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Editor-in-Chief

Prof. Altaf Ahmad

Department of Botany,
Aligarh Muslim University, Aligarh, U.P.
E-mail: ahmadaltaf72@gmail.com
Mobile: +91 81780 45031

Editor-in-Chief

Prof. Altaf Ahmad

Department of Botany,
Aligarh Muslim University, Aligarh, U.P.
E-mail: ahmadaltaf72@gmail.com

Editor

Dr. Syed Shabih Hassan

Scientist (Fisheries)
Department of Fisheries Resource Management
College of Fisheries, Guru Angad Dev Veterinary and
Animal Sciences University, Ludhiana – 141004 (Punjab)
E-mail: fish_ab@rediffmail.com

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Prof. Altaf Ahmad

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Editor

Dr. Syed Shabih Hassan

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Landran, Mohali, Punjab

National Environmental

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206 Raj Tower - I

Alaknanda Comm. Centre,

New Delhi - 110 019

Incharge Publication

Gian C. Kashyap

nesapublications@gmail.com

Incharge- Accounts

Rakesh Kumar Roy

infones88@gmail.com

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OBSERVATION OF CHLOROPHYCEAE (*PEDIASTRUM* MEYEN) IN MANGLI RIVER OF BUNDI, RAJASTHAN (INDIA)

Ruchi Sagar* and Dilip Kumar Rathore

Department of Botany
Government College Bundi (Rajasthan)

Review Paper

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ABSTRACT

Algae are a global group of thalloid plants that can survive in a range of environmental conditions, such as freshwater, marine water, warm water, and cold water. They are also a useful indicator for assessing the quality of water. The study focuses on *Pediastrum*, a freshwater green algae (Chlorophyceae: Chlorococcales), found in Mangli river, Bundi. Water samples were collected from five different locations (S1, S2, S3, S4, S5) of Mangli river during various seasons (Pre-monsoon, monsoon and Post-monsoon) from 2022 to 2024. In the present study, total 11 species of *Pediastrum* were identified and *Pediastrum tetras*, *Pediastrum tetras* var. *excisum*, *Pediastrum duplex* var. *rugulosum* and *Pediastrum boryanum* var. *campanulatum* have been reported as dominant algae and also from all the sites of studied river. This study represents the first report of *Pediastrum* species from the Mangli river.

No. of Pages: 5

Keywords: *Pediastrum*, Mangli River, Chlorophyceae, Algae.

INTRODUCTION

Bundi district situated in the Kota division of state Rajasthan and it has several rivers flowing through it, which are tributaries of the Chambal River. The main tributaries river includes Mej, Bajan, Kural and Mangli river. The Mangli river is particularly important for Bundi district because the district is located very close to it, making it crucial source of water supply for Bundi. It is one of the important sources of water supply for the drinking, livestock, agriculture etc. purposes for nearby locality. The Mangli River originates from the Bhadkya Mataji waterfall at Bijolia, located above the Uparmal Plateau, and meets the Kurel River at its confluence near Sangwada village, approximately 12 km from the Kota-Bundi national highway. The length of the Mangli river is 44-48 km from its point of origin to its confluence site. The hydrological characteristics of the Mangli river create

favorable conditions for the development and distribution of freshwater algal diversity.

Algae are the global group of thalloid plants that can survive in a range of environmental conditions, such as freshwater, marine water, warm water, and cold water. They are also useful indicator for assessing the quality of water. Chlorophyceae is an important class of algae and chlorococcales order of chlorophyceae is dominant, largest and widely distributed along the world. *Pediastrum*, *Tetradon*, *Closteridium* and *Hydrodictyon* are belong to hydrodictyaceae family. These family cells are found generally in free living, unicellular, cylindrical form.

Pediastrum is found in slow running water. It is a type of freshwater algae that inhabit colonies or groups. Colonies are stars shaped and cell wall is made of

*Corresponding author: ruchi198989verma@gmail.com

sporopollenin which helps the algae to survive under unfavorable condition. It play important role in photosynthesis and ecological food chain. The genus *Pediastrum* is a free floating, coenobial, green algae occurs commonly in natural freshwater lentic environments like ponds, lakes, reservoirs etc. Their occurrence in brackish and salty waters is rare (Keshri and Mallick, 2013). Parra (1979) provides a detailed taxonomic revision of the genus *Pediastrum* Meyen, clarifying species boundaries and providing identification keys and highlighted its prevalence in freshwater lentic habitats and rare occurrence in brackish waters, remaining a key reference for ecological and systematic research. The outer layer of cell wall of *Pediastrum* is composed of sporopollenin combined with silicon oxide which makes them high resistance to decay. Therefore, they remain preserved well in lake sediments as fossil record for palynological studies (Komarek and Jankovska 2001). Thus, the knowledge of *Pediastrum* can be useful for the determination of trophicity or salinity of water at present and past (Paształeniec and Poniewozik, 2004). *Pediastrum* has been studied by Bhatnagar and Bharadwaj (2015); Pilatti *et al.* (2023); Rai & Misra (2012); Jena & Adhikary (2007); Meena (2017); Lenarczyk and Saługa (2018); Baruah *et al.* (2022). Four species of *Pediastrum* Meyen identified by Barupal and Narayan (2016) and 22 species were identified by Navatha & Reddy (2016). *Pediastrum* diversity in Rajasthan has been extensively studied by Tyagi *et al.* (2006); Tiwari and Chauhan (2006); Rathore *et al.* (2014); Barupal and Narayan (2016); Patel and Rana (2020) and Rathore (2020).

MATERIAL & METHODS:

The Present study has been done from 2023 to 2025 and algal samples have been collected from all the selected sites (S1, S2, S3, S4, S5) across three seasons i.e. Pre-monsoon (Feb-May), Monsoon (Jun-Sep) and Post-monsoon (Oct-Jan) of Mangli river. Algal samples were collected with the help of phytoplankton net and a steel utensil and preserved in 4% formaldehyde in labelled bottles for further study in laboratory. With the setup of trinocular microscope and digital camera clear image of the algae has been captured and identified with the help of standard keys, monograph and flora (Philipose, 1967; Sevindik, 2010; John *et al.*, 2011; Merza and Abdul, 2020; Pereira *et al.*, 2024).

RESULTS & DISCUSSIONS:

After thorough examination of collected algal samples, 11 *Pediastrum* species were identified and taxonomic numeration with details as follows:

1. *Pediastrum tetras* (Ehrenb) Ralfs (Plate 1, Fig. 1)

The colony is round, four to eight-celled, and has a diameter of 26 μ . It resembles a flat plate, with cells that have and do not have intercellular spaces. The marginal cells are divided into two lobes and have a diameter of 6 μ , while the interior cells have four to six sides and a single linear incision.

Collection site: S2 & S3 during monsoon & post-monsoon.

2. *Pediastrum tetras* var. *excisum* (RABENSH) (Plate 1, Fig. 2)

Colonies are 18.5 μ in diameter; cells are 10.5 μ long and 12 μ broad; marginal cells have lobes that are more or less deeply concave; the remaining cells are comparable to those found in *P. tetras*.

Collection site: S2 & S3 during pre-monsoon.

3. *Pediastrum tetras* var. *tetradon* (corda) RABENH (Plate 1, Fig. 3a-3b)

Colonies: 4–8–16 cells; deep cell incision with lobes next to the marginal cell incision; colonies: 30 μ in diameter; marginal cells: 10 μ long and 9–10 μ wide; inner cells: 8 μ long and 9 μ wide.

Collection site: S2 & S3 during post-monsoon.

4. *Pediastrum duplex* var. *rugulosum* Raciborski (Plate 1, Fig. 4)

Colonies 4 angled inner cells with a deep incision; smooth cell wall; marginal cells measuring 6 μ in width and 10 μ in length; inner cells measuring 4–13 μ in width and 3–12 μ in length; triangular or trapezoid marginal cells at the basal portions; two triangular processes formed by a deep incision; the process outer side was slightly/deeply concave.

Collection site: S2 & S3 during pre-monsoon.

5. *Pediastrum boryanum* var. *campanulatum* Wille (Plate 1, Fig. 5a-5b)

Colonies are free-floating, round to ellipsoid, include 16–32–64 cells, and lack holes. They have a campanulate shape rather than being flat. Coenobia

have a diameter of 90 to 150 μ . The length of the marginal cells is slightly longer than their width. Cells are close to one another. The marginal cell processes feature a deep incision, are V-shaped and are as long as the cells. The inner cells have a little incision on the outside. The cell wall is composed of granules. The marginal cells are 15 μ long and 18 μ in diameter. The inner cells are 10 μ long and 15 μ in diameter.

Collection site: S2 & S3 during pre-monsoon.

6. *Pediastrum duplex* var. *clathratum* (Plate 1, Fig.6)
Residences eight-celled cells and intercellular gaps roughly correspond to the species type, but the cell wall is clearly granulate with a diameter of 16 μ .

Collection site: S2 & S3 during monsoon & post-monsoon.

7. *Pediastrum duplex* Meyen var *subgranulatum* (Raciborski) (Plate 1, Fig.7a-7b)
8–16–32 celled colonies. In organisms that are colonies, cells are essentially intercellular gaps. However, the cell wall is clearly granular. Colonies of 16–32 cells and a diameter of 100 μ with cells measuring 18 μ .

Collection site: S2 & S3 during post-monsoon.

8. *Pediastrum duplex* Meyen var. *gracillium* W. et G.S. West (Plate 1, Fig.8a-8b)
Large intercellular spaces are present in colonies; cells are narrow, either as broad or narrower than the processes; marginal cells are curved outward and have two long processes with an emarginated apex; inner cells are similar to marginal cells but have shorter processes; colonies have a diameter of 50 μ ; marginal cells are 14 μ long and 8 μ broad; inner cells are 13 μ long and 10 μ broad.

Collection site: S1, S2, S3 & S4 during pre-monsoon.

9. *Pediastrum boryanum* var *longicorneplex* (Plate 1, Fig.9a-9b)
Colonies that are round to oval in shape and typically

contain 16–32 cells organized in concentric rings with no gaps between cells. The outer surface of marginal cells is slightly to profoundly emarginated, with two short processes ending in stumpy spines, and the interior cells are polygonal with straight sides. The cell wall is often granulate, but it can occasionally be smooth. The diameter of the cell is 30 μ . 8 μ in length. Colonies with sixty-four cells up to 90 μ in diameter.

Collection site: S1 & S3 during post-monsoon

10. *Pediastrum simplex* meyen var *duodenarium* (bailey) RABENH (Plate 1, Fig.10)
Colonies circular to oval, of 16-32 or more cells. Inner side of margin cells nearly straight, outer side produced into a gradually tapering process.
Collection site: S2 & S3 during post-monsoon

11. *Pediastrum simplex* Meyen (Plate 1, Fig.11)
Colonies of 8 cells, ranging from round to oval. The marginal cell's is almost straight, its outer side forms a progressively tapering process, and its inner cell is polygonal. Cells are in close proximity to one another and typically lack intercellular gaps. Smooth cell wall, 8 μ wide, 19 μ length.

Collection site: S2 & S3 during monsoon

The present study highlights the diversity of *Pediastrum* in the Mangli River, documenting 11 species and varieties, including *P. tetras*, *P. tetras* var. *excisum*, *P. duplex* var. *rugulosum* and *P. boryanum* var. *campanulatum*. *Pediastrum* is reported first time from this studied river, emphasizing its importance as an indicator of freshwater ecosystem health. It help in further studies which focus on seasonal variations, ecological factors influencing algal distribution and molecular characterization to better understand the diversity and ecological role of *Pediastrum* in freshwater river.

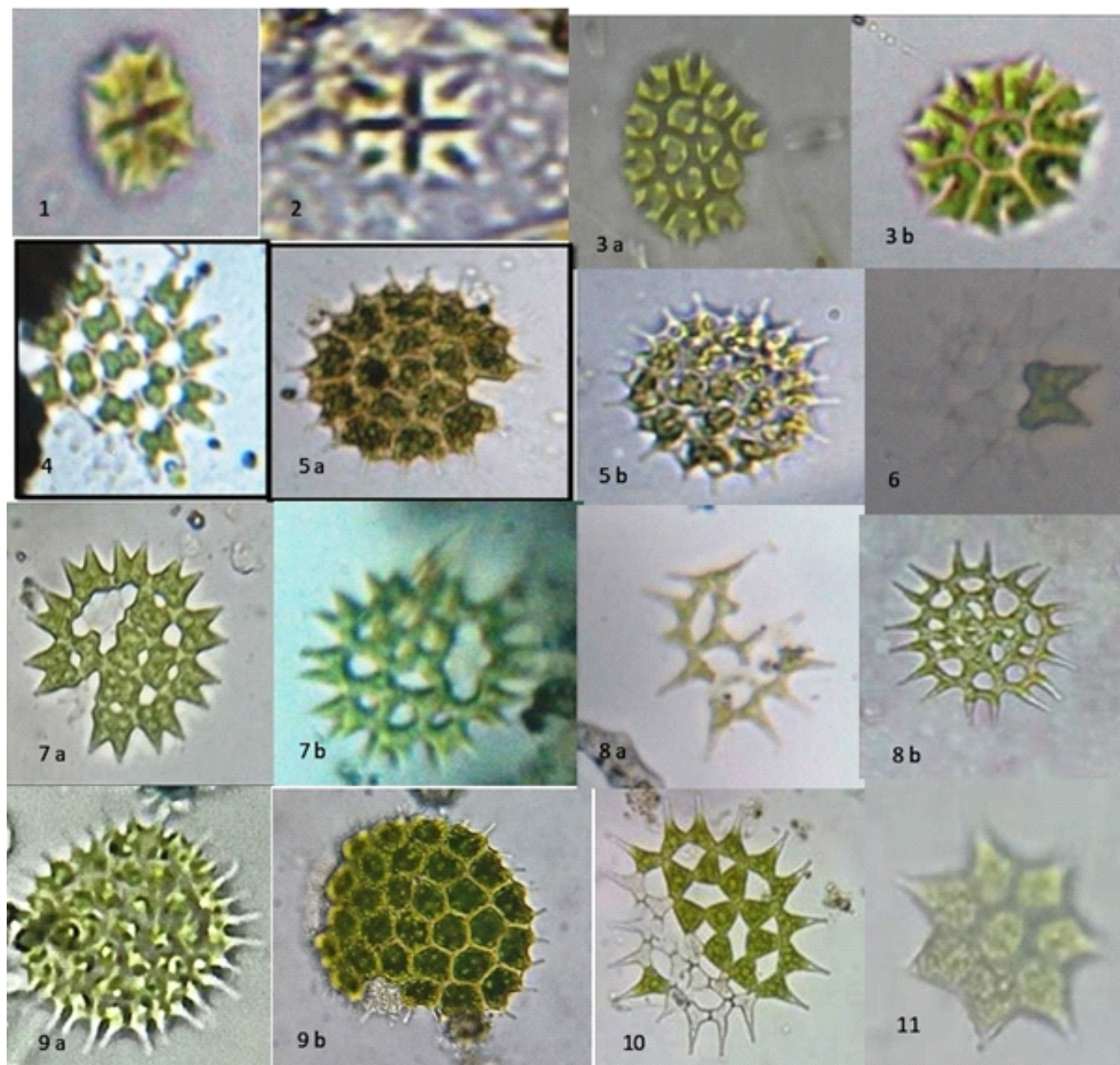


Plate 1. *Pediastrum* identified from Mangli river, Bundi district (Rajasthan).

1. *Pediastrum tetras* (Ehrenb.) Ralfs; 2. *Pediastrum tetras* var. *excisum* (RABENSH); 3. a, b-*Pediastrum tetras* var. *tetradon* (corda) RABENH; 4. *Pediastrum duplex* var. *rugulosum* Raciborski; 5. a, b- *Pediastrum boryanum* var. *campanulatum* wille; 6. *Pediastrum duplex* var. *clathratum*; 7. a, b- *Pediastrum duplex* Meyen var. *subgranulatum* (Raciborski); 8. a, b- *Pediastrum boryanum* var. *longicorneplex*; 9. a, b- *Pediastrum Duplex* Meyen var. *subgranulatum* (Raciborski); 10. *Pediastrum simplex* Meyen var. *duodenarium* (bailey) RABENH; 11. *Pediastrum Simplex* Meyen

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CONTRASTIVE PARADIGM TO UPHELD AND SECURING THE NECESSITY OF LIFE

Suparna Sanyal Mukherjee^{1*} and Saikat Kumar Basu²

¹Department of Education, DIC of Sociology & Anthropology
Seacom Skills University, Bolpur, Birbhum, West Bengal, India

²PFS, Lethbridge, Alberta, Canada

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ABSTRACT

Livelihood sustenance refers to the means by which individuals or households secure the necessities of life, such as food, water, shelter, and income. A livelihood comprises the capabilities, assets, and activities required for a means of living. It is deemed sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities, assets, and activities both now and in the future, while not undermining the natural resource base. The sustainable livelihoods approach facilitates the identification of practical priorities for actions that are based on the views and interests of those concerned but they are not a panacea. It does not replace other tools, such as participatory development, sector-wide approaches, or integrated rural development. However, it makes the connection between people and the overall enabling environment that influences the outcomes of livelihood strategies. It brings attention to bear on the inherent potential of people in terms of their skills, social networks, and access to physical and financial resources, and ability to influence core institution. Sustainable livelihood development among tribal communities is a crucial aspect of ensuring their well-being and preserving their cultural heritage. Here are some key points related to this topic:

Natural Resource Management: Tribal communities often rely heavily on natural resources for their livelihoods. Sustainable management of these resources, such as forests and water bodies, is essential.

Community Empowerment: Empowering tribal communities, especially women and youth, is vital. This can be achieved through education, skill development, and creating opportunities for micro-enterprises.

Cultural Preservation: Sustainable livelihood programs should respect and integrate traditional knowledge and cultural practices of tribal communities

Policy Support: Effective policies and frameworks are needed to support sustainable livelihoods.

Challenges and Opportunities: While there are significant challenges such as land degradation, climate change, and socio-economic disparities, there are also opportunities.

The Bonn Challenge is a global effort to bring 150 million hectares of the world's deforested and degraded land into restoration by 2020, and 350 million hectares by 2030. Hence, the present sequel emphasized in the village Jhal Bhanga of Jhargram Forest Beat, Jhargram Forest Range, and Jhargram Forest Division of the Jhargram District of West Bengal, on the process of forest restoration, protection under the framework of Forest Policy guidelines, enhance cultural preservation along with community empowerment of a vulnerable tribal group the Lodha and a settled agriculturist group the Santal who are pursuing livelihood sustenance in the context of uphold the necessity of life at this 21st century.

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Keywords: Community, Culture, Development, Livelihood, Sustenance, Tribes.

*Corresponding author: drsuparnasanyalmukherjee@gmail.com

The skills, resources, and activities necessary for a means of subsistence make up a livelihood. When it can withstand and bounce back from shocks and strains while preserving or improving its resources, activities, and capabilities, it is considered sustainable, without compromising the foundation of natural resources, both today and in the future (Guhathakurta and Roy, 2000). There are many scientists who have peered into the matter which is still in vogue. Land use of Forest is continuous efforts since time immemorial (Bhowmick, 1963/1994; Bose, 1971). Land is used for different purposes such as agriculture, forestry, mining, building houses, roads, and setting up industries. The claim that stewardship of terrestrial ecosystems, particularly forests, and their rich biodiversity, is essential for sustainable development has achieved broad recognition (Sengupta, 1969). The conservation of life on land is recognized as Goal 15 of the 17 Sustainable Development Goals (SDGs). When the SDGs were adopted by the UN in 2015, all indicators showed that life on Earth was in decline (Mukherjee, 2015), eroding the ability to meet human needs (Danda, 2002). SDG 15 asks for the protection, restoration, and sustainable use of terrestrial ecosystems along with the sustainable management of forests, combating desertification, halting and reversing land degradation, and halting biodiversity loss (Negi, 1994, 1996).

Clearly, the pressures of population growth, economic development, and increased consumption will only intensify the challenges for the maintenance of life on land (Negi, 1996). In this chapter, we examine the opportunities and challenges that merit particular attention if we are serious about SDG 15 and reversing the decline of life on Earth. The present study looked into the matter of sustainable development of the selected tribes for enhancement of the better propagation. The study enhanced the primordial phenomena of the area concerned. It will be looked into the sustainable fact at this 21st century (Mukherjee, 2015).

The Method of Sustainable Livelihoods

One method to think about the goals, parameters, and priorities of development initiatives is through the sustainable livelihoods approach. It is founded on changing perspectives on the lives of the weak and impoverished as well as the significance of institutions and policies. It assists in creating development initiatives that are: People-cantered;

Multilevel; Responsive and Participatory; Integrated with the Public and Private Sectors; Dynamic; and Sustainable (Fig. 1).

Although it is not a panacea, the sustainable livelihoods approach makes it easier to identify realistic goals for activities that are founded on the opinions and interests of everyone involved. It is not a substitute for other instruments like integrated rural development, sector-wide strategies, or participatory development (Bhowmick 1980). It does, however, draw a link between individuals and the broader enabling environment, which affects how livelihood options work out. It draws emphasis to people's innate potential in terms of their abilities, social networks, financial and material resources, and capacity to influence important institutions (Danda, 1991).

This positive perspective is extended by appreciative inquiry, which was first created as a tool for industry to steer clear of destructive approaches to issue solving. A community takes charge of creating and obtaining information through the highly inclusive process of appreciative inquiry, which maximizes the positive (as opposed to limiting the negative) and then develops solutions based on the most fruitful prior experiences.

The Sustainable Livelihoods Framework

The framework for sustainable livelihoods aids in the organization of the variables that limit or improve livelihood opportunities and illustrates their interrelationships (Beotra, 1989). The sustainable livelihood approach tries to broaden the fundamental idea that various households have varying access to livelihood assets (Fig. 1). The following are the livelihood assets that the impoverished frequently have to choose between and make trade-offs for:

Human capital, such as health, nutrition, education, knowledge and skills, ability to work, and adaptability
Social capital, including networks and connections (such as kinship, neighbourhoods, and patronage), relationships of trust and understanding and support, formal and informal groups, common behaviours and values, rules and sanctions, collective representation, decision-making mechanisms, and leadership.

Wildlife, wild foods and fibres, trees and forest products, land and crops, water and aquatic resources, biodiversity, and environmental services are examples of natural capital.

Financial capital, such as savings, credit, and debt (formal and informal), remittances, pensions, and wages;

Physical capital, such as infrastructure (transport, roads, vehicles, safe housing and buildings, water supply and sanitation, energy, and communications); and tools and technology (production tools and equipment, seed, fertilizer, pesticides, and traditional technology).

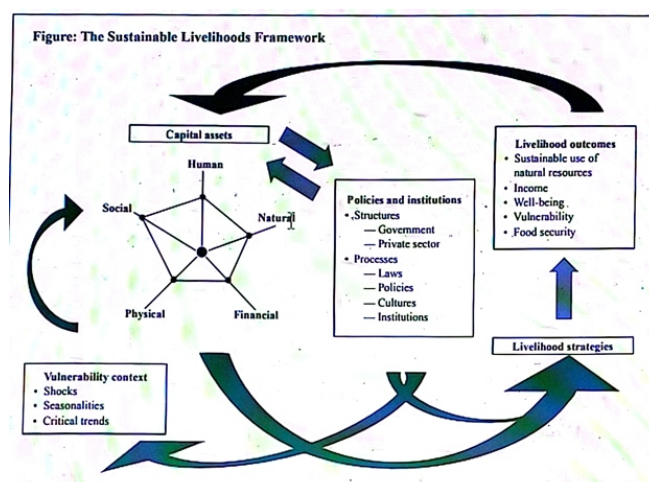


Fig 1: Assets of capital.

Vulnerability Context

Vulnerability is defined as insecurity in the well-being of individuals, households, and communities in the face of changes in their external environment. People move between poverty and adversity, and the concept of vulnerability better captures the processes of change than poverty line measurements. Vulnerability has two aspects: an internal side of defencelessness brought on by a lack of ability and means to cope with these; and an external side of shocks, such as conflict, illnesses, floods, storms, droughts, pests, and diseases;

and critical trends, such as demographic, environmental, economic, governance, and technological trends (Bhattacharya and Dey, 1953; Mukherjee, 2015).

Institutions and Policies

The environment of structures and procedures also changes livelihood choices and results, which are not solely reliant on capital asset availability or limited by the vulnerability setting. Structures are the public and private sector entities that establish and carry out laws and policies, provide services, make purchases, engage in trade, and carry out a wide range of other tasks that have an impact on people's quality of life (Sengupta, 1969).

The laws, rules, policies, agreements, operational arrangements, societal norms, and practices that ultimately dictate how structures function are all included in processes. Without the right organizations and procedures in place to carry out policies, policy-determining structures cannot function effectively. All facets of livelihoods depend on processes. They offer rewards that encourage people to make wiser decisions (Danda, 2002).

The land (Table 1) is among the most important natural resources. It covers only about thirty percent of the total area of the earth's surface and all parts of this small percentage are not habitable. The uneven distribution of population in different parts of the world is mainly due to varied characteristics of land and climate. The rugged topography, steep slopes of the mountains, low-lying areas susceptible to water, logging, desert areas, and thickly forested areas are normally sparsely populated or uninhabited. Plains and river valleys offer suitable land for agriculture. Hence, these are the densely populated areas of the world.

Table 1: The land area under the Forests District in West Bengal (in sq. kms).

Sl. No.	District	Reserved Forests	Protected Forests	Unclassed State Forests & Others	Total Area
1	Darjeeling	1115	-	89	1204
2	Jalpaiguri	1483	217	90	1790
3	Cooch Behar	-	42	15	57
4	Bakura	80	1311	91	1482
5**	Purba Medinipur	8	1166	535	1709
6**	Paschim Medinipur				
7	Burdwan	3	192	82	277

8	Purulia	112	729	35	876
9	Birbhum	8	54	97	159
10	Hooghly	3	-	-	3
11	Nadia	5	3	5	13
12	Murshidabad	1	7	-	8
13	Malda	8	5	7	20
14	Uttar Dinajpur	8	4	6	18
15	Dakshin Dinajpur				
16	24-Parganas(N)	43	-	-	43
17	24-Parganas(S)	4177	42	1	4220
18	Howrah	-	-	-	-
19	Calcutta	-	-	-	-
Total		7054 (59.38%)	3772 (31.75%)	1053 (8.87%)	11879 (100%)
All India		423,311	217,245	127,881	768,437

**Purba Medinipur & Paschim Medinipur Figures have been computed together.

Bonn Challenge and Forest Land

The Bonn Challenge is a global goal to bring 150 million hectares of degraded and deforested landscapes into restoration by 2020 and 350 million hectares by 2030. Launched by the Government of Germany and IUCN in 2011, the Challenge surpassed the 150-million-hectare milestone for pledges in 2017. The Bonn Challenge brings together countries that share borders, ecosystems, and economies in regional platforms to collaborate on common goals and challenges. These platforms help catalyze political will and ambition in restoring degraded lands.

Objectives of the Challenge

- The Challenge was launched by the Government of Germany and the IUCN Initially, the Bonn Challenge was launched with 2020 goals in Bonn, Germany in 2011.
- Afterward, at the 2014 UN Climate Summit, the goals were extended to 2030 by the New York Declaration on Forests.
- As of June 2021, 74 commitments have been made by various national governments, private companies, etc. The pledges total to 210 million hectares.
- The Bonn Challenge is aligned with the Sustainable Development Goals (SDG) in relation

to Aichi Targets, the Paris Climate Agreement, and the Land Degradation Neutrality (LDN) goal.

- The Challenge helps countries in the achievement of national priorities of food and water security and rural development. At the same time, it aids countries in achieving their commitments to mitigate land degradation, climate change, and biodiversity loss.
- The Challenge exhorts the achievement of their narrated goals through an approach to restoration called forest landscape restoration (FLR). FLR restores ecological integrity while enhancing human well-being.

The Village Jual Bhanga

The Forests of all categories maintain two tiers of canopy lairs to protect the environment. Trees are the first and shrubs the second canopy which protects the environment continuously, while assistance for maintaining livelihood sustenance of the forest dwellers is the other phenomenon, for protection of life and environment, in sighted in the Jual Bhanga village of Jhargram District, West Bengal. The tribes Lodha and the Santal are the residing communities with different socio-economic and socio-cultural nomenclature (Table 2).

Table 2: Forest-covered areas of Jual Bhanga.

SI No.	Forest covered areas	Ares in sq.ft	Lodha's dependence	Santal's dependence	Total dependence Lodha+Santal
1	Actual	1100sq.ft	49%	40%	2.8%
2	Floor area	1235sq.ft	30%	40%	2.2%
3	Canopy	900sq.ft	21%	20%	1.3%
4	Total	3200sq.ft	3.2%	3.2%	6.3%

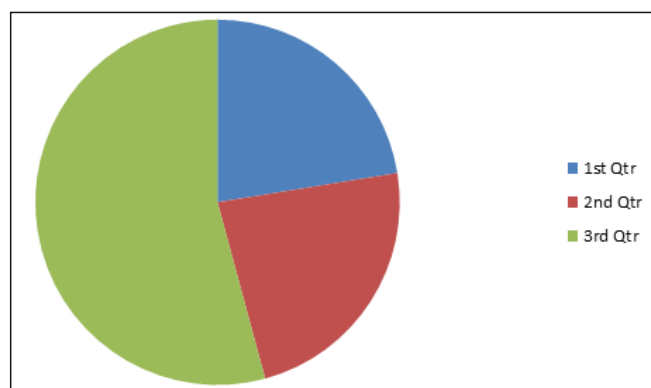
Table 2 exhibits the actual forest-covered areas of the village of Jual Bhanga. Total areas in sq. ft denotes 3200 sq. ft which is 6.3% of the total Jhargram Forest Covered land areas. The actual forest cover area is 2.8%, the floor area is 2.2% and the canopy is 1.3%. The forest restoration and building up a green laboratory is very important for the enhancement of the canopy according to floor management the forest rebuilt can ensure future propagation.

The Table 3 depicts the degree of dependence on the forest of the chosen forest-dwelling tribes who are residing in the village of Jual Bhanga. Regular dependence on the Lodha is higher than the Santal. Occasional and non-dependence show a high ratio in the case of Santal. Hence, forest dependence is still in vogue among the tribes for enameling forests as a source of all kinds of potentialities.

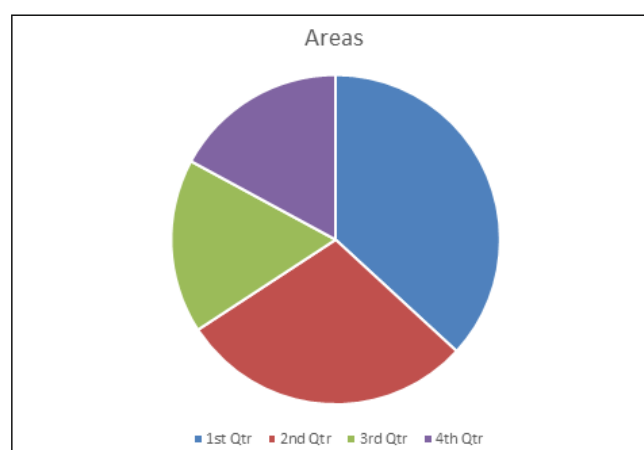
Table 3: Degree of Dependence on the Forest for Collections of Non-Timber of Minor Forest Produces.

SN	Name of the Selected Tribes	Total No of Population	Regular Dependence		Occasional Dependence		Non-Dependence	
			Total	%	Total	%	Total	%
01	Lodha	156	40	26%	35	23%	81	51%
02	Santal	58	08	14%	15	26%	35	60%
03	Total	214	48	22%	50	23%	116	54%

The degree of dependence on the forest in the above pie diagram shows the exact phenomena. 22% of the first qtr counts the regular dependence, 2nd qtr depicts 23% of the occasional dependence, and no dependence is exhibiting 54% (Fig. 2). Hence dependence continues at 45% and no dependence is 54% for the forest resides. Enabling restoration is needed.

**Fig. 2: Degree of dependence on the forest for collections of Non-Timber minor forest produces.**

The actual forest cover area is 2.8%, the floor area is 2.2% and the canopy is 1.3%. The forest restoration and building up a green laboratory is very important for the enhancement of the canopy according to floor management the forest rebuilt can ensure future propagation (Fig. 3).

**Fig 3. The actual forest covered areas of Lodha & Santal.**

Strategies and Results for Livelihoods

The goal of livelihood strategies is to attain livelihood results. A variety of factors, including intensification versus diversification, migration and remittances, grants and pensions, non-natural resource-based and off-farm activities, short-term versus long-term outcomes, and intensification versus diversification, may be taken into consideration while making decisions on livelihood choices. (Programs and projects that benefit some can also disadvantage others, which is one of the numerous issues with development.). More income, more well-being, decreased vulnerability, better food security, more sustainable use of the natural resource base, and restored human dignity are all possible livelihood outcomes, albeit there may be conflict between them.

The present investigation on Indian Boscage and its legal entity peers into the subdue factor needed for delineation of the Environmental Protection. Forest Floor Management through three-tier canopy development is a challenging counteract, which has been peered through community concerns of the village Jua Bhangra. The new method adds herbs at the lower rung of the canopy.

The herbs, shrubs, and trees are the three tiers Forest Canopy that protects the environment, ensures forest floor management, and enhances livelihood sustenance with the ushering of a new era, though the COVID-19 pandemic situation has enhanced and reduces carbon emission to some extent still for protection of rapid climate change and to propagate environmental challenge and its justness.

Technological upgradation is required up to the mark. Policy guidelines should be mass-oriented in accordance with Bio-diversity protection and Forest conservation through natural habitat.

Thereby, The Bonn Challenge is a global effort to bring about 150 million hectares of the world's deforested and degraded land into restoration by 2020, and 350 million hectares by 2030. Hence, the present study has been a proven fact which was emphasized in the village Jua Bhangra of Jhargram Forest Beat, Jhargram Forest Range, and Jhargram Forest Division of the Jhargram District of West Bengal, on the process of

forest restoration, forest floor management, plantation of new trees and protection thereof to elucidate India as a tree plantation laboratory at this 21st century.

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PHYTOCHEMICAL SCREENING FOR VARIOUS PRIMARY AND SECONDARY METABOLITES OF *OXYSTELMA ESCULENTUM* R. BR.

Laxmi Sharma and Rajendra Prasad

Department of Botany
Government College Bundi (Rajasthan)

Research Paper

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ABSTRACT

Oxystelma esculentum is an annual climber that grows around water logged area so it is also known as water climber: 'Jal-lata' or 'Jaldudhi' in Hindi. It belongs to the family Apocynaceae. The current paper deals with the qualitative analysis of *O. esculentum* which was done using ethanolic extract. It determined the presence of different types of primary and secondary metabolites in which proteins, carbohydrates, alkaloids, phenols, tannins, flavonoids, terpenoids showed more presence while glycosides and saponins showed moderate presence.

No. of Pages: 6

Keywords: Primary metabolites and secondary metabolites, *Oxystelma esculentum*, climber.

INTRODUCTION

Oxystelma esculentum is an annual climber. It grows around water logged area. Its common name is water climber while the vernacular name is 'Jal-lata' or 'Jaldudhi'. It belongs to the family Apocynaceae. It is an important medicinal plant that is used in the traditional system of medicine for its various ailments e.g., decoction and infusion of the plant are used to give treatment to mouth ulcers, sore throats, dysuria, chronic fever, and gonorrhoea, also as a hepatoprotective agent and blood purifier. These all-medicinal properties are due to the presence of different phytochemicals present in the plant. Phytochemicals are differentiated in primary metabolites and secondary metabolites based on their functions in plants. Primary metabolites contained carbohydrates amino-acids, proteins, and chlorophylls while secondary metabolites contained alkaloids, flavonoids, saponins, terpenoids, glycosides, tannins, and phenols etc. The current study has been performed to determine the phytochemical analysis of leaf, stem, and fruit of *Oxystelma esculentum*. The qualitative analysis is done using ethanolic extracts of the plant's samples.

MATERIALS AND METHODS

1. Collection of plant materials

The plant material selected for the current study is *Oxystelma esculentum* R.Br. belonging to the family Apocynaceae. It is commonly found in forests, thickets and open areas and thrive in various soil types with good drainage. It has white flowers with a yellow center, sometime tinged with pink or purple and are bell-shaped, nodding downwards. The flowers have pink or purple lines on the inside. The fruits are green, turning brown when ripe and contain small, dark brown seeds. It was collected in the month of September 2024 from the catchment area of Mangali river, Bundi district, Rajasthan (India). It categorized and identified by the Department of Botany and herbarium of this climber has been prepared and preserved in the Herbarium chamber of Department of Botany, Govt. College, Bundi.



Fig. 1: Flowers.

Fig. 2: Fruits *Oxystelma esculentum* R.Br

Fig. 3: Flowers and Leaves.

2. Preparation of Plant Extract

To prepare the extract the plant samples were washed with distilled water to remove the sediment particles. Then for drying the washed plant samples were absorbed on blotting paper and spread out in the shade at 25 to 26°C. A tissue blander was used to grind the dried plant parts and then the sample was preserved in refrigerator for future experimental use. Powered plant samples (60gm) were packed in thimble of Soxhlet apparatus and extracted with ethanol for 24 hours.

3. Phytochemical Analysis

The ethanolic plant extract of *Oxystelma esculentum* R.Br. were tested for primary metabolites such as proteins, carbohydrates, reducing sugars and fats & oils and secondary metabolites such as alkaloids, terpenoids, flavonoids, saponins, tannins, glycosides and phenolic groups etc. The phytochemical analysis of the plant extract was performed based on the standard methods.

Table 1: List of primary metabolites and secondary metabolite's test.

S. No.	Metabolites	Name of test
1.	Carbohydrates & reducing sugar	Molisch's test
		Benedict's test
2.	Proteins	Million's test
		Biuret test
3.	Fats and Fixed Oils	Saponification test
		Mayer's test
4.	Alkaloids	Wagner's test
		Hager's test
5.	Phenols & Tannins	Lead Acetate test
		Ferric Chloride test
6.	Flavonoids	Alkaline test
		Froth test
7.	Saponins	Horizon's test
8.	Terpenoids	
9.	Glycoside	Legal test

RESULTS AND DISCUSSION

The Qualitative phytochemical analysis of stem, fruits leaf, and root extracts of *Oxystelma esculentum* R.Br. in table no.2 summarized the presences of severable phytoconstituents. It reveals the presences of carbohydrates, proteins, fat & fixed oils, reducing sugar, alkaloids, flavonoids, glycosides, phenol, saponins, terpenoids, and tannins in the ethanolic plant extract in variable degree of precipitation such as copious, slight, and moderate in each tested plant extracts.

- **Carbohydrates and Reducing sugars:**

Presence of carbohydrates & reducing sugars has been analyzed through different tests (Molisch's test and Benedict's test). The results for carbohydrates and reducing sugars (Molisch's test and Benedict's test) revealed the high grade of precipitation (+++) in ethanolic plant extract of leaves and stems of *Oxystelma esculentum*, while, the same tests resulted in moderated degree of precipitation (++) in fruits extract.

- **Proteins**

Presence of proteins was analyzed using Millon's test and Biuret's test. In the ethanolic leaf extract of *Oxystelma esculentum*, Millon's test showed a higher degree of precipitation (+++), whereas Biuret's test indicated a moderate degree (++) in the stem extract, Millon's test showed a moderate degree (++) while Biuret's test revealed a higher degree (+++) of precipitation. In the fruit extract, Millon's test showed a mild degree (+), whereas Biuret's test indicated a moderate degree (++) of precipitation.

- **Fats & Fixed Oils:**

Presence of fats & oils has been analyzed through the Saponification test. The results for fats & oils (Saponification test) revealed the moderated level of precipitation (++) in ethanolic plant extract of stems, whereas, the same test resulted in mild degree of precipitation (+) in ethanolic plant extract of leaves and fruits of *Oxystelma esculentum*.

- **Alkaloids:**

The presence of alkaloids was analysed using Mayer's test, Hager's test, and Wagner's test. In the ethanolic leaf extract of *Oxystelma esculentum*, all three tests indicated a higher degree of precipitation (+++). In the fruit extract, all three tests showed a moderate degree (++) of

precipitation. In the stem extract, Mayer's test and Wagner's test revealed a moderate degree (++) of precipitation, whereas Hager's test showed a mild degree (+) of precipitation.

- **Flavonoids:**

Presences of flavonoids contents have been analyzed through Alkaline reagent test. The results of Alkaline reagents test for flavonoids revealed higher degree of precipitation (+++) in ethanolic extract of leaves, moderate degree of precipitation (++) in stems and mild degree (+) of precipitation in fruits extract of *Oxystelma esculentum*.

- **Phenols and Tannins:**

Presences of Phenols and Tannins have been analysed through two tests (Lead acetate test and Ferric chloride test). These tests shared same results as the both tests ascertained the presence of phenols and tannins with higher degree of precipitation (+++) in ethanolic plant extract of leaves, while, the same test resulted in mild level of precipitation (+) in stem extract and moderate degree of precipitation (++) in fruit extract of *Oxystelma esculentum*.

- **Saponins:**

Saponins in ethanolic plant extract revealed higher degree of precipitation (+++) in leaves, while, the same resulted in moderated degree of precipitation (++) in ethanolic plant extract of fruit and stem, independently froth test.

- **Terpenoids:**

Presences of terpenoid contents have been analysed through Horizon test. The results of this test showed higher degree of precipitation (+++) in ethanolic plant extract of leaves, while, the similar test result in moderated degree of precipitation (++) in fruit extract and mild degree of precipitation (+) in stem extract of *Oxystelma esculentum*.

- **Glycosides:**

Presence of Glycoside has been analysed through Legal test. The results of this test showed higher degree of precipitation (+++) in ethanolic plant extract of leaves, while, the similar test result in moderated degree of precipitation (++) in fruit and stem extract of *Oxystelma esculentum*.

Present finding is supported similar research worked by Ananth *et al.* (2010); Baswal *et al.* (2022); Gahtori *et*

al. (2024); Khatun *et al.* (2012); Panda (2019); Pandya and Anand (2011); Prabhakar *et al.* (2018); Prasad and Sharma (2014, 2016, 2018, 2019, 2020, 2021); Rahman *et al.* (2015); Ranganathan and Chinnaiyan (2011); Saini and Chauhan (2015); Savitha and Balamurugan

(2014); Savithramma *et al.* (2011); Sharma (2022); Sivakumar and Kavitha (2014); Uma *et al.* (2023); Venkataswamy *et al.* (2010). They evaluated various climber species which also support current research work.

Table 2: Qualitative analysis for primary metabolites and secondary metabolites in alcoholic leaf, stem, fruit and roots extracts of *Oxystelma esculentum*.

S. No.	Name of Phytochemicals	Name of Test	Extracted Plant Part	Results
1.	Carbohydrates and Reducing sugar	Molisch's test	Leaf	+++
			Stem	+++
			Fruit	++
		Benedict's test	Leaf	+++
			Stem	+++
			Fruit	++
2.	Proteins	Million's test	Leaf	+++
			Stem	++
			Fruit	+
		Biuret test	Leaf	++
			Stem	+++
			Fruit	++
3.	Fats & Fixed Oils	Saponification test	Leaf	+
			Stem	++
			Fruit	+
4.	Alkaloids	Mayer's test	Leaf	+++
			Stem	++
			Fruit	++
		Wagner's test	Leaf	+++
			Stem	++
			Fruit	++
		Hager's test	Leaf	+++
			Stem	+
			Fruit	++
5.	Phenols and Tannins	Ferric Chloride test	Leaf	+++
			Stem	+
			Fruit	++
		Lead Acetate test	Leaf	+++
			Stem	+
			Fruit	++

6.	Flavonoids	Alkaline reagent test	Leaf	+++
			Stem	++
			Fruit	+
7	Saponins	Froth Test	Leaf	+++
			Stem	++
			Fruit	++

CONCLUSION

In the current study, the phytochemical screening of *Oxystelma esculentum* R.Br. revealed the presence of various primary and secondary metabolites, including proteins, carbohydrates, fats, flavonoids, alkaloids, saponins, terpenoids, tannins, phenols, and glycosides. It is annual climber which easily found around Mangli river catchment area. It is beneficial in treating various diseases. These findings suggest that the plant may possess medicinal properties, supporting its traditional uses. Further studies are recommended to isolate and characterize these bioactive compounds and explore their potential therapeutic applications.

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ARTIFICIAL INTELLIGENCE (AI) FROM THE PERSPECTIVES OF SECURITY, ETHICAL AND PRIVACY ISSUES

S. K. Basu

PFS, Lethbridge, Alberta, Canada

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ABSTRACT

Artificial Intelligence (AI) has rapidly transitioned from a research discipline to a foundational component of critical infrastructure, commerce, education, healthcare, defence, and everyday digital services. This paper examines AI through the interconnected lenses of security, ethics, and privacy, arguing that these dimensions must be addressed holistically to ensure trustworthy and sustainable deployment. From a security perspective, AI systems introduce novel attack surfaces, including data poisoning, model inversion, adversarial examples, and supply-chain vulnerabilities, while simultaneously serving as defensive tools in cybersecurity operations. The dual-use nature of AI amplifies systemic risk, particularly as large-scale models are integrated into high-stakes environments. Ethically, AI systems raise concerns about bias, discrimination, opacity, and accountability. Algorithmic decision-making can reproduce or exacerbate societal inequalities when trained on skewed or unrepresentative data. The opacity of complex models challenges traditional notions of explainability and informed consent, complicating governance and redress mechanisms. Furthermore, the concentration of AI capabilities within a small number of powerful organizations creates asymmetries in power, access, and influence. Privacy considerations are equally pressing. AI's reliance on vast datasets, often containing sensitive personal information, heightens risks related to surveillance, re-identification, and unauthorized secondary use. Techniques such as differential privacy and federated learning offer partial mitigation but introduce trade-offs in utility, transparency, and accountability. Regulatory frameworks, including data protection laws and emerging AI governance regimes, struggle to keep pace with technological advances. The paper concludes that robust AI governance requires integrated security-by-design, ethics-by-design, and privacy-by-design approaches, supported by interdisciplinary collaboration, technical safeguards, regulatory oversight, and public engagement. Only by aligning technical innovation with normative principles can AI systems be deployed in ways that enhance societal welfare while minimizing harm.

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References: 10

Keywords: Artificial Intelligence, AI, ethical, privacy, government, public, security.

INTRODUCTION

Artificial Intelligence (AI) is the field of computer science focused on creating systems that can perform tasks that normally require human intelligence (Ikwanusi et al., 2023). In simple terms: AI is when machines are designed to think, learn, or make

decisions like humans (Lee, 2024). AI represents one of the most transformative technological advancements of the modern era, distinguished by its capacity to augment human capabilities, optimize complex systems, and generate innovative solutions across diverse domains (Ikwanusi et al., 2023; Khan,

2024). Among its most positive attributes is scalability: AI systems can process vast amounts of data with speed and precision far beyond human capability, enabling real-time insights and evidence-based decision-making (Ikwuanusi et al., 2023). This efficiency enhances productivity in sectors such as healthcare, education, finance, and transportation (Santosh and Gaur, 2022).

Another significant strength of AI is its consistency and accuracy in pattern recognition. By reducing human error and bias when properly designed and monitored, AI can improve diagnostic accuracy in medicine, strengthen fraud detection in finance, and enhance safety in industrial operations (Khan, 2024). Its adaptability through machine learning further allows systems to improve over time, refining performance as they encounter new data (Zhang et al., 2021).

AI also promotes accessibility and personalization (Gautam et al., 2022). Intelligent tutoring systems tailor educational experiences to individual learners (Ikwuanusi et al., 2023); while assistive technologies empower individuals with disabilities through speech recognition, computer vision, and natural language processing (Lee, 2024). In business and research, AI accelerates innovation by automating repetitive tasks, freeing human professionals to focus on creativity, strategy, and critical thinking (Shukla and Taneja, 2024).

Importantly, AI fosters global connectivity and collaboration. By enabling advanced communication tools, language translation, and knowledge discovery, AI reduces barriers across cultures and disciplines (Santosh and Gaur, 2022). When guided by ethical principles and human oversight, AI serves as a powerful tool for social good supporting sustainability initiatives, disaster response, medical breakthroughs, and inclusive growth (Khan, 2024).

AI-related privacy issues

AI brings huge benefits to our daily lives (Ikwuanusi et al., 2023); but, it also raises serious privacy concerns that directly affect how we live, work, and interact (Santosh and Gaur, 2022). Here's how AI-related privacy issues impact us:

Constant data collection: AI systems rely on large amounts of data to function. This means that smart phones track location, search history, and voice commands. Similarly, social media platforms analyze

posts, likes, and messages. Smart home devices record voice and usage patterns (Lee, 2024). For example, companies like Google, Meta, and Amazon collect behavioural data to personalize services (Ikwuanusi et al., 2023). One may feel like one is being constantly watched. Even ordinary activities searching online or talking near a smart speaker can generate personal data profiles (Khan, 2024).

Loss of personal control over information: AI can analyze and combine data from multiple sources to predict our political views, health conditions, shopping habits, and personality traits (Santosh and Gaur, 2022). Often, people don't know what data is collected, how it's used and who it's shared with (Ikwuanusi et al., 2023). One may lose control over his/her digital identity. Decisions about you may be made by algorithms without your knowledge (Shukla and Taneja, 2024).

Targeted advertising and manipulation: AI powers personalized advertising and content feeds. Platforms like YouTube and TikTok use AI to recommend content that keeps you engaged. One may see advertisements tailored to our specific fears, interests, or vulnerabilities. Content algorithms can influence opinions, buying decisions, and even political beliefs. Filter bubbles may limit exposure to diverse viewpoints (Ikwuanusi et al., 2023; Stahl, 2021).

Facial recognition and surveillance: AI-powered facial recognition is used in airports, and law enforcement (Santosh and Gaur, 2022). Some governments and companies deploy large-scale surveillance systems. Reduced anonymity in public spaces, risk of wrongful identification, potential misuse for mass surveillance, and monitoring are important steps (Gautam et al., 2022). This can affect freedom of expression and behaviour (Khan, 2024).

Data breaches and security risks: AI systems store massive datasets. When breached, they expose financial information, medical records, and private conversations. Identity theft, financial fraud, reputational damage, and emotional stress are common (Dhirani et al., 2023; Santosh and Gaur, 2022).

Bias and discriminatory decisions: AI systems can make decisions about loan approvals, and job applications (Lee, 2024). Insurance eligibility in the training data contains bias, and AI may unfairly disadvantage certain groups. Opportunities may be

limited based on flawed or biased algorithmic predictions often without transparency or appeal (Shukla and Taneja, 2024).

Deepfakes and identity misuse: AI can generate realistic fake videos, voice recordings, and images (Santosh and Gaur, 2022). Impact on life include reputation damage, fraud scams (*e.g.*, fake voice calls) and systematic spread of misinformation (Khan, 2024). It becomes harder to trust what we see and hear.

Dynamics of AI security

The future of AI security is shaping up to be one of the most important technology challenges of the next decade. As AI systems become more powerful and integrated into infrastructure, education, business, and defence, security will evolve across several key dimensions (Li and Zhang, 2017).

Attackers can manipulate AI inputs (*e.g.*, slightly altered images or data) to cause incorrect outputs (Li and Zhang, 2017). Future defences will include adversarial training, robust model architectures, and real-time anomaly detection (Stahl, 2021). Companies like OpenAI, Google DeepMind, and Anthropic invest heavily in preventing model stealing through secure APIs, watermarking outputs and hardware-based protections (Dhirani et al., 2023).

AI is increasingly used to detect zero-day vulnerabilities, monitor network anomalies and in automate incident response. Platforms from companies like CrowdStrike and Palo Alto Networks already integrate AI-driven threat detection (Gautam et al., 2022). Future systems will predict attacks before execution, use autonomous defensive agents, and coordinate across global threat networks (Khan, 2024). Unfortunately, AI also empowers attackers like automated phishing generation, deepfake scams, AI-generated malware, and social engineering at scale (Stahl, 2021). The rise of generative AI tools following breakthroughs like OpenAI's GPT models has dramatically lowered the barrier for sophisticated attacks (Lee, 2024). Future counter measures include deepfake detection systems, AI content authentication standards, and cryptographic identity verification (Dhirani et al., 2023).

Governments across the planet now treat AI as strategic infrastructure (Gautam et al., 2022). AI models may be classified as critical assets that export controls on advanced chips and increased AI weaponization concerns (Santosh and Gaur, 2022).

Countries like the United States and China are investing heavily in both AI capabilities and AI security frameworks. Hence, there is need for AI-specific cybersecurity regulations. The international AI arms control discussions, and mandatory model auditing (Shukla and Taneja, 2024).

AI governance and regulation: We are entering the era of AI policy involving risk-tiered regulations, mandatory transparency reports, as well as alignment and safety standards (Li and Zhang, 2017). The European Union AI Act is one of the first large-scale regulatory frameworks. Future trends will therefore focus around licensing requirements for frontier models, third-party safety audits and liability frameworks for AI harm (Lee, 2024).

Ethical and privacy issues of AI

Artificial Intelligence (AI) is rapidly transforming societies by enabling automation, predictive analytics, personalization, and decision-making at unprecedented scale (Stahl, 2021). While these systems promise efficiency, innovation, and economic growth, they also raise significant ethical and privacy concerns that challenge existing legal, social, and moral frameworks (Gautam et al., 2022; Lee, 2024). The ethical and privacy issues surrounding AI stem largely from its reliance on large-scale data collection, opaque algorithmic processes, and autonomous decision-making capabilities (Dhirani et al., 2023; Gautam et al., 2022).

One of the central privacy concerns in AI systems is mass data collection. AI models, particularly machine learning and deep learning systems, depend on vast datasets that often include personal, behavioural, biometric, and location-based information (Gautam et al., 2022). This data is frequently gathered through online platforms, smart devices, surveillance systems, and social media, sometimes without meaningful informed consent (Stahl, 2021). The aggregation and analysis of such data increase the risks of surveillance, re-identification of anonymized information, and misuse by corporations or governments. Even when anonymization techniques are applied, advances in data analytics can re-link anonymized datasets to identifiable individuals, undermining privacy protections (Zhang et al., 2021).

Another major ethical issue is bias and discrimination. AI systems learn patterns from historical data, which may reflect societal inequalities and prejudices (Gautam et al., 2022). When these biased datasets are

used to train models, the resulting systems can perpetuate or even amplify discrimination in areas such as hiring, credit scoring, healthcare, and law enforcement. For example, algorithmic decision-making tools have been criticized for disproportionately affecting marginalized communities (Gautam et al., 2022). This raises concerns about fairness, accountability, and the need for transparent auditing processes (Shukla and Taneja, 2024).

Transparency and explainability also present ethical challenges. Many advanced AI models, especially deep neural networks, operate as “black boxes,” making it difficult to understand how specific outputs are generated. This opacity complicates accountability when AI systems make harmful or erroneous decisions (Stahl, 2021). Individuals affected by automated decisions may lack the ability to challenge outcomes if the reasoning behind them is not interpretable (Gautam et al., 2022). The demand for explainable AI reflects the broader ethical principle that systems influencing human lives should be understandable and contestable (Li and Zhang, 2017).

Accountability and responsibility are closely linked concerns. When AI systems cause harm; whether through faulty medical diagnoses, autonomous vehicle accidents, or erroneous legal risk assessment, it is often unclear who should be held responsible: the developer, the deploying organization, the data provider, or the algorithm itself (Gautam et al., 2022; Khan, 2024; Lee, 2024). Existing legal frameworks struggle to address distributed responsibility in complex AI ecosystems, necessitating updated regulatory approaches and governance models (Ikwuanusi et al., 2023; Stahl, 2021).

Security risks further compound privacy issues (Ikwuanusi et al., 2023). AI systems are vulnerable to adversarial attacks, data poisoning, and model inversion techniques that can extract sensitive information from trained models (Khan, 2024). Such vulnerabilities threaten both individual privacy and broader societal security (Ikwuanusi et al., 2023; Stahl, 2021). As AI becomes integrated into critical infrastructure, healthcare systems, and financial markets, the stakes of these security breaches grow significantly (Gautam et al., 2022; Lee, 2024).

In response to these concerns, regulatory initiatives and ethical guidelines have emerged globally.

Frameworks such as the General Data Protection Regulation (GDPR) emphasize data minimization, user consent (Stahl, 2021); and the right to explanation in automated decision-making (Lee, 2024). International organizations, including UNESCO, have developed ethical AI recommendations promoting human rights, transparency, and accountability (Li and Zhang, 2017). However, enforcement challenges and rapid technological advancement continue to test the effectiveness of such measures (Khan, 2024).

A comprehensive response to ethical and privacy issues requires law + ethics + technology + participation + accountability, working together (Ikwuanusi et al., 2023; Stahl, 2021). This approach is especially crucial in areas like ethnomedicine, indigenous knowledge systems, biodiversity research, and digital data governance, where ethical failures can cause irreversible harm (Li and Zhang, 2017).

In conclusion, AI's ethical and privacy challenges are multifaceted and evolving. They encompass issues of data protection, bias, transparency, accountability, and security (Lee, 2024). Addressing these concerns requires interdisciplinary collaboration among technologists, policymakers, ethicists, and civil society (Ikwuanusi et al., 2023; Khan, 2024). Effective governance must balance innovation with safeguards that protect individual rights and promote equitable outcomes, ensuring that AI development remains aligned with fundamental ethical principles and democratic values (Ikwuanusi et al., 2023; Li and Zhang, 2017).

The big future question hangs around

Alignment- Can we ensure AI systems act in accordance with human values?

Autonomous Systems: How do we secure AI agents that can independently act online?

AGI risk: If Artificial General Intelligence emerges, security shifts from “cyber risk” to existential risk.

Where this is heading from the perspectives of 2026-2035 outlooks?

1. AI security becoming its own major industry.
2. Governments creating AI safety agencies.
3. AI red-teaming becomes mandatory.
4. Hardware-level AI isolation (secure AI chips).
5. Cryptographic proof-of-origin for all AI-generated content.

Conclusion and future directions

In summary, the positive attributes of AI lie in its efficiency, accuracy, adaptability, personalization, and collaborative potential. As a complement to human intelligence rather than a replacement, AI holds significant promise to enhance quality of life, drive economic development, and address some of the world's most complex challenges. AI privacy issues impact personal freedom, democracy, financial security, social trust and mental well-being. As AI becomes more integrated into daily life-smart cities, healthcare, education, and workplaces-privacy concerns become more significant. AI is not inherently bad. It improves healthcare, navigation, fraud detection, and accessibility. The real challenge is balancing innovation, data protection, ethical regulation and documentation. Many countries are developing privacy laws (like data protection regulations) to address these concerns, but technology evolves faster than regulation. Ethical and privacy-related issues can be addressed comprehensively only through a multi-layered, integrated approach that combines law, technology, institutional governance, and social awareness. Below is a structured framework that is widely applicable across sectors such as research, healthcare, technology, ethnomedicine, environment, and social sciences.

1. Strong legal and policy frameworks: Clear data protection laws (e.g., informed consent, data ownership, right to withdraw). Alignment with national and international standards (e.g., GDPR-like principles, India's Digital Personal Data Protection Act). Sector-specific ethical guidelines (research ethics, indigenous knowledge protection, biomedical ethics). Key outcome: Legal accountability and enforceable safeguards.

2. Ethical governance and oversight: Establish Ethics Committees / Institutional Review Boards (IRBs), Mandatory ethical impact assessments before any projects begin. Inclusion of diverse stakeholders (scientists, legal experts, community representatives) in the system to avoid bias, nepotism and corruptions. Key outcome: Ethical risks are identified and mitigated early.

3. Informed consent and community participation: Use free, prior, and informed consent (FPIC), especially for indigenous and tribal communities. Consent must be clearly explained, voluntary, culturally appropriate and there should be a process of ongoing consent, not a one-time formality. Key outcome: Respect for autonomy and cultural rights.

4. Data minimization and purpose limitation: Collect only necessary data, use data strictly for stated purposes, and avoid secondary use without renewed consent. Key outcome: Reduced risk of misuse or exploitation.

5. Privacy-by-Design and security measures: Anonymization and pseudonymization of personal data, and secure storage, encryption, and controlled access. Regular security audits and breach-response plans. Key outcome: Technical protection of sensitive information.

6. Transparency and accountability: Clearly communicate what data is collected, why it is collected, and who has access. Public disclosure of funding sources and potential conflicts of interest, and provide clear mechanisms for grievance redressal. Key outcome: Trust and institutional credibility.

7. Benefit sharing and fair use: Ensure equitable sharing of benefits, especially when using traditional knowledge or biological resources. Recognition, compensation, and co-authorship where appropriate. Compliance with access and benefit-sharing (ABS) frameworks (e.g., Nagoya Protocol). Key outcome: Prevention of biopiracy and exploitation.

8. Capacity building and ethical literacy: Regular training on ethics and privacy for researchers, practitioners, and administrators. Awareness programs for communities about their rights. Integration of ethics into academic curricula. Key outcome: Ethical culture rather than rule-based compliance alone.

9. Continuous monitoring and review: Periodic review of ethical practices as technologies and social contexts evolve. Adaptive policies responsive to emerging risks (AI, genomics, digital health). Key outcome: Long-term ethical resilience.

10. Ethical pluralism and context sensitivity: Respect cultural, social, and ecological contexts, and avoid one-size-fits-all solutions. Balance innovation with human dignity, ecological sustainability, and social justice. Key outcome: Context-appropriate and inclusive ethics.

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A REPORT ON THE NEGATIVE IMPACTS OF OVEREXERTION

E. Pandit¹ and S. K. Basu^{2*}

¹Senior Science Communicator, Indian Science News Association (ISNA),
Rajabazar Science College, Kolkata, West Bengal, India;

²PFS, Lethbridge, Alberta, Canada

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ABSTRACT

The report examines the harmful effects of overworking on individuals, organizations, and society. It highlights that high impact workouts without sufficient rest leads to serious physical, mental, and social consequences. One major impact identified is physical health deterioration. This increases the risk of cardiovascular diseases, high blood pressure, weakened immune function, chronic fatigue, and sleep disorders. Lack of recovery time prevents the body from repairing itself, leading to long-term health complications. The report also emphasizes mental health challenges. Prolonged workout-regime related stress contributes to anxiety, depression, irritability, and burnout. Employees who overwork often experience reduced concentration, memory problems, and emotional exhaustion, which can negatively affect job performance. In addition, overexertion harms productivity and organizational outcomes. Although longer hours may seem beneficial in the short term, sustained load decreases efficiency, increases errors, and raises absenteeism and turnover rates. The burnout can lead to reduced enthusiasm and engagement.. The report further discusses social and personal consequences, including strained relationships, reduced family time, and poor work-life balance. Over time, this imbalance can damage personal well-being and overall life satisfaction. In conclusion, the report stresses that overexertion is counterproductive and unsustainable. It recommends promoting a healthy balance, reasonable workout duration, supportive gym-policies, and regular rest to protect the trainees' well-being and maintain productivity.

No. of Pages: 5

References: 6

Keywords: Overexertion, negative, impacts, health, balance, stress.

INTRODUCTION

Exercise provides several health advantages and is essential for a healthy lifestyle. In the fast-paced world of today, exercise is absolutely essential (Ekelund et al., 2019). It enables the body to sustain its basic metabolic rate and helps in the preservation of both mental and physical health (Patterson et al., 2028). However, overtraining can have a number of detrimental consequences. Overtraining is when the body is subjected to excessive physical stress without enough time to recover. Initially stress from exercise

can trigger the body's adaptive response, which enhances physical performance, strength, and endurance. This delicate equilibrium is upset, nevertheless, by prolonged, intense exercise combined with insufficient rest periods (Ekelund et al., 2019, 2020).

Symptoms associated with over training are called Overtraining Symptoms (OTS). A very common OTS is rhabdomyolysis, which is caused by the breakdown of muscle tissue, which releases proteins such as

*Corresponding author: saikat.basu@alumni.uleth.ca

myoglobin and creatine kinase. Along with additional symptoms including muscle aches, weakness, black urine, and in extreme situations, decreased urine flow, it might harm the kidneys (Ekelund et al., 2016). Overtraining can lead to hormonal imbalances such as cortisol, testosterone, and growth hormone. These abnormalities might impair metabolism and muscle growth. Furthermore, overtraining can weaken the immune system, leaving people more vulnerable to infections, illnesses, and extended recovery times (Stamatakis et al., 2019).

Muscle strains, sprains, and injuries including runner's knee, tendinitis, and stress fractures can result from overexertion. Work-out enthusiasts also experience prolonged pain and stiffness in the muscles, due to overtraining. It can also cause chronic weariness and a drop in general energy levels. It negatively affects the body by weakening the immune system, leaving people more vulnerable to diseases and infections (Ekelund et al., 2016, 2019, 2020). Overtraining can cause irritation, mood fluctuations, and even depressive symptoms. Anxiety and despair can be exacerbated by the physical strain of over training. It can cause insomnia and poor sleep quality by upsetting sleep cycles (Patterson et al., 2018; Elekund e al., 2029) Excessive training without proper recuperation might result in diminished strength, endurance, and performance rather than the anticipated outcomes. Lastly, it may result in a decrease in total physical activity since it can sap motivation and enjoyment from working out (Guthold et al., 2019).

In this study, we decided to undertake a survey to understand the impact and effect of over training. The aim was to understand how over workout affected their physical and mental health. We also tried to find out the reasons behind overtraining. The study can help in building consciousness around overtraining, educate people about the negative impacts, and strategize easy preventive measures.

Methodology

The study is primarily based on an online survey. People staying in and around Kolkata, India were the survey participants. They were asked to fill a simple questionnaire that included the following questions:

1. Name-
2. Age-
3. Sex-
4. Ever experienced OTS?

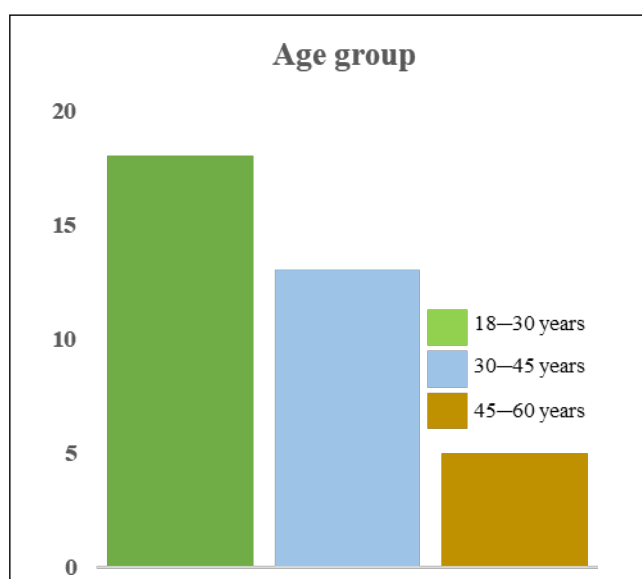
5. Type of work out practiced?
6. Is it a daily practice?
7. Any diet/workout practice that negatively impacted your health?
8. Describe the adverse effect of over training?
9. Ever misled by a trainer or coach?
10. If yes, share your experience
11. Did it affect your mental health?
12. If yes, how?
13. Share your thought: How to avoid negative impact of workout and only make it a positive experience

The survey was done vis Facebook messenger, WhatsApp and email. Some of the participants connected via calls to share their thoughts were recorded and later analyzed for the survey.

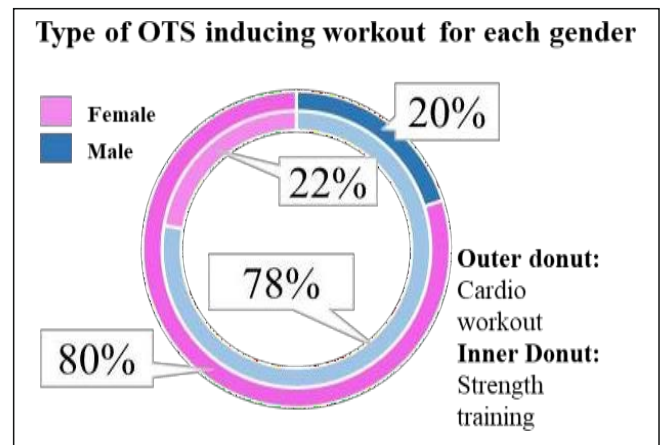
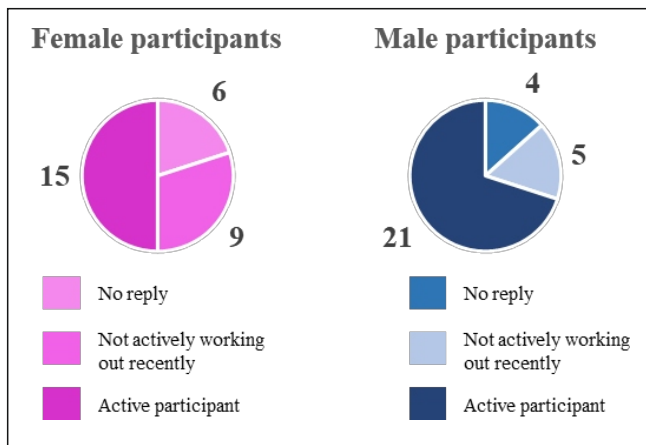
RESULT

Age group and gender of the participants

Participants of this survey were all above the age of 18. As children mostly exercise under adult supervision, they were not included for this survey. A majority of the participants were from the age group of 18-30 years (n=18), followed by the age group of 30-45 years (n=13). A few participants were from the 45-60 age group (n=5).

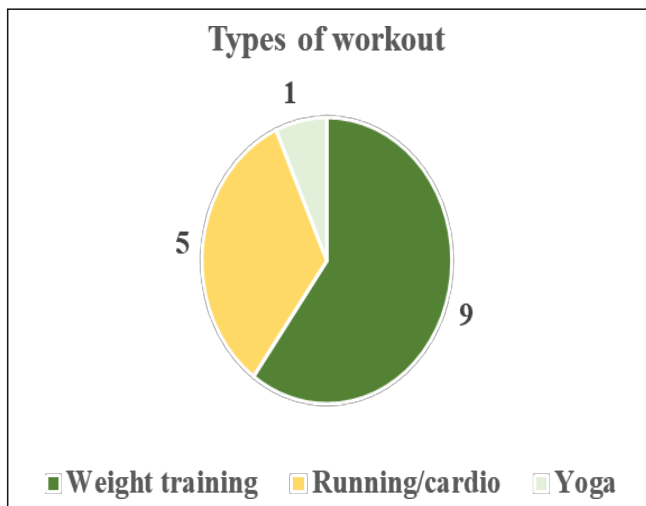


The survey was shared with a total of 60 members (30 female, 30 male), among which 36 were final participants. Members who did not reply to the survey or mentioned not actively working out over the past 6 months were not considered for the survey



Participants experiencing OTS and nature of their workout

Among the participants, a total of 15 participants reported experiencing OTS. 7 out of the 15 female participants experienced OTS (46.6%) and 8 out of 21 male participants confirmed their OTS experience (38%). A look into the kind of outwork practiced by the participants who experienced OTS revealed an interesting data.



9 participants experiencing OTS mentioned weight training was their primary workout, which was more than 60%. 5 participants stated that their primary workout involved cardiovascular activities like running (on field or in at treadmill). While majority of weight training induced OTS was seen among male participants, female participants mostly experienced OTS from cardio.

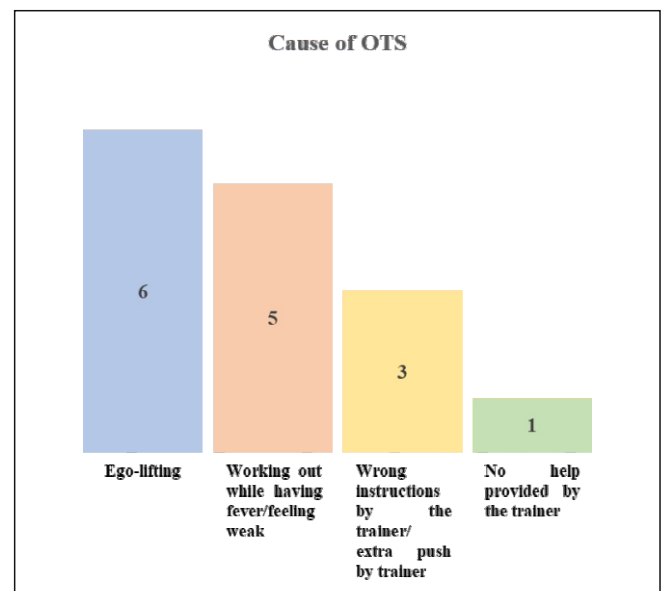
All the participants, barring one, mentioned that they work out regularly (4-7 days a week). All those who experienced OTS, workout for 6-7 days every week.

Adverse effect caused by overtraining

Participants have mentioned varied symptoms starting from back-ache to prolonged joint pain. Many participants mentioned experiencing multiple symptoms, often at the same time. The list of adverse effects has been listed below along with the number of participants who mentioned them.

- High fever and muscle pain (13)
- Back/lower back pain (10)
- Stiffness (9)
- Breathing issues (12)
- Sprain/ligament tear (7)
- Hormonal imbalance (3)
- Sleeping disorder (6)
- Headache and fatigue (15)

Some of the participants mentioned that they were hospitalized for issues like muscle tear, severe fever etc.

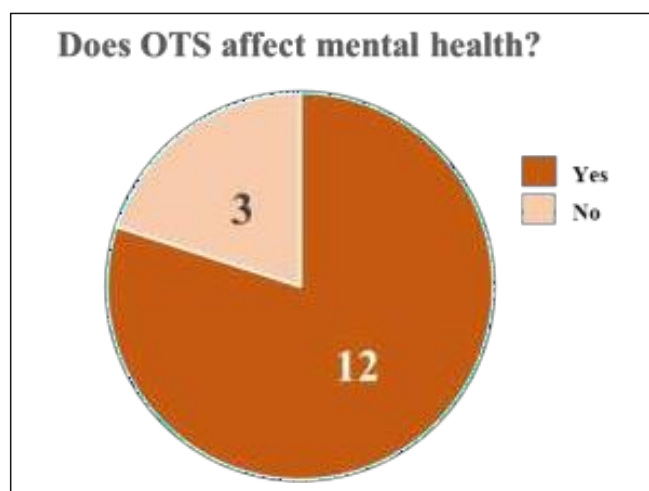


When asked about the reasons behind the OTS; participants mentioned some very common symptoms. While the majority of OTS symptoms among weight-training participants was because of ego-lifting (67% of weight lifters, 40% in general), around 33% experienced OTS after working out while being weak or feeling feverish. Lack of proper guidance or misguidance by trainers also played an important role in OTS symptoms among participants (27%).

Role of diet

The right diet plays an important role in replenishing the body for people who work out on a regular basis. The right balance of macro as well as micro-nutrients is a must to maintain the strength and agility. Many of the participants who experienced OTS were not following proper diet and were starving themselves to lose weight quickly (11/15). Some also mentioned not drinking water in between workout sets. This can be a major reason that causes muscle stiffness and soreness while working out.

Impact of OTS on mental health



Overtraining has been shown to have negative impacts on athletes' mental health, including an increase in eating disorders, depression, low motivation, and rage. Furthermore, up to 10% of athletes experience burnout as a result of overtraining; which has been shown to impair their mood, confidence, and sense of self and result in despair. In our study, most of the participants suffering from OTS, reported that their mental health was affected. Some of the other participants, who did not experience adverse physical effects of OTS, also mentioned being affected mentally. Some of the common symptoms mentioned included:

1. Complete loss of motivation to workout (3 participants)
2. Increased rage associated issues (10 participants)
3. Could not focus on job/family requirements (7 participants)
4. Did not want to socialize and only focus on training (3)
5. Desire to take shortcut measures (steroid intake) to get quick results

How to avoid the adverse effects of overtraining

The participants were also asked to share their thoughts on how to avoid the negative impact of workout and only make it a positive experience. Most of them mentioned that proper guidance and support is required to maintain a healthy workout routine throughout. Most of the participants who did not experience OTS mentioned that stretching before workout helps them to avoid the problem. Some participants mentioned that changing their focus from 'working out to lose weight' to 'working out to stay healthy' allowed them to avoid overtraining and associated complications.

Discussion

The survey helped to understand the most frequent adverse effects associated with overtraining. Individuals practicing weight-training 6-7 days every week often suffer from OTS. Strength training should be practised with adequate rest in between as that allows the body to recover. Lack of rest leads to stress and can increase the risk of injuries. The study also shows how important it is to understand the health conditions before working out. Self-evaluation is absolutely important and should be given to the body in case weakness or fever is experienced. Ego lifting is going to the gym to flaunt muscles and strength rather than to gain them. It is common among people who care more about their appearances than they do about improving themselves. It is often associated with increased risk of injury along with poor forms and stunted progress. It was also identified as a chief reason for OTS. Finding a good trainer to assist and guide during workouts is absolutely necessary. The study also focuses on that, showing how lack of right guidance causes adverse effects during training. The study also highlights how OTS affects mental health. Exercise would be uplifting for mental wellbeing. If certain workout routines are causing a negative impact on mental health, that requires change and modification.

Limitations

The study has certain limitations. The participants lacked diversity as most of them were urban dwellers from Kolkata. A bigger group of participants can help in drawing confirmatory conclusions. Also, most of the result is based on answers provided by the participants. Physical and mental evaluation of participants suffering from OTS can help in better understanding of the adverse effects.

Conclusion

Overtraining can be extremely harmful for the body. This study can be conducted among a bigger group of participants in the future to get more confirmatory data. Discussions with doctors, psychologists and other experts can help in chalking out a guideline that can make overtraining and related effects avoidable and make the workout sessions truly beneficial for the overall health of trainees.

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MANAGEMENT OF PEDICULOSIS CAPITIS (QUML/SUBIYAN) THROUGH CLASSICAL UNANI THERAPEUTICS: A CASE REPORT

Khan Iram Mohd Tayyab¹, Ifra Abdul Qaiyyum^{2*} and Naseem Akhtar Khan³

¹Department of Moalajat, A&U Tibbia College, Karol Bagh, New Delhi, India

²Department of Amraz-e Jild wa Tazeeniyat
Mohammadia Tibbia College and Assayer Hospital, Mansoor, Malegaon, Maharashtra.

³Department of Moalajat, A&U Tibbia College, Karol Bagh, New Delhi

Case Study

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ABSTRACT

Background: Pediculosis capitis, an ectoparasitic infestation caused by *Pediculus humanus capitis*, is prevalent worldwide and particularly affects children, though adults may also be afflicted. It commonly presents with pruritus, scalp irritation, excoriations, and may predispose to secondary bacterial infections. In Unani medicine, the condition is described as *Quml* or *Subiyan*, attributed to predominance of *Sauda* (black bile), inadequate hygiene, and humoral imbalance that favour parasitic proliferation.

Case Presentation: A 64-year-old female reported persistent lice infestation with severe scalp itching for one year, unresponsive to conventional anti-lice shampoos.

Management & Outcome: The patient was managed with topical application of vinegar diluted 1:1 with water, followed by fine-toothed combing for nit removal, and scalp cleansing with alum potash solution. After 1.5 months, both clinical and dermoscopic evaluation demonstrated complete clearance of infestation with significant symptomatic relief and no adverse reactions.

Conclusion: This case highlights the potential of Unani therapeutic measures—particularly vinegar and alum as safe, effective, and culturally acceptable alternatives for pediculosis capitis. Well-designed controlled studies are warranted to validate their efficacy and facilitate standardization.

No. of Pages: 4

References: 18

Keywords: Pediculosis capitis, Parasitic, Quml, Subiyan, Unani medicine, Vinegar, Traditional therapy.

INTRODUCTION

Pediculosis capitis (head lice infestation) is one of the most common ectoparasitic infestations worldwide, caused by *Pediculus humanus capitis* [1]. It predominantly affects school-aged children and adolescents and is strongly associated with poor hygiene, overcrowding, and low socio-economic conditions [2]. Though often perceived as a minor nuisance, infestation can lead to severe pruritus, excoriations, secondary bacterial infections, sleep

disturbance, and psychosocial stress, thus constituting a significant public health concern [3,4]. The human struggle against lice dates back to ancient times. Archaeological discoveries of bone combs and nit remain provide evidence of lice infestations since prehistoric eras [5]. In the modern era, scientific advances, especially the 19th-century contributions of Louis Pasteur, enhanced the understanding of parasitic life cycles and their prevention [6]. Contemporary medicine recognizes pediculosis

*Corresponding author: dr.ifraabdulqaiyyum@gmail.com

capitis as a blood-feeding ectoparasitic condition wherein lice bites introduce saliva, leading to itching and inflammatory reactions [7].

In Unani medicine, pediculosis capitis is described under the terms *Quml* and *Subiyan* [8]. Classical Unani physicians including Ibn Sina (*Al-Qanun fi al-Tibb*) and Zakariya Razi (*Kitab al-Hawi*) attributed the development of lice to humoral imbalance, particularly the predominance of *Sauda* (black bile), compounded by uncleanliness and deranged bodily states [9,10]. The condition is considered both a local manifestation and a systemic reflection of humoral derangement [11]. Treatment approaches in Unani emphasize *tanqiya* (elimination of morbid matter), external applications such as *sirka* (vinegar), *fitkari* (alum), herbal remedies, and strict personal hygiene [12].

With increasing resistance to conventional pediculicides and growing global demand for safe, natural, and culturally acceptable alternatives, Unani interventions offer promising management strategies [5]. This case report presents the successful treatment of pediculosis capitis with classical Unani therapeutics, highlighting their contemporary clinical relevance.

Case Presentation

A 64-year-old female patient was brought to the outpatient department with a one-year history of persistent scalp lice infestation and severe itching. She had previously used multiple allopathic anti-lice shampoos, but these provided no relief. The patient was managed with a topical application of vinegar diluted in water (50:50 ratio), followed by fine-toothed combing for nit removal. Additionally, scalp washing with alum potash solution was advised. After 1.5 months of treatment, both clinical and dermoscopic evaluations revealed marked improvement, with complete relief from infestation and no reported adverse effects. Dermatological examination showed multiple nits firmly attached to the scalp hair shafts, along with excoriation due to scratching. The patient reported continuous itching. No cervical lymphadenopathy or other systemic abnormalities were detected.

Diagnostic Assessment

The diagnosis of pediculosis capitis was established based on clinical examination and dermoscopy. Multiple live lice (adult and nymph stages) and viable nits were observed, firmly attached to hair shafts, predominantly in the occipital and parietal regions of

the scalp. The patient presented with persistent pruritus and scalp irritation. No cervical lymphadenopathy or systemic abnormalities were noted. Dermoscopic evaluation confirmed the presence of lice and nits, providing a definitive diagnostic assessment.(13)

Therapeutic Intervention

The patient was managed using classical Unani therapeutics combined with topical measures:

Oral Medications (14,15,16)

- **Qurs Kafoor** – 2 tablets twice daily, for blood purification and antiparasitic effect.
- **Habbe Musaffi Khoon** – 2 tablets twice daily, for systemic detoxification and humoral balance.

Topical Measures

- **Vinegar and water solution (50:50):** Applied to the scalp, followed by fine-toothed combing to remove nits. Vinegar softens the cementing material attaching nits to hair shafts, facilitating mechanical clearance. Thus, it enhances the mechanical clearance of lice and nits, making the treatment more effective. (14,15,16)
- **Alum (Potash) solution:** Dissolved in water and used for scalp washing once every 10 days.
- Daily gentle rubbing of the scalp with a rough cotton cloth after vinegar application was advised. (5)

The patient followed up every 15 days for 6 weeks. The regimen was continued for 1.5 months, with regular monitoring for response and adverse effects.

Follow-up and Outcome

Follow-up assessments were conducted at **baseline** and **1.5 months**:

- **Baseline:** Multiple live lice and nits were present, with severe pruritus and scalp excoriation.
- **1.5 months:** Complete clearance of lice and nits was observed. Significant reduction in itching and scalp irritation was noted. No adverse effects were reported.

The patient reported improved psychological well-being, confidence, and social interactions, while

family members observed a positive change in mood and overall comfort.

This case demonstrates that the Unani regimen was



Before Treatment

safe, effective, and well-tolerated, achieving complete resolution of chronic pediculosis capitis within 1.5 months.



After Treatment

Discussion

Pediculosis capitis is a common parasitic infestation affecting children and adults, particularly in settings of poor hygiene and overcrowding (17). In Unani medicine, it is described under the terms Quml or Subiyan, attributed to an abnormal predominance of Sauda (black bile), humoral imbalance, and uncleanliness (9). The condition manifests as scalp pruritus, irritation, and excoriation, consistent with classical descriptions in Persian/Unani texts.

The current case highlights a chronic pediculosis capitis in a 64-year-old female who had failed multiple conventional anti-lice treatments. This emphasizes the persistence of lice infestations in resistant cases and the need for alternative therapeutic approaches. Classical Unani theory supports the use of both systemic and local interventions, aimed at purifying the blood, restoring humoral balance, and mechanically removing parasites from the scalp (9,10).

In this patient, oral Unani medications Qurs Kafoor and Habbe Musaffi Khoon were administered to correct humoral imbalance and enhance systemic detoxification. These medications, combined with topical applications such as vinegar-water solution and alum washing, facilitated the mechanical removal

of nits and created a scalp environment unfavorable for lice survival. Vinegar, in particular, softens the cementing substance attaching nits to hair shafts, a principle also supported in modern pediculosis management for aiding mechanical clearance. (14,15,16).

The patient's follow-up at 1.5 months demonstrated complete clearance of lice and nits, with significant improvement in pruritus and scalp irritation, and no reported adverse effects. This outcome reflects the efficacy and safety of a holistic Unani approach, integrating systemic and topical therapy with attention to hygiene and scalp care. Psychological benefits, including improved confidence and social comfort, further highlight the patient-centered advantages of this regimen.

Modern treatments, such as permethrin cream, malathion, and dimethicone, primarily act as pediculicides targeting the lice nervous system or causing asphyxiation of parasites (Fasulo & Weems, 2015). While effective, these treatments are sometimes limited by resistance, recurrent infestations, or chemical sensitivities. In contrast, Unani therapy provides a culturally acceptable and low-toxicity alternative, particularly valuable in chronic or resistant cases.(18)

Furthermore, this case supports historical accounts of pediculosis management in Unani literature, where combined systemic detoxifiers, topical herbal formulations, and hygiene measures were emphasized. The holistic principles—correcting humoral imbalance, purifying blood, and removing local infestations—align with the observed clinical outcomes and demonstrate the continuing relevance of traditional therapies in modern practice.

Limitations: This is a single case report; larger controlled studies are needed to validate efficacy, determine standardized dosages, and assess comparative outcomes with conventional therapies.

Conclusion:

The Unani approach, combining systemic blood purification and topical mechanical removal, proved effective in resolving chronic pediculosis capitis in this patient. This therapy is safe, well-tolerated, and culturally aligned, offering a promising alternative or complementary strategy for managing persistent head lice infestations.

Patients' Perspective

The patient reported that scalp infestation had affected her confidence and led her to avoid social situations. After 1.5 months of Unani therapy, she noticed visible improvement, clearance of nits, and was satisfied with progress. She expressed hope for continued recovery and maintenance of scalp health.

Informed Consent

Written informed consent was obtained from the patient (or guardians where applicable) for publication of this case report and any accompanying images.

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Nil.

Conflicts of Interest

None declared.

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STUDY OF BEAK ADAPTATIONS AND THEIR FUNCTIONAL ROLES IN SOME BIRD SPECIES AT HARSI RESERVOIR, GWALIOR DISTRICT, (M.P.), INDIA

¹Jitendra Singh Kirar and ²Dushyant Kumar Sharma

¹Department of Zoology, Ambah P. G. (Auto.) College Ambah Morena (M.P.), India

²Department of Zoology, SMS Govt. Model Science College Gwalior (M.P.), India

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ABSTRACT

The wide variety of beak shapes in birds is commonly thought to reflect adaptations to different diets and feeding behaviours. However, because the beak also plays important roles beyond feeding and because most previously documented links between beaks and diet focus on size rather than shape it is still uncertain how much of beak shape diversity can be attributed to feeding ecology.

I quantified the relationship between beak shape and diet and found that diet is strongly and significantly correlated with beak shape in waterfowl. Ancestral reconstructions of beak shape, together with the inferred diet of the anseriform fossil *Presbyornis*, support filter-feeding as the ancestral condition for most waterfowl. This ancestral state was followed by multiple, significantly convergent transitions from a duck-like beak to a more goose-like form. The evolution of a goose-like beak is associated with increased leaf consumption, reduced intake of invertebrates, and greater mechanical advantage of the beak.

These findings indicate that feeding ecology has been the dominant selective pressure driving the diversification of waterfowl beak shapes, including the repeated, convergent evolution of geese. Rapid and convergent adaptation of the beak to feeding is therefore not unique to passerines, nor is it restricted to size-related changes in shape. The observed positive evolutionary relationship between mechanical advantage and herbivory further demonstrates that lever mechanics can account for the functional evolution of the kinetic upper beak in birds. Overall, the results suggest that functions other than feeding have likely played a relatively minor role in shaping overall beak diversity.

No. of Pages: 8

Keywords: Bird, Beak modification, Feeding behavior, Feet Adaptations Harsi Reservoir.

INTRODUCTION

Bird beaks are modified jaws covered by a hard, horny sheath known as the rhamphotheca. Since birds do not have teeth, the beak carries out all the functions related to feeding, including capturing, holding, cutting, crushing, and swallowing food. Through natural selection, beaks have evolved in different shapes and sizes according to a bird's diet, feeding habits, and habitat, leading to adaptive radiation.

Different bird species utilize a wide variety of food resources, such as seeds, insects, fish, nectar, fruits, and small vertebrates, through specialized beak adaptations. These adaptations enable birds to efficiently exploit specific food sources.

Beak size and shape are widely recognized as adaptations to the specific food resources available in a bird's environment (Storer 1971; Grant 1986; Gosler

1987; Benkman & Lindholm 1991; Smith 1993; Gosler & Carruthers 1994; Weiner 1995; Barbosa & Moreno 1999; Bardwell et al. 2001; Grant & Grant 2002; Marquiss & Rae 2002; Parchman & Benkman 2002; Temeles & Kress 2003). However, other potential functions of the beak have received comparatively less attention. Recent comparative research suggests that certain features of beak morphology may also be influenced by additional environmental pressures, such as the need to control harmful ectoparasites (Marshall 1981; Moyer et al. in press). For example, species with longer maxillary overhangs tend to carry fewer feather lice than species with shorter overhangs (Clayton & Walther 2001). Similarly, within a single species, populations exhibiting longer overhangs have lower louse burdens than those with shorter overhangs (Moyer et al. 2002b). Collectively, these findings indicate that the maxillary overhang likely plays an important role in ectoparasite control through preening.

Specialized beaks help reduce interspecific competition, allowing multiple bird species to coexist peacefully within the same habitat. Studying different types of beaks offers valuable insights into avian diet, behaviour, habitat preferences, and evolutionary patterns among species.

The remarkable diversity of bird beaks allows different species to occupy separate ecological niches with very little overlap. This specialization represents one of the clearest examples of evolutionary adaptation in birds, illustrating how structure is shaped by function in the design of nature.

MATERIALS AND METHODS

The study area, Harsi Reservoir, is constructed on the Parwati River and is located near Harsi village in Dabra Tehsil of Gwalior District, Madhya Pradesh (Fig.1). The reservoir lies approximately 100 km from Gwalior city. It was built across the Parwati River between 1928 and 1935. Harsi Reservoir is surrounded by hills and small hillocks on three sides and consists of a composite earthen dam. The dam is situated at latitude 25°57'59" North and longitude 77°58'00" East. The reservoir provides an important habitat and attracts a variety of migratory bird species.

Sampling was conducted from 6:00 a.m. to 11:30 a.m. in the morning and from 4:00 p.m. to 6:00 p.m. in the evening, with timings varying according to seasonal conditions. The study was carried out using two methods: (1) the Point Count Method (Javed and Kaul, 2002) and (2) the Line Transect Method. Photographs were taken using a digital camera (Nikon D-5300) for identification and documentation, while an Olympus

binocular was used for visual observation and counting. All observed aquatic bird species were recorded and identified with the help of field guide books by Grimmett et al. (1999) and Ali (2006).

BEAK MODIFICATION AND THEIR FUNCTION IN SOME BIRD

Modern birds lack teeth, and their upper and lower jaw bones are elongated to form a distinctive beak or bill. This beak is covered by a horny sheath known as the rhamphotheca. As the forelimbs are modified into wings for flight, they lose many of their original functions. These functions are largely taken over by



Fig. 1(a): A view of Harsi Reservoir.



Fig. 1 (b): A view of Harsi Canal.

the beak and feet, making the beak serve the roles of both the mouth and the forelimbs. The beak plays a crucial role in obtaining and handling food, preening feathers, gathering and arranging nesting materials, offense and defence, and feeding the young. Beaks exhibit remarkable variation in shape, size, and structure, reflecting their adaptation to different modes of life and feeding habits.

Beaks exhibit great diversity in shape, size, and structure. Some of the important modifications and types are as follows:

Seed-eating beak:

Granivorous, or seed-eating, birds possess strong,

stout, short, and conical beaks. These beaks are well adapted for cracking and crushing seeds. Examples include sparrows, finches, and cardinals. Birds with particularly strong and powerful beaks can break large and hard seeds, while those with smaller and comparatively weaker beaks are suited for picking up small seeds, which are either swallowed whole or crushed before eating.

Cutting Beaks:

Some birds have long, sharp, and slender beaks with cutting edges. These beaks are adapted for multiple functions such as cutting food, breaking eggs, and slicing fruits. An example of such a bird is the crow.



House sparrow (*Passer domesticus*)



House crow (*Corvus splendens*)



Parakeet (*Psittacula krameri*)

Fruit-Eating Beak:

Many birds feed primarily on fruits, and their beaks are specially adapted for breaking hard fruits, nuts, and tough seeds. Examples include parrots and hornbills.

In parrots, the beak is sharp, massive, deeply hooked, and extremely strong. This powerful structure enables them to crack open hard seeds and nuts with ease.

In hornbills, the beak is very large, heavy, and appears cumbersome. However, despite its size, it is relatively light in weight. The large beak, along with the casque on top, acts as a resonating chamber that helps the bird produce exceptionally loud calls.

Insectivorous Beak:

Many birds are insectivorous, and their beaks are specially adapted for catching insects, often while in flight. Generally, the beak is small, wide, and delicate. Examples include hoopoes, robins, and kingbirds.

In the hoopoe, the beak is long, slender, and slightly curved. It is used for probing into the soil or turning over leaves to search for insect grubs and pupae.

In flycatchers, such as kingbirds, the beak is short and strong. It is equipped with numerous rictal bristles at the base, which help in capturing insects during flight. Green bee-eater (*Merops orientalis*)



Green bee-eater (*Merops orientalis*)

Wood-Chiselling Beak:

This type of beak is long, straight, strong, and chisel-shaped. It is specially adapted for drilling into tree bark or wood to extract insect larvae and to excavate holes for nest building. The woodpecker is a typical example of a bird with this kind of beak.



Black rumped Flameback (*Dinopium benghalense*)

Tearing and Piercing Beak:

Carnivorous birds that feed on flesh, such as eagles, owls, kites, hawks, and vultures, possess short, pointed, sharp-edged, and strongly hooked beaks. These powerful beaks are specially adapted for tearing and piercing flesh. They are supported by well-developed mandibular muscles, which provide the strength necessary to grip and rip apart their prey. Examples include vultures, hawks, eagles, owls, and kites.



Spotted Owlet (*Athene brama*)

Fish-Catching Beak:

Aquatic birds possess long, strong, and sharply pointed beaks that are well adapted for catching fish, frogs, toads, and other aquatic animals. Examples include herons and kingfishers, whose beaks enable them to swiftly seize slippery prey.

In cormorants, the beak is long and narrow, with edges that bear sharp, backwardly directed tooth-like projections. These structures help in firmly gripping and holding fish once they are captured.



Kingfisher (*Halcyon smyrnensis*)

Mud-Probing Beak:

Birds with mud-probing beaks, such as lapwings, sandpipers, stilts, and snipes, have extremely long and slender beaks. These beaks function as elongated probes, allowing the birds to thrust them deep into water or soft mud in search of worms, larvae, and other small invertebrates. Examples include lapwings, sandpipers, stilts, and snipes.



Common Greenshank (*Tringa nebularia*)

Water and Mud-Straining Beak:

This type of beak is broad and flat, with the edges of the jaws modified into horny serrations or transverse lamellae. These lamellae act like sieves, allowing water and mud to pass out while retaining food particles in the mouth. Birds with this adaptation include ducks, teals, geese, and flamingos.



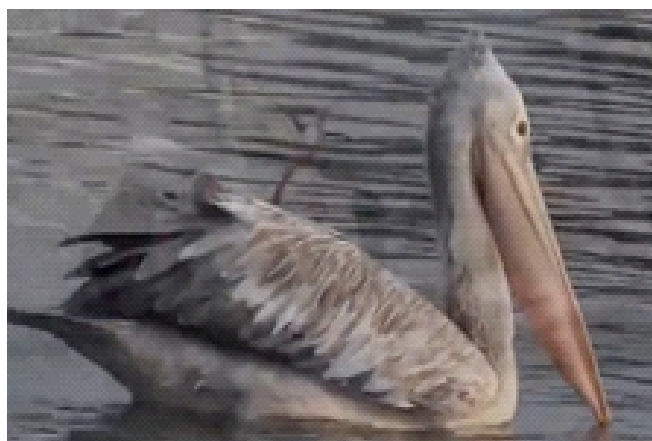
Swan Goose (*Anser cygnoides*)

Spatulate Beak:

The spoonbill has a highly specialized spatulate beak, which is flattened along its entire length and widens into a broad, spoon-like tip. This unique shape is adapted for dabbling in water and mud to search for insects, fish, worms, mollusks, and other small aquatic animals.



Eurasian Spoonbill (*Platalea leucorodia*)



Grey pelican (*Pelecanus philippensis*)

Pouched Beak:

Birds such as pelicans, which consume large quantities of fish, have a large beak equipped with an extensible gular pouch attached to the lower mandible. This pouch functions like a fishing net, allowing the bird to scoop up and hold significant amounts of water and fish at a time.

Flower-Probing Beak:

Birds that feed on the nectar of flowers develop long, slender, and pointed beaks. These beaks are specially adapted for reaching deep into flowers to suck nectar and sometimes capture small insects. Examples include hummingbirds and sunbirds.



Purple Sunbird (*Cinnyris asiaticus*)

RESULTS AND DISCUSSIONS

All birds possess bills, or beaks, and these structures vary greatly in form. Because of this wide variation, bills are often used as an important characteristic for distinguishing among bird species. Although birds lack teeth as adults, their embryos briefly develop them. The bill itself is covered by a hard, horny sheath. Many differences in bill shape are linked to specialized feeding habits. However, bills are not used only for feeding. They also play roles in several other behaviours. Some birds use their bills in ritualized displays, such as threat or appeasement displays. In addition, bills can be used for digging, building nests, sewing leaves together, drilling into wood, and performing many other tasks.

Watching different species of birds feed creates a sense of wonder at the wide range of foods they consume and the diverse shapes of their bills that are adapted for obtaining them. Birds eat many kinds of items, including nuts, hard and soft seeds, insects, larvae, roots, flowers, sap, fungi, nectar, carrion, and other

Table 1: Type of Beak and Their Functional Roles in Some Bird Species at Harsi Reservoir, Gwalior district.

S. No.	Type of Beak	Shape	Use	Example
1.	Seed-eating	Strong, Conical, Base broad, pointed tip	Cruses hard seed	sparrows, finches, and cardinals.
2.	Cutting and Biting	Strong, long, slender, sharp edge	Cutting and biting	crow
3.	Fruit-Eating	Sharp, hooked, strong	Breaking hard fruits	parrots and hornbills
4.	Insectivorous	Small, wide, delicate	Catching flying insect	hoopoes, robins, and Green bee-eater
5.	Wood-Chiselling	Long, straight, chisel like	Drilling into wood	woodpecker
6.	Tearing and Piercing	Short, hooked, sharp	Scavenger birds	vultures, hawks, eagles, owls, and kites
7.	Fish Catching	Sharply pointed, saw like	Capture fish, frog, etc	kingfishers
8.	Mud-Probing	Long, slender	Catching flying insect	lapwings, sandpipers, stilts, and snipes.
9.	Water and Mud Straining	Broad, flat, transverse lamellae	Straining food from mud and water	ducks, teals, geese, and flamingos.
10.	Spatulate	Flat, spoon shape	Dabbling into water and mud	Eurasian Spoonbill
11.	Pouched	Pouch like extension	Acts as fishing net	pelicans
12.	Flower-Probing	Long, pointed	Nectar of flower	hummingbirds and sunbirds

organic materials. The form of a bird's bill reflects its adaptation to particular types of food. Although it is impossible in a short discussion to describe all the variations in bill size and shape, examining a few examples helps illustrate the remarkable design and function of these structures.

In carnivorous birds of prey, such as falcons and owls, the beak functions like a meat hook. These birds usually capture prey with their feet and kill it by biting the neck and dislocating the cervical vertebrae. Their bills contain a feature called a tomial tooth on each side of the upper bill, located just behind the curved tip. A corresponding notch in the lower mandible fits into this tooth, helping the bird grip and tear flesh.

Birds that catch insects in flight, such as flycatchers, have broad, slightly hooked beaks. Many also possess long bristles or feathers at the base of the bill, which help them detect and capture fast-moving insects while flying.

Different shapes and types of bills and beaks serve a variety of functions. One fascinating specialization can be seen in the beaks of tropical fruit pigeons. These birds feed on large fruits, and their bills can open not only vertically but also horizontally, similar to the jaws of a snake when it swallows large prey. Another remarkable example is the beak of the toucan, which acts as a natural radiator, helping to cool the bird while it searches for food.

The woodpecker finch, found only in the Galápagos Islands, also shows an unusual adaptation. Unlike typical woodpeckers that use their long tongues to pull insects from trees, the woodpecker finch has a relatively short beak and tongue. To compensate, it uses tools such as cactus spines to probe into crevices and extract insects. In general, the shape of a bird's beak is closely related to its function. In some species, males and females have different types of beaks. The male has a relatively straight and sharp beak, while the female possesses a thinner, longer beak that curves

downward. Males use their strong beaks to break open the tunnels of grubs found in dead wood. Once the tunnels are opened, females use their longer, curved beaks to extract the grubs. These differences in beak structure between males and females reflect a unique division of labour during feeding.

These examples clearly show how bird bills have evolved to suit specific feeding habits. In some species, the bill has become so specialized for a particular type of food that the survival of the bird depends entirely on the availability of that food source. Thus, the study of bird bills continues to provide valuable insights into evolution and the history of life on Earth.

Anatomically, a bird's bill consists of a compact, modified layer of epidermal cells that forms around the bony core of the upper and lower jaws, known as the mandibles. The bill is usually hard and thick, but it is not completely rigid. Depending on the species, bills can bend or twist to varying degrees. Despite their strength, bills are relatively light for their size, which is one of the many adaptations that help birds maintain the ability to fly.

Although birds do not have teeth, some bill structures perform functions similar to them. For example, certain bills have sharp edges that can cut or tear food. In addition, birds possess specialized bony and muscular structures that work together with the bill to handle the physical stresses involved in feeding.

It is also interesting to note the location of birds' nostrils. In most species, the nostrils are located near the base of the upper mandible, though there are a few notable exceptions.

In some bird species, such as pelicans, certain structures or projections develop on the bill only during the breeding season. These features are temporary and are shed after the reproductive period ends.

Another example is the puffin, which has a brightly coloured, triangular-shaped bill. During the breeding season, scales appear on both the upper and lower mandibles of the bill. These scales are believed to play a role in courtship and mating displays.

CONCLUSION

Birds use their beaks for many important purposes. Different birds have different types of beaks that help them survive in their environment. Beaks are used for

eating food, catching prey, breaking seeds, drinking water, building nests, feeding their young, and protecting themselves. The shape and size of a bird's beak are specially adapted to the type of food it eats and the way it lives. Therefore, the beak is a very important and useful part of a bird's body that helps it live and survive in nature.

Different bird species have evolved distinct bill shapes that help them obtain and consume specific types of food, illustrating the concept of adaptive radiation. A well-known example is the finches of the Galápagos Islands and the Hawaiian honeycreepers. These birds adapted to their environments by developing specialized bills suited to different food sources such as seeds, insects, and nectar.

In some species, sexual dimorphism is also seen in bill structure, meaning that males and females have different bill shapes or sizes. These differences often relate to their specific feeding roles. In addition, certain species experience seasonal changes in bill coloration, usually influenced by hormonal changes during breeding periods.

Overall, the wide range of shapes and specializations seen in bird beaks and bills reflects their evolutionary adaptations to different ecological niches and feeding strategies.

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JEALOUSY-VISITING FROM MULTIPLE PERSPECTIVES

Saikat Kumar Basu^{1*}, Sutapa Badhan² and Alminda Magbalot-Fernandez³

¹Executive Research Director, PFS, Lethbridge, Alberta, Canada

²Clinical Psychologist, RCI Registered (Special Educator-Autism Spectrum Disorder) & Counsellor, and Secretary-Education Counselling and Helping Organization (ECHO), Kolkata, West Bengal, India

³Vice President for Academic Affairs, Rizal Memorial Colleges, Inc., Davao City Philippines

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ABSTRACT

Jealousy, in philosophical terms, is a complex emotional state that encompasses feelings of insecurity, fear, resentment, or envy over a perceived threat to something valued, such as relationships, status, or possessions. Philosophers throughout history have examined jealousy as a moral, psychological, and existential phenomenon, offering diverse perspectives on its nature, origins, and implications. Jealousy is understood as a mix of emotions—often involving insecurity, envy, or fear—that arises when someone perceives a threat to something they value, such as a relationship, status, or possession. It is closely tied to comparisons with others and often reflects societal expectations and insecurity. This article introspects jealousy from the multiple perspectives through the lens of literature, society, culture, religion and mental health.

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INTRODUCTION

Jealousy is often linked to romantic relationships, where it is viewed as a natural but potentially destructive emotion when one feels insecure or threatened by a third party. In some cultures, jealousy may stem from disparities in wealth, success, or beauty, highlighting societal pressures to achieve certain benchmarks. It can also manifest in friendships, families, or workplaces, often shaped by cultural norms about loyalty, fairness, or competition. In individualistic cultures, jealousy might be more tied to personal achievements or romantic exclusivity. In collectivist societies, it may stem from maintaining group harmony or fulfilling familial expectations. It is both a universal emotion and one deeply influenced by the context and values of the culture in which it

occurs. Jealousy is often described as "feeling protective" or "possessive" over something or someone. It can also be shorthand for envy when people want what others have, even though envy and jealousy are distinct in more formal definitions.

Jealousy from a Literary Perspective

In literary terms, jealousy is often depicted as a complex and powerful emotional state arising from feelings of insecurity, fear, or resentment over a perceived threat to something one values—usually a relationship, status, or possession. It is a common theme in literature and is used to explore the depths of human emotion and behaviour.

Jealousy is typically associated with characters experiencing:

*Corresponding author: saikat.basu@alumni.uleth.ca

Romantic rivalry-A fear of losing a loved one to someone else (e.g., Othello's jealousy in Shakespeare's Othello).

Envy-A desire for someone else's success, possessions, or qualities (e.g., Iago's jealousy of Cassio's promotion in Othello).

Possessiveness-An obsession with maintaining control over someone or something (e.g., Heathcliff's possessive jealousy in Emily Brontë's Wuthering Heights).

Literary works often use jealousy to drive conflict, develop characters, and reveal deeper themes such as the destructive power of obsession, the fragility of trust, or the consequences of unchecked emotions. Authors may also use jealousy as a metaphor for larger societal issues, like class tension or ambition. In classical literature and socio-cultural studies, jealousy is often defined as a complex emotional response that arises from a perceived threat to one's social, romantic, or personal relationships.

This emotion typically encompasses feelings of insecurity, fear, resentment, and a desire to protect or possess what one values deeply. From the perspective of pure literature, jealousy has traditionally been depicted as a powerful, consuming force that drives individuals to extreme actions, often leading to moral or tragic consequences. Examples from classical works include Othello by Shakespeare, where jealousy leads to destructive betrayal and loss, or the Iliad, where Helen's relationships spark envy and rivalry among powerful leaders. This depiction often shows jealousy as irrational yet deeply human, a force that can override logic and royalty.

Jealousy from the Perspective of the Society and Culture

Socio-culturally, jealousy reflects societal values around ownership, honour, and fidelity. For example, in many traditional societies, jealousy was tied to the preservation of family honour and social status. In patriarchal contexts, male jealousy was often linked to control over a partner's fidelity, emphasizing property-like dynamics in relationships. In communities, jealousy could also arise from competition over social standing, possessions, or power, leading to rivalry. Across cultures, jealousy has also been understood as a form of social control, intended to maintain established norms and deter deviations from social expectations, such as infidelity or perceived betrayal

within alliances. This classical literary and socio-cultural definition of jealousy presents it as an intense, socially grounded emotion that surfaces in response to real or imagined threats to personal bonds and social order. This interpretation highlights jealousy's role as both a reflection of personal insecurity and a mirror of societal expectations.

Jealousy from the Perspective of Eastern Philosophy

Indian and Eastern philosophical traditions offer profound insights into understanding and managing emotions like jealousy. In Indian thought, jealousy is seen as a product of ego, attachment, and ignorance, which obstruct spiritual growth and inner peace. Here are perspectives from key Indian philosophical systems:

1. **Vedanta Root Cause:** In Vedanta, jealousy (matsarya) arises from identifying oneself with the ego (ahankara) and being attached to material possessions, relationships, or achievements. It is a result of ignorance (avidya) about the true Self (Atman), which is beyond comparisons. The Vedanta teaches that understanding the unity of all beings and realizing the Self eliminates jealousy. By cultivating detachment (vairagya) and self-awareness through meditation and knowledge (jnana), one can overcome jealousy.
2. **Bhagavad Gita Teachings on Jealousy:** The Gita addresses jealousy as an outcome of desires and attachment to the fruits of actions. In Chapter 16, Lord Krishna categorizes jealousy as a quality of the demonic nature (asuri pravritti), which leads to suffering. Lord Krishna emphasizes the importance of selfless action (karma yoga) and devotion (bhakti yoga). By dedicating one's actions to a higher purpose and cultivating contentment, jealousy dissolves.
3. **Analysis of Jealousy in Buddhism:** In Buddhism, jealousy is a form of mental defilement (kilesa), rooted in craving (tanha) and aversion (dosa). It arises from comparing oneself to others and clinging to the illusion of "I" and "mine". The antidote to jealousy is cultivating mudita (sympathetic joy), which involves feeling happiness for others' success. Mindfulness (sati) and meditation (vipassana) help recognize and dissolve the arising of jealousy in the mind.
4. **Perspective of Jealousy based on Jainism:** In Jain

philosophy, jealousy is considered a form of internal violence (antaraya karma) because it disturbs the peace of the soul and creates negative karmic bonds. Practicing non-possessiveness (aparigraha) and contentment can help overcome jealousy. By focusing on self-purification and inner progress, one avoids unhealthy comparisons.

5. **Yogic Philosophy on the Obstacles to Inner Peace:**

In the Yoga Sutras of Patanjali, jealousy can be seen as a manifestation of kleshas (afflictions) like raga (attachment) and dvesha (aversion), which disrupt mental clarity. Patanjali recommends the practice of pratipaksha bhavana (cultivating opposing thoughts). For jealousy, this means replacing it with gratitude and kindness. Regular meditation, self-discipline (tapas), and ethical living (yamas and niyamas) help calm the mind and transcend jealousy.

6. **Bhakti Traditions Jealousy in Devotion:**

Bhakti traditions view jealousy as a distortion of love and devotion. For example, in Krishna's leelas, episodes of jealousy among the gopis are transformed into deeper love and surrender. By cultivating unconditional love and surrender (prapatti) to the divine, devotees transcend jealousy, experiencing unity with God and others.

7. **Jealousy as explained in Sankhya Philosophy:**

Sankhya attributes jealousy to the dominance of rajas (activity and restlessness) in the mind, leading to competition and comparison. Practicing equilibrium (sattva) through introspection, detachment, and disciplined living helps overcome jealousy.

8. **Key Practices to Address Jealousy as explained in**

Taoism, Laoism and Confucianism: Recognizing jealousy without judgment and letting it pass. Practicing gratitude for what one has and celebrating others' achievements; and understanding the impermanence of external achievements. Realizing the interconnectedness of all beings and aligning with a higher purpose.

Indian philosophy emphasizes that jealousy is not an inherent trait but a conditioned response. Through self-awareness, ethical living, and spiritual practice, one can transcend jealousy and cultivate a state of inner peace and contentment.

Jealousy from the Perspective of Western Philosophy

Jealousy, from the perspective of Western philosophies, has been explored in various ways, reflecting its complexity as both an emotional and moral experience. Different traditions and thinkers provide distinct interpretations of jealousy and its role in human life. Here's an overview:

1. **Ancient Greek Philosophy**

Plato: In dialogues like *Phaedrus* and *The Symposium*, Plato associates jealousy with desires rooted in the material world. He views it as a lower, irrational emotion that stems from attachment to transient things and obstructs the pursuit of higher ideals like truth, beauty, and the good.

Aristotle: In *Nicomachean Ethics*, Aristotle distinguishes jealousy (zelos) from envy (phthonos). Jealousy can be seen as a response to the fear of losing something valued, often tied to love or competition. For Aristotle, emotions like jealousy are not inherently bad but need moderation and must serve virtuous purposes.

2. **Stoicism:** The Stoics, including thinkers like Seneca, Epictetus, and Marcus Aurelius, viewed jealousy as a disruptive emotion that arises from attachment to external possessions or relationships. According to their teachings jealousy stems from the false belief that external things (e.g., a partner, status, or wealth) are essential for happiness. They encouraged practicing apatheia (freedom from destructive emotions) by focusing on what is within our control and aligning oneself with reason and virtue.

3. **Early Christian Philosophy**

St. Augustine: In works like *Confessions*, Augustine addresses jealousy in the context of sin and human relationships. He sees it as a manifestation of pride and insecurity, emerging from a lack of trust in God. Augustine considers jealousy a spiritual disorder that damages love and fosters separation.

Thomas Aquinas: In *Summa Theologica*, Aquinas discusses jealousy as a form of sorrow over another's good, tied closely to envy. He classifies it as a vice but emphasizes that it can be redirected when moderated by virtue, such as when it inspires self-improvement.

4. **Enlightenment and Modern Philosophy**

David Hume: Hume, in *A Treatise of Human Nature*,

explores jealousy as a product of comparison and the human tendency to measure oneself against others. He considers it a passion driven by pride and self-interest, influenced by social dynamics and competition.

Jean-Jacques Rousseau: Rousseau links jealousy to inequality and social comparison. He suggests that jealousy is exacerbated by societal structures that promote competition and materialism, rather than fostering natural human compassion.

Immanuel Kant: Kant associates jealousy with a lack of moral maturity, as it represents a fixation on external circumstances rather than adherence to the moral law. For Kant, jealousy undermines autonomy and reason.

5. Existentialism

Søren Kierkegaard: Kierkegaard, in exploring emotions like anxiety and despair, indirectly touches on jealousy as a reflection of insecurity and a failure to ground oneself in authentic selfhood. Jealousy arises when individuals derive their identity from others rather than from their relationship with the infinite.

Jean-Paul Sartre: Sartre views jealousy as an expression of human freedom and the "look" of others. In *Being and Nothingness*, he argues that jealousy arises when people see others as threats to their own subjectivity or freedom, revealing the tension between self and others.

6. Psychoanalysis and Postmodern Thought

Sigmund Freud: While not a philosopher in the traditional sense, Freud's ideas profoundly influenced Western thought. Freud interprets jealousy as a complex emotional state rooted in unconscious desires, particularly related to love and rivalry, often tracing its origins to childhood experiences.

Postmodernism: Thinkers like Michel Foucault and Jacques Derrida examine jealousy in the context of power, identity, and language. They explore how social structures and cultural narratives shape emotions like jealousy, suggesting it is not purely personal but deeply shaped by external forces.

Key Themes Across Western Philosophy

Emotional Regulation: Many traditions emphasize the need to moderate jealousy through reason and self-awareness. Jealousy is often framed as a moral failing, though some philosophers recognize its potential to

inspire personal growth. It is frequently tied to relationships, whether romantic, competitive, or social, reflecting humanity's interdependence. Jealousy often reveals underlying insecurities or fears of inadequacy, shaped by cultural and individual factors.

Through these perspectives, jealousy is understood as a multifaceted emotion that, while natural, demands careful reflection and regulation to avoid its destructive potential.

Jealousy from the Perspective of Islam

In Islam, jealousy, or "hasad" in Arabic, is considered a spiritual and moral disease that can harm both the individual experiencing it and others. It is seen as a negative trait because it stems from dissatisfaction with Allah's decree and blessings upon others. The Qur'an and Hadith provide guidance on understanding and addressing jealousy, emphasizing the need for gratitude, humility, and reliance on Allah.

Jealousy as defined in Hasad is when a person wishes for the removal of blessings from someone else, whether those blessings are wealth, success, beauty, or other advantages. It contrasts with a positive desire, such as ghibta (envy without malice), where a person wishes for similar blessings without desiring harm to others.

The Qur'an warns against jealousy, particularly in Surah Al-Falaq, where we seek refuge in Allah from "the envy of the envious" (Qur'an 113:5). Prophet Muhammad (peace be upon him) said: "Beware of jealousy, for verily it destroys good deeds the way fire destroys wood." (Sunan Abi Dawood, 4903). Jealousy often arises from arrogance, greed, or a lack of trust in Allah's wisdom. It reflects dissatisfaction with what Allah has decreed for oneself and others, which can weaken one's faith.

Regularly thanking Allah for one's blessings reduces the tendency to compare oneself with others. The Prophet (peace be upon him) encouraged making dua for the one you feel jealous of, as it purifies the heart.

Contentment (Qana'ah): Focusing on Allah's wisdom and trusting that He provides what is best for each individual can diminish jealousy. Recognizing jealousy as a sin and repenting helps cleanse the soul.

Jealousy can sometimes manifest as the evil eye, where someone's envy affects others negatively. The Prophet (peace be upon him) taught protection against this by

reciting Surahs like Al-Falaq and An-Nas and frequently invoking Allah's blessings (mashaAllah). Ikkpl Islam recognizes two cases where jealousy, in the form of ghibta, is permissible. When someone has knowledge or wisdom and uses it for good. When someone is wealthy and spends generously for the sake of Allah. This is based on the Hadith: "There is no envy except in two cases..." (Sahih Bukhari, 73:15)

Jealousy in Islam is seen as harmful and counterproductive, both spiritually and socially. It disrupts peace, creates animosity, and diminishes faith. Muslims are encouraged to focus on self-purification, gratitude, and reliance on Allah to counter this negative emotion. By aligning one's heart with Islamic principles, jealousy can be transformed into contentment and admiration for others' blessings.

Jealousy from the Perspective of Judaism

In Judaism, jealousy, like all emotions, is seen as part of the human experience, but it is something that should be approached with self-awareness and spiritual refinement. Jewish teachings offer nuanced perspectives on jealousy, recognizing both its potential dangers and its opportunities for growth.

The Torah warns against destructive jealousy, which is rooted in envy and resentment. For example: The Ten Commandments explicitly prohibit coveting: "You shall not covet your neighbour's house... or anything that belongs to your neighbour" (Exodus 20:14). Coveting involves an unhealthy desire for something that belongs to someone else, often leading to negative actions or feelings of bitterness. Stories like Cain and Abel highlight the dangers of jealousy, where Cain's envy of God's favour toward Abel led to the first act of murder (Genesis 4). The sages of the Talmud associate jealousy with selfishness and spiritual weakness, as it distracts a person from focusing on their own blessings and divine purpose. A famous teaching states: "Jealousy, desire, and honour remove a person from the world" (Pirkei Avot 4:21).

Judaism also acknowledges a concept of kin'at sofrim (the "jealousy of scholars"), a positive form of jealousy that can inspire personal growth. For instance: The Talmud teaches: "The jealousy of scholars increases wisdom" (Bava Batra 21a). When someone sees others achieving greatness or living righteously, it can motivate them to improve themselves, as long as it remains free of resentment. Jealousy, when properly channelled, can push a person to strive for higher spiritual and moral achievements.

In the Torah, God is described as El Kana—a "jealous God" (Exodus 20:5). This phrase reflects God's desire for exclusive devotion from the Jewish people, as idolatry is seen as a betrayal of the covenant. This divine "jealousy" is not petty or insecure; rather, it symbolizes God's deep commitment to the relationship with humanity and the ethical principles of the Torah.

Judaism provides tools to combat destructive jealousy through the following actions, such as focusing on one's blessings and recognizing that everything comes from God helps foster contentment. Belief that God provides everyone with exactly what they need for their unique purpose can reduce feelings of negativity. Redirecting jealous feelings into personal growth and striving for holiness transforms the emotion into something positive. Cultivating love for others and celebrating their successes helps diminish jealousy.

Judaism views jealousy as a natural but potentially harmful emotion. While destructive jealousy can lead to sin and disconnection, constructive jealousy—when motivated by self-improvement and spiritual growth—can inspire greatness. The Torah and rabbinic tradition guide individuals to refine their character and align their desires with divine values.

Jealousy from the Perspective of Mental Health

In the context of mental health, jealousy is an emotional response that typically arises from perceived threats to a valued relationship or from feelings of insecurity, fear, or loss. This feeling often involves comparing oneself to others or feeling envious of others' achievements, relationships, or qualities. While jealousy is a common, natural emotion, it can become problematic when it becomes persistent, intense, or irrational, leading to significant distress or conflict in relationships.

Chronic or extreme jealousy may be associated with issues like low self-esteem, anxiety, or certain personality disorders. It can contribute to obsessive thoughts, distrust, and controlling behaviour, which may strain personal and professional relationships. Managing jealousy often involves therapy, where individuals work on building self-worth, improving communication skills, and developing healthier coping mechanisms for insecurity.

From a mental health perspective, jealousy is a complex emotional response that typically arises from feelings of insecurity, fear, or concern over losing something of

value—often related to relationships, status, or personal identity. It can have both adaptive and maladaptive aspects, depending on its intensity and how it is managed. Individuals with low self-worth may be more prone to jealousy as they feel less secure in their relationships or achievements. Insecure attachment (e.g., anxious or avoidant attachment) can fuel jealousy in romantic relationships. Trauma, betrayal, or infidelity in previous relationships can make someone more sensitive to potential threats. Negative thought patterns, such as assuming the worst about a partner or comparing oneself to others, can amplify jealous feelings.

Different types of jealousy have been documented. One of the most common types is regarded as Romantic jealousy; that involve fear of losing a partner to a real or perceived rival. The second one is referred to as Social jealousy that includes envy of another person's friendships, achievements, or social standing. The third one is regarded as 'Pathological jealousy'; which is a more intense, irrational form that may involve delusions or obsessive thoughts, often seen in conditions like obsessive-compulsive disorder (OCD) or delusional jealousy.

In severe cases, jealousy can take a pathological form (e.g., Othello syndrome), where it becomes delusional and is often associated with mental health disorders like schizophrenia, bipolar disorder, or substance abuse. These cases require professional intervention, including therapy and sometimes medication. By simply understanding the underlying causes and addressing them in healthy ways, individuals can transform jealousy into an opportunity for self-growth and stronger relationships.

Jealousy is reported to have significant implications upon mental health with both short-term and long term impacts being clinically reported in the literature. The most common short term impacts reported are jealousy that can trigger a fight-or-flight response, causing emotional distress. Excessive and uncontrollable jealousy can lead to arguments, mistrust, and even breakups. The long-term impacts include chronic jealousy that can erode self-esteem and lead to feelings of hopelessness. Furthermore, unmanaged jealousy can result in unhealthy behaviours, including controlling or abusive tendencies. Recurrent jealous thoughts may contribute to obsessive patterns that disrupt daily life. Recognizing and acknowledging jealousy as a natural

emotion can help reduce shame and facilitate growth. The Cognitive- Behavioural Therapy (CBT) helps identify and challenge distorted thinking patterns that fuel jealousy. The Couples Therapy addresses communication issues and builds trust in relationships. Developing a sense of self-worth independent of external validation can reduce feelings of jealousy. Practices like meditation or journaling can help individuals manage emotional triggers more effectively. Open and honest conversations with loved ones can reduce unprovoked misunderstanding and insecurity.

Jealousy can have complex effects on individuals, often impacting both mental well-being and behaviour. This emotion often triggers feelings of anxiety, insecurity, anger, or sadness, which can lead to emotional distress. It may cause people to obsess over comparisons and perceived inadequacies, leading to low self-esteem. Chronic jealousy has been linked to increased stress, depression, and anxiety. It can make a person more self-critical or prone to rumination, keeping them locked in a cycle of negative thinking.

Jealousy can affect personal relationships by creating distrust, tension, or conflict. It can lead to controlling or possessive behaviours, which can harm relationships and push people away. When jealousy consumes attention, it can make it hard to focus on personal goals or responsibilities, impacting productivity, especially in competitive environments like work or school. On a positive note, jealousy can sometimes push individuals to recognize areas for self-improvement, leading to growth if channelled constructively. It can highlight unmet needs or goals, prompting positive change if approached healthily. Ultimately, jealousy can become either a destructive or constructive force, depending on how it's managed. Recognizing it as a natural emotion and understanding its roots can help transform it from a harmful influence to a motivator for personal growth.

Handling jealousy on a personal level can be challenging but is very achievable with self-awareness, reflection, and intentional action. Learning to manage jealousy takes time and patience. Remember that you're allowed to feel this way, and with consistent practice, you can transform jealousy into a tool for self-awareness and growth. Here are steps to help you work through feelings of jealousy and use them for personal growth:

1. **Acknowledge Your Feelings:** Recognize and admit to yourself that you're feeling jealous without judging yourself. Jealousy is a natural emotion, and it's okay to feel it. The important thing is what you do with it.

2. **Identify the Root Cause:** Take some time to understand what's causing your jealousy. Is it a fear of missing out, insecurity, or a desire for something that someone else has? Knowing the root cause can help you address the underlying issue rather than just the surface emotion.

3. **Challenge Negative Thoughts:** Jealousy often comes with negative, self-defeating thoughts. When you notice yourself comparing, remind yourself that everyone's journey is unique. Try replacing these thoughts with positive affirmations about your own strengths and progress.

4. **Focus on Self-Improvement:** If your jealousy stems from wanting something that someone else has, ask yourself if you can work toward achieving it. Set personal goals and make a plan to improve in areas that are meaningful to you, whether they're related to career, relationships, or personal growth.

5. **Express Gratitude:** Practicing gratitude can shift your focus from what you lack to what you already have. Regularly remind yourself of the things you value in your life and celebrate your own successes, no matter how small they may seem.

6. **Limit Comparisons:** Social media and constant exposure to others' curated lives can fuel jealousy. Try reducing time on platforms that trigger comparison, or unfollow accounts that make you feel inadequate.

7. **Channel Jealousy into Inspiration:** Rather than viewing others' success as a threat, see it as proof that certain achievements are possible. Let their accomplishments inspire you to pursue your own dreams, and learn from their journeys if applicable.

8. **Communicate Openly (If Appropriate):** If jealousy is affecting a relationship with someone close, consider having an honest conversation about it. When shared thoughtfully, your feelings can sometimes strengthen trust and understanding.

9. **Work on Building Self-Confidence:** Often, jealousy is linked to insecurity. Building self-confidence can make you feel more satisfied with who you are and less likely to compare yourself negatively to others. Engage

in activities that make you feel accomplished and practice self-compassion.

10. **Seek Support if Needed:** If jealousy feels overwhelming or hard to manage alone, consider talking to a friend, family member, or therapist. Sometimes an outside perspective can help you see things more clearly and give you strategies to manage your emotions.

Conclusions

Philosophers like Aristotle considered jealousy in relation to virtues and vices. In *Nicomachean Ethics*, Aristotle distinguishes between jealousy (*phthonos*) and emulation (*zelos*). While jealousy involves a desire to deprive someone of what they have, emulation seeks self-improvement to attain similar goods. Jealousy, in this framework, is seen as a vice because it reflects a lack of magnanimity and an excessive focus on comparison.

Existentialists, such as Jean-Paul Sartre, view jealousy as a reflection of the human condition and our relational nature. Sartre, in *Being and Nothingness*, argues that jealousy arises from the tension between freedom and dependency in relationships. It emerges when individuals feel their sense of identity or freedom is threatened by another person's freedom or choices, particularly in love. This tension underscores the insecurity inherent in human relationships.

Philosophers influenced by psychoanalysis, like Jacques Lacan, interpret jealousy as a manifestation of desire. According to Lacan, human desire is shaped by the "Other" (society, culture, or interpersonal relations). Jealousy often reveals our desires for recognition and validation, which are mediated by comparisons to others. It exposes the ways in which identity and self-worth are intertwined with external relationships.

Philosophers like Spinoza and Nietzsche differentiate jealousy from envy. Spinoza, in his *Ethics*, sees jealousy as a negative passion arising from inadequate understanding. He suggests that jealousy can distort our perception of others and ourselves, leading to destructive behaviour. Nietzsche, on the other hand, critiques jealousy as an expression of "resentment" or reactive emotion in weak individuals, contrasting it with noble forms of striving for greatness.

Jealousy often relates to the ethics of ownership and control. For instance, jealousy in romantic

relationships can reflect a sense of possessiveness or entitlement over a partner. Feminist philosophers like Simone de Beauvoir critique jealousy as a symptom of patriarchal norms, where individuals are treated as possessions rather than autonomous beings. From this perspective, jealousy reveals deeper social structures of power and inequality.

Philosophical traditions like Stoicism and Buddhism emphasize the role of detachment in overcoming jealousy. Stoics argue that jealousy arises from misplaced values-focusing on external things beyond our control rather than cultivating inner virtue. Similarly, Buddhism views jealousy as a form of attachment and ignorance that perpetuates suffering. Both traditions advocate for self-mastery and equanimity to transcend jealousy.

Some philosophers see jealousy as an opportunity for self-reflection. It can reveal what we value most and where our insecurities lie. By examining jealousy critically, individuals can gain insight into their desires, relationships, and ethical priorities. In summary, jealousy, from a philosophical standpoint, is more than a mere emotion-it is a window into human nature, revealing our vulnerabilities, relational dependencies, and moral choices. Whether viewed as a vice to overcome or a signal for introspection, it invites deeper inquiry into the nature of self, desire, and social existence.

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THE STUDY OF EFFECT OF *DACUS CILIATUS* ON CROP OF *CUCUMIS SATIVUS* IN HAZARIBAG DISTRICT, JHARKHAND

***Namrata Sharan and Manoj Kumar**

Department of Zoology
Vinoba Bhave University Hazaribag, Jharkhand

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ABSTRACT

Dacus ciliatus is a major pest affecting *Cucumis sativus* production, causing significant vegetable damage and yield loss. This study assessed infestation levels across different blocks in Hazaribag district from June to October. Mean vegetable damage ranges from 06.28% to 56.82%, with an overall average of 29.16%. Peak infestation occurred in September, indicating the need for targeted pest management strategies during this period.

No. of Pages: 4

References: 20

Keywords: *D. ciliatus*, *Cucumis sativus*.

INTRODUCTION

Cucumber (*Cucumis sativus*) is an important vegetable crop susceptible to *Dacus ciliatus* infestation. Yield losses due to this pest vary across regions and seasons. This study evaluates the extent of damage caused by *D. ciliatus* in Hazaribag, providing insights for effective pest control measures.

MATERIALS AND METHODS:

Field trials were conducted at four Blocks of Hazaribag district, Jharkhand, India. The visited farm was having the mixed vegetable crops consisting of *cucumis sativus* and *Solanum lycopersicum*. The selected site consist only cucumber plants. Area of each vegetable crop field visited was more than 8 acres in each block. *Dacus* species were collected from selected vegetable hosts using insect net, yellow sticky trap and TRI-TRAP devices.

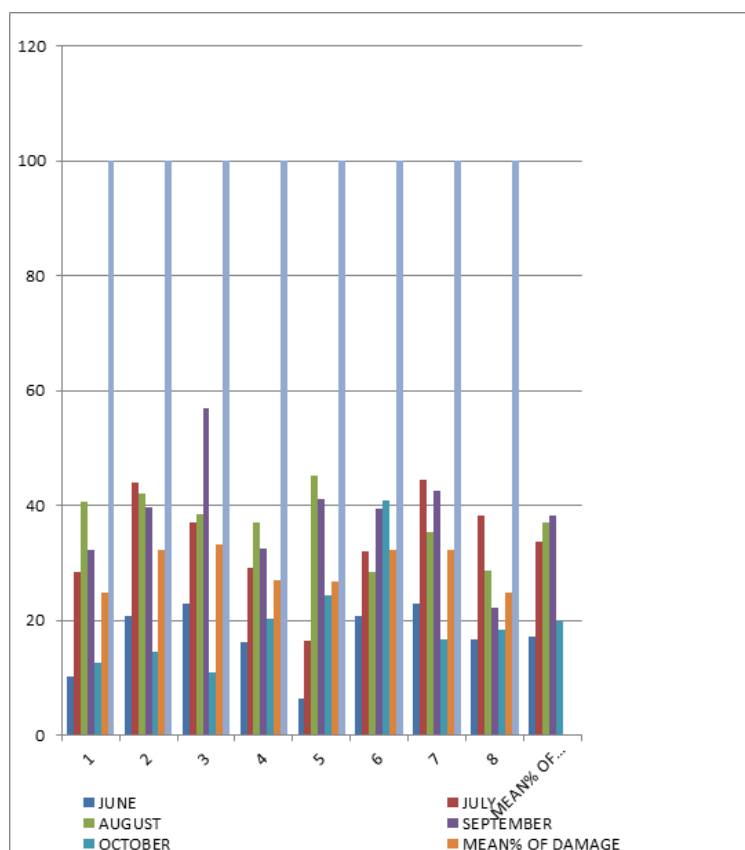
A standard insect net was used to collect *Dacus* pests in field during dark time in absence of sunlight in morning of day and evening time of day. Sweep netting was conducted in areas with host plants at a consistent pace and duration. Pests were collected from net and identified to species level. Yellow sticky traps were used to capture *Dacus* adults. Yellow sticky traps were placed near host plants at a height of approximately 1-2 meters above ground level. Pests were collected regularly from the yellow sticky traps and identified to species level. Yellow sticky traps were replaced regularly to maintain their adhesive properties and effectiveness. Tri-traps baited with eugenol were used to capture *Dacus* adults. Eugenol was used as a lure in the Tri-traps to attract *Dacus* adults. Tri-traps were placed near host plants at a height of approximately 1-2 meters above ground level. Pests were collected regularly from the Tri-traps and identified to species

level. Assessment of damaged fruits based on the presence of feeding punctures was made by selecting 100 ripe vegetables at random before as well as at the end of the field trial.

Observation:

Dacus ciliatus infestation observed in *cucumis sativus* from June to October. Peak infestation in September 38.33 % , Lowest damage in October 10.99 % . Overall mean vegetable damage 29.16%.

No. of Sites	June	July	August	September	October	Mean % Damage	Total no. of Vegetables Examined
1	10.26	28.44	40.62	32.31	12.52	124.15 (X=24.83)	100
2	20.66	43.95	42.04	39.69	14.62	160.96 (X=32.192)	100
3	22.86	37.02	38.46	56.82	10.99	166.15 (X=33.23)	100
4	16.28	29.08	37.02	32.48	20.22	135.08 (X=27.01)	100
5	06.28	16.38	45.22	41.04	24.28	133.20 (X=26.64)	100
6	20.66	32.06	28.42	39.52	40.88	161.54 (X=32.30)	100
7	22.89	44.47	35.26	42.63	16.62	161.87 (X=32.37)	100
8	16.58	38.16	28.62	22.12	18.42	123.90 (X=24.78)	100
Total	136.47	269.56	295.66	306.61	158.55		
Mean %	X=17.06	X=33.69	X=36.95	X=38.33	X=19.81		
Damage	(24.4)	(35.48)	(37.42)	(38.25)	(26.43)		



% of infestation figures in parenthesis are angular transformation .

Result:

Infestation peaked in September 38.33% likely due to favorable climatic conditions. Locality specific management strategies are needed to mitigate yield loss.

Conclusion:

D. ciliatus causes substantial *Cucumis sativus* yield loss (mean 29.16%). Targeted pest control during July-September is recommended to reduce damage.

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FORMULATION AND PHYSICOCHEMICAL STANDARDIZATION OF A UNANI POLYHERBAL FACE SERUM

Musarrat Ali Anwar Husain^{1*}, Iraqui Abuzar Lari²,
Ifra Abdul Qayyum³ and Sharique Zohaib⁴

¹Department of Ilmul Saidla (Unani Pharmacy)
Mohammadia Tibbia College, Malegaon, Maharashtra, India

²Department of Ilaj Bit Tadbeer
Mohammadia Tibbia College, Malegaon, Maharashtra, India

³Department of Jild wa Taziniyat (Dermatology)
Mohammadia Tibbia College, Malegaon, Maharashtra, India

⁴HOD Department of Ilmul Saidla (Unani Pharmacy)
Mohammadia Tibbia College, Malegaon, Maharashtra, India

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ABSTRACT

Background: Unani medicine offers a rich repository of medicinal plants for dermatological care, emphasizing the concept of Itidl-e-Mizaj (humoral balance) and Tanqiyat-e-Jild (skin purification) for skin health.

Objective: To formulate a stable, cosmetic-grade Polyherbal face serum based on Unani principles and to establish its physico-chemical fingerprint for standardization.

Materials and Methods: The serum was formulated using ingredients mentioned in classical Unani texts for their Mulattif (emollient), Muqawwi-e-Barat (skin tonic), and Muhallil (anti-inflammatory) properties: Arq-e-Gulab (Rose water), Sandal Safaid (*Santalum album* L.), Aloe vera gel, Roghan-e-Badam (*Prunus dulcis* oil), and Gul (*Rosa damascena* essential oil). The formulation was subjected to organoleptic, physico-chemical (pH, viscosity, refractive index, spreadability), and accelerated stability testing as per International Council for Harmonisation (ICH) guidelines.

Results: The serum was a light-pink, homogenous emulsion with a characteristic floral aroma. Key parameters were: pH (5.8 ± 0.1), viscosity (2150 ± 50 cP), refractive index (1.401 ± 0.002), and excellent spreadability (18.2 ± 0.4 g.cm/s). It remained stable under accelerated conditions ($40^\circ\text{C} \pm 2^\circ\text{C} / 75\% \pm 5\% \text{ RH}$ for 3 months) with no phase separation, significant change in pH, or microbial growth.

Conclusion: A stable Unani-based face serum was successfully developed. The established physico-chemical standards ensure batch-to-batch reproducibility and form a vital foundation for subsequent pharmacological and clinical studies to validate its skin rejuvenating claims.

No. of Pages: 4

References: 8

Keywords: Unani Cosmetics, Itidal-e-Mizaj, Tanqiyat-e-Jild, Polyherbal Formulation, Stability Testing, Sandal Safaid, Arq-e-Gulab.

INTRODUCTION

Skin health and aesthetics, termed Hifzan-e-Sehat-e-Jild in Unani medicine, are intricately linked to the

balance of the four Akhlat (humours) and the overall Mizaj (temperament) of an individual. Classical scholars like Hakim Ibn Sina (980-1037 AD) in Al-

*Corresponding author: dr.ifraabdulqayyum@gmail.com

Qanun fi al-Tibb and Hakim Jalinus (Galen) elaborated on dermatological principles, attributing skin ailments such as Khushunki (dryness) and Tajaweef (wrinkles) to disturbances in Akhlat and Mizaj [1]. Topical formulations, known as Zimad (paste) or Marham (ointment), were designed to correct these imbalances using naturally derived Mufradat (single drugs) with properties like Barid (cooling), Rutubat (moisturizing), and Muhallil (anti-inflammatory) [2].

The Department of Ilmul Saidla wa Murakkabat (Pharmaceutics & Cosmeticology) specializes in transforming classical Unani formulations into stable, standardized products, while the Department of Jild wa Tanzniyat (Dermatology & Venereology) provides the clinical and anatomical rationale for their use. In contemporary times, there is a growing global demand for natural, evidence-based cosmetic products. While Unani literature is abundant with skincare descriptions, there is a paucity of scientific research that translates these textual formulations into standardized, shelf-stable cosmetic products [3]. Standardization is a critical step to ensure safety, efficacy, and quality control, bridging traditional wisdom with modern regulatory requirements [4].

This interdisciplinary study, therefore, aimed to develop a stable, polyherbal face serum based on specific Unani drugs with documented dermatological benefits. The primary objective was to formulate the serum and establish a comprehensive physico-chemical profile through rigorous standardization protocols.

2. Materials and Methods

2.1. Selection and Authentication of Raw Materials

Ingredients were selected based on their recurrent mention in classical texts for facial care and their actions relevant to Jildiyat (dermatology) [1,2,5]:

1. Arq-e-Gulbb (Rose water, *Rosa damascena* Miller): Used as the aqueous base for its Qabiz (astringent), Mulattif, and Muqawwi-e-Dimagh (cephalic tonic) properties, beneficial in Hararat (inflammatory) conditions of the skin.

2. Sandal Safaid (White Sandalwood, *Santalum album* L. heartwood powder): For its Muhallil and Mujaffif (drying) actions on subtle Waram (inflammation) and its role in Tanqiyat (purification).

3. Aloe vera gel, (*Aloe barbadensis* Miller): A renowned Murattib (moisturizer), Mulaem (demulcent), and wound healer, directly addressing Yabusat (dryness) of the skin.

4. Roghan-e-Badam (Sweet Almond oil, *Prunus dulcis* (Mill.) D.A. Webb): A primary Rutubat-inducing emollient (Murawwiq), used for nourishing dry and wrinkled skin.

5. Gul (Rose essential oil, *Rosa damascena*): Added for its Lazzat (fragrance) and its Qawi-e-Dimagh (cephalic tonic) effect, which indirectly influences skin vitality.

Botanical authentication was performed by a plant taxonomist. Voucher specimens were deposited in the departmental herbarium.

2.2. Formulation Development

The serum was formulated as an oil-in-water (O/W) emulsion, a preparation type relevant to modern Saidla (pharmaceutics).

Composition (% w/w):

Phase A (Aqueous): Arq-e-Gulbb (73%), Sandal Safaid paste (2% w/v infusion, filtered), Aloe vera gel gel (15%).

Phase B (Oily): Roghn-e-Bdbdm (6%), Gul oil (0.5%), Beeswax (1.0% as natural emulsifier and mm-i-protector).

Phase C (Additives): Glycerin (2% as humectant), Potassium sorbate (0.1% as preservative).

Method of Preparation: (As per Unani Pharmaceutical Techniques): Phase B was gently heated to 65°C in a Karahi. Phase A was separately warmed to 68°C. Phase B was gradually added to Phase A with continuous manual stirring using a glass rod until emulsification commenced, followed by homogenization for 5 minutes. The mixture was cooled to room temperature, and Phase C ingredients were incorporated with slow stirring until a smooth, homogenous Rutbat (emulsion) was obtained.

2.3. Physico-Chemical Standardization

The freshly prepared serum (Batch No. US-01/2024) was evaluated in triplicate (n=3).

1. Organoleptic Properties: Colour, odour, consistency, and feel.

2. pH: Measured using a calibrated digital pH meter at 25°C.

3. Viscosity: Determined using a Brookfield viscometer.

4. Refractive Index: Measured using an Abbe refractometer.

- 5. Spreadability:** Calculated using the parallel plate slide method.
- 6. Accelerated Stability Study:** Conducted as per ICH Q1A(R2) guidelines [6].
- 7. Microbial Limit Test:** Performed as per USP <61> [7].

3. Results
The formulated serum (US-01/2024) was a smooth, non-greasy, light-pink emulsion with a pleasant floral-woody odor, meeting the Jildiyat criterion of being non-irritant and pleasant.

Table 1: Physico-Chemical Parameters of the Unani Polyherbal Face Serum.

Parameter	Result (Mean ± SD, n=3)	Reference/Acceptable Range
Physical State	Homogenous, smooth emulsion	Homogenous, free from lumps
pH	5.8 ± 0.1	4.5 - 6.5 (Skin compatible)
Viscosity (cP)	2150 ± 50	Suitable for serum application
Refractive Index	1.401 ± 0.00	
Spreadability (g.cm/s)	g.cm/s 18.2 ± 0.4	Higher value indicates better spread

Table 2: Accelerated Stability Data (40°C ± 2°C / 75% ± 5% RH)

Time (Days)	Appearance	Phase Separation	pH	Viscosity (cP)
0	Light pink, homogenous	None	5.8	2150
30	No change	None	5.7	2100
60	No change	None	5.8	2080
90	Slight darkening	none	5.9	2050

No microbial growth was observed within the prescribed limits.

4. Discussion

The developed serum, termed skin elixir in Unani terminology, integrates principles from both Ilmul Saidla (for formulation) and Ilmul Jild (for therapeutic rationale). The pH (5.8) is optimal for the skin's acid mantle, supporting barrier function and commensal microflora, aligning with the Unani concept of Hifz-e-Sehat (preservation of health) [8].

From an Unani pharmacological (Ilmul Advia) perspective:

- Arq-e-Gulab (Barid, Latif) and Sandal Safaid (Barid, Khashin) counteract Hararat and Waram, common in aging or stressed skin [1].
- Roghan-e-Badam (Barid, Ratb) and Aloe vera gel (Barid, Ratb) provide essential Rutubat, combating Yabusat, a key pathogenic factor (Asbab-e-Maddi) in wrinkle formation (Tajaweef).
- The combination aims to promote Itidal-e-Mizaj (equilibrium) in the skin, which is the primary goal of Unani treatment.

The stability data confirms the formulation's robustness, a key concern in Saidla. The slight darkening observed at day 90 is acceptable and common in natural formulations. This study successfully demonstrates the collaboration between Jibb-e-Jild (Dermatology) and Saidla (Pharmaceutics) in advancing Unani cosmetic sciences.

5. Conclusion

A stable, skin-compatible polyherbal face serum based on Unani principles was successfully formulated through interdisciplinary expertise. The comprehensive physico-chemical profile established herein serves as a primary standard for quality control. Future Directions: This study paves the way for advanced analytical profiling, in vitro bioactivity assays relevant to skin aging, and controlled clinical trials within the Department of Jild wa Tanzniyat to validate the rejuvenating and Muqawwi-e-Balat (skin strengthening) efficacy.

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MOLECULAR AND CELLULAR PERSPECTIVES IN DEVELOPMENTAL BIOLOGY AND EMBRYOLOGY

¹Payal Soan and ²Ajit Kumar Sharma

¹Department of Biotechnology, Dr. B Lal Institute of Biotechnology, Jaipur (Rajasthan)

²Department of Basic life and Applied Science, Apex University, Jaipur (Rajasthan)

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ABSTRACT

Developmental biology and embryology study the process of a single zygote becoming a complex organism, integrating genetics, cell biology, physics, and evolution. New technologies, such as stem-cell-based embryo models, single-cell omics, and advanced imaging, have transformed the field into a highly quantitative, mechanistic discipline. Early embryogenesis involves the conserved segregation of cell lineages, leading to the formation of the blastocyst, which contains extraembryonic precursors and pluripotent cells. Classical embryology in the early 19th century laid the foundation for the modern field, which shifted toward experimental or causal embryology starting in the 1940s. The study of human embryology traditionally relied on comparative approaches using mammalian models, but new low-input methods now allow direct study of the human embryo. The latter half of the 20th century saw a revolution in embryology with the rise of molecular biology, leading to the fusion of embryology and genetics into developmental biology. Advancements in molecular biology, particularly molecular genetics, have allowed for a deeper understanding of gene expression and the genetic control of developmental processes.

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Keywords: Development biology, embryology, embryogenesis, cell lines, pluripotent cells.

INTRODUCTION

Contemporary Perspectives

Today, developmental biology is a multidisciplinary field encompassing stem cells, teratology, and the genetic basis of congenital disorders, and also includes experimental plant reproductive biology. Quantitative and imaging-based approaches provide high-resolution data on dynamic changes in gene regulation, cell fate, and tissue morphology, facilitating the creation of comprehensive theoretical models. New genomic data and gene-editing tools enable studies to be extended to non-model organisms, including amphioxus, ascidian, and ciliates, to investigate development and evolutionary mechanisms.

Challenges and Future Directions

The complexity of developmental processes, including the interplay of genetic and environmental factors, necessitates continued research and innovation, maintaining a balance between classical and modern approaches. New advances in *in vitro* modeling using stem cells

have revived mechanistic studies of allochory (overall rate change) and heterochory (specific step duration change) in developmental timing. The future involves integrating diverse methodologies, with ongoing research in stem cell biology holding promise for advancing the understanding of human development and disease.

*Corresponding author: ajit2612@gmail.com

Developmental biology and embryology study how a single cell (the zygote) becomes a complex organism, integrating genetics, cell biology, physics, and evolution. Recent tools like stem-cell-based embryo models, single-cell omics, and advanced imaging have transformed this into a highly quantitative, mechanistic field.

Embryology has long been a cornerstone of the life sciences, evolving significantly over the years. The integration of molecular biology into embryology has transformed developmental biology into a dynamic field that encompasses various concepts and techniques. This article explores the historical and contemporary aspects of developmental biology and embryology, highlighting key contributions and shifts in understanding.

Early embryogenesis is characterized by the segregation of cell lineages that fulfill critical roles in the establishment of pregnancy and development of the fetus. The formation of the blastocyst marks the emergence of extraembryonic precursors, needed for implantation, and of pluripotent cells, which differentiate toward the major lineages of the adult organism. The coordinated emergence of these cell types shows that these processes are broadly conserved in mammals. However, developmental heterochrony and changes in gene regulatory networks highlight unique evolutionary adaptations that may explain the diversity in placentation and in the mechanisms controlling pluripotency in mammals. The incorporation of new technologies, including single-cell omics, imaging, and gene editing, is instrumental for comparative embryology. Broadening the knowledge of mammalian embryology will provide new insights into the mechanisms driving evolution and development. This knowledge can be readily translated into biomedical and biotechnological applications in humans and livestock, respectively (Alberio, 2019).

Historical Context

Understanding human embryology has historically relied on comparative approaches using mammalian model organisms. With the advent of low-input methods to investigate genetic and epigenetic mechanisms and efficient techniques to assess gene function, now study the human embryo can be done directly. These advances have transformed the investigation of early embryogenesis in nonrodent species, thereby providing a broader understanding of

conserved and divergent mechanisms. Here, an overview of the major events in human preimplantation development and place them in the context of mammalian evolution by comparing these events in other eutherian and metatherian species. The advances of studies on postimplantation development and discuss stem cell models that mimic postimplantation embryos. A comparative

perspective highlights the importance of analyzing different organisms with molecular characterization and functional studies to reveal the principles of early development. This growing field has a fundamental impact in regenerative medicine and raises important ethical considerations (Gerri et al., 2020). The evolution of embryology can be traced back to the early 19th century, where foundational knowledge was established regarding developmental processes. This period, often referred to as the classical era, laid the groundwork for modern embryology, which began to take shape in the 1940s with the rise of experimental or causal embryology. This shift marked a departure from classical descriptive embryology, which was heavily influenced by recapitulation theory, towards a more experimental approach that sought to understand the mechanisms behind development [2].

T. H. Morgan played a pivotal role in this transition, advocating for a mechanistic and experimental approach to biology. His work emphasized the importance of genetics in understanding heredity and development, leading to the establishment of genetics as a distinct discipline [1]. Morgan's influence extended to embryology, where he sought to correlate genetic factors with developmental processes, ultimately shaping the trajectory of modern biology [3].

Integration of Molecular Biology

The latter half of the 20th century witnessed a significant revolution in embryology, driven by advancements in molecular biology. This period saw the emergence of molecular genetics, which fundamentally altered the landscape of developmental biology. The integration of molecular techniques allowed for a deeper understanding of gene expression and its role in development, leading to the fusion of embryology and genetics into what is now known as developmental biology [6].

Boris Ephrussi's contributions are noteworthy in this context, as he sought to reconcile genetics and embryology through experimental approaches. His

work highlighted the importance of both nuclear and cytoplasmic factors in differentiation and development, paving the way for a more integrated understanding of these fields [4]. The advancements in molecular biology have since enabled researchers to explore the genetic control of development, further bridging the gap between genetics and embryology [8].

Contemporary Perspectives

Today, developmental biology encompasses a wide array of topics, including the study of stem cells, teratology, and the genetic basis of congenital disorders. The field has expanded to include experimental plant reproductive biology, which integrates techniques from various disciplines to enhance our understanding of reproductive processes in higher plants [5]. This multidisciplinary approach reflects the ongoing trend of integrating different scientific fields to address complex biological questions.

Across developmental systems, quantitative and imaging-based approaches have provided unprecedented resolution of dynamic changes in gene regulation and cell fate specification, along with complex changes in tissue morphology. This has set the stage for a wealth of comprehensive theoretical models, parameterised by experimental data, able to reproduce key aspects of biological behaviour and jointly enabling a higher level of abstraction, going from the identification of the molecular components to understanding complex functional relationships between these components. Despite these successes, gaining a cross-scale understanding of developmental systems will require further collaboration between disciplines, from developmental biology to bioengineering, systems biology and biophysics. We highlight the exciting multi-disciplinary research discussed at The Company of Biologists workshop 'Fostering quantitative modelling and experimentation in Developmental Biology'. (Biga, 2023).

Moreover, the advent of new technologies, such as imaging and bioinformatics, has revolutionized the study of embryology. These tools allow for the quantitative analysis of developmental processes, enabling researchers to explore the intricate networks of gene interactions that govern development [9]. The currently increasing genomic data and the recently available gene-editing tools make it possible to extend our studies to non-model organisms. In this review, we review the recent work on the regulatory signaling of

developmental and regeneration processes, environmental adaptation, and evolutionary mechanisms using both the existing model animals such as zebrafish and *Drosophila*, and the emerging nonstandard model organisms including amphioxus, ascidian, ciliates, single-celled phytoplankton, and marine nematode. In addition, the challenging questions and new directions in these systems are outlined as well (Zhao et al., 2021). Organismal development requires the reproducible unfolding of an ordered sequence of discrete steps (cell fate determination, migration, tissue folding, etc.) in both time and space. Here, we review the mechanisms that grant temporal specificity to developmental steps, including molecular clocks and timers. Individual timing mechanisms must be coordinated with each other to maintain the overall developmental sequence. However, phenotypic novelties can also arise through the modification of temporal patterns over the course of evolution. Two main types of variation in temporal patterning characterize interspecies differences in developmental time: allochrony, where the overall developmental sequence is either accelerated or slowed down while maintaining the relative duration of individual steps, and heterochrony, where the duration of specific developmental steps is altered relative to the rest. New advances in *in vitro* modeling of mammalian development using stem cells have recently enabled the revival of mechanistic studies of allochrony and heterochrony (Diaz-Cuadros, & Pourquié, 2023). The application of quantitative methodologies is expected to shape the future of developmental biology, fostering a deeper understanding of the mechanisms underlying morphogenesis and differentiation [10].

Over the past two decades, our understanding of mouse development from implantation to gastrulation has grown exponentially with an upsurge of genetic, molecular, cellular, and morphogenetic information. New discoveries have exalted the role of extraembryonic tissues in orchestrating embryonic patterning and axial specification. At the same time, the identification of unexpected morphogenetic processes occurring during mouse gastrulation has challenged established dogmas and brought new insights into the mechanisms driving germ layer formation. In this article, we summarize the key findings that have reinvigorated the contemporary view of early postimplantation mammalian development (Rivera-Pérez, & Hadjantonakis, 2015).

Challenges and Future Directions

Despite the significant progress made in the field, challenges remain. The complexity of developmental processes and the interplay between genetic and environmental factors necessitate continued research and innovation. As developmental biology evolves, it is crucial to maintain a balance between classical approaches and modern techniques to fully comprehend the intricacies of development [7]. Mechanical forces play a crucial role in shaping embryo development, driving key morphogenetic processes like compaction, blastocyst formation, implantation, and egg cylinder formation (Huang et al., 2024).

Gene regulatory networks and tissue morphogenetic events drive the emergence of shape and function: the pillars of embryo development. Although model systems offer a window into the molecular biology of cell fate and tissue shape, mechanistic studies of our own development have so far been technically and ethically challenging. However, recent technical developments provide the tools to describe, manipulate and mimic human embryos in a dish, thus opening a new avenue to exploring human development (Shahbazi, M. (2020).

The future of developmental biology lies in its ability to integrate diverse methodologies and perspectives. The ongoing exploration of stem cell biology, in particular, holds great promise for advancing our understanding of human development and disease [9]. As researchers continue to uncover the genetic and epigenetic mechanisms that drive development, the field is poised for further breakthroughs that will enhance our knowledge of both normal and pathological processes.

Single-cell and spatial omics technologies offer fresh perspectives for investigating embryonic development, offering potential for profound contributions to understanding molecular foundations in the future (Liu et al., 2025).

Dynamical systems theory concepts, such as phase portraits, stochasticity, response to time-dependent signals, and oscillations, help understand developmental regulatory mechanisms and cell fate decision-making. (Kadiyala). Combining embryonic and extra-embryonic stem cells in three-dimensional embryo models can provide valuable insights into cell-cell interactions essential for human embryogenesis (Weatherbee et al., 2020)

Development from single cells to multicellular tissues and organs involves more than just the exact replication of cells, which is known as differentiation. The primary focus of research into the mechanism of differentiation has been differences in gene expression profiles between individual cells. However, it has predominantly been conducted at low throughput and bulk levels, challenging the efforts to understand molecular mechanisms of differentiation during the developmental process in animals and humans. During the last decades, rapid methodological advancements in genomics facilitated the ability to study developmental processes at a genome-wide level and finer resolution. Particularly, sequencing transcriptomes at single-cell resolution, enabled by single-cell RNA-sequencing (scRNA-seq), was a breath-taking innovation, allowing scientists to gain a better understanding of differentiation and cell lineage during the developmental process. However, single-cell isolation during scRNA-seq results in the loss of the spatial information of individual cells and consequently limits our understanding of the specific functions of the cells performed by different spatial regions of tissues or organs. This greatly encourages the emergence of the spatial transcriptomic discipline and tools. Here, we summarize the recent application of scRNA-seq and spatial transcriptomic tools for developmental biology. We also discuss the limitations of current spatial transcriptomic tools and approaches, as well as possible solutions and future prospects (Choe et al., 2023).

Combining high-throughput generation and high-content imaging of embryo models will enable large-scale screening assays in the fields of (embryo) toxicity, drug development, embryogenesis, and reproductive medicine. This study shows the continuous culture and in situ (i.e., in microwell) imaging-based readout of a 3D stem cell-based model of peri-implantation epiblast (Epi)/extraembryonic endoderm (XEn) development with an expanded pro-amniotic cavity (PAC) (E3.5-E5.5), namely XEn/EPiCs. Automated image analysis and supervised machine learning permit the identification of embryonic morphogenesis, tissue compartmentalization, cell differentiation, and consecutive classification. Screens with signaling pathway modulators at different time windows provide spatiotemporal information on their phenotypic effect on developmental processes leading to the formation of XEn/EPiCs. Exposure of the biological model in the

microwell platform to pathway modulators at two time windows, namely 0-72 h and 48-120 h, show that Wnt and Fgf/MAPK pathway modulators affect Epi differentiation and its polarization, while modulation of BMP and Tgf β /Nodal pathway affects XEn specification and epithelialization. Further, their collective role is identified in the timing of the formation and expansion of PAC. The newly developed, scalable culture and analysis platform, thereby, provides a unique opportunity to quantitatively and systematically study effects of pathway modulators on early embryonic development(Shanker et al., 2023).

Embryonic development research has the potential to revolutionize biomedical sciences and human health if tackled in a multidisciplinary manner. The challenges of this field are by no means confined to understanding the intricate biological mechanisms but also have humanitarian implications. To fully appreciate the mechanisms underlying human development, principles of embryogenesis have predominantly been analyzed employing animal models which allow us to broaden our view on developmental processes. As a result of recent pioneering work and technical progress centered around stem cell-based 3D approaches, we are entering into a historical new phase of learning about mammalian embryonic development(Brand-Saberi, 2024).

In conclusion, the evolution of developmental biology and embryology reflects a rich history of scientific inquiry and innovation. From its classical roots to the integration of molecular biology, the field continues to expand and adapt, offering new insights into the fundamental processes of life. As we move forward, the collaborative efforts of researchers across disciplines will be essential in unraveling the complexities of development and its implications for health and disease.

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APPLICATION OF BIOCOMPOST IN MINIMIZING THE USE OF INORGANIC FERTILIZERS AND THEIR IMPLICATIONS ON ENHANCEMENT IN CROP AND SOIL QUALITY — AN EXPERIMENTAL STUDY

Rishikesh Yadav and Rajkumar Yadav

Department of Botany, T.D.P.G. College, Jaunpur
Affiliated to VBSU University, Jaunpur (U.P.)

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ABSTRACT

This study assesses the effects on crop productivity and soil quality measures of substituting biocompost (BC) for a portion of the recommended inorganic fertilizer dose (RDF). Five treatments were simulated in a randomized block-style trial: Control (no fertilizer), RDF (100% inorganic), RDF75+BC25, RDF50+BC50, and BC (100% biocompost), each with four replicates. Analysis was done on yield (kg/plot → t/ha), soil pH, available N, P, and K, and soil organic carbon (SOC%). Highly significant variations between treatments were revealed by a one-way ANOVA on simulated yields ($F = 158.0$, $p < 0.001$). The highest mean yield (simulated mean = 15.37 t/ha) was obtained with the 75% RDF + 25% BC treatment. Compared to the control, treatments including biocompost maintained or improved available NPK and raised SOC. The benefits of integrated nutrient management—partially replacing inorganic fertilizers with organic inputs like biocompost—for increased crop output and soil quality are supported by these simulated results. Important disclaimer: actual trials are required for field recommendations; data are simulated and meant for presentation.

No. of Pages: 5

References: 13

Keywords: Biocompost, integrated nutrient management, inorganic fertilizer reduction, soil organic carbon, crop yield, simulated experimental data.

INTRODUCTION

Although the continuous use of inorganic fertilizers has been crucial in raising agricultural productivity, their overuse and uneven application has led to groundwater contamination, soil degradation, nutrient imbalance, a decrease in soil organic carbon, and decreased fertilizer use efficiency (Lal, 2009; Bedada et al., 2014; Wu et al., 2015). Long-term sustainability issues arise because inorganic fertilizers provide nutrients quickly but do not enhance the biological and physical characteristics of soil (Erhart et al., 2005; Sharma et al., 2019).

A well-known method for maintaining crop yield while enhancing soil quality is integrated nutrient management (INM), which mixes mineral fertilizers with organic amendments like vermicompost or biocompost (Kumar et al., 2017; Polthanee et al., 2021). Numerous studies have shown that substituting compost or biocompost for a portion of the recommended fertilizer dose (RDF) increases soil organic carbon (SOC), improves microbial activity, and increases nutrient availability, all of which improve crop yield and soil health (Singh et al., 2017; Manzoor et al., 2024).

In addition to providing organic matter that enhances soil structure, water-holding capacity, and nutrient retention, biocompost acts as a slow-release source of vital nutrients (Erhart et al., 2005; Tomer et al., 2018). According to research, using inorganic fertilizers and organic manures together in the right proportions can result in yields that are on par with or greater than applying chemical fertilizers alone (Devi et al., 2025; Hou et al., 2024). Biofertilizers and compost-based nutrient inputs improve soil fertility and crop nutritional quality in a variety of agro-ecological settings, according to meta-analytical research (Pei et al., 2025).

Objective: To evaluate the effect of partial substitution of inorganic fertilizer with biocompost on crop yield and soil quality (SOC, available N, P, K, pH) using a randomized trial framework (simulated data for demonstration).

Materials and Methods Experimental design

Treatments (5): Control (no fertilizer), RDF100 (100% recommended inorganic fertilizer), RDF75+BC25 (75% RDF + 25% biocompost on nutrient equivalence basis), RDF50+BC50 (50% RDF + 50% BC), BC100 (biocompost only).

- Replicates: 4 replicates per treatment (randomized block style).
- Observations recorded per plot: crop yield (kg per plot; converted to t/ha), soil organic carbon (SOC %), available N (kg/ha), available P (mg/kg), available K (kg/ha), and soil pH.
- **Note:** All experimental numbers below are *simulated* to illustrate reporting and analysis workflows.

Statistical analysis Summary statistics (mean, SD) by treatment.

- One-way ANOVA for yield across treatments ($\alpha = 0.05$).
- Visualization: boxplot of yield by treatment.
- Software used: Python (NumPy, pandas, SciPy, matplotlib) — analysis executed and outputs are supplied (dataset CSV and boxplot image).

Results

Effect of Biocompost on Crop Yield

The crop yield was significantly influenced by different nutrient management treatments. Among all

treatments, the integrated application of inorganic fertilizer and biocompost resulted in higher yield compared to the control. The maximum mean crop yield was recorded under RDF 75% + biocompost 25%, followed by RDF 50% + biocompost 50% and RDF 100%, whereas the lowest yield was observed in the control treatment without fertilizer application. Sole application of biocompost also produced higher yield than the control but was inferior to integrated treatments.

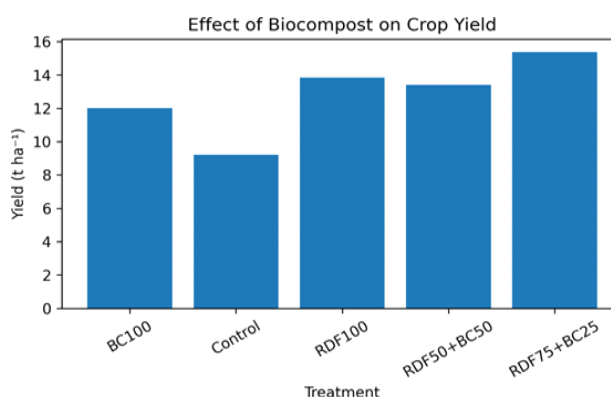


Fig. 1: Effect of biocompost and inorganic fertilizer combinations on crop yield (t ha⁻¹). Values represent mean of four replications.

Effect of Biocompost on Soil Organic Carbon (SOC)

The amount of organic carbon in the soil increased noticeably as the amount of biocompost in the nutrient management treatments increased. The highest SOC was found under 100% biocompost, demonstrating the beneficial contribution of organic amendments to carbon sequestration. Additionally, compared to control and RDF alone, integrated treatments showed noticeably greater SOC, indicating that partial replacement of inorganic fertilizers with biocompost enhances the status of soil organic matter.

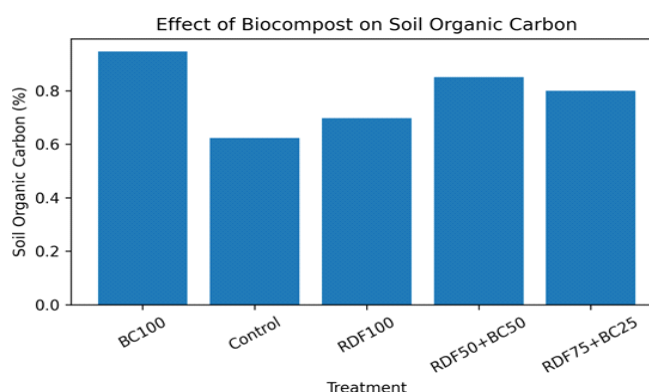


Fig. 2: Effect of different nutrient management treatments on soil organic carbon (%).

Effect of Biocompost on Soil Available Nitrogen

The amount of available nitrogen in the soil varied greatly between treatments. Because of the mineralization of the organic matter in the biocompost, integrated nutrition treatments showed more accessible nitrogen than the control, suggesting better nutrient availability. RDF 75% + biocompost 25% had the maximum nitrogen availability, followed by RDF 50% + biocompost 50%; control plots had the lowest nitrogen content.

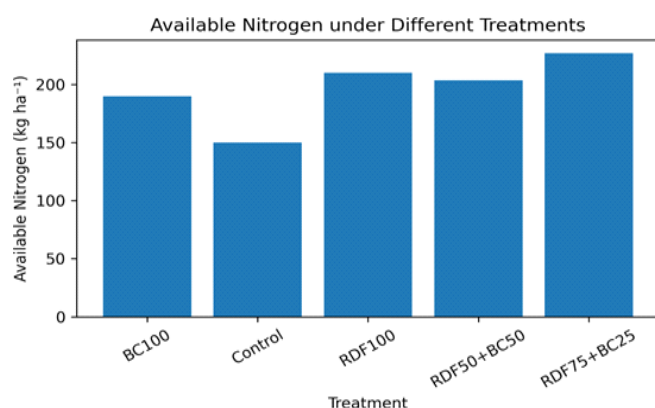


Fig. 3: Available nitrogen (kg ha⁻¹) under different nutrient management treatments.

Effect of Biocompost on Soil pH

The pH of the soil varied less between treatments, however the application of biocompost had a buffering influence on the reactivity of the soil. While RDF alone

marginally lowered soil pH, treatments that received biocompost kept soil pH closer to neutral. This suggests that with heavy fertilizer application, biocompost aids in maintaining soil pH stability.

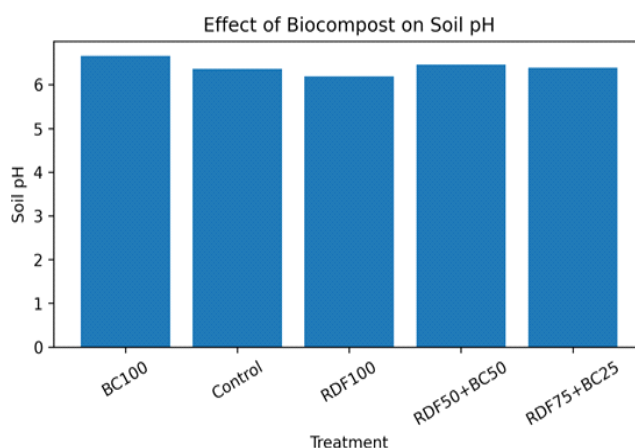


Fig. 4: Effect of biocompost application on soil pH.

Overall Performance of Integrated Nutrient Management

All things considered, the combined application of biocompost and a lower dose of inorganic fertilizer outperformed the application of either inorganic fertilizer or biocompost alone. The best combination for increasing crop output and simultaneously improving soil quality metrics was found to be RDF 75% + biocompost 25%.

Table 1: Mean crop yield (t ha⁻¹) and soil quality parameters including soil organic carbon (SOC), available nitrogen (N), phosphorus (P), potassium (K), and soil pH as influenced by different biocompost and inorganic fertilizer treatments.

Treatment	Mean yield (t/ha)	SD (t/ha)	Mean SOC (%)	Mean Avail N (kg/ha)	Mean Avail P (mg/kg)	Mean Avail K (kg/ha)	Mean pH
Control	9.212	0.613	0.623	149.83	12.385	116.70	6.365
RDF100	13.842	0.229	0.697	210.08	17.640	166.00	6.1925
RDF75+BC25	15.373	0.387	0.800	226.83	19.240	176.68	6.390
RDF50+BC50	13.402	0.260	0.851	203.45	19.355	169.30	6.465
BC100	12.003	0.193	0.947	189.75	15.692	163.35	6.660

Interpretation of simulated results:

- Among treatments, the RDF75+BC25 simulated treatment generated the highest mean yield (~15.37 t/ha) and the maximum available N and K, indicating a synergistic advantage of mixing biocompost with reduced inorganic fertilizer.
- The soil-carbon-building effect of biocompost was demonstrated by the increasing SOC with increasing quantities of biocompost in the treatment (simulated trend: Control < RDF100 < RDF75+BC25 < RDF50+BC50 < BC100). This is consistent with field data showing that organic

amendments improve the physical and biological characteristics of soil and raise SOC.

Discussion

The simulated experiment illustrates important trends frequently seen in field trials and reviews: combining biocompost with inorganic fertilizer can improve soil organic carbon and nutrient availability relative to control while maintaining or increasing output. Partial substitution (75% RDF + 25% BC) yielded the highest yield in the simulated results, which is in line with documented instances where yields from mixed organic and mineral applications are on par with or higher than those from 100% mineral fertilizer alone.

Soil quality: In line with meta-analyses and long-term trials where vermicompost/compost treatments considerably improve SOC and microbial activity compared to mineral fertilizer alone, the simulated SOC increased as the proportion of biocompost grew. Long-term production, water retention, and soil structure are all supported by this enhancement.

Mechanisms: In addition to providing organic matter and a gradual release of nutrients, biocompost also increases biological activity (microbial biomass), which can improve nutrient mineralization, decrease nutrient leaching, and improve the fertilizer usage efficiency of applied mineral fertilizers. Compost and biofertilizers have also been demonstrated to enhance certain crops' nutritional quality characteristics.

Practical implications: Farmers could reduce inorganic fertilizer rates (e.g., 25–50% replacement) by using biocompost if local field studies validate these trends. This would result in comparable or higher yields and improved soil health, reducing input cost volatility and environmental risks. However, local soil, crops, compost quality, and management all affect precise substitution levels and economics.

Limitations:

- The data shown here are simulated for demonstration purposes; actual field trials must account for crop water management, baseline soil fertility, application time, and compost nutrient content.

Results are impacted by the broad variations in biocompost quality (nutrient content, maturity, and pathogen status). To compare labor/transport costs with fertilizer savings, field-scale economic research is required.

Conclusion

This simulated experiment shows that using biocompost (such as RDF75+BC25) in place of some inorganic fertilizer may boost crop yields and enhance the organic carbon and nutrient status of the soil. Practice recommendations should be made after empirical field tests with locally produced biocompost and economic analysis.

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please contact Academy at
nesapublications@gmail.com / infonesja88@gmail.com