas to your boss and coworkers.

Think about why you want to reduce stress at work. You might want to protect your heart and your health by reducing stress. Or maybe you simply want to enjoy your life more and not let work stress control how you feel. Your reason for wanting to change is important. If your stress reason come from you and not someone else, it will be easier for you to make a healthy change for good.

Next, set a goal for yourself that involves reducing your stress level. Think about both a long-term and a short-term goal. If you are truly miserable because of a stressful job, it may be time to think about changing jobs. Make sure you know whether it is you or the job that's the problem.

Before you quit, spend time thinking about other job options. Not having a job will probably also lead to stress. Getting another job before you quit is best, but sometimes that isn't possible. Decide what is less stressful for you-unemployment or being miserable in your current job. It might help to talk with a counselor about your choices.

Conclusion

Exercise increases your overall health and your sense of well-being, which puts more pep in your step every day. But exercise also has some

direct stress-busting benefits. Physical activity helps to bump up the production of your brain's feel-good neurotransmitters, called endorphins. Although this function is often referred to as a runner's high, a rousing game of tennis or a nature hike also can contribute to this same feeling.

Regular exercise can increase self-confidence and lower the symptoms associated with mild depression and anxiety. Exercise also can improve your sleep, which is often disrupted by stress, depression and anxiety. All this can ease your stress levels and give you a sense of command over your body and your life.

Keywords: Stressful job, burnout in working place, job stress, manage job stress, job stress symptoms.

Introduction

Job stress comes in different forms and affects your mind and body in different ways. Small things can make you feel stressed, such as a copy machine that never seems to work when you need it or phones that won't quit ringing. Major stress comes from having too much or not enough work or doing work that doesn't satisfy you. Conflicts with your boss, coworkers, or customers are other major causes of stress (DK, April 26, 2018).

It's normal to have some stress. Stress releases hormones that speed up your heart, make you breathe faster, and give you a burst of energy. Stress can be useful when you need to focus on or finish a big project. But too much stress or being under stress for too long isn't good for you. Constant stress can make you more likely to get sick more often. It can make chronic pain worse and can also lead to long-term health problems such as heart disease, high blood pressure, back problems, and depression.

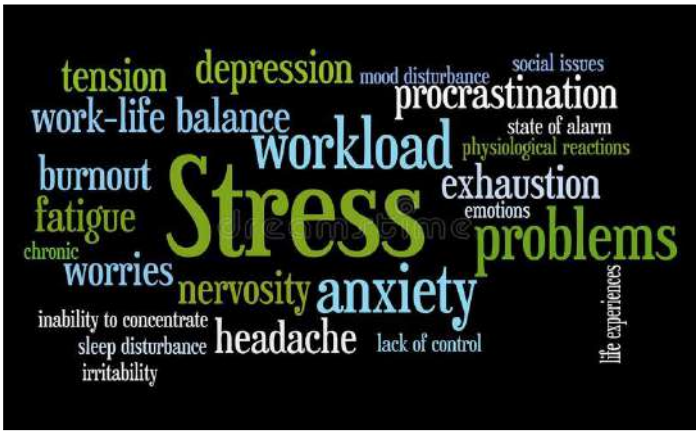
Look for these signs of job stress: (Placeholder1)

- Headaches
- Trouble sleeping
- Problems concentrating
- Short temper
- Upset stomach
- Job dissatisfaction and low morale

What causes job stress?

Most of the time, it's the major sources of stress that lead to job burnout and health problems. Job stress can affect your home life too. Here are some common sources of major job stress, with examples of each

Lack of Control: Belief in one's ability to exert control over the environment and to produce desired results is essential for an individual's well being. It has been repeatedly argued that the perception of control is not only desirable, but it is likely a psychological and biological necessity (Lauren A.Leotti,Sheena S Iyengar,Kevin N.Ochsner, 2010).



Feeling as if you have no control over your work or job duties is the biggest cause of job stress. People who feel like they have no control at work are most likely to get stress-related illnesses. Here's an example:

Shelly is responsible for putting together a report that her boss must deliver at a 4 p.m. meeting. She's been waiting all day for the notes and numbers she needs. Shelly finally gets the notes from her boss at 3:15 and rushes to prepare the report and charts and to make copies in time. She gets it done, but she feels mad and resentful. This is the third time this week that this has happened (Surinder Kaur, 2011).

Increased responsibility

Taking on extra duties in your job is stressful. You can get more stressed if you have too much work to do and you can't say no to new tasks.

John volunteers for every new project, because he heard that's the best way to get promoted. But the tasks are starting to pile up, and he's feeling overwhelmed. He knows he can't really manage one more thing. But this morning, John's boss asked him to take on another project, and John agreed. Now he's more worried than ever about getting everything done. (Panel Y Seult, M.Freeney; JoanTiernan, December 2009,)

Job satisfaction and performance

Do you take pride in your job? If your job isn't meaningful, you may find it stressful. Are you worried about doing well at work? Feeling insecure

about job performance is a major source of stress for many people (Katopol, 2014).

Rahul has worked in his new job for 8 months. He thinks he is doing well. But his boss doesn't say much, so Rahul isn't sure. He wonders if he's on the right track, but he's afraid to ask.

Uncertainty about work roles

Be the same as Roshni. Roshni worries about what this means for her. Being unsure about your duties, how your job might be changing, or the goals of your department or company can lead to stress. If you report to more than one boss, juggling the demands of different managers can also be stressful (Ohana, 2020).

Mr. Raju old manager was promoted. Now Raju is working for someone new. She's heard that the new boss plans to "shake things up" in her department. The new boss just hired Emily, whose job seems to

Poor communication

Tension on the job often comes from poor communication. Being unable to talk about your needs, concerns, and frustrations can create stress. (Hawksley, 2013)

A new job with more responsibility and better pay just opened up in Jill's department. Jill knows she can do this job. And she's been with the company longer than anyone else on her team. She waits for her manager to ask if she is interested. But after several weeks, a coworker is promoted to the new job. Jill feels hurt and angry, but she doesn't say anything

Lack of control

Lack of support from your boss or coworkers makes it harder to solve other problems at work that are causing stress for you.

Julie works in a busy office answering customer complaint calls all day. It would be easier to handle all the calls if he could at least trade tips with his coworkers. But everyone else is busy too. His coworkers never make it out of their cubicles during the day, even to let off a little steam.

Poor working conditions

Unpleasant or dangerous physical conditions, such as crowding, noise, or ergonomic problems, can cause stress.

Sham is exposed to constant noise at work.

He wears earplugs, but at the end of her shift her ears are ringing. She often comes home with a headache

Meet with your manager

Meet with your manager at least once a year (every 3 or 6 months is even better) to talk about your job and your performance. If a performance review is already part of your job, treat it as a chance to clear up issues that may be causing stress for you. Here are some questions to ask:

What is expected of me in this job?

Where is this company going? How do I fit into that plan?

How am I doing? What are my strengths? How can I improve?

What can I expect from you if there's a problem with my work or my job?

If I continue to do well, how might my efforts to be recognized (Wicke, 2019)

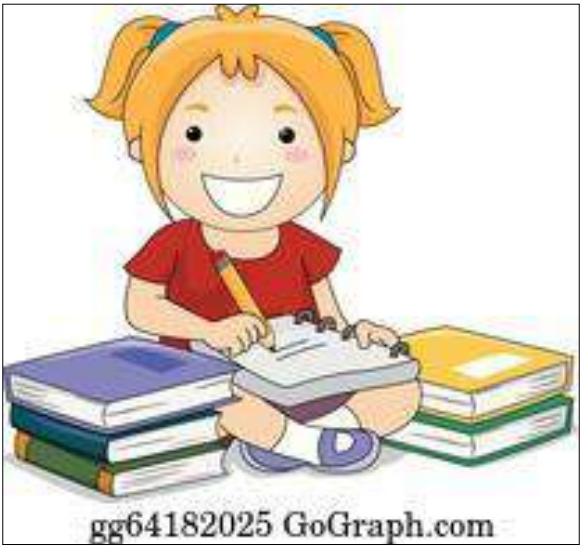
You and your job (Evy Kuijpers,Dorien Tam Kooji: Marianne van Woerkom, 2020).

Get organized: Keep track of your projects and deadlines by making a list of what's urgent. Decide what matters most and what can wait.

Don't put things off: Use a schedule planner to plan your day or week. Just seeing on paper that there is time to get each task done can help you get to work. Break a large project into small steps, and set a deadline for each one.

Learn to say "no." Don't over commit yourself. If you take on too much, you're creating stress.

Focus: Do one thing at a time. In some cases, you can do two things at a time. But if you start to feel stressed, go back to doing one thing at a time.

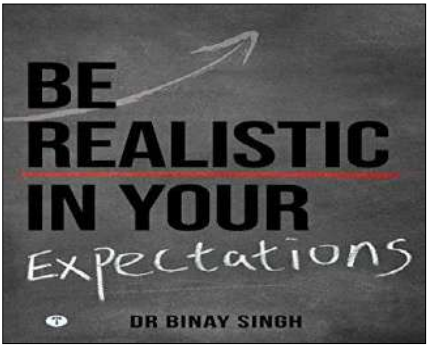


Concentrate: Try to limit distractions and interruptions. Ask others to give you a block of time when you are not disturbed.

Delegate: Ask someone else to take on a task. It's not always important to have all the control.

- **Take care of yourself** (Halrynjo, 2009)

Unplug: Don't let the technologies that help you do your work get in the way of your leisure time. Consider turning off cell phones or beepers when you are with family or friends. And avoid checking work email when you're not at work



Be realistic: Remember that everyone has good days and bad days at work. For more information, see the topic Stop Negative Thoughts: Choosing a Healthier Way of Thinking.

Reward yourself: When you finish a difficult task, celebrate. Enjoy a snack at your desk, or-if your job permits-take a short walk or visit with a coworker.

Schedule time for fun: If you spend every second of your day getting things done, you may resent never having time for yourself. If your employer offers a flexible work schedule, use it in a way that fits your work style. Go into work earlier and take a longer break at lunch to make time for a yoga class or a walk.

Practice breathing and relaxation techniques: You can do these at home or in a quiet place at work. For more information, see:

Stress Management: Breathing Exercises for Relaxation.

Stress Management: Doing Guided Imagery to Relax.

Stress Management: Doing Progressive Muscle Relaxation

Setting a goal to reduce stress

First, identify what's creating stress at work. Maybe it's lack of control over your job. Or maybe it's worry about losing your job or how you are doing at work. You might feel stress because you're unable to express your thoughts and ideas to your boss and coworkers.

Think about why you want to reduce stress at work. You might want to protect your heart and your health by reducing stress. Or maybe you simply want to enjoy your life more and not let work stress control how you feel. Your reason for wanting to change is important. If your reason comes from you and not someone else; it will be easier for you to make a healthy change for good.

Next, set a goal for yourself that involves reducing your stress level. Think about both a long-term and a short-term goal (DJ, 2011).

Here are a few examples:

- Sham's long-term goal is to reduce stress by managing her frustration over things she can't control at work. Her short-term goal is to learn to do deep breathing and relaxation exercises when she gets stressed. She'll try it the next time her boss hands her a last-minute project.
- Jisha's long-term goal is to reduce stress by speaking up at work and expressing her interests and ideas more effectively. Her short-term goal is to practice being more assertive. When she's ready, she'll contribute an idea at a department meeting.

- Rahul's long-term goal is to reduce stress by having a better understanding of what's expected of him at work. His short-term goal is to find out how he is doing now. He plans to schedule a meeting with his boss to talk about his performance and how he can improve.
- Jeet's long-term goal is to reduce stress by learning to say "no" to projects he doesn't have time to handle. His short-term goal is to get organized and prioritize the projects he has now. He is going to make a list of all of his work and then prioritize the tasks that are most important.

After setting your goals, think about what might get in your way. Use a personal action plan (What is a PDF document) to write down your goals, the possible barriers, and your ideas for getting past them. By thinking about these barriers now, you can plan ahead for how to deal with them if they happen.

Most important, make sure you get support from friends and family in your efforts to reduce job stress. If your company has an employee assistance program, you might use it to talk with a counselor. A counselor can help you set goals and provide support in dealing with setbacks.

Know when to quit

If you are truly miserable because of a stressful job, it may be time to think about changing jobs. Make sure you know whether it is you or the job that's the problem.

Before you quit, spend time thinking about other job options. Not having a job will probably also lead to stress. Getting another job before you quit is best, but sometimes that isn't possible. Decide what is less stressful for you-unemployment or being miserable in your current job. It might help to talk with a counselor about your choices (Johnson, 2008).

Exercise and stress relief

Exercise increases your overall health and your sense of well-being, which puts more pep in your step every day. But exercise also has some direct stress-busting benefits.

- **It pumps up your endorphins:** Physical activity helps to bump up the production of your brain's feel-good neurotransmitters, called endorphins. Although this function is often referred to as a runner's high, a rousing game of tennis or a nature hike also can contribute to this same feeling.

- **It's meditation in motion:** After a fast-paced game of racquetball or several laps in the pool, you'll often find that you've forgotten the day's irritations and concentrated only on your body's movements. As you begin to regularly shed your daily tensions through movement and physical activity, you may find that this focus on a single task, and the resulting energy and optimism, can help you remain calm and clear in everything that you do.
- **It improves your mood:** Regular exercise can increase self-confidence and lower the symptoms associated with mild depression and anxiety. Exercise also can improve your sleep, which is often disrupted by stress, depression and anxiety. All this can ease your stress levels and give you a sense of command over your body and your life.

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Chapter - 9
Psychopharmacology

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Chapter - 9

Psychopharmacology

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Abstract

We live in an age of psychopharmacology. One in six persons currently takes a psychotropic drug. These drugs have profoundly shaped our scientific and cultural understanding of psychiatric disease. By way of a historical review, we try to make sense of psychiatry's dependency on psychiatric drugs in the care of patients. Modern psychopharmacology began in 1950 with the synthesis of chlorpromazine. Over the course of the next 50 years, the psychiatric understanding and treatment of mental illness radically changed. Psychotropic drugs played a major part in these changes as state hospitals closed and psychotherapy gave way to drug prescriptions. Our review suggests that the success of psychopharmacology was not the consequence of increasingly more effective drugs for discrete psychiatric diseases. Instead, a complex mix of political economic realities, pharmaceutical marketing, basic science advances and changes in the mental health-care system have led to our current infatuation with psychopharmacology.

Keywords: Psychopharmacology, history, antipsychotics, antidepressants, mental illness, treatment

Introduction

Over the course of many decades, psychotropic drugs have been shown to be effective in managing a wide range of mental and emotional disorders. These chemical substances have significantly transformed the treatment of mental illness. However, as the use of these drugs has increased, so have their effects and potential side effects.

Definition of psychotropic drugs

A psychotropic drug is any medication that primarily affects behaviour, experience, or other psychological functions, as defined by the Logman Dictionary of Psychology and Psychiatry.

Classification

Psychotropic drugs can be classified into six main categories, which include antipsychotic agents, antidepressant agents, antimanic agents, antiepileptic agents, antianxiety agents, sedatives, and hypnotics, as well as antiparkinsonian agents.

Antipsychotic agents

Antipsychotic agents are also known as neuroleptics, major tranquillizers, phenothaiazines, ataractics, anti-schizophrenic and D2 receptor (dopamine receptor) blockers, however the term antipsychotic appears to be the most appropriate. They were introduced into the United States in the 1950s with the phenothiazines. Other drugs in this classification soon followed. Since that time a second generation of medications has been developed. The first generation antipsychotics are called "typical" and the second generation are called "atypical" or "novel". This group of drug has a major clinical use in the treatment of psychotic disorders and psychotic treatment.

History

- **Rauwolfia alkaloids:** The plant Rauwolfia serpentine (Benth) is a climbing shrub indigenous to India. It was named so in the honour of Dr. Leonard Rauwolf, a 16th century botanist. In ancient Ayurvedic medicine, the extract of this plant (sarpgandha) has been claimed to be useful in cases of insomnia, insanity and even snakebite. From various alkaloids of this plant reserpine is commonly used in therapeutics. Primarily it can be used as antihypertensive agent.

The first attempt was made in the Paris in 1951.

Indications/Use

Although used earlier as urinary antiseptic and anti-helminthic (use stopped due to toxicity), the current indications for the use of antipsychotics include the following:-

a) Organic psychiatric disorders

1) Delirium (in small doses e.g. haloperidol, resperidone).
2) Dementia (for psychotic features and severe agitation).
3) Delirium tremors (occurring in drug and alcohol withdrawal states:- e.g. haloperidol, resperidone).
4) Drug induced psychosis (e.g. haloperidol in amphetamine-induced psychosis).

5) Other organic mental disorders (e.g. organic hallucinosis, organic delusional disorder, secondary mania).

b) Non-organic psychotic disorders

1) Schizophrenia.
2) Schizo-affective disorder.
3) Acute psychoses.
4) Mania (with or without mood stabilizers).
5) Major depression (for psychotic features, agitation and melancholic features, along with anti-depressants).
6) Delusional disorder, including MHP (mono symptomatic hypochondrial psychosis) (e.g. pimozide).

c) Child psychiatric disorders

1) Attention deficit disorder with hyperactivity (in low doses, when stimulant medication is either not available or is contraindicated, e.g. thioridazine rarely used).
2) Infantile autism and other pervasive developmental disorder (e.g. haloperidol).
3) Conduct disorders in children (presenting with aggression) (very rarely used).

d) Neurotic and other psychiatric disorders

1) Severe intractable and disabling anxiety (e.g. rarely low doses of thioridazine).
2) Treatment refractory obsessive compulsive disorder (e.g. low doses of olanzapine).
3) Anorexia nervosa.

e) Medical disorders

1) Huntington's chorea (e.g. haloperidol).
2) Intractable hiccups (e.g. chlorpromazine in law doses) rarely used.
3) Nausea and vomiting (rarely in low doses) ondansetron, an antiemetic drug is a weak antipsychotic.
4) Neuroleptanesthesia (droperidol with fentanyl, a meperidine) rarely used.
5) Tic disorders e.g. Gilles de la tourette syndrome (e.g. haloperidol, resperidone).

6) Eclampsia (chlorpromazine, promethazine and pethidine are given together as a lytic cocktail) rarely used these days.
7) Heat stroke (e.g. chlorpromazine) (rarely used).
8) Tetanus (e.g. chlorpromazine) (rarely used).
9) Intractable pruritus (rarely used).
10) Pre-anesthetic medication (e.g. chlorpromazine) (rarely used).

Pharmacokinetics

The orally administered antipsychotics are absorbed erratically and variably from the gastro- intestinal tract, with uneven blood levels with low bioavailability. Intramuscular and intravenous administration provide much more reliable blood levels. On an average, the oral liquid dose produces a peak level at $1\frac{1}{2}$ hours, while the intramuscular dose peaks at 30 minutes. The antipsychotics are highly lipophilic and highly protein-bound. They easily enter areas with good blood supply like brain, lung, kidneys and fetus and accumulate there. They are not dialyzable.

The half-lives of almost all antipsychotics are long and theoretically a single dose administration per day is enough to produce sustained therapeutic blood levels. So we can say that acute effects of a single dose generally last 6-8 hours. The elimination $t^{1/2}$ is variable, but in the range of 18-30 hours. However in practice, divided doses are given initially to avoid side effects. Later, an attempt is made to give the whole dose or a major part of total daily dose at night.

Steady state plasma levels are usually reached in 5-10 days. Once the drug is withdrawn, it may remain in the body for many days to many months.

The main metabolic pathway is through liver (Hepatic microsomal enzymes). Oxidation and conjugation are the most important methods of metabolism for phenothiazines. Many of the metabolites, e.g. mesoridazine (For thioridazine), reduced haloperidol (for haloperidol) and 9- hydroxyl-risperidone (for risperidone) are also active compounds. Chlorpromazine has more than 150 metabolites, some of which are active. The excretion of the metabolites is through kidneys and liver (entero-hepatic circulation).

Most of the antipsychotics tend to have a therapeautic window. If the blood level is below this ‘window’, the drug is ineffective. If the blood level is higher than the upper limit of the ‘window’, there is toxicity or the drug is again ineffective.

Mechanism of action

But, most probably, one of the major mechanism is the antidopaminergic activity of this drug. Antipsychotic drugs block d_{2-} receptors, the dopamine receptors which are mainly present in the mesolimbic system (mesolimbic system is concerned with the emotional reactions and the nigro-striatal system. The relative potencies of these drugs in competing for D_2 receptors parallel quite closely their clinical potencies. It is currently believed that the antipsychotic drugs are effective in treating psychosis due to their action on the D_2 receptors located in the mesolimbic system, while the extrapyramidal side effects (EPSE) are caused by the blockade of the D_2 receptors in the nigro-striatal system. Sedation is caused by histaminergic blockade, which is maximum for drugs like chlorpromazine and thioridadazine.

The antipsychotic drugs (antipsychotics) are used in a range of conditions. They are the mainstay of the treatment of schizophrenia and will be discussed below in that context. However, they are also the mainstay of the management of delusional disorder, psychosis which occurs in dementia, they have a place in the management of delirium, and they must be added to antidepressants for the successful management of psychotic depression. The antipsychotics have a central place in the management of acute mania (even in the absence of delusions and hallucinations). Olanzapine and aripiprazole have recently gained acceptance as mood stabilizers (prophylactic agents in mood disorders). Quetiapine has recently been approved by the FDA (USA) as a treatment for bipolar depression (Dando & Keating, 2006). In rare cases they are used in the management of insomnia and anxiety (Carson *et al*, 2004), but this is not recommended and is best left to experts.

1. **Phenothiazines**
    - Chlorpromazine
    - Fluphenazine
    - Mesoridazine
    - Trifluoperazine
    - Thioridazine
    - Triflupromazine
    - Prochlorperazine
    - Perphanazine
2. **Thioxanthene**
    - Flupenthixol

- Chlorprothixene

3. **Butyrophenones**
    - Haloperidol
    - Trifluperidol
4. **Diphenylbutylpiperidines**
    - Pimozide
5. **Indolic derivatives**
    - Molindone
6. **Dibenzoxazepines**
    - Loxapines
7. **Atypical antipsychotics**
    - Clozapine
    - Risperidone
    - Aripiprazol
    - Olanzapine
    - Ziprasidone
    - Quetiapine

The typical antipsychotics

The typical antipsychotic drugs were the first effective antipsychotics. Chlorpromazine was the first, being described by French doctors in 1952. Others followed, including: haloperidol, fluphenazine and thiothixene. There is a straight line relationship between the affinity of the typical antipsychotics for the dopamine D2 receptor and the therapeutic dose of these agents in acute schizophrenia (Illustration). This is consistent with the dopamine hypothesis of schizophrenia Illustration. Typical antipsychotics. Affinity for the dopamine D2 receptor (y-axis). Therapeutic doses (x-axis). This straight line relationship supports the dopamine hypothesis of schizophrenia.

Haloperidol: It is a potent antipsychotic with pharmacological profile that substituted phenothiazines. It produces few autonomic effects, is less epileptogenic, does not cause weight gain, jaundice is rare. It is most preferred drug for acute schizophrenia, Huntington's disease and Tourette's syndrome.

Side-effects of typical antipsychotics

The extrapyramidal system (EPS)-the EPS is not a side-effect of antipsychotics, but needs to be mentioned before certain side effects. The EPS is a motor system composed of dopamine (DA) and acetylcholine (Ach) neurons which enjoy a reciprocal relationship. In some individuals when DA receptors are blocked, the balance in the system is disrupted, leading to side-effects.

Acute neurological side-effects (acute EPS effects) occur secondary to D2 receptor blockade in the EPS. These can appear on the first day of treatment and can take various forms of involuntary muscle spasm, particularly involving of the jaw, tongue, neck and eyes. A dramatic form is oculogyric crisis-in which the neck arches back and the eyes roll upward. A potentially dangerous form is laryngospasm-an early warning sign may be the patient's voice becoming higher pitched.

Balance has been disturbed resulting in muscle spasm, and can be restored by acute treatment with oral or intramuscular injection of an anti-Ach-such as benztropine (2mg). The response is immediate and pleasing.

Medium-term neurological side-effects are also due to D2 blockade in the EPS. Akathisia usually occurs within the first few day of treatment and involves either a mental and/or motor restlessness. Mental restlessness presents as increasing distress and agitation. Motor restlessness usually affects the lower limbs, with shifting from one foot to the other while sitting and constant crossing and uncrossing of the legs while sitting. This is a difficult condition to manage. Useful steps include lowering the dose of the antipsychotic (if possible), adding diazepam or propranolol, or adding an anticholinergic (none of these agents is dramatically effective). Parkinsonism usually occurs some days or weeks after the commencement of treatment. There is a mask-like face, rigidity of limbs, bradykinesia, and loss of upper limb-swing while walking. Tremor and festinating gait are less common. The best management is reduction in dose of the antipsychotic (if possible) and the addition of an anticholinergic agent.

Chronic neurological side-effects (late EPS effects) usually occur after months or years of continuous D2 blockade. Tardive dyskinesia (TD) manifests as continuous choreoathetoid movements of the mouth and tongue, frequently with lip-smacking and may also involve the head, neck and trunk. Late EPS effects may continue after cessation of the typical antipsychotic.

Neuroendocrine effects result from blockade of dopamine transmission in the infundibular tract. Prolactin levels rise, with most antipsychotic agents and extreme cases may cause galactorrhea, amenorrhoea and infertility.

Neuroleptic malignant syndrome (NMS) is probably due to disruption of dopaminergic function, but the mechanism is not understood. Untreated, the mortality rate is 20% and immediate medical attention is mandatory. The symptoms include muscle rigidity, hyperthermia, autonomic instability and fluctuating consciousness. Renal failure secondary to rhabdomyolysis is a major complication and the cause of mortality.

Anticholinergic side-effects include dry mouth, difficulty with micturition, constipation, blurred vision and ejaculatory failure. Anticholinergic delirium is a toxic confusional state; it usually occurs in patients taking a range of drugs directed at different symptoms, and antipsychotics may play a role.

- Histamine blockade may produce severe sedation.
- Alpha adrenergic blockade may produce postural hypotension, cardiac arrhythmias and impotence.
- Dermatological side-effects include skin rash and photosensitivity.
- Weight gain is common with most typical antipsychotics.

Second generation antipsychotics

- A search for an antipsychotic drug, which acts only on the mesolimbic system but has no effect on the nigro-striatal system, has led to the development of a heterogenous group of drugs, collectively known as atypical or newer antipsychotics. These are also known as second generation antipsychotics (SGAs) or serotonin-dopamine antagonists or (SDAs) like risperidone and olanzapine.
- By definition these drugs are effective antipsychotics without producing undesirable extra pyramidal side effects and do not cause elevation of the serum prolactin levels.
- These are characterized by a selective limbic dopamine blockade, D_4 receptor blockade or a combination of potent 5-HT_2 and weak D_2 antagonism. Such a drug ideally would have serious side-effects like tardive dyskinesia and neuroleptic malignant syndrome.
- Atypical antipsychotics in addition to their effect on the positive symptoms are believed to be effective in the treatment of negative symptoms like apathy, decreased sociality, anhedonia of chronic

schizophrenia. Clozapine in particular is effective in the management of treatment-resistant schizophrenia.

The atypical antipsychotics

- The term "atypical" cannot be defined, and should (but probably will not) be replaced by "second generation". When these drugs first appeared they were called atypical because they did not produce EPS. However, experience has shown that they do produce these side-effects.
- It can be agreed, however, that they cause EPS less commonly and less severely than the typical (first generation) antipsychotic agents.
- The atypical antipsychotics have a greater affinity than did the typical antipsychotics for 5HT-2A receptors. Also, the atypicals have a greater affinity for 5HT-2A receptors than for D2 receptors.
- There is an interaction between serotonin and dopamine neurons in the basal ganglia. In this important region, which is associated with movement, serotonin neurons inhibit the release by dopamine neurons of dopamine. The exact mechanism is unclear, but may involve axo-axonal synapse. This explains the low rate of EPS side-effects associated with the atypical agents.
- Exceptions abound, however and amisulpride, generally classed as an "atypical" has no affinity for serotonin receptors. Ultimately, all we can say of the atypicals are that they are newer antipsychotics, which are less likely to cause EPS than the older agents.
- Both typical and atypical antipsychotics are effective in reducing the positive symptoms of schizophrenia (hallucinations, delusions and positive thought disorder). The negative symptoms of schizophrenia include social withdrawal, self-neglect, loss of energy and drive, and poverty of thought. It has been construed that the negative symptoms are composed of two subgroups of symptoms: primary negative symptoms (being part of the illness process), and secondary negative symptoms (being apparent rather than actual symptoms of the disorder, instead, being secondary to drug treatment). Claims are made that the atypicals may produce no secondary negative symptoms, and go some way in relieving primary negative symptoms (Carpenter, 1996). Other symptoms of schizophrenia include cognitive and mood difficulties and reduced quality of life. Evidence suggests that the atypical antipsychotics are helpful in all of these domains (Burton, 2006) than typical agents.

- Structural brain changes associated with the disease process of schizophrenia have been identified. There is evidence that atypical antipsychotics (but not the typicals) ameliorate these changes. For example, the volumes of the thalamus and cortical grey matter increase with atypical antipsychotic treatment (Scherk & Falkai, 2006).

Mechanism of action

- In addition to the dopaminergic receptor blockade, some atypical antipsychotics like resperidone and clozapine also block 5HT receptors in the frontal cortex and the striatal system, which helps to lessen EP reactions and is related to their usefulness in negative symptoms. It also blocks alpha 2 adrenergic receptors.
- It has narrow therapeutic window.
- Provides a wider range of safety- in that it has lower propensity to cause EPS and tardive dyskinesia.
- Helps to improve negative symptoms.
- Does not elevate serum prolactin levels in human
- May not catalepsy in animals.

Side-effects of the atypical antipsychotics

- Most of the side effects of the typical antipsychotics can also be encountered with the atypical agents, however, they are less frequent and generally less severe.
- Weight gain is problem in schizophrenia and other mental disorders, in part, because of poor eating habits and lack of exercise. However, the atypical antipsychotics exacerbate this problem. A meta-analysis (Allison and Casey, 2001) estimated that over a 10 week period the mean increase was as follows:
    1) Clozapine 4.45 kg.
    2) Olanzapine 4.15 kg.
    3) Risperidone 2.1 kg (quetiapine probably similar).
    4) Ziprasidone 0.04 kg (aripiprazole probably similar).
- The prevalence of type 2 diabetes in people with schizophrenia is double that of the general population. Over recent years there has been concern this may be a direct result of atypical antipsychotic treatment. As the atypical antipsychotics are the most effective

component in the medical management of psychotic disorders, this question was soberly examined. An association between schizophrenia and diabetes has been recognized for over a century. Risk factors for diabetes include poor overall health, lifestyle and level of access to heath care.

- Atypical antipsychotics are associated with weight gain, but there is no evidence for an intrinsic role for the antipsychotics in the aetiology of diabetes. As this issue has been brought to the attention of clinicians, they have a responsibility to monitor the diabetes risk factors of patients (Poulin *et al.*, 2005).
- Hyperlipidemia (raised cholesterol and triglycerides) appears to be associated with the dibenzodiazepine-derived antipsychotics (clozapine, olanzapine and quetiapine).
- QTc interval prolongation has been a matter of concern. The average QTc interval in healthy adults is about 400 msec and a QTc interval of 500 msec or more is a risk factor for torsade de pointes (a ventricular arrhythmia which can lead to syncope, ventricular fibrillation and sudden death).

One study found the following prolongations:

1) Ziprasidone 20.3 ms.
2) Quetiapine 14.5 ms.
3) Risperidone 11.6 ms.
4) Olanzapine 6.8 ms.
5) Haloperidol 4.7 ms.

Myocarditis and cardiomyopathy are rare (0.015-0.188%; Merrill *et al.*, 2005) side effects of clozapine therapy.

- Recommendations for the monitoring/management of the side effects of the atypical antipsychotics have been provided (Marder *et al*, 2004). However, further work is required. When weight gain is anticipated (clozapine, olanzapine, quetiapine and risperidone) weight and BMI should be recorded. Nutritional and life style (exercise) advice is recommended. With excessive weight gain a change to another agent may be considered.
- When diabetes is anticipated (clozapine and olanzapine in particular) the weight is to be monitored and laboratory measures (e.g. fasting blood glucose) may be indicated. When hyperlipidemia is anticipated (clozapine, olanzapine and quetiapine) serum cholesterol and

triglycerides may be monitored. When QTc prolongation is anticipated (ziprasidone, particularly), EEG monitoring is recommended in cases of increased cardiac risk (known heart disease, syncope, family history of early sudden death). Myocarditis has been associated with clozapine and clozapine clinics have specialized screening procedures.

Individual atypical antipsychotics

- As in all branches of medicine, if a disorder cannot be controlled with standard doses of a particular agent, first the dose is increased judiciously and if the desired result remains evasive, another agent is trialled. The management of psychosis is difficult. Fortunately we have a range of atypical antipsychotics; while they have some similar actions, they come from a range chemical classes, and all have particular advantages. A series of trials may be necessary for the best possible outcome.

Clozapine

- Clozapine is often effective in treating schizophrenia which has been unresponsive to all other antipsychotics. It is unique in causing neutropenia (potentially fatal) in 1-2% of patients. Thus, clozapine is reserved for severe otherwise unresponsive schizophrenia, and must be managed by specialized clinics which conduct regular (weekly for the first 18 weeks) blood tests.
- Other side-effects include significant weight gain, hypotension and tachycardia. Hypersalivation (unknown with the typical antipsychotics) can be troublesome with clozapine (and rarely with some other atypicals, such as olanzapine). 1% of patients experience seizures-this does not mean clozapine must be ceased-instead, anticonvulsants are added. This is a formidable array of side-effects, nevertheless the antipsychotic benefits are substantial. Clozapine is also useful in the treatment of TD.

Risperidone

- Risperidone is an effective antipsychotic. At high doses (8 mg and above) it loses some of its advantages over typical antipsychotics insofar as acute EPS readily appear. A major disadvantage is the elevation of prolactin levels. A preparation which dissolves in the mouth is available. Risperidone has an advantage over the other atypicals in that an IMI depot (long-acting) preparation is available.

This can be administered once per fortnight during the maintenance phase, somewhat reducing compliance problems.

Paliperidone

- Paliperidone is the active metabolite of risperidone, which was released when the patent of the parent chemical was about to expire. It has a slightly improved side-effect profile. There is less weight gain, but more EPS problems, and the elevation of prolactin remains problematic. The dosing strategy is simple, a special capsule enables a single daily dose.

Olanzapine

- Olanzapine is an effective antipsychotic which has gained acceptance as a mood stabilizer (used in the prophylaxis of mood disorder; Tohen *et al*., 2005). It has a pharmacological action and side-effect profile similar to clozapine (except, it is not associated with blood dyscrasia). The most troublesome side-effects are weight gain and sedation. The risks of diabetes and hyperlipidemia need to be considered.
- An occasional side-effect, which is seen regularly with clozapine, is hypersalivation. Olanzapine does not elevate prolactin to a significant degree. The sedating/calming effect of olanzapine is useful in acute disturbance. Olanzapine has an advantage of over the other atypical medications in being available in an IMI form for acute administration.
- A preparation which dissolves in the mouth is available. A long-acting depot form is available but because physiological response is variable, the patient must be observed for 3 hours following every injection (which is proving to be a disincentive).

Quetiapine

- Quetiapine is an effective antipsychotic which has a receptor binding profile similar to clozapine, but with relatively lower affinity for all receptors. The side-effect profile is favourable, 75% of respondents denying any side-effects (Hellewell *et al*., 1999). Sedation and hypotension are reported, especially during the commencement phase. Weight gain and the risk of diabetes and hyperlipidemia need to be considered. Quetiapine has little affinity for muscarinic receptors so that blurred vision and difficulty with micturition are rarely problems. The rate of EPS is similar to placebo and there is no

significant elevation of prolactin. Quetiapine may cause sedation and weight gain.

Aripiprazole

- Aripiprazole is a recently released antipsychotic. Rather than an antagonist of dopamine receptors, it appears to be a high affinity partial agonist at presynaptic D2 receptors and an antagonist at postsynaptic D2 receptors. It has little affinity for D3, D4 and D1-like receptors and its affinity for 5HT-2A receptors is low.
- There is some alph-1 blockade and orthostatic hypotension has been reported. The efficacy appears similar to risperidone and less than olanzapine, but the side-effect profile appears favourable at manufacturer recommended doses, with minimal elevation of prolactin. Aripiprazole has a role as a mood stabilizer.

Antidepressants

Antidepressants are those drugs, which are used for the treatment of depressive illness. These are also called as mood elevators or thymoleptics.

Classification

Class	Example	Trade Names	Oraldosage (MG/DAY)
Trycyclic antidepressants (TCAs)	Imipramine	Antidep	75-300
	Amitriptyline	Tryptomer	75-300
	clomipramine	Anafranil	75-300
	Dothiepin	Prothiaden	75-300
Selective serotonin reuptake	Fluoxetine	Fludac	10-80
Inhibitors (SSRIs)	Sertraline	Serenata	50-200
Dopamine antidepressants	Fluvoxamine	Faverin	50-300
Atypical antidepressants	Amineptine	Survector	100-400
Monoamine	Trazodone	Trazalon	150-600
Oxidase inhibitors	Isocarboxazid	marplan	10-30
(MAOIs)			

Indication

Depression

- Depressive episode
- Dysthymia
- Reactive depression

- Secondary depression
- Abnormal grief reaction

Childhood psychiatric disorders

- Enuresis
- Separation anxiety disorder
- School phobia
- Night terrors

Other psychiatric disorders

- Panic attack.
- Generalized anxiety disorder.
- Agoraphobia, social phobia.
- OCD with or without depression.
- Eating disorder.
- Borderline personality disorder.

Medical disorder

- Chronic pain.
- Migraine.
- Peptic ulcer disease.

Pharmacokinetics

Antidepressant are highly lipophilic and protein bound. The half-life is long and usually more than 24 hours. It is predominantly metabolized in the liver.

Mechanism of action

- The exact mechanism is unknown. The predominant action is by increasing catecholamine levels in the brain.
- TCAs are also called as mono amine reuptake inhibitors (MARIs). The main mode of action is by blocking the reuptake of norepinephrine (NE) and/or serotonin (5-HT) at the nerve terminal, thus increasing the NE and 5-HT levels at the receptors site.
- MAOIs instead act on MAO (monoamine oxidase), which is responsible for the degradation of catecholamines after re-uptake. The final effect is the same, a functional increase in the NE and 5-

HT levels at the receptors site. The increase in brain amine levels is probably responsible for the antidepressant action.it takes about 5 to 10 days for MAOIS and 2 to 3 weeks for TCAs to bring down depressive symptoms.

- SSRIs act by inhibiting the re-uptake of serotonin and increasing its levels at the receptor site.

Side effect with nursing responsibility

Side effect		Nursing care
Blurred vision	=	Temporary avoid hazardous tasks.
Dry mouth	=	Encourage fluids, frequent rinses, sugar free hard candy and gums. Check for mouth sores.

Constipation = Increased fluids, dietary fiber and roughage, exercise, monitor bowel habits, use stool softeners and laxatives only if necessary.

Tachycardia = Eliminate caffeine and beta blockers.

Urinary retention = Encourage fluids and frequent voiding, moniter voiding patterns, administer catherize.

Dizziness/lightheadeness=Adequatehydration, elasticstocking, protect from falls.

Ejaculatory dysfunction = Take after sexual intercourse, not immediately before.

Gastrointestinal disturbances = Take with meals

Hypotension = Frequent BP, elastic stocking, gradual change of position, protect from falls.

Insomnia = Take as early in the day as possible, sleep hygine, eliminate caffeine, relaxation technique.

Perspiration =Frequent changes of clothes, goodhygiene, increased fluids.

Serotonin syndrome

Weight gain = Increase exercise, reduced caloric diet

Sexual dysfunction = Take after sexual intercourse, use lubricant if vaginal dryness is present, antidotes such as slidenefil, bupropion or bethnecol.

Other nursing responsibility

- Patient on MAOIs should be warned against the danger of ingestive tyramine rich foods which can result in hypertensive crisis. Some of these foods are beef liver, chicken liver, fermented sausages, dried fish, overriped fruits, chocolate and beverages like wine, beer and coffee.
- Report promptly if occipital headache, nausea, vomiting, chest pain or other unusual symptoms occurs these can herald the onset of hypertensive crisis.
- Instruct the patient not to take any medication without prescription.
- Caution the patient to change his position slowly to minimize orthostatic hypotension.
- Strict monitoring of vitals, especially blood pressure is essential.

Antianxiety agent, sedatives & hypnotics

These are called as minor tranquilizers. Most *of* them belong to the benzodiazepine group of drugs.

Classification

1. **Barbiturates:** Example, phenobarbital, pentobarbital, secobarbital and thiopentone.
2. **Non-barbiturate non-benzodiazepine antianxiety agent:** For example, Meprobamate glutethimide, ethanol, diphenhydramine and methaqualon.
3. **Benzodiazepins:** Presently benzodiazepines are the drugs of first choice in the treatment of anxiety, and for the treatment of insomnia.

- Very short-acting-For example, Triazolam, Midazolam.
- Short-acting-Example, Oxazepam (serepax), Lorazepam (Ativan, Trapex, Larpose), Alprazolam (Restyle, Trika, Alzolam, Quiat, Anxit).
- Long acting-Example, Chlordiazepoxide (Librium), Diazepam (Valium, Calmpose), Clonazepam (Lonazep), Flurazepam (Nindral), Nitrazepam (Dormin).

Indications

1) Anxiety disorder.
2) Insomnia.

3) Depression.
4) Panic disorder & social phobia.
5) Obsessive-compulsive disorder.
6) Post-traumatic stress disorder.
7) Bipolar I disorder.
8) Other psychiatric indications include alcohol withdrawal, substance-induced & psychotic agitation.

Dosage (mg/day)

1) **Alprazolam:** 0.5-6 PO.
2) **Oxazepam:** 15-120 PO.
3) **Lorazepam:** 2-6 PO/IV/IM.
4) **Diazepam:** 2-10 PO/IM/slow IV.
5) **Clonazepam:** 0.5-20 PO/IM.
6) **Chlordiazepoxide:** 15-100 PO; 50-100 IV.
7) **Nitrazepam:** 5-20 PO.

Mechanism of action

Benzodiazepines bind to specific sites on the GABA receptors & increase GABA levels. Since GABA is an inhibitory neurotransmitter, it has a calming effect on the central nervous system, thus reducing anxiety.

Contraindication

1. Renal impairment.
2. Liver impairment.
3. Respiratory impairment.

Side-effect

1. Nausea, vomiting, dry mouth.
2. Weakness, vertigo, body aches.
3. Blurring of vision, sedation.
4. Epigastric pain, diarrhea.
5. Impotence, ataxia, retrograde amnesia.
6. Impairment of driving skill.
7. Dependence & withdrawal symptoms.

Nursing responsibility

1) Administer with food to minimize gastric irritation.
2) Advise the patient to take medication exactly as directed. Abrupt withdrawal may cause insomnia, irritability, & sometimes even seizures.
3) Explain about adverse effects & advise him to avoid activities that require alertness.
4) Caution the patient to avoid alcohol or any other CNS depressants along with benzodiazepines; also instruct him not to take any over-the-counter medication.
5) If IM administration is preferred give deep IM.
6) For IV administration don't mix with any other drug. Give slow IV as respiratory or cardiac arrest can occur; monitor vital signs during IV administration.

Antiparkinsinian agents

In clinical practice anticholinergic drugs, amantadine & the antihistamine have their primary use as treatments for medication induced movement disorders, particularly neuroleptic-induced Parkinsonism, acute dystonia & medication-induced tremor.

Classification

1. Anticholinergics

- Trihexyphenidyl.
- Benztropine.
- Biperiden.

2. Dopaminergic agents

- Bromocriptine.
- Carbidopa/Levodopa.

3. Monamine oxidase type b inhibitors

- Selegiline.

4. Trihexyphenidyl

- Artane.
- Trihexane.

- Trihexy.
- Pacitane.

Dosage

1-2 mg per day initially, maximum dose up to 15 mg/day in divided dose.

Mechanism of action

It acts by increasing the release of dopamine from presynaptic vasicles, blocking the reuptake of dopamine into presynaptic nerve terminals or by exerting an agonist effect on postsynaptic dopamine receptors. Trihexyphenidyl reaches peak plasma concentrations in 2-3 hours after oral administration 7 has duration of action up to 12 hours.

Indications

1. Drug induced Parkinsonism.
2. Adjunct in the management of Parkinsonism.

Contraindications

1. Closed angle glaucoma.
2. Urinary or intestinal obstruction.
3. Hypersensitivity. Prostatic hypertrophy.

The drugs are given with caution to patients with

1. Myasthenia gravis
2. Atherosclerosis
3. Respiratory problems

Side effects

1. Dizziness, nervousness, drowsiness.
2. Weakness, headache, confusion.
3. Blurred vision, tachycardia.
4. Orthostatic hypotension, dry mouth.
5. Nausea, vomiting, constipation.
6. Urinary retention & decreased sweating.

Nurse's responsibilities

1) Assess parkinsonian and extrapyramidal symptoms. Medication should be tapered gradually.

2) Caution patient to make position changes slowly to minimize orthostatic hypotension.
3) Instruct the patient about frequent rinsing of mouth and good oral hygiene.
4) Caution patient that his medication decrease perspiration and over-heating may occur during hot weather.

Antiepileptic agent

Antiepileptic drugs (AEDs) suppress the start of seizure activity & reduce the spread of seizure activity. The straight forward goals for AED treatment of epilepsy are as follows:

1) Control seizure activity.
2) Keep side effects of AED therapy to a minimum.

Classification

1. Standard antiepileptic drugs

a) Benzodiazepines
   - Clonazepam (Klonopin)
   - Diazepam (Valium)
   - Lorazepam (Ativan)

b) Carbamazepine (Tegretol, Carbatrol)
c) Ethosuximide (Zarontin)
d) Phenobarbital
   - Phenytoin (Dilantin)

e) Primidone (Mysoline)
f) Valproates (Divalproex)

2. Newer antiepileptic drugs

a) Felbamate (Felbatol)
b) Lamottigine (Lamictal)
c) Gabapentin (Neurontin)
d) Lamotrigine (Lamictal)
e) Oxcarbazepine (Trileptal)
f) Topiramate (Topamax)

Dosage

- **Carbamazepine:** 800-1200 mg/day in divided doses.
- **Phenobarbital:** 60-100 mg/day
- **Phenytoin:** 300-600 mg/day.
- **Valproates:** 750-3000 mg/day.
- **Topiramate:** 4oo mg/day.

Mechanism of action

It causes reversible depression of the activity of all excitable tissues, the CNS being extensively sensitive. It facilitates inhibitory neurotransmission in the CNS, presumably by interacting with GABA receptors. It depresses the sensory cortex, decreases motor activity, alters cerebral function and produces drowsiness, sedation and hypnosis.

Indication

1) Grandmal epilepsy, partial complex partial seizures.
2) Febrile convulsions in children.
3) Sedation-short term management of insomnia.
4) Eclampsia and pre eclampsia.
5) Anxiety disorders and acute panic attacks.
6) Alcohol withdrawal-for relief of agitation, tremor, delirium tremens, hallucinations etc.

Contraindication

1) Pregnant and nursing mothers.
2) Hypersensitivity.
3) Bone marrow depression.
4) Heart blocks, sinus bradycardia.
5) Renal or liver disease.
6) Children under 2 years.

Side-effect

1) Drowsiness, dizziness, headache
2) Nausea, vomiting, constipation
3) Fine hand tremors
4) Hypotension, Bradycardia
5) Weight gain, polyuria

6) Prolonged bleeding time
7) Risk of severe rashes

Nursing responsibilities

1) Ensure the client does not participate in activities that require alertness.
2) Administer medication with meals to minimize GI upset.
3) Monitor vital sign twice or thrice a day.
4) Monitor daily intake output & weight
5) Ensure that client understands the importance of regular blood tests while receiving anticonvulsant therapy.
6) Ensure that client is informed that he or she must report evidence of skin rash of physician immediately.
7) Encourage increased fluid and fiber in the diet.

Mood stabilizers

Introduction

Drugs are usually effective in treatment of acute mania and therefore the word anti manic is often used to describe them.

But as they are effective in preventing mood swings in bipolar disorder the better term is mood stabilizing. Agent

A mood stabilizer is a psychiatric medication used to treat mood disorders characterized by intense and sustained mood shifts, typically bipolar disorder.

A quick walk to mood disorders

- Mania-(at least 1 week).
- Feeling very high on life.
- Talking rapidly.
- Feeling grandios.
- Racing thoughts and speech.
- Erratic and impulsive actions.
- Delusions and hallucinations (severe).
- Hypomania-(4 days or more).
- Like but less severe than mania.
- Euphoric, energetic and productive.

- No hallucinations or delusions.
- Characterized by an unusually good mood.
- Depression-(at least 2 weeks).
- Feeling hopeless, sad or empty.
- Fatigue, energy and concentration loss.
- Thoughts of death or suicide.
- Mixed episode-Symptoms of both the disorders are present.
- Treatment is directly related to the phase of the episode and severity
- Mood stabilizers.

Lithium

- Discovered in 1817 by arfuedson.
- First time used for treatment of mania by john cade in 1949.

Indication

Cyclothemia-a mental state charactized by marked swings of mood between depression and elation. Bipolar disorder.

Neurologic effects of lithium

Lithium increases the volume of brain structures involved in emotional regulation (i.e., in the hippocampus, prefrontal cortex and amygdala) Increase in brain volume leads to improved mental health. During manic phases of bipolar disorder, the brain tissue becomes inflamed, if lithium is ingested, it helps to alleviate the inflammation. Lithium inhibits glycogen synthase kinase 3 (Gsk3) and inositol trisphosphate (InsP3) these enzymes, when overexpressed, can lead to psychiatric disorders.

Proposed mechanisms of action

Lithium balances the activities of neurotransmitters, which result in neuroprotective effects. In particular, lithium affects glutamatergic activity Excess glutamate uptake by glutamatergic receptors results in seizures, thus, by decreasing their activity, neurons can be protected.

Absorption, distribution, and excretion well absorbed in the GI tract

Distributed into most body tissues and across the blood brain barrier

Elimination half-life 24 hrs, 18 hours in children, 36 hrs in geriatric patients, 40-50 hrs in patients with impaired renal function excreted primarily in urine.

Contraindications

Should be especially monitored in patients with:

Renal Disease, Cardiac Disease, Dehydration or low salt intake, Pregnancy/breastfeeding.

Toxicity occurs at doses close to the therapeutic range so treatment should begin at a low dose and increased based on daily serum.

Mild adverse events

- Nausea, muscle weakness, vertigo, thirst, fatigue, hand tremors.

Serious adverse events

- Ataxia, tinnitus, blurred vision and slurred speech, Seizures, vomiting and diarrhea Coma, death.

Dosage

- **Lithium carbonate:** 300mg tab (licab).
- **Lithosun-SR:** 400 mg tab.
- **Lithium citrate:** 300mg/5ml liquid. (Not available in India).
- **Usal range:** 900-2100mg/day in 2-3 divided doses.

Blood lithium levels

- Therapeutic levels-0.6-1.2 mEq/L the concentration of medicine in blood stream required for the medication to be effective. (for treatment of acute mania).
- Prophylactic levels-0.6-1.0 mEq/L (for prevention of relapse in bipolar disorder).
- Toxic lithium levels > 2.0 mEq/L.

Signs and symptoms of lithium toxicity

- Ataxia-loss of full control of bodily movements.
- Coarse tremor-one in which vibrations are slow.
- Nausea and vomiting.
- Impaired memory & concentration.
- Nephrotoxicity-toxic to kidney.
- Muscle weakness, Convulsions.
- Muscle twitching-small, local, involuntary muscle contraction and relaxation which may b visible under the skin.

- Dysarthria-a speech disorder caused by disturbances of muscular control coz of damage to CNS or PNS.
- Coma, Nystagmus-rapid involuntary movement.

Management of lithium toxicity

Discontinue, Gastric lavage, Adsorption with activated charcoal.

Ingest fluids, Maintain fluid and electrolyte balance.

Serious manifestation of lithium toxicity, hemodialysis.

Carbamazepine

- Synthesized in 1953 by schindler.
- Onset of action can be faster as compared to lithium but slower compared to valproate.

It is available in the market under different trade names like.

Tegretol, Mazetol, Zepto. Zen Retard.

The average daily dose is 600-1800mg orally, in divided doses.

Indications

Seizures-, complex partial seizures, GTCs, seizures due to alcohol withdrawal.

Psychiatric disorders- rapid cycling bipolar disorder.

Schizoaffective disorders, Borderline personality disorders.

Cocaine withdrawal syndrome, Psychosis with epilepsy.

Aggression.

Mechanism of action

- Normally, sodium moves into a neuronal cell by passing through a gated sodium channel in the cell membrane.
- Carbamazepine may prevent or halt seizures by closing or blocking sodium channels thus preventing sodium from entering the cell. Keeping sodium out of the cell may slow nerve impulse transmission, thus slowing the rate at which neurons fire.

Side effects

- Drowsiness, confusion, headache, hypertension, vomiting, diarrhea.
- Abdominal pain, Hepatitis, Oliguria.

- Thrombocytopenia-def of platelets in dis case bleeding in tissues and slow blood clot after injury.
- Agranulocytosis-def of granulocytes increase vulnerability to infctn.
- Dry mouth.

Sodium valproate

Valproic acid was first synthesized by Burton and used as an organic solvant.

1963-MEUINER discovered antiepileptic properties of valproaic acid.

1966-LAMBERT reported valproate might be effective as an antimanic.

1978-Approved by US FDA as an antiepilectic drug

1996-Approved by US FDA for treatment of acute mania.

Ex: Encorate, valpirin, epilim, epival

- The usual dose 15mg/kg/day with a maximum of 60mg/kg/day orally.

Indications

- Acute mania, prophylactic treatment of bipolar disorder, rapid cycling bipolar disorder
- Schizoaffective disorder, Seizures
- Other disorders like bulimia nervosa, obsessive-compulsive disorder, agitation & PTSD.

Why Use an Anticonvulsant as a Mood Stabilizer: The Kindling Hypothesis

- It is hypothesized that epilepsy and mood disorders may be caused by dysfunctional cation (Na & Ca) pumps, which leads to an imbalance between excitatory (glutamate) & inhibitory (GABA) neurotransmitters.
- Anticonvulsants are thought to prolong inactivation of cation channels during activity such as seizure (or mood episode), preventing spread & leading to downstream changes in GABA & glutamate.

Side-effects

- Nausea, Diarrhea, Sedation, Ataxia, Dysarthria, Tremor, Weight Gain.

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Chapter - 10
Optimization of Adventitious Root Culture System in Soybean for Enhanced Production of Quercetin

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Chapter - 10

Optimization of Adventitious Root Culture System in Soybean for Enhanced Production of Quercetin

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Abstract

The response of adventitious root induction from cotyledonary nodes of soybean in different lighting conditions, and different concentrations of indole-3-butyric acid (IBA) were studied. Among the different lighting condition of explants placed in MS medium supplemented with IBA (1 mg/l), 16-hour photoperiod showed effective adventitious root induction when compared to explants placed in complete darkness. Total phenolic (33.07 mg g^{-1}) and flavonoid content (48.0 mg g^{-1}) was higher in adventitious roots of cotyledonary node explant of IBA 1mg/l in 16h photoperiod when compared to control roots (phenolic content = 166.6 mg g^{-1}; flavonoid content = 677 mg g^{-1}). The HPLC analysis confirmed that the quercetin content was improved in adventitious roots (293.3 mg g^{-1}) from cotyledonary node explant of IBA 1mg/l in 16-hour photoperiod compared to control roots (31.9 mg g^{-1}) in MS medium without any hormones. On an average, 9.1-fold increase in quercetin was achieved in adventitious roots of cotyledonary node explant grown in medium containing IBA (1mg/l) in 16h photoperiod compared to control. The antioxidant activity of adventitious roots improved as the volume of extracts used for assay was increased from 20 to 100 µl. In addition, the antioxidant potential of adventitious roots was significantly higher when compared to control. In DPPH assay, adventitious roots extracts (20, 40, 60, 80 and 100 µl) showed higher potency of inhibition when compared to the control. Hence, the adventitious root extracts were able to scavenge DPPH radicals in a concentration dependent manner.

Keywords: Soybean, adventitious root culture, light, auxins, HPLC

Introduction

For the past few decades, plants have been highly used for the production of potent bioactive compounds for manufacturing food supplements, cosmetics, and used as alternative medicines. Plant tissue cultures can produce

phytocompounds which is almost four-fold than microorganisms (Zhong 2001). Although plants themselves can synthesize these phytochemicals, production depends on geographical location, climatic conditions, seasonal variations and growth conditions. *In vitro* biosynthesis of these phytochemicals by plant tissue cultures allows mass production, and thus a continuous supply-demand relationship. Among various phytocompounds synthesized by plants, quercetin is considered as one of the potent compounds having many biological functions.

Quercetin plays a vital role in the prevention of diseases such as cancer (Murakami *et al*. 2008), anti-hypertensive, vasodilator, anti-obesity, anti-hypercholesterolemic, anti-inflammatory, anti-atherosclerotic activities (Sultana and Anwar 2008; Salvamani *et al*. 2014) anti-bacterial and anti-viral effects (Anand David *et al*. 2016). It is also proven against the prevention of cardiovascular diseases, neurodegenerative diseases, asthma, hay fever, and hives (Anand David *et al*. 2016).

Interestingly, quercetin has also been shown to modulate mitochondrial function, by altering mitochondrial biogenesis, influencing the membrane potential and by its effect on electron transport chain and generation of ATP, and ultimately inhibiting/inducing intrinsic apoptosis (Lakroun *et al*. 2015). Accordingly, quercetin intake is positively correlated with the health. Quercetin can also be taken as a dietary supplement with daily recommended doses of 200-1200 mg, as well as a nutraceutical through functional foods with a concentration range of 10-125 mg per serving. Dietary supplementation with quercetin and its addition into food is highly supported by data on its safety (Okamoto T 2005).

Biosynthesis of quercetin

Quercetin is present in many plants such as *Glycine max*, *Camellia sinensis*, *Moringa oleifera*, *Coriandrum sativum* etc. The phenylpropanoid pathway is the pathway through which quercetin is synthesized in plants. In the case of quercetin, chalcone synthase (CHS) catalyzes the condensation of three equivalents of malonyl-coenzyme A (derived from the metabolism of glucose) with one equivalent of coumaroyl-coenzyme A (derived from the shikimic acid pathway) to give the corresponding chalcone, chalcone naringenin (2′,4,4′,6′-tetrahydroxychalcone). Chalcone 4 isomerase (CHI) catalyzes the C-ring closure to give naringenin (4′,5,7-trihydroxyflavanone). The C-ring is hydroxylated by flavanone 3-hydroxylase to give dihydrokaempferol (3,4′,5,7-tetrahydroxyflavanone). The B-ring is further hydroxylated by flavonoid 3′ hydroxylase to give dihydroquercetin, which is

dehydrogenated by flavonol synthase to give quercetin. Subsequent sugar conjugations are carried out by various flavonoid glycosyltransferases. The biosynthesis of quercetin is shown in Fig. 1.

Adventitious root culture

The roots that are formed from non-root tissues during the normal development and in response to various stress factors, such as nutrient deficiency, mechanical injury, drought, and flooding. Numerous molecular mechanisms such as internal and external physiological factors are involved in the development of adventitious roots (Sorin *et al*. 2005). These roots are usually developed from the leaves, petioles, nodes, and internodes (Rahmat and Kang 2019). In Addition, it helps plants to survive adverse environmental conditions.

Formation of adventitious roots takes place in four stages (Zhang *et al*. 2017):

1) **The root pre-emergence:** Modifications in molecular and biochemical mechanisms prior to cytological development until the occurrence of root primordial.
2) Development of roots.
3) Growth of roots.
4) Configuration of the developed roots.

Adventitious root development from the stems or hypocotyls is stimulated by the removal of root tissue, which is an ecologically and economically viable method of plant vegetative propagation (De Klerk 1996). Adventitious roots are produced through direct organogenesis from cambium cells and indirect organogenesis from callus tissues (Khanam *et al*. 2018). When compared to undifferentiated tissues, the differentiated ones, similar to adventitious roots, are comparatively more established, stable and can store a high quantity of secondary metabolites (Murthy *et al*. 2008). Obviously, adventitious rooting characteristics of plants vary from species to species for the genetic differences in rooting ability in different species. Additionally, adventitious root development has often been correlated with environmental factors such as temperature, light conditions, water, and nutrient supply (Smart *et al*. 2002). In plants, auxins and ethylene are growth-promoting hormones for adventitious rooting, whereas gibberellin and cytokinin (CK) have been suggested as rooting inhibitors. Recently, many studies have focused on understanding auxins and adventitious root response signaling pathways (Liao *et al*. 2011). As the most studied and abundant natural auxin, Indole-3-acetic

acid (IAA) was the first used to promote adventitious root formation. Indole-3-butyric acid (IBA) has become the most widely used auxin for inducing adventitious root in many species. IBA is more potent than IAA and is suggested to be a precursor of IAA (Cooper 1935; Woodward 2005). Although auxin plays a central role in adventitious rooting, phytohormones interact with one another and the complex cross-regulatory interaction network between auxin and many different phytohormones controls root development (Bellini *et al*. 2014).

Among different culture techniques, adventitious root culture is the most attractive system for the production of biomass and commercially important metabolites. Easily up-scaling of adventitious root culture to bioreactor is another advantage of this method (Baque *et al*. 2013). As compared to other culture techniques (cell, embryo, and intact plant), root culture (hairy and adventitious) is widely exploited for the production of bioactive compounds due to high efficiency and similarities with those from mother plants (Cui *et al*. 2010). Both biotic and abiotic stress conditions alter the synthesis of bioactive compounds in plants. Therefore, the synthesis of bioactive compounds in adventitious root culture can be regulated by exposure to different external elements. Furthermore, it is relatively easy to get control over the physical and chemical environmental conditions of adventitious root cultures (Sivanandhan *et al*. 2012). Adventitious roots induced under sterile conditions in phytohormone supplemented medium have shown high rate of proliferation, tremendous potentialities of accumulation, and stable production of valuable secondary metabolites. Adventitious roots are of natural product, grow vigorously in phytohormone-free media and possess great potential to accumulate valuable secondary metabolites. Cultivation of adventitious roots has been suggested as an alternative to natural compound production. In the field of plant biotechnology, hairy roots, induced by Ri plasmid insertion, have been reported to be a promising pathway for producing rare and endangered medicinal plant species (Zhong 2001). However, compared with hairy root cultures and field cultivation, this approach is safer, more stable, and easier to manage (Sudha and Seeni 2001).

In this chapter, we focus on the strategies for the optimization of adventitious root cultures from soybean for the production of quercetin.

Materials and Methods

Materials

Plant source: The soybean seeds (CO_3 cv) were collected from Tamil Nadu Agriculture University, Coimbatore, Tamil Nadu, India.

Explants: Cotyledonary nodes.

Preparation of nutrient medium stock solution: Murashige and Skoog's (MS) medium (Murashige and Skoog, 1962) was used in this study. Stock solution of macro, micro, minor, potassium iodide, Fe (EDTA), vitamins and glycine was prepared in sterilized bottle and stored in the refrigerator. The stock solution was mixed with appropriate proportion for each medium, pH was adjusted to 5.6-5.8 with 0.1 N hydrochloric acid or sodium chloride and 0.75% agar was dissolved in the medium and distributed in the test tubes. The tubes or bottle were autoclaved at 121°C for 15 minutes and 15 lbs pressure.

Methods

***In vitro* culture of seeds**

Surface sterilization of seeds

The soybean seeds were washed with running tap water with few drops of tween 20 until the bubbles/foam disappear. The seeds were then taken into the laminar air flow chamber. Initially the seeds are rinsed with 70% ethanol for 45 seconds and washed thrice with distilled water. Further, they were surface sterilized with 0.1% of mercuric chloride for 3 minutes and washed thrice with sterile distilled water. Subsequently, the seeds were blot dried and inoculated aseptically in MS basal medium and incubated in dark for 4 days. Later the tubes with seeds were incubated at 16/8-hour light/dark photo period at 25± 2 °C.

***In vitro* explant preparation:** The cotyledonary node and hypocotyls explants were prepared from 7-day old seedlings.

Cotyledonary node and hypocotyl explant preparation: The explants were placed on sterile petri plates for dissection and roots were removed using a sterile scalpel. Cotyledonary nodes were separated using a sterile scalpel. From a single seedling, two explants of cotyledonary nodes were obtained by removing the roots. The epicotyl was subsequently removed to obtain two identical cotyledonary node explants.

Optimization of adventitious root culture

The cotyledonary nodes that were prepared as mentioned above were placed in MS solid medium supplemented with different plant growth hormones such as IBA, IAA, NAA and 2,4-D in varying concentrations (0.5-1.5mg/l). Six explants were inoculated in each conical flask. The cotyledonary node explants were placed in abaxial and adaxial orientations in IBA-supplemented medium. Further, the flask containing cotyledonary node

explants was incubated in two different light conditions (16h photoperiod and complete dark) and incubated for 30 days to observe the rooting response. Explants inoculated in MS medium supplemented with IAA, NAA and 2,4-D in varying concentrations (0.5-1.5mg/l) were placed only in adaxial orientation to check the root-inducing effect. After 30 days of culture, the root growth attributes such as percentage of root response, number of roots, mean root length, number of lateral roots, and root fresh weight were evaluated.

Extraction and quantification of quercetin

Serial maceration extraction (SME) method

The roots are cleaned, dried under shade, and powdered. The adventitious roots were powdered using liquid nitrogen. 10 mg of each adventitious root powder was extracted with 10 ml of methanol. The samples were then macerated on a shaker with 150 rpm at 22 °C overnight. The extract was then filtered through Whatman no.1 filter paper. The concentrated sample was dissolved in 1 ml of methanol and filtered using a 0.45 µm PVDF syringe filter. The concentrated filtrate was further used for the quantification of quercetin using RP-HPLC.

Extraction for estimation of total phenolic, flavonoids, quercetin, and antioxidant content

The adventitious roots and control roots were separated from the solid medium, rinsed with sterile water, and air-dried. The roots were then ground using a mortar and pestle into fine powder in liquid nitrogen. About one gram (DW) of fine root powder was transferred to glass tubes and extracted with 10 ml of methanol (99.9%). The samples were then macerated on an orbital shaker at 150 rpm for 3 days (22 °C). The extract was dried using a rotary vacuum evaporator (Cyber Lab). About 1mg of dried methanolic adventitious root extract powder was dissolved in 1 ml of HPLC grade methanol (99.9%) and filtered using a 0.45µm polyvinylidene fluoride syringe filter.

Quantification of total phenolic, flavonoid and quercetin content

About 40 µl of filter sterilized root extracts (1mg ml^{-1}) were taken to assess the total phenolic and flavonoid content. Total phenolic compounds were determined according to the method of Singleton *et al*. 1999 using Folin-Ciocalteu reagent. The gallic acid at 1mg ml^{-1} was used as standard. Total flavonoid content was determined by the method described by Crozier *et al*. 1997 using quercetin (1mg ml^{-1}) as standard. Quantification of quercetin was performed using Waters 2998 liquid chromatography (Waters, Milford, MA) equipped with the photodiode array detector (PDA). The data were processed

with Empower 2 software. Twenty microliters of filter sterilized root extracts (1mg ml^{-1}) and standard (1mg ml^{-1} quercetin) were injected into the Symmetry® C18 column (4.6 mm x 250 mm, 5 µm) and eluted isocratically with HPLC-grade methanol: water (with 0.2% orthophosphoric acid) in a ratio of 70:30 v/v at a flow rate of 1.0 ml min^{-1}. The quercetin was detected with a PDA detector at a wavelength of 375 nm. The amount of quercetin present in each root extract was calculated by comparing the standard area with the sample area. The standard and sample solution was injected in triplicate. The quantification was calculated by the following formula

$$\text{Quercetin (mg/g)} = \text{Peak area of the sample/ Peak area of the standard} \times 1000$$

1,1-Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging

The ability of the extracts to scavenge the DPPH radical was assessed spectrophotometrically (Gyamfi *et al*. 1999). About 20 µl, 40 µl, 60 µl, 80 µl, and 100 µl of filter sterilized root extracts (1mg ml−1) were mixed with 450 µl of Tris-HCl buffer (50 mmol/l; pH 7.4) and 1.0 ml of DPPH (0.1 mmol/l in methanol). The resultant absorbance was recorded at 517 nm after 30 min of incubation at 37 °C. The percentage of inhibition was calculated as the percentage of inhibition = [(A0 – A1)/A0] × 100 where A0 was the absorbance of the control (blank without extract) and A1 was the absorbance

Ferric reducing antioxidant power (FRAP) and assay

The FRAP, a method for measuring total reducing power of electron-donating substances, was assessed according to (Benzie and Strain 1996). About 20 µl, 40 µl, 60 µl, 80 µl, or 100 µl of filter sterilized root extracts (1mg ml^{-1}) were mixed with freshly prepared 6 ml of FRAP reagent (0.1 M acetate buffer: 0.02M FeCl3: 0.01M TPTZ = 10:1:1). The absorbance was measured at 592 nm (Thermo Evolution 201 UV-Spectrometry) after 30 min incubation at 37 ºC.

Statistical analysis

Data were statistically analyzed using analysis of variance (ANOVA) using SPSS version 11.09 (IBM corporation). Data are presented as means ± standard error. The mean separations were carried out using Duncan's multiple range test (DMRT) and significance was determined at 5% level.

Result

Effect of explant orientation

The percentage of adventitious root induction varied between the cotyledonary node explant orientations at different concentrations of IBA

(Table.1). The culture of cotyledonary explants of both adaxial and abaxial side facing the medium led to root initiation after 5 days respectively. Among the different orientations of explants placed in the IBA medium, the adaxial side facing the medium showed effective adventitious root induction when compared to explants placed on the abaxial side. Among the adaxial orientation treatments under different IBA (0.5-1.5mg/l) concentrations, IBA at 1.0 mg/l showed the best response in all root growth attributes compared to any other treatments tested in the present study. The percentage of root response using IBA (1mg/l) in MS medium was 98.6% with an average production of 7.7 roots per explant with a mean root length of 35.5cm per explant and produced an average of 51.2 lateral roots per root with an average fresh weight of 3.0g per explant respectively after 30 days of culture. Explants cultured in MS medium without any hormones responded poorly with 66.6% of root response and produced only an average of 2.6 roots per explant and 15.1 cm as an average root length per explant with 22.6 as an average number of lateral roots per root of explant during the same culture period.

Effect of lighting condition on induction of adventitious roots from cotyledonary nodes

The response of adventitious root induction varied between the lighting condition and the different concentrations of IBA (Fig.1 and Table.1). Among the different lighting condition of explants placed in the IBA medium, 16 h photoperiod showed effective adventitious root induction when compared to explants placed in complete darkness. Among the different concentrations of IBA, 1.0 mg/l was most effective for root induction under 16-hour photoperiod and IBA with 0.5 mg/l in complete darkness shows second best root induction. The culture of cotyledonary node explants placed under both 16-hour photoperiod and complete darkness in the medium led to root initiation after 5 days respectively. The percentage of root response using IBA (1mg/l) in MS medium placed under 16-hour photoperiod was 98.6% with the average production of 7.7 roots per explant with a mean root length of 35.5cm per explant and produced an average of 51.1 lateral roots per root with an average fresh weight of 3.1g per explant respectively after 30 days of culture. Conversely, explants cultured in MS medium without PGR showed responded poorly with 66.6% of root response and produced only an average of 2.6 roots per explant and 15.1 cm as the average root length per explant with 22.6 as an average number of lateral roots per root of explant and produced an average fresh weight of 0.25g per explant during the same culture period under 16h photoperiod. The percentage of root response using IBA (0.5mg/l) in MS medium under complete darkness was 95.3% with the average production of

6.1 roots per explant with a mean root length of 32.2cm per explant and produced an average of 47.7 lateral roots per root with an average fresh weight of 2.31g per explant respectively after 30 days of culture. On the other hand, explants cultured in MS medium without PGR showed responded poorly with 60.3% of root response and produced only an average of 1.6 roots per explant and 12.8 cm as the average root length per explant with 18.3 as an average number of lateral roots per root of explant and produced an average weight of 2.31g per explant during the same culture period under complete darkness.

Table 1: Effect of explant orientation and lighting condition on induction of adventitious root from cotyledonary nodes of soybean cv. CO_3 cultured in MS medium containing different concentrations of IBA

PGR (mg/l)	Percentage of response (%)	No. of roots/explant	Mean root length (cm)	No. of lateral roots/root	Root Fresh weight/ Explant (mg)
16h photoperiod					
Control*	66.6 ± 0.86^{k}	02.6 ± 0.13^{j}	15.1 ± 0.38^{j}	22.6 ± 0.86^{k}	0.25 ± 0.01^{i}
IBA*					
0.5	87.6 ± 1.36^{e}	5.2 ± 0.21^{d}	25.1 ± 0.61^{e}	33.6 ± 1.56^{f}	1.22 ± 0.02^{e}
1.0	98.6 ± 0.96^{a}	7.7 ± 0.33^{a}	35.5 ± 0.83^{a}	51.2 ± 2.34^{a}	3.02 ± 0.03^{a}
1.5	91.0 ± 1.12^{c}	5.5 ± 0.14^{d}	29.1 ± 0.41^{c}	38.3 ± 1.86^{d}	1.96 ± 0.03^{d}
Control#	58.3 ± 1.65^{m}	1.2 ± 0.08^{l}	11.5 ± 0.82^{l}	16.0 ± 0.89^{n}	0.14 ± 0.01^{j}
IBA#					
0.5	85.4 ± 0.86^{f}	4.9 ± 0.13^{e}	23.0 ± 0.88^{f}	30.6 ± 0.79^{g}	1.11 ± 0.02^{f}
1.0	91.3 ± 0.73^{c}	6.1 ± 0.20^{c}	32.0 ± 1.03^{b}	43.0 ± 1.63^{c}	2.15 ± 0.04^{c}
1.5	84.3 ± 0.98^{g}	4.5 ± 0.18^{f}	21.3 ± 0.68^{g}	35.6 ± 1.89^{e}	1.11 ± 0.01^{f}
Complete dark					
Control*	60.3 ± 1.52^{l}	1.6 ± 0.09^{k}	12.8 ± 0.36^{l}	18.3 ± 2.10^{m}	0.14 ± 0.01^{j}
IBA*					
0.5	95.3 ± 1.21^{b}	6.9 ± 0.31^{b}	32.2 ± 0.89^{b}	47.7 ± 1.89^{b}	2.31 ± 0.02^{b}
1.0	88.6 ± 1.01^{d}	5.3 ± 0.26^{d}	27.3 ± 0.57^{d}	38.0 ± 1.55^{d}	1.29 ± 0.02^{e}
1.5	83.0 ± 0.85^{h}	4.0 ± 0.13^{g}	20.3 ± 0.96^{h}	28.6 ± 1.23^{h}	1.03 ± 0.03^{g}
Control#	53.6 ± 0.81^{n}	1.2 ± 0.13^{l}	10.2 ± 0.46^{m}	13.6 ± 0.80^{n}	0.14 ± 0.01^{j}
IBA#					
0.5	80.0 ± 0.91^{i}	3.6 ± 0.21^{h}	19.7 ± 0.84^{h}	25.3 ± 0.93^{i}	0.97 ± 0.01^{g}
1.0	79.6 ± 1.33^{i}	3.6 ± 0.14^{h}	16.3 ± 0.71^{i}	23.6 ± 0.90^{j}	0.91 ± 0.02^{g}
1.5	74.6 ± 1.14^{j}	03.0 ± 0.19^{i}	14.1 ± 0.69^{k}	20.0 ± 0.91^{l}	0.78 ± 0.01^{h}

*The cotyledonary nodes were placed adaxial side facing the medium.

#The cotyledonary nodes were placed abaxial side facing the medium.

Control: Explants cultured on MS medium without any phytohormones.

The data were tabulated after 30 days of culture in the respective medium. Each treatment contained three replicates with at least 10 explants per replicate. Data represent the mean (±) standard error of three replicates. Values with the different letters within columns are significantly different according to Duncan's multiple range test (DMRT) at a 5% level.

Effect of auxins on induction of adventitious root from cotyledonary nodes of soybean cv. CO_3

Effects of different auxins were studied in cotyledonary node explants incubated under 16h photoperiod using the optimized protocol (Table.2). The percentage of adventitious root induction varied between the different concentrations of auxins used. Comparing the different concentrations of auxins IAA, NAA, 2,4-D (0.5-1.5mg/l), IBA 1mg/l was most effective for root induction and IAA with 0.5mg/l shows the best root induction when compared with other concentrations of IAA. The percentage of root response using IAA (0.5mg/l) in MS medium under 16h photoperiod was 98.3% with the average production of 5.9 roots per explant with a mean root length of 21.1cm per explant and produced an average of 38.2 lateral roots per root with an average fresh weight of 1.89g per explant respectively after 30 days of culture. NAA with 0.5mg/l shows the best root induction when compared with other concentrations of NAA. The percentage of root response using NAA (0.5mg/l) in MS medium under 16h photoperiod was 98.3% with the average production of 5.3 roots per explant with a mean root length of 18.1cm per explant and produced an average of 34.6 lateral roots per root with an average fresh weight of 1.79g per explant respectively after 30 days of culture. 2,4-D with 1mg/l showed the best response when compared with other concentrations of 2,4-D placed under a 16h photoperiod. The percentage of root response using 2,4-D (1mg/l) in MS medium under 16h photoperiod was 56.3% with the average production of 10.6 roots per explant with a mean root length of 3.3cm per explant and produced an average of 7.6 lateral roots per root with an average fresh weight of 0.86g per explant respectively after 30 days of culture. On the other hand, explants cultured in MS medium without PGR responded poorly with 66.6% of root response and produced only an average of 2.6 roots per explant and 15.1 cm as an average root length per explant with 22.6 as the average number of lateral roots per root of explant and produced an average fresh weight of 0.25g per explant during the same culture period under 16h photoperiod. The culture of cotyledonary explants placed under 16-hour photoperiod in the medium led to root initiation after 5 days respectively. The percentage of root response using IBA (1mg/l) in MS medium placed under 16-hour photoperiod was 90.3% with the average production of 17.6 roots per

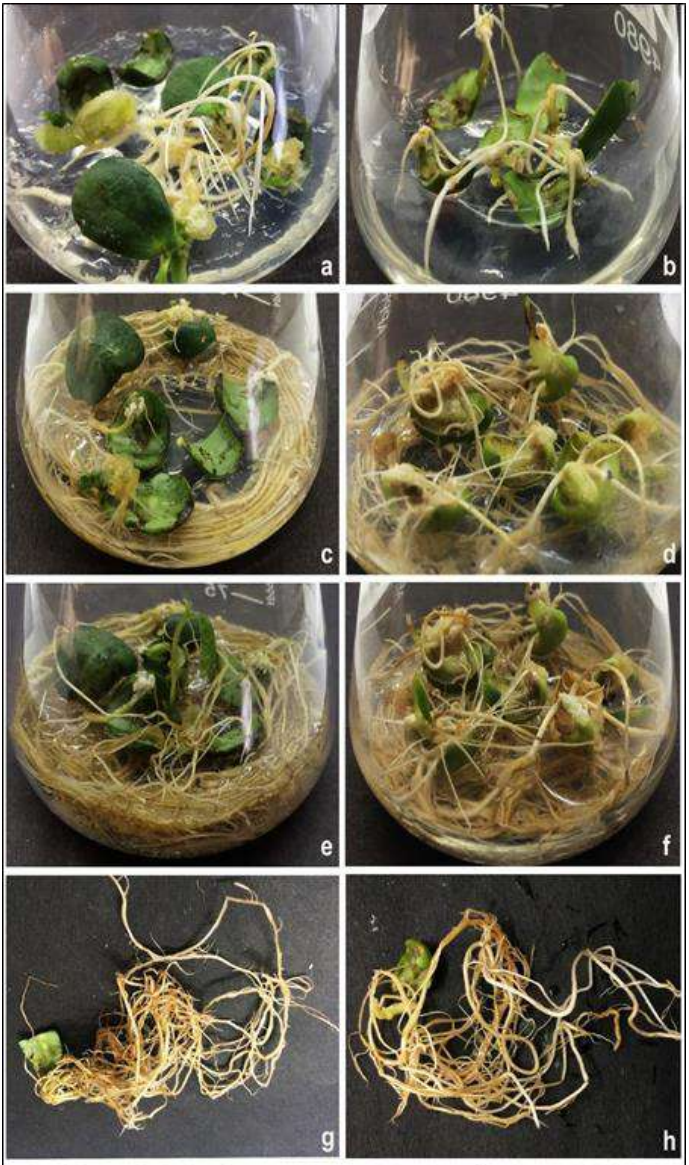
explant with a mean root length of 21.5cm per explant and produced an average of 22.5 lateral roots per root with an average fresh weight of 0.51g per explant respectively after 30 days of culture. Conversely, explants cultured in MS medium without hormones showed responded poorly with 66.6% of root response and produced only an average of 2.6 roots per explant and 15.1 cm as the average root length per explant with 22.6 as an average number of lateral roots per root of explant and produced an average fresh weight of 0.25g per explant during the same culture period under 16h photoperiod.

Table 2: Effect of auxins on induction of adventitious root from cotyledonary nodes of soybean cv. CO_3

PGR (mg/l)	Percentage of response (%)	No. of roots/explant	Mean root length (cm)	No. of lateral roots/root	Root Fresh weight/ Explant (mg)
Control	66.6 ± 0.86^{f}	02.6 ± 0.1^{3i}	15.1 ± 0.38^{e}	22.6 ± 0.86^{h}	0.25 ± 0.01^{h}
IBA					
1.0	98.6 ± 0.96^{a}	07.7 ± 0.33^{b}	35.5 ± 0.83^{a}	51.2 ± 2.34^{a}	3.02 ± 0.03^{a}
IAA					
0.5	98.3 ± 0.56^{a}	05.9 ± 0.19^{d}	21.1 ± 0.50^{b}	38.2 ± 0.95^{b}	1.89 ± 0.01^{b}
1.0	95.6 ± 1.12^{b}	03.6 ± 0.14^{g}	14.3 ± 0.44^{f}	35.9 ± 0.89^{d}	1.11 ± 0.02^{e}
1.5	91.3 ± 0.75^{c}	03.0 ± 0.13^{h}	11.5 ± 0.53^{h}	24.5 ± 0.86^{g}	0.86 ± 0.01^{f}
NAA					
0.5	98.3 ± 0.69^{a}	05.3 ± 0.24^{e}	18.1 ± 0.36^{c}	34.6 ± 0.73^{c}	1.79 ± 0.03^{c}
1.0	89.6 ± 0.99^{d}	04.2 ± 0.11^{f}	16.0 ± 0.48^{d}	31.9 ± 0.87^{e}	1.26 ± 0.02^{d}
1.5	80.7 ± 1.02^{e}	04.0 ± 0.16^{f}	13.8 ± 0.76^{g}	25.5 ± 0.98^{f}	1.18 ± 0.01^{e}
2,4-D					
0.5	44.3 ± 0.85^{i}	06.3 ± 0.19^{d}	02.1 ± 0.12^{j}	05.3 ± 0.56^{j}	0.25 ± 0.01^{h}
1.0	56.3 ± 0.73^{g}	10.6 ± 0.13^{a}	03.3 ± 0.34^{i}	07.6 ± 0.76^{i}	0.86 ± 0.02^{f}
1.5	48.9 ± 0.49^{h}	07.2 ± 0.11^{c}	02.5 ± 0.45^{j}	03.2 ± 0.59^{k}	0.65 ± 0.01^{g}

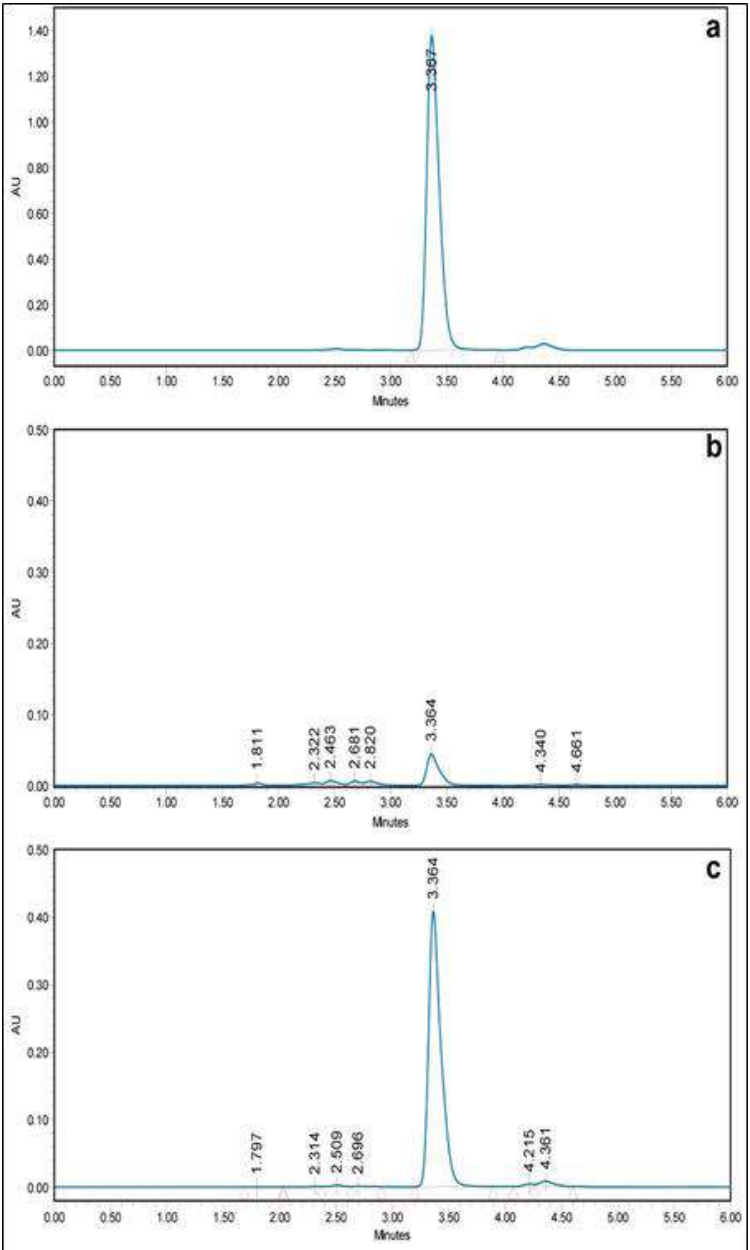
The cotyledonary nodes were placed adaxial side facing the medium and incubated under a 16-h photoperiod for 30 days.

Control: Explants cultured on MS medium without any phytohormones each treatment contained three replicates with at least 10 explants per replicate. Data represent mean (±) standard error of three replicates. Values with the different letters within columns are significantly different according to Duncan's multiple range test (DMRT) at a 5% lev



Adventitious root induction from cotyledonary node explant of soybean cv. CO 3. **a, c, e, g** Induction and proliferation (**a**: after 10 days of culture; **c**: after 20 days of culture; **e, g**: after 30 days of culture) of adventitious roots from cotyledonary node explants cultured in MS medium containing 1 mg/l IBA and incubated under 16h photoperiod; **b, d, f, h** Induction and proliferation (**b**: after 10 days of culture; **c**: after 20 days of culture; **e, g**: after 30 days of culture) of adventitious roots from cotyledonary node explants cultured in MS medium containing 0.5 mg/l IBA and incubated under complete darkness.

Fig 1



HPLC chromatograms of quercetin in IBA (1 mg/l) induced adventitious roots and control roots of cotyledonary nodes. **a** Standard of quercetin; **b** methanolic extract of control roots; **c** methanolic extract of IBA (1 mg/l) induced adventitious roots.

Fig 2

Total phenolic, flavonoid and quercetin content in the extract from adventitious roots of soybean cv. CO_3

Total phenolic (33.07 mg g^{-1}) and flavonoid content (48.0 mg g^{-1}) was high in adventitious roots of cotyledonary node explant of IBA 1mg/l in 16h photoperiod when compared to control roots (phenolic content = 166.6 mg $g^{-}1$; flavonoid content = 677 mg g^{-1}) (Table.3). The results of HPLC analysis confirmed that the quercetin content was improved in adventitious roots (293.3 mg g^{-1}) of cotyledonary node explant of IBA 1mg/l in 16h photoperiod compared to control roots (31.9 mg g^{-1}) in MS medium without PGR. Hence, there was a 9.1-fold increase in quercetin content in adventitious root cultures of cotyledonary node explant of IBA 1mg/l in 16h photoperiod compared to control (Fig.2).

Table 3: Total phenolic, flavonoid and quercetin content in the extract from adventitious roots of soybean cv. CO_3

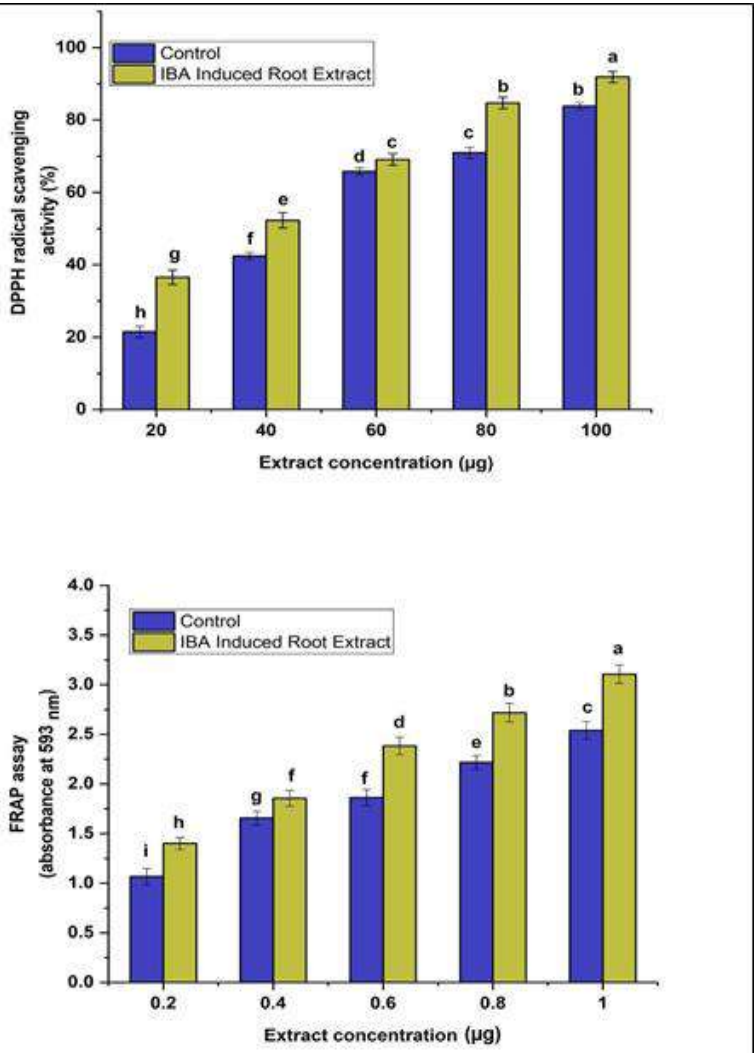
	Phenolic content (mg/g)*	**Flavonoid content (mg/g)#**	**Quercetin content (mg/g)**
Control	038.2 ± 1.2[b]	126 ± 2.9[b]	031.9 ± 1.6[b]
IBA (1 mg/l)	166.6 ± 3.1[a]	677 ± 3.3[a]	293.9 ± 1.9[a]

Ten ml of methanol (99.9%) was added to one gram (DW) of fine root powder and placed on an orbital shaker at 150 rpm for 3 days (22 °C). The extracts were dried, and about 1mg of root extract powder was dissolved in 1 ml of HPLC-grade methanol (99.9%). About 40 µl of root extracts (1mg ml^{-1}) was taken for analysis of phenolic and flavonoid content. About 20 µl of root extracts (1mg ml^{-1}) was taken for HPLC analysis. Data represent the mean value of three replicates (five root biomass per replicate) with standard errors. Values with the different letters within columns are significantly different according to Duncan's multiple range test (DMRT) at a 5% level.

Control Adventitious roots induced from cotyledonary nodes cultured on MS basal medium; *mg Gallic acid equivalent/g DW of extract; # mg quercetin equivalent/g DW of extract.

FRAP reducing ability and DPPH radical scavenging assay

The antioxidant potential of adventitious roots was carried out using FRAP and DPPH assay (Fig. 3). The reducing ability of the root extract of adventitious roots of IBA 1mg/l in 16h photoperiod was determined using the FRAP assay. The formation of blue-colored TPTZ-Fe^{2+} complex from colorless oxidized TPTZ-Fe^{3+} by the action of the electron donating antioxidants was recorded at absorbance 595 nm. The antioxidant activity of adventitious roots of IBA 1mg/l improved as the volume of extracts used for assay was increased from 20 to 100 µl. In addition, the antioxidant potential of adventitious roots of IBA 1mg/l was significantly higher when compared to the control. In the DPPH assay, adventitious root extracts of IBA 1mg/l (20, 40, 60, 80 and 100 µl) showed higher potency of inhibition when compared to control root extracts. Furthermore, the extracts of adventitious roots of IBA 1mg/l were able to scavenge DPPH radicals in a concentration-dependent manner.



Assessment of antioxidant activity in methanolic extracts of IBA (1 mg/l) induced adventitious roots and control roots of soybean using FRAP and DPPH assay. *Control* methanolic extract of control roots from cotyledonary node of soybean. *Bars* represent the mean values of three replicates (five root biomass per replicate) with standard errors. Mean separations were carried out according to Duncan's multiple range test (DMRT) at a 5% level.

Fig 3

Discussion

In this present study we took one of the valuable secondary metabolites (quercetin) which belongs to the flavonoid group to improve its content in

soybean via adventitious root culture. In this present study, we selected adventitious root as the system and induced adventitious root in cotyledonary node explants of soybean with different concentrations of auxin and quantified quercetin content. In this present study, we have undergone adventitious root induction in cotyledonary node explants of soybean. It is reported that cotyledon segments derived from zygote embryos are suitable tissues for studying adventitious root formation. Among different hormones used in this study, IBA showed effective root induction when compared with other hormones (IAA, NAA 2,4-D). IBA was also reported to be superior for adventitious root development in *O. stamineus* (Pick *et al*. 2009), *E. angustifolia* (Jang *et al*. 2012), *O. prostrata* (Martin *et al*. 2008), *P. corylifolia* (Baskaran and Jayabalan 2009) and W. *somnifera* (Murthy and Praveen 2013). In this study, cotyledonary explants' orientation was also examined in which cotyledonary explants placed adaxial side facing the medium is more effective than the abaxial side. These findings were coherent with Shri and Davis 1992, where the best organogenic responses in *Cicer arietinum* (L.) were obtained from the adaxial side of cotyledon explants. In this study, cotyledonary explants of soybean in 1mg/l of IBA-containing medium kept under 16-hour photoperiod showed effective adventitious root production when compared with complete darkness. Similarly, it is proved that 1 mg/l IBA was the best auxin for the induction of adventitious roots from leaf explants of *M. citrifolia* under light conditions (Baque *et al*. 2010).

Plant polyphenols are a significant group of compounds that act as primary antioxidants of free radical scavenging. These compounds can chelate with metal ions that could catalyze the formation of ROS which promotes lipid peroxidation (Iqbal *et al*. 2015). Among polyphenols, flavonoids are of great importance because they help the human body to fight against diseases. Molecular structures, the position of the hydroxyl group, and other features in its chemical structure determine the ability of flavonoids to act as potent antioxidants (Iqbal *et al*. 2015). In flavonol, quercetin is most abundant with good antioxidant properties and possesses structural features for free radical scavenging activity (Kalita *et al*. 2013). Therefore, it is significant to determine the total phenol, flavonoid, and quercetin content in adventitious root extracts. In the present study, total phenol, flavonoid and quercetin content were significantly higher in methanolic extracts of adventitious roots when compared to control roots. The FRAP and DPPH are the most common assays to estimate the antioxidant potential of samples. The ferric ion-reducing antioxidant potential of samples was estimated from their ability to reduce colorless oxidized TPTZ-Fe $^{3+}$ to TPTZ-Fe $^{2+}$ (blue-colored complex). The DPPH molecule that contains stable-free radicals has been extensively used to

estimate the radical scavenging ability of antioxidants. The DPPH scavenging ability is attributed to the hydrogen-donating ability of compounds in plant extracts (Ebrahimzadeh *et al*. 2008). In this present study, the results of FRAP and DPPH assay confirmed that the antioxidant activity of root extracts from adventitious roots produced from cotyledonary node explant of soybean on treatment with 1mg/l IBA in 16h photoperiod was significantly higher when compared to control root extracts. In addition, in both FRAP and DPPH assay, the antioxidant potential of extracts increased as the volume used to assay was increased from 20 to 100 µl. Our results indicated that the radical scavenging ability of adventitious root extracts (20 to 100 µl) might be mostly related to their concentration of phenolics and flavonoids. Rao *et al*. 2018 reported that the ability of the extracts to reduce Fe^{3+} could be attributed to the number of hydroxyl groups in the phenolic and flavonoid compounds. Chiang *et al*. 2016 reported that FRAP and DPPH radical scavenging ability could be attributed to the flavonoids present in plant extract of *Zingiberaceae* family.

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