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Ethnobotanical Study of Dye-Yielding Plants and Traditional Dyeing Practices among the Meitei Community of Manipur

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Abstract

This study explores the ethnobotanical knowledge of dye-yielding plants and traditional dyeing practices among the Meitei community of Manipur, Northeast India. It documents the plants used for dyeing, the dye extraction and application methods, and the cultural significance of natural dyes in handloom products. The Study highlights the rich biodiversity of Manipur and the indigenous knowledge embedded in dyeing techniques, which are at risk due to modernization and the increased use of synthetic dyes. Traditional dyeing methods employed by the Meitei community involve labour-intensive techniques, with specific knowledge passed down through generations. Despite the availability of synthetic dyes, natural dyes hold significant cultural, economic, and ecological importance. The Study emphasizes the need for conservation strategies, sustainable harvesting practices, and policy interventions to revive and promote the use of natural dyes. The findings contribute to ethnobotanical research and advocate for sustainable practices in the textile industry, ensuring the preservation of indigenous knowledge and ecological balance.

Keywords: Ethnobotany, Manipur, Natural dyes, Meitei community, Traditional dyeing, Dye-yielding plants

1. Introduction

The practice of dyeing textiles with natural pigments is an ancient art form that has played a significant role in cultural traditions, artistic expression, and the livelihoods of communities worldwide. This time-honored craft involves extracting colours from plants, minerals, and other organic sources to create vibrant and lasting hues. In India, a country recognized as one of the world's twelve megadiversity centers, the rich biodiversity provides an extensive reservoir of dye-yielding plants. For centuries, artisans across different regions of India have harnessed the natural pigments of indigenous flora to colour textiles, crafts, and everyday objects.

Among the many regions that have preserved this traditional knowledge, Manipur, a state in Northeast India, stands out for its extensive plant diversity and deep-rooted cultural heritage. The Meitei

community, a predominant ethnic group in Manipur, has maintained a long-standing tradition of utilizing natural dyes in textile production. Their knowledge of dye-yielding plants has been passed down through generations, forming an integral part of their artistic and cultural identity. The Meitei people employ various plant species for dye extraction, using different parts of plants—such as roots, leaves, flowers, and bark—to obtain colours for their handloom products. Traditional garments such as *phanek*, *moirangphee*, and *khwangphanek* are known for their natural hues, each carrying symbolic and ritualistic significance in Manipuri society.

Historically, natural dyes were used in textiles and bamboo products, fishing nets, and decorative crafts, demonstrating the versatility of plant-based colourants in Manipuri culture. The dye extraction and application process required specialized knowledge of plant species, colour fixation techniques, and the effects of mordants to enhance colour durability. The cultural importance of natural dyes is reflected in ancient texts such as the *Royal Chronicle*, which documents the dyeing practices of the Meitei community.

However, the advent of synthetic dyes in the early 20th century has led to a significant decline in the traditional practice of natural dyeing. By 1930, synthetic dyes became widely available in Manipur's markets, offering artisans an inexpensive and time-efficient alternative to plant-based dyes. The growing preference for synthetic dyes over natural alternatives can be attributed to several factors, including improved transportation networks, increased access to education, the expansion of tourism, and the ease of obtaining a wider variety of colours. As a result, the cultivation and use of dye-yielding plants have diminished, leading to the gradual loss of indigenous knowledge related to natural dyeing.

Despite this decline, there has been a resurgence of interest in natural dyes due to growing awareness of synthetic dyes' environmental and health hazards. Chemical dyes contribute significantly to water pollution and contain toxic substances that pose health risks to artisans and consumers. In contrast, natural dyes are biodegradable, non-toxic, and eco-friendly, making them a sustainable alternative for the textile industry. Efforts are now being made to conserve dye-yielding plant species, document traditional dyeing techniques, and promote eco-friendly textile production to support cultural heritage and sustainable development.

This Study aims to document the ethnobotanical knowledge of dye-yielding plants and traditional dyeing practices among the Meitei community of Manipur. It seeks to identify the plant species used in natural dyeing, explore their extraction and application methods, and assess the cultural significance of traditional dyes in Manipuri society. Furthermore, this research will examine the challenges posed by synthetic dyes and evaluate strategies for the conservation and revival of natural dyeing practices. By bridging the gap between traditional knowledge and modern sustainable practices, this study contributes to preserving Manipur's rich cultural heritage while promoting environmentally conscious alternatives in textile production.

2. Review of Literature

The Study of natural dyes and dye-yielding plants has long been a significant focus in ethnobotanical research, mainly due to the increasing awareness of environmental sustainability and the cultural importance of traditional knowledge (H. M. Sharma et al., 2005). Across India, various indigenous communities have historically used plant-based dyes for textiles, crafts, and ceremonial attire, with techniques passed down through generations (Akimpou & Yadava, 2005). However, this traditional knowledge has faced challenges in recent decades due to the widespread adoption of synthetic

dyes, which offer a faster and more cost-effective alternative (P. Sharma & Singh, 2021). Amid growing concerns over environmental pollution and health hazards associated with synthetic dyes, there has been a resurgence of interest in natural dyeing practices, particularly in regions rich in biodiversity, such as Northeast India (Meitei & Khuman, 2022).

Manipur, one of the most biodiverse states in Northeast India, has a strong tradition of natural dyeing deeply embedded in its cultural and artistic heritage (Potsangbam et al., 2008). Several studies have highlighted the extensive plant diversity in the region and the indigenous knowledge systems associated with natural dye extraction and application (Kikim et al., 2015). The Meitei community, one of the dominant ethnic groups in Manipur, has played a crucial role in preserving and practicing traditional dyeing techniques. References to the use of plant-based dyes can be found in historical texts such as the *Royal Chronicle*, emphasizing the long-standing significance of this craft in Manipuri society (D. S. Ningombam et al., 2012).

Research has documented numerous plant species used by the Meitei community for dyeing. Sharma et al. (2005) identified 34 dye-yielding plant species from 30 families, each producing distinct colours depending on the plant part used, extraction methods, and mordants applied. Some of the most commonly used dye plants include *Strobilanthus flaccidifolius* (Kum) for deep blue-black hues, *Rubiacordifolia* (Luhong) for red shades, *Curcuma longa* (Yaingang) for yellow dyes, and *Acacia catechu* (Kabokhajee) for brown hues (Singh et al., 2009). Mordants, derived from 19 different plant species, are vital in enhancing colour vibrancy and durability in natural dyeing (Sharma et al., 2005).

Despite natural dyes' cultural and ecological significance, traditional dyeing practices in Manipur have declined due to synthetic dyes' increasing availability and affordability. Since the early 20th century, synthetic dyes have replaced mainly plant-based alternatives due to their ease of use and ability to produce a broader range of colours with less effort (Sharma & Singh, 2021). The decline of natural dyeing has raised concerns about the loss of indigenous knowledge and the environmental impact of synthetic dye production (Thangjam & Singh, 2021).

In response to these challenges, interest has been renewed in the conservation and sustainable use of dye-yielding plants. Recent studies emphasize the need for systematic documentation of traditional knowledge, the promotion of sustainable harvesting practices, and the integration of modern scientific methods to enhance the commercial viability of natural dyes (N. Singh et al., 2023). Efforts to revive natural dyeing practices can preserve cultural heritage, provide economic opportunities for local artisans, and contribute to the global movement toward eco-friendly textile production (Meitei & Khuman, 2022).

This research review examines the ethnobotanical knowledge of dye-yielding plants and traditional dyeing practices among the Meitei community of Manipur. It will document the plant species used, explore their extraction and application techniques, and assess the cultural significance of natural dyes. Additionally, this study will address the challenges posed by synthetic dyes and explore potential strategies for reviving and sustaining traditional dyeing practices. By bridging traditional knowledge with contemporary sustainability initiatives, this Study seeks to conserve Manipur's rich ethnobotanical heritage and promote eco-friendly alternatives in the textile industry.

3. The Rationale of the Study

The rationale for this study is grounded in the urgent need to preserve ethnobotanical knowledge, promote sustainability, and support the socio-economic well-being of the Meitei community in Manipur. Traditional dyeing practices hold immense cultural, ecological, and economic significance. They serve

as a vital repository of indigenous knowledge on plant resources and their utilization. This knowledge passed down through generations, encompasses dye extraction techniques and an in-depth understanding of dye-yielding plants and their natural habitats.

For centuries, the Meitei people have used plant-based dyes to produce traditional garments with deep cultural and symbolic meaning in rituals and social identity. However, this rich tradition is seriously threatened due to the increasing dominance of synthetic dyes. The growing preference for chemical-based dyes endangers traditional dyeing practices. It disrupts the livelihoods of artisans, farmers, and weavers who depend on these techniques. Additionally, the decline in traditional practices has contributed to the loss of plant biodiversity, further emphasizing the need to document and safeguard the ethnobotanical knowledge of dye-yielding plants in Manipur.

This study aims to synthesize and consolidate findings from existing research, highlighting the importance of traditional dyeing methods and identifying strategies for their conservation and revival. By doing so, it contributes to broader efforts in preserving cultural heritage, promoting sustainable resource management, and enhancing the socio-economic development of local communities. Comprehensive research on dye-yielding plants in Manipur remains scarce, and much of the existing knowledge is undocumented. This study seeks to bridge this gap by systematically recording dye extraction processes, plant species, and their cultural applications to ensure the transmission of this knowledge to future generations.

Beyond cultural preservation, the study emphasizes the environmental benefits of natural dyes. Unlike synthetic dyes, which contain harmful chemicals and contribute to environmental pollution, natural dyes are biodegradable, non-toxic, and eco-friendly. As global interest in sustainable and organic textiles continues to rise, reviving traditional dyeing techniques can provide eco-friendly alternatives in the textile industry.

Moreover, biodiversity conservation plays a crucial role in this research, as many dye-yielding plants in Manipur are endemic and increasingly threatened. The study promotes sustainable harvesting and conservation strategies by identifying and documenting these plant species to ensure their long-term availability.

The study also explores the economic potential of revitalizing natural dyeing practices. With the growing global demand for sustainable fashion, promoting naturally dyed textiles can open new economic opportunities for local artisans, farmers, and weavers. Integrating traditional knowledge with contemporary textile markets can empower local communities and strengthen their financial resilience.

Ultimately, the presentstudy fills a critical gap by providing a comprehensive ethnobotanical analysis of dye-yielding plants used by the Meitei community. By combining indigenous knowledge with modern sustainability initiatives, the study contributes to ethnobotany, textile research, and conservation efforts, fostering cultural preservation and sustainable development in Manipur.

4. Methodology

The Study employs a comprehensive survey and analysis of existing literature on dye-yielding plants and traditional dyeing practices among the Meitei community of Manipur. A systematic search using academic databases, journals, books, and online resources identified relevant studies on ethnobotany, natural dyes, and traditional dyeing techniques. The study selection prioritized methodological rigor, relevance, and detailed insights into Meitei dyeing traditions.Data extraction focused on plant species, dyeing methods, cultural significance, challenges, and conservation strategies.

The extracted data were organized into thematic sections to provide a structured overview of ethnobotanical knowledge and dyeing practices. A critical analysis was conducted to identify common themes, contradictions, and research gaps. The findings were then compiled into a review report, summarizing key insights, significance, and recommendations for future research and conservation efforts.

5. Objective of the Study

The primary objectives of this study are:

i. To explore traditional dye-yielding plants and traditional dye-yielding practices used by the Meitei communities of Manipur.
ii. To explore traditional dyeing methods and techniques practiced by the Meitei community and theirapplication.
iii. To assess the cultural significance of natural dye and dyeing practices in Manipur.
iv. To identify the factors contributing to the decline of traditional dyeing practices in Manipur.
v. To assess the sustainability and conservation of dye-yielding plants in Manipur and
vi. To explore the potential strategies for reviving and conserving traditional dyeing practices and dye-yielding plants in Manipur.

6. Findings of the Study

The findings of this study provide an in-depth examination of ethnobotanical knowledge, traditional dyeing practices, cultural relevance, and the challenges and opportunities associated with preserving natural dyeing techniques in the Meitei community of Manipur. These findings are structured according to the four key objectives of the Study:

Objective 1: Identification and Documentation of Dye-Yielding Plants Used by the Meitei Community

The study reveals that the Meitei community in Manipur possesses a rich tradition of utilizing local plants to dye textiles. The Meitei and tribal communities of Manipur have a long history of using various plants to dye textiles and other materials. This practice, deeply embedded in their cultural heritage, has been passed down through generations, with specific plants being used to create distinct colours for handloom textiles such as *Phanek* and *MoiraangPhee*(H. Singh & Devi, 2020).The Meitei community of Manipur uses a rich array of plant species for dyeing. Studies have documented a significant number of dye-yielding plants, highlighting the extensive ethnobotanical knowledge of the community.

a) ***Number of Species:*** Various studieshave reported that various vegetable dye-yielding plants are used by the Meitei and tribal peoples of Manipur to extract dyes. One study documentedthat 34 plant species belonging to 30 families are used in the extraction of dyes by the Meitei community of Manipur. Besides these dye-yielding plants, another 19 species belonging to 14 families used as dye mordants have also been included(Sharma et al., 2005). Another study identified 30 dye-yielding plant species belonging to 23 families used by tribal communities of the Senapati District of Manipur (Kikim et al., 2015).Other studies suggest thatmore than 50 plant species in Manipur are used as dyes (Potsangbam et al., 2008).

b) ***Key Species****:* Among the diverse plant species used for dyeing, some hold particular significance due to their unique dyeing properties and cultural importance:
   - ***Strobilanthus flaccidifolius (Kum):***This plant is highly valued for producing blue-black and indigo colours. It is considered the most essential plant for dyeing in Manipur and is used by various communities(S. Ningombam et al., 2008; N. R. Singh, Yaiphaba, Devi, et al., 2009).
   - ***BixaOrellana*:** Known for yielding yellow and orange dyes, this species is widely used in Manipur to colour textiles and other items.
   - ***Acacia catechu*:** This plant provides brown and black dyes and prepares local ink and cotton fabrics.
   - ***Quercus dealbata*:** This species gives dark brown colours and is used as a substitute for other *Quercus* species in dyeing.

c) ***Plant Parts Used:*** Different plant parts are utilized for dye extraction, each contributing unique colours and properties(Kikim et al., 2015):
   - Fruits are the maximum source of natural dyes (30%), followed by bark (20%), flowers (16.6%), and leaves (13.3%).
   - Other plant parts used include whole plants, roots, and seeds.

d) ***List of Dye-Yielding Plants:***Studies have compiled extensive lists of dye-yielding plants used by the Meitei community, along with their local names, families, and uses. These lists provide valuable resources for identifying and documenting dye-yielding plants in Manipur (Akimpou & Yadava, 2005; Lunalisa et al., 2008; S. Ningombam et al., 2008; H. M. Sharma et al., 2005; N. R. Singh, Yaiphaba, Devi, et al., 2009).Some of the most commonly used dye-yielding plants in Manipur include (**Table 1**):

Table 1: Commonly Used Dye-yielding Plants in Manipur

Sl. No.	**Botanical Name**	**Family**	**Common Name/Local Name**	**Colour(s) Produced**	**Plant Part(s) Used**
1	*Acacia catechu* [(L.f.) Willd]	Fabaceae	Kabokhajee (M)	Brown, black, Reddish Black	Bark, Heartwood
2	*Achyranthes aspera* L.	Amaranthaceae	Khujumpere (M)	Adhesive	Whole plant
3	*Amooraspectabilis*Miq.	Meliaceae	U-ngang (M)	Bright red, Pale Scarlet	Bark, Hearwood
4	*Areca catechu* Linn.	Arecaceae	Kwa pambi (M)	Copper red	Nuts
5	*Averrhoea carambola* L.	Oxalidaceae	Heinoujom (M), Rupuan (R)	Adhesive	Fruit
6	*Basella alba* L.	Basellaceae	UrokSumbal (M)	Deep purple, different	Whole plant,

				colours	Ripe fruits, leaves, stems
7	*Bauhinia purpurea* L.	Fabaceae	Chingthraoangangba (M), Gaubeh (V)	Rose purple	Flower, fresh flowers
8	*Berberis manipurana*Ahr.	Berberidaceae	Oonapu (M)	Yellow	Stem and roots
9	*BixaOrellana* L.	Bixaceae	Ureirom (M), Phei-sangbang (R)	Yellow-orange, pale red	Seeds, Arils of the seed
10	*Carthamustinctorius* L.	Asteraceae	Kusumlei (M, R)	Golden yellow, pink, red	Flower, Petals
11	*Cassia fistula* L.	Fabaceae	Chau-hui (M)	Red	Bark and sapwood
12	*Celosia argentea* L.	Amaranthaceae	Haoreiangangba (M)	Pink red	Flower
13	*Clerodendrumbracteatum* Wall. ex Walp.	Verbenaceae	Kuthap (M)	Pale green	Leaves
14	*Clerodendrumodoratum* D. Don	Verbenaceae	Kuthap (M),Ganmakhui (R)	Greenish (pale green), Pale green	Leaves
15	*Clerodendrumcolebrookianum*Walp.	Verbenaceae	Kuthapangouba (M), Anphui (V,H)	Pale green	Leaves
16	*Clitoriaternatea* L.	Papilionaceae	Aprajita (M)	Blue	Flower, Dried flowers
17	*Cordia grandis*Forst.	Boraginaceae	Lamuk (M)	Black	Fruit and bark
18	*Curcuma domestica*Valeton syn. *C. longa* Linn.	Zingiberaceae	Yaingang (M), Gachangrim (R)	Chrome yellow,Goden Yellow	Rhizomes
19	*Cuscutareflexa*Roxb.	Cuscutaceae	Uri napu (M)	Yellow	Whole plant
20	*Dipterocarpus turbinatus*Gaertn.f.	Dipterocarpaceae	Yangou (M)	Whitish	Wood, sap

21	*Emblica officinalis*Gaertn.	Euphorbiaceae	Heikru (M), Talouthai (R), Suklu (V)	Black brown, reddish black	Bark, fruit
22	*Erythrina stricta*Roxb.	Papilionaceae	Kuraoangangba (M)	Coral red, Deep blue	Dried flowers, Flowers
23	*Hibiscus rosa-sinensis* Linn.	Malvaceae	Juba kushum (M)	Red	Fresh flowers
24	*Iris bakeri* Wall	Iridaceae	Komberei (M)	Blue	Flower, Dried flowers
25	*Juglans regia* L.	Juglandaceae	Heijuga (M), Makha (V)	Black	Unripe fruits
26	*Lithocarpusdeal bata*Miq. Rehder	Fagaceae	Sahi (M), Tha (R)	Dark brown, reddish dye	Tree bark
27	*Lithocarpusdeal bata*Miq. Rehder	Fagaceae	Kuhi (M) Sahi (M), Tha (R)	Dark brown	Tree bark
28	*Lithocarpusfene strata* (Roxb.) Redhder	Fagaceae	Sahi (M), Tha (R)	Dark brown	Tree bark
29	*Lithocarpuspach yphylla* (Kurz) Rehd.	Fagaceae	KuhiPasaniapac hyphylla (Kurz) Schottky	Black, Dark Brown, Reddish-brown to brown	Bark
30	*Mahonia manipurensis* Takeda	Berberidaceae	U-napu (M)	Natural yellow	Stem, root bark
31	*Mallotusphilipp ensis*Muell-Arg.	Euphorbiaceae	Ureiromlaba (M)	Crimson red	Fruits
32	*Melanorrhoeaus itata* Wall.	Anacardiaceae	Khe-U (M), Pungdon (M)	Oily black, Oily blackish dye, An oily blackish dye	Wood, root, wood and roots
33	*Melastomamala bathricum* Linn.	Melastomatace ae	Yachubi (M)	Violet, dark blackish red	Ripe Fruits, leaves, flower
34	*Osbeckiachinens is* L.	Melastomacea e	Yachubi (M)	Dark black	Ripe Fruits,

					leaves, flower
35	*Parkiaroxburghii* G. Don	Mimosaceae	Kampai (R), Yongchak (M)	Dark brown, Brown	Fruit skin
36	*Pasaniapachyphylla* (Kurz.) Scott.	Fagaceae	Kuhi (M), Dungc (R)	Reddish dye, black colour	Fresh bark pieces, Stem bark
37	*Parkiatimoriana* (A.DC.) Merr.	Mimosaceae	Yongchak (M)	Brown, Reddish	Fruit peel, Stem and fruits
38	*Piper Betle* Linn.	Piperaceae	Pana mana/Kwa mana (M)	Deep reddish dye	Leaves, seeds
39	*Phyllanthus emblica* L.	Euphorbiaceae	Heikru (M) Talouthai (R), Suklu (V)	Black Brown	Bark, fruit
40	*Plumbago indica* L.	Plumbaginaceae	Mukaklei (M, R),	Pale red	Flower, Petals
41	*Polygonum chinense* L.	Polygonaceae	Angomyensil (M)	Adhesive	Whole plant
42	*Psidium guajava* L.	Myrtaceae	Pungton (M, V), Bungton-thai (R)	Adhesive, reddish brown	Mature fruit, Fresh mature fruits
43	*Punicagranatum* Linn.	Punicaceae	Kaphoi (M), Puclei-thai (R)	black and brown colour	Bark or fruit skin
44	*Quercus dealbata*	Fagaceae	Tha (R), Shahi (M)	Dark brown or less colour intensity	Bark
45	*Rubiacordifolia* Linn.	Rubiaceae	Moyumpambi (M)	Deep pink	Stem and roots
46	*Solanum ferox* Linn.	Solanaceae	Khamu (M)	Deep chocolate coloured	Mature fruits
47	*Solanum incidum* Linn.	Solanaceae	Khamu (M)	Purple dye	Plant
48	*Strobilanthescusa* (Nees) Imlay	Acanthaceae	Kum (M)	black dyes	leaves and stem
49	*Strobilanthescusia* (Nees) Imlay syn.	Acanthaceae	Kumna/Kum (M), Kheimbang (R)	Indigo, Blue-black, Black	Mature leaves

	Strobilanthus flaccidifolius				
50	*Tagetespatula* Linn.	Asteraceae	Sanarei (M)	yellow and golden yellow	Dried flowers
51	*Tectonagrandis* L.f.	Verbenaceae	Chingsu (M), Chuangbang (R)	Red, yellow, black, maroon, brownish	Leaves, bark
52	*Terminalia citrina*Roxb. ex Flem.	Combretaceae	Manahee (M)	Blackish	Bark
53	*Zizania caduciflora* Hand. -Mazz.	Poaceae	IshingKambong (M)	Black	Culms

Note:*(M) = Meitei, (V) = Vaiphei, (R) = Rongmei*

Objective 2: Traditional Methods of Dye Extraction and Application

The Meitei community of Manipur possesses a deep-rooted ethnobotanical knowledge of natural dye preparation and application. Over generations, they have developed and refined sophisticated dyeing techniques, which involve complex processes such as fermentation, boiling, and mordanting to enhance colourfastness'(Potsangbam et al., 2008). These methods reflect their deep understanding of plant properties and cultural traditions, making them an integral part of Meitei heritage. The extraction of plant-based dyes varies based on the plant species and the desired colour intensity. The Meitei community primarily employs boiling, fermentation, and direct application as extraction techniques(Sharma & Singh, 2021).

i. ***Boiling Method*:** The boiling of plant materials is one of the most commonly used extraction techniques:
   - Acacia catechu bark is boiled for about an hour to produce a dark brown or black dye, often used in traditional textiles.
   - Curcuma longa (turmeric) rhizomes are boiled to obtain a vibrant yellow dye, frequently used for religious and ceremonial garments.

ii. ***Fermentation Method:*** Fermentation is employed for dye plants that require prolonged soaking to develop their colour:
   - *Strobilanthus flaccidifolius (Kum plant)* undergoes fermentation in a covered water pitcher, producing a deep blue-black dye (Ningombam et al., 2012; Singhet al., 2009).
   - *Lawsoniainermis (henna)* leaves are soaked and fermented to extract a reddish-brown dyetraditionally used for textile dyeing and body art.

iii. ***Crushing and Direct Application:***Certain flowers and fruits release their pigments directly when crushed:

- *Bauhinia purpurea* flowers are crushed and applied to fabrics, creating a soft rose-purple hue.
- *BixaOrellana* (*annatto*) seeds are crushed to extract an orange-red dye commonly used for cosmetic and fabric dyeing.

iv. ***Mordanting Techniques:*** Mordants are essential for fixing natural dyes onto fabrics and improving colour intensity (Singh et al., 2009). The Meitei community utilizes a variety of natural mordants:

- ***Alkaline Mordants*:** Ash from *Achyranthes aspera (Khuchumpere*) and lime are commonly used to brighten colours.
- ***Acidic Mordants*:** Extracts from *Garcinia anomala* (*Heibung*) and *Citrus sinensis* (*Heijang*) are added to stabilize and intensify colours.
- ***Shell Ash Mordants:*** The *ash of oyster shells (KumSunu)* plays a crucial role in the Kum dyeing process, helping achieve a rich black hue(Ningombam et al., 2008; Singh et al., 2009).

v. ***Colour Enhancement Techniques:*** To enhance the depth, durability, and vibrancy of colours, various ingredients are added to dye solutions:

- *Pasaniapachyphylla* bark and banana leaf ash increase colour intensity.
- *Molasses* and *mustard oil* are mixed into the dye bath to ensure better adhesion.
- *Averrhoa carambola* (starfruit) juice is added to improve the dye's adhesive properties, particularly for *Bixaorellana* dyes.

Dye Application Process

The dyeing process involves multiple steps to achieve rich, long-lasting colours (Singh et al., 2023).

a) Fabric Preparation

- Fabrics are thoroughly washed to remove dirt and oils, ensuring better dye absorption.
- Some fabrics undergo a pre-mordanting process to enhance dye fixation.

b) Dyeing Process

- Textiles are immersed in the dye bath for a specific duration, depending on the desired shade.
- The process is repeated multiple times to achieve more profound and vibrant colours.
- Example: In the dyeing of traditional Phanek, the fabric is dipped, squeezed, and air-dried multiple times until the desired colour is reached.

c) Drying and Final Treatment

- Dyed fabrics are squeezed to remove excess dye and dried in shaded areas to prevent colour fading.
- Some textiles are washed with fruit extracts (e.g., *Averrhoa carambola*) to improve colour longevity.

KumYeiba: A Sacred and Complex Dyeing Process

Among Manipur's most revered dyeing traditions is the KumYeiba technique, used to produce deep blue-black Kum dye from Strobilanthus flaccidifolius(P. Ningombam & Devi, 2022). This intricate process involves(Singh et al., 2009):

1. Soaking mature Strobilanthus flaccidifolius leaves in a covered water pitcher, allowing them to decompose.
2. Fermenting the mixture for several days to develop the dye.
3. Stirring the solution with a multi-pronged stick to separate the solid residues.
4. Adding oyster shell ash (KumSunu) to the fermented dye bath increases potency.
5. Dipping fabrics repeatedly in the solution, squeezing out excess liquid, and drying in a well-ventilated area away from direct sunlight.
6. The process is repeated multiple times to achieve a rich, permanent black hue, characteristic of traditional Meitei textiles.

Objective 3: Cultural Significance of Natural Dyes in Manipur

Natural dyes and dyeing practices hold significant cultural importance in the Meitei community, reflecting their deep-rooted traditions and connection with nature. These dyes are not merely colouring agents but are integral to the community's cultural identity and social practices.

i. ***Traditional Attire:*** Natural dyes are used to colour traditional clothes worn on various occasions:
   - Specific hues for traditional clothes like *Pungouphanek*, *Thangjingmapalphanek*, *Phigephanek*, and *Mugaphanek* are derived from plant-based dyes.
   - These clothes are used during deaths, anniversaries, marriages, and worship ceremonies, highlighting the cultural significance of natural dyes in social and religious contexts.

ii. ***Ritualistic Use:***Natural dyes are also used in ritualistic performances and ceremonies:
   - The Tangkhul community's tradition of buying dyes for textiles in the Imphal market is highlighted in dramatized ritual performances during the Kanglei Umang Lai Haraoba festival.

iii. ***Social Identity:***The use of natural dyes is closely linked to the social identity and cultural heritage of the Meitei community:
   - The specialty of locally extracted plant dyes is that the synthetic dyes cannot match the particular hue and chroma of these dyes. This uniqueness contributes to the distinctiveness of Meitei handloom products, which are famous worldwide for their indigenous designs and quality.

iv. ***Traditional Skills:***Dyeing skills are passed down through generations, preserving traditional knowledge and cultural practices:
   - The Meitei women practice dyeing using varieties of plant leaves, flowers, and tree bark, with *Kum* being more significant due to its superior quality.

Objective 4: Factors Contributing to the Decline

The gradual decline of traditional dyeing practices among the Meitei community of Manipur has been influenced by several factors, leading to a shift towards synthetic dyes. The introduction of chemical dyes in the early 20th century was a turning point, as synthetic dyes became widely available in the Imphal market around 1905 AD, with fast chemical dyes gaining popularity by 1930 AD (Akimpou et al., 2005). These dyes provided multiple advantages, including easy availability, a wider range of colours, reduced preparation time, and cost-effectiveness, making them preferred over natural alternatives.

As synthetic dyes gained prominence, traditional knowledge of natural dye extraction and application began to fade. Younger generations showed less interest in learning labour-intensive dyeing techniques, leading to a decline in the transmission of indigenous knowledge (Ningombam et al., 2012). Additionally, synthetic dyes offered convenience but posed environmental concerns due to their toxic chemical composition, water pollution, and health hazards (Sharma & Singh, 2021). Some of the other challenges in preserving traditional dyeing practices are -

i. ***The decline in Availability of Dye-Yielding Plants****:* The decreasing availability of dye-yielding plants due to deforestation, habitat destruction, and overharvesting has made it increasingly difficult for artisans to access essential raw materials (Thangjam& Singh, 2021). Many plant species may become endangered without conservation efforts, threatening traditional dyeing methods (Sharma & Singh, 2021).

ii. ***Increasing Use of Synthetic Dyes****:* The affordability and accessibility of synthetic dyes have significantly reduced the demand for plant-based dyes (Meitei &Khuman, 2022). As a result, fewer artisans engage in natural dyeing, losing traditional knowledge and weakening the connection between dyeing practices and cultural identity (Singh et al., 2023).

iii. ***Labor-Intensive Nature of Traditional Dyeing****:* Traditional dyeing techniques require specialized skills, patience, and manual labor, making them time-consuming and less appealing to younger artisans (Meitei & Khuman, 2022). Unlike synthetic dyes that produce instant results, natural dye extraction and application can take days, discouraging continued practice and leading to a generational gap in the transmission of skills (Ningombam et al., 2012).

iv. ***Lack of Documentation and Awareness****:* Most knowledge related to natural dyeing has been orally passed down through generations, making it vulnerable to loss. The absence of formal records has hindered research and innovation in the field (Singh et al., 2023). Without systematic documentation, preservation efforts remain challenging, further threatening the survival of this cultural heritage (Saratchandra & Devi, 2022).

Addressing these challenges requires conservation efforts, awareness programs, and the integration of traditional dyeing into modern markets to ensure its sustainability and revival.

Objective 5: To assess the sustainability and conservation of dye-yielding plants in Manipur.

The sustainability and conservation of dye-yielding plants in Manipur are critical for preserving the environment and the cultural heritage of the Meitei community(Devi, 2019). The decline in traditional dyeing practices and the threats to plant biodiversity highlight the urgent need for conservation efforts.

a) ***Decline in Traditional Dye Use:***The Study highlights a significant decrease in the use of natural dyes due to the widespread availability and convenience of synthetic chemical dyes (Devi & Singh, 2021). Synthetic dyes offer a broader colour range, faster processing, and easy accessibility, making them preferable over traditional alternatives. Consequently, conventional dye knowledge extraction and application are gradually disappearing, with younger generations showing reduced interest in learning these skills.

b) ***Threats to Dye-Yielding Plants:***Several factors threaten the sustainability of dye-yielding plants in Manipur:
   - ***Habitat Loss:***Deforestation, agricultural expansion, and urbanization lead to the destruction of natural habitats where dye-yielding plants grow (Singh et al., 2023).
   - ***Over-exploitation:***Unsustainable harvesting practices can deplete plant populations, particularly for species with slow growth rates or limited distribution (Ningombam& Devi, 2022).
   - ***Pollution:***Industrial and agricultural pollution can contaminate soil and water sources, affecting the health and survival of dye-yielding plants.
   - ***Climate Change:***Changes in temperature and rainfall patterns can alter the distribution and productivity of dye-yielding plants.

c) ***Ecological Importance:***Dye-yielding plants play essential roles in the ecosystem:
   - They provide habitats and food sources for various animal species.
   - They contribute to soil conservation and watershed protection.
   - They enhance the aesthetic value of landscapes.

d) ***Need for Sustainable Practices:***Sustainable harvesting and management practices are essential for ensuring the long-term availability of dye-yielding plants:
   - Promoting community-based conservation initiatives involving local people in plant resource management.
   - Implementing regulations to prevent over-exploitation and illegal harvesting.
   - Encouraging the cultivation of dye-yielding plants in home gardens and community forests.

e) ***Need for Conservation:***To mitigate the threats facing dye plants, conservation initiatives must be undertaken. Research suggests that sustainable harvesting, reforestation, and community-based conservation programs are necessary to ensure the long-term survival of these resources (Meitei &Khuman, 2022). Moreover, commercializing natural dyes could be an economic opportunity, providing a systematic and scientific approach (Thangjam& Singh, 2021).

f) ***Traditional Knowledge and Sustainable Practices:***Traditional dyeing methods are eco-friendly and biodegradable, unlike synthetic dyes that release harmful chemicals into the environment (Sharma & Singh, 2021). Indigenous ecological knowledge plays a key role in sustainable resource management. For instance, community-led conservation models, such as protecting Strobilanthes flaccidifolius, have successfully preserved biodiversity(Konjengbam, 2023).

g) ***Integrating Traditional and Modern Approaches:***A blended approach combining traditional knowledge with modern scientific techniques can enhance sustainability. Researchers emphasize the need for scientific advancements such as biotechnology, organic farming, and controlled harvesting to optimize dye production while maintaining ecological balance (Singh et al., 2023).

h) ***Economic Benefits:***Revising and commercializing natural dyes can provide employment opportunities and boost the local economy. Promoting eco-friendly textiles could integrate the traditional dyeing industry into national economic policies, improving artisans' livelihoods (Saratchandra & Devi, 2022).

Objective 6: Revival and Conservation Strategies

Reserving dye-yielding plants in Manipur is crucial for sustaining the region's rich cultural and ecological heritage. The decline of traditional dyeing practices, driven by environmental threats and the rise of synthetic dyes, necessitates a comprehensive conservation strategy that integrates traditional knowledge, scientific advancements, and community engagement.

i. ***Documenting Traditional Knowledge:***To safeguard Indigenous dyeing traditions, systematic documentation of traditional knowledge is essential:
   - Conducting **ethnobotanical surveys** to catalog dye-yielding plants used by the Meitei community.
   - Documenting and Recording **traditional dyeing techniques**, including extraction, mordanting, and application processes, through mediums such as books, films, and videos.
   - Compiling information on the **cultural significance** of natural dyes in social and religious practices (Meitei &Khuman, 2022).
   - Establishing and maintaining archives to safeguard traditional knowledge and practices for future references and research.

ii. ***Promoting Awareness and Education:***Public awareness and education play a key role in encouraging the use and conservation of natural dyes:
   - Organizing **workshops, exhibitions, and seminars** to highlight the value of traditional dyeing methods.
   - Integrating **natural dye studies into school curricula** to educate future generations.
   - Utilizing **media platforms** to promote natural dyes' environmental and health benefits.

iii. ***Encouraging Sustainable Harvesting:***Sustainable resource management is essential for the long-term availability of dye-yielding plants:
   - Implementing **harvesting guidelines** to prevent over-exploitation.
   - Encouraging the **cultivation of dye plants** in home gardens and community forests (Ningombam& Devi, 2022).
   - Providing **training on sustainable harvesting techniques** to local communities.

iv. ***Economic Incentives and Market Expansion:***Economic sustainability can drive conservation efforts by creating livelihood opportunities:
   - Supporting **small-scale enterprises** that produce and market naturally dyed textiles.
   - Offering **financial aid and technical assistance** to traditional artisans.
   - Promoting **eco-tourism initiatives** centred on natural dyeing practices (Ngangbam& Devi, 2023).

v. ***Integrating Traditional and Modern Approaches:***Scientific advancements can enhance the efficiency and sustainability of natural dye production:
   - Researching **plant-based dye compounds** for improved extraction and durability.

- Modern technologies monitor plant populations and assess environmental impacts (Konjengbam, 2023).
- Developing **eco-friendly mordants and dyeing techniques** that align with sustainable practices.

7. Conclusion

The ethnobotanical Study of dye-yielding plants and traditional dyeing practices among the Meitei community of Manipur reveals a rich cultural heritage and a deep connection with the natural environment. The diversity of plant species used for dyeing, the intricate methods employed, and the cultural significance of natural dyes highlight the importance of preserving this traditional knowledge. However, the decline in traditional dyeing practices due to the introduction of synthetic dyes and the threats to dye-yielding plants necessitate urgent action. By implementing strategies that promote sustainable harvesting, document traditional knowledge, raise public awareness, provide economic incentives, and integrate traditional and modern approaches, it is possible to revitalize traditional dyeing practices, conserve dye-yielding plants, and ensure the long-term sustainability of this valuable cultural and natural heritage. These efforts will preserve the unique cultural identity of the Meitei community and contribute to broader goals of sustainable development and environmental conservation in the region.

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