The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026 pp. 103-109

The Research Analytics
(A Peer Reviewed, Indexed and Open Access Journal)

14

Eco-Friendly Festival Colours from Indigenous Flora: A Sustainable Model Integrating Ethnobotany and Student Innovation

Lokeshwari Rathia
Assistant Professor of Botany, (Department of Botany), Govt. Sukhram Nage College Nagri, District-Dhamtari (C.G.)

Abstract
Synthetic festival colours are increasingly associated with dermatological disorders and environmental contamination. The present study documents a participatory, practice-based botanical intervention aimed at developing herbal gulal using locally available floral resources in a tribal-dominated region of Chhattisgarh. Unlike conventional laboratory-based studies, this work integrates student participation, indigenous plant knowledge, and low-cost processing techniques to produce safe, biodegradable colour powders. Flowers of Butea monosperma, Clitoria ternatea, Tagetes spp., Azadirachta indica, and Curcuma longa were used as primary raw materials. The preparation protocol emphasized minimal instrumentation, making it suitable for rural institutions. The study highlights the potential of herbal gulal as a botany-driven livelihood model, promoting sustainable practices, experiential learning, environmental awareness and community-oriented entrepreneurship.
Keywords-*Herbal gulal, natural dyes, experiential learning, tribal resources, eco-friendly festivals, botanical entrepreneurship.*

Introduction:

The celebration of Holi, the vibrant festival of colors, is deeply embedded in the cultural and spiritual traditions of India. Central to this festivity is the use of gulal, a colored powder symbolizing joy, unity and historically derived its hues from plant-based sources. However, the commercial gulal available today is often manufactured using synthetic dyes and industrial chemicals, many of which pose significant risks to human health & the environment. Reports of skin irritation, respiratory problems, and ecological degradation associated with these synthetic colors have raised concerns among health professionals and environmentalists alike. Jain et al (2015) reported that synthetic dyes poses harmful effects on the skin, mucoša of the mouth and eye infection like Conjuctivitis. Das et al. (2015) reported that artificial gulal contains heavy metals. In response to these challenges there has been a growing interest in the development of herbal gulal an ecofriendly and skin-safe alternative, formulated, using plant-derived pigments and natural binding agents. Despite its cultural relevance and increasing demand in conscious consumer markets, the formulation & efficacy of herbal gulal remain underexplored in scientific literature. Tiwari et al (2020) studied the extraction & preparation method of herbal gulal from *Beta Vulgaris*. Jha et al. (2015) studied that natural colorants like flavonoids and carotenoids are present in the flowers of Marigold. Gupta et al. (2015) studied that more than 450 plant sources from.which natural dyes can be extracted. alpana at al (2024) studied that tesu gulal (*Butea monosperma*) is a valuable option for production of herbal gulal in a low cost. This research presents a novel approach to the preparation of herbal gulal using

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

locally available plant sources rich in bio active pigments, such as *Butea monosperma Curcuma longa, Rosa Indica*, Marigold (*Tagetes spp*.) *Clitoria ternatea*. The work explores the potential of herbal gulal as a vehicle for promoting ethnobotanical awareness, sustainable practices and small scale rural entrepreneurship.

Tribal-dominated regions such as Chhattisgarh are rich in floral diversity and traditional ethnobotanical knowledge, yet these resources remain largely untapped for value-added applications. Indigenous communities possess practical knowledge regarding the use of flowers and plant parts for colouring and medicinal purposes, which can be effectively integrated into sustainable livelihood models. However, there is limited scientific documentation on participatory, low-cost, and educational approaches for herbal gulal production using locally available plant resources in such regions.

S.no.	Common name	Botanical name	Quantity used	Cost	Collected by
1	Palash	*Butea monosperma*	10kg	free of cost	Group 1
2	Rose	*Rosa indica*	400g	free of cost	Group 2
3	Marigold	*Tagetes spp.*	1kg	free of cost	Group3
4	Aparajita	*Clitoria ternatea*	200g	free of cost	Group4
5	Turmeric	*Curcuma longa*	200g	20/-per 100g	Group5
6	Beetroot	*Beta vulgaris*	0.5kg	20/-per 0.5kg	Local market

The present study addresses this research gap by adopting a participatory, practice-based botanical approach for the preparation of herbal gulal using locally available plant species. Emphasis is placed on low-cost processing techniques requiring minimal instrumentation, making the approach suitable for rural and resource-limited institutional settings. By integrating student participation and indigenous plant knowledge, the study aims to promote experiential learning, environmental awareness, and community-oriented botanical entrepreneurship.

Thus, the study seeks to contribute to the revival of traditional eco-friendly practices while addressing contemporary concerns related to health, environment, and sustainable development. The findings are expected to support the use of herbal gulal as a viable alternative to synthetic festival colours and to highlight its potential role in ethnobotanical education and rural livelihood generation.

Materials & Methods :

Table 1-material used for preparation of herbal gulal

instruments-

1. steel container,
2. cotton/Muslin cloth,
3. weighing machine,
4. grinder
5. strainer

1)Study Area and Participant Involvement

The study was conducted at the Department of Botany, Govt. Sukhram Nage College, Nagri, District Dhamtari, Chhattisgarh, India. The region is characterized by rich floral biodiversity and strong ethnobotanical traditions. Undergraduate students of the Botany department were actively involved in the project as part of experiential and skill-based learning. Students were

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

grouped and guided throughout the process, including plant material collection, dye extraction, and herbal gulal preparation, under faculty supervision.

2)Selection and Collection of Plant Materials :-

Fresh flowers of *Tagetes erecta, Rosa indica, Clitoria ternatea*, and *Butea monosperma* were selected based on their traditional use, pigment richness, non-toxic nature, and local availability. Plant materials were collected during early morning hours from nearby villages and home gardens to ensure maximum pigment retention. Only healthy, disease-free flowers were selected. In addition, turmeric(*Curcuma longa*) and beetroot (*Beta vulgaris*) were procured from the local market for comparative pigment sources.

3)Pre-treatment of Plant Materials :-

Collected flowers were manually sorted to remove non-floral parts and debris. The petals were thoroughly washed with potable water to remove dust and surface contaminants. Excess water was drained prior to extraction. Fresh petals were used immediately to prevent pigment degradation.

4)Dye Extraction Procedure :-

Natural dye extraction was carried out using a simple aqueous extraction method. The cleaned petals were ground with a measured quantity of clean water using a mixer grinder to obtain a homogeneous slurry. The slurry was filtered using clean cotton or muslin cloth to separate the liquid dye extract from solid residues. The filtrate was collected in clean stainless steel containers and used immediately for preparation to avoid microbial spoilage.

5)Preparation of Herbal Gulal :-

Corn flour was used as the base material due to its fine texture, inert nature, and skin-friendly properties. The dye extract was gradually mixed with an appropriate quantity of corn flour to form a uniform mixture. The mixture was spread in thin layers and air-dried under mild sunlight to remove moisture without affecting colour quality. After complete drying, the material was gently powdered and sieved to remove lumps, resulting in a fine and homogeneous herbal gulal.

6)Quality Assessment :-

The prepared herbal gulal was visually evaluated for colour intensity, texture, and uniformity. A preliminary direct skin contact test was performed on a small area of skin to assess any immediate irritation or allergic reaction. No adverse effects were observed during the testing period, indicating the suitability of the product for external application.

7)Tools and Equipment Used :-

The preparation process utilized minimal and easily accessible equipment, including stainless steel containers, mixer grinder, cotton or muslin cloth, weighing balance, sieve, and drying trays. The use of basic instrumentation highlights the feasibility of herbal gulal preparation in rural and resource-limited institutional settings.

Result & Discussion:

The present study successfully demonstrated the preparation of herbal gulal using locally available floral resources through a simple, participatory, and low-cost approach. The extracted natural dyes from *Tagetes erecta, Rosa indica, Clitoria ternatea*, and *Butea monosperma* produced distinct, vibrant colours ranging from yellow and orange to pink and blue, confirming the presence of stable natural pigments such as carotenoids, flavonoids, anthocyanins, and chalcones. The colours obtained were visually appealing and comparable in brightness to commercially available synthetic gulal, indicating the effectiveness of the extraction and formulation process.

The use of corn flour as a base material resulted in a fine-textured, free-flowing powder with uniform consistency. Sun-drying under mild conditions effectively removed moisture without causing discoloration or degradation of pigments, suggesting that low-energy drying methods

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

are suitable for herbal gulal preparation. Sieving further enhanced powder quality by eliminating clumps and ensuring homogeneity. Importantly, no chemical binders, preservatives, or synthetic additives were required, reinforcing the eco-friendly nature of the formulation. Unlike many published studies that emphasize pigment chemistry, extraction optimization, or industrial scalability, the present work focuses on process simplicity, educational engagement, and community involvement. The novelty of this study lies in documenting a college-based, participatory botanical model that integrates student learning with practical application. Active involvement of Botany students in raw material collection, dye extraction, and gulal preparation enhanced experiential learning and fostered awareness regarding ethnobotanical resources and sustainable practices.

The study also highlights the importance of utilizing region-specific plant resources, particularly in tribal-dominated areas such as Nagri, Chhattisgarh. Indigenous knowledge related to plant identification, flowering seasons, and traditional uses played a supportive role in the project. By relying on locally available flora and basic equipment, the model demonstrates feasibility for replication in rural colleges and resource-limited institutions. This approach strengthens the link between academic botany, environmental responsibility, and local livelihoods.

From a socio-economic perspective, the herbal gulal preparation model has potential applications beyond academic experimentation. The process can be scaled at a small-community level to generate seasonal income opportunities, especially for self-help groups, students, and rural youth. The emphasis on sustainable resource use and minimal investment aligns with principles of green entrepreneurship and skill-based education advocated under national higher education and sustainability frameworks.

Overall, the results indicate that herbal gulal prepared using simple techniques is not only environmentally safe and socially acceptable but also educationally enriching. The integration of botanical knowledge, community participation, and sustainability principles positions this approach as a viable alternative to synthetic festival colours and as a model for experiential and skill-based learning in botanical sciences.

Table 2-observation & evaluation of herbal gulal prepared from different plant sources:-

S. No.	Plant source	Colour obtained	Medical/functional properties
1	Palash (*Butea monosperma*)	Orange-red	Antioxidant
2	Rose(*Rosa indica*)	Light pink	Anti-inflammatory,antibacterial
3	Marigold(*Tagetes spp*).	Yellow to orange	Antioxidant,wound healing
4	Aparajita (*Clitoria ternatea)*	Blue	Supports skin health
5	Turmeric(*Curcuma longa*)	Light yellow	Anti-inflammatory,antioxidan
6	Beetroot (*Beta vulgaris*)	Reddish pink	Rich in micronutrients

Conclusion :-

The present study demonstrates that herbal gulal can be effectively prepared using locally available floral resources through simple, low-cost, and environmentally sustainable methods. The successful extraction of natural pigments from *Tagetes erecta, Rosa indica, Clitoria ternatea, Butea monosperma*, and other plant sources confirms the potential of indigenous flora as safe alternatives to synthetic festival colours. The absence of chemical additives and the use

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

of biodegradable base materials further enhance the environmental compatibility and user safety of the prepared gulal.

Beyond product development, the study highlights the significance of integrating botanical education with practical, community-oriented applications. Active involvement of undergraduate Botany students in the entire process promoted experiential learning, strengthened understanding of ethnobotanical knowledge, and encouraged environmental responsibility. The participatory approach adopted in this study demonstrates how academic institutions, particularly those in rural and tribal regions, can utilize local biodiversity to address contemporary environmental and health concerns.

The findings also underline the potential of herbal gulal preparation as a small-scale livelihood and micro-entrepreneurship model. The reliance on locally sourced raw materials, minimal instrumentation, and simple processing techniques makes the model economically viable and easily replicable in resource-limited settings. Such initiatives can contribute to sustainable rural development while fostering eco-friendly cultural practices.

In conclusion, the study validates herbal gulal as a safe, sustainable, and socially relevant alternative to synthetic festival colours. Adoption of similar participatory botanical models across educational institutions can play a vital role in promoting sustainability education, preserving traditional knowledge, and supportin…

(Selection and Sortning)

(Prepared Herbal Gulal)

(Powdered and Sieved Gulal)

(Hebal Gulal Stall)

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

Future Scope

The present study successfully demonstrates that herbal gulal can be prepared effectively using locally available plant resources through simple, eco-friendly, and cost-effective methods. The use of natural plant pigments from *Butea monosperma*, *Rosa indica, Tagetes spp., Clitoria ternatea*, Curcuma longa, and Beta vulgaris resulted in visually appealing, smooth, and skin-friendly gulal without the addition of synthetic chemicals or harmful dyes. The findings confirm that plant-based gulal is biodegradable, non-toxic, profitable and environmentally safe, making it a suitable alternative to commercially available synthetic colours.

An important outcome of the study is its emphasis on a participatory and educational approach. Active involvement of students in plant collection, pigment extraction, and gulal preparation enhanced experiential learning, ethnobotanical awareness, and practical understanding of sustainable practices. The study also highlights the potential of herbal gulal preparation as a community-based model that can promote eco-friendly cultural celebrations while supporting traditional botanical knowledge.

From an environmental perspective, the replacement of chemical colours with herbal gulal can significantly reduce soil and water pollution associated with synthetic dyes and heavy metals. Economically, the use of freely available or low-cost plant materials and minimal equipment makes this approach feasible for rural communities, self-help groups, and small-scale entrepreneurs.

References

1. Sharma A., Singh SK, Singh A., Vishwakarma N., Tesu gulal-A livelihood option for tribal farm women of Shahdol district (2024) 424-426
2. Tiwari S.K., Extraction of natural dye & preparation of gulal from *Butea monosperma* and assessment of dyeing properties (2023): 92-95
3. Sumit Ray Khare, Sanjeev Singh Baghel, Jassi Singh, Ashmita Sharma, The art of making colors from Mythological Traditions to Organic Holi Colors (2023) 83-86.
4. Das, P., Goswami, N., and Borah, P., 2015. Development of low-cost eco-friendly Holi powder. 4(3): 466-468
5. Gupta, D. and Thappa, D.M., 2015. Dermatoses due to Indian cultural practices. Indian J of dermatology 2015; 60(1): 3-12.
6. Sharma, A., and Saxena, R., Moderation of eco-friendly trends in Indian festival; Holi. Archives of Applied Science Research, 2013, 5(3), 129-133
7. Singh, P., Borthakur, A., Singh, R., Awasthi, Sh., Pal, D.B., Srivastava, P., Tiwary, D. and Mishra, P. K., Utilization of temple floral waste for extraction of valuable

The Research Analytics ISSN (Online): 3107-6165
Volume 2, Issue 1, Jan-March 2026

products: A close loop approach towards environmental sustainability and waste management. Pollution, 2017, 3, 39-45.
8. Bhatnagar A, Gupta SK, Hanumanthappa V, Garg N. A study on after effects of Holi: color injury, ocular trauma, and assault at a tertiary care ophthalmic center in North India. Int J Res Foundation Hosp Healthc Adm. 2018;6(1):31-6.
9. Jain S, Jakhar P, Pandey N, Shivkumar VB. Urticarial vasculitis following exposure to Holi colors: A rarity. Egypt Dermatol Online J. 2015;11(2):1-8.
10. Ghosh, S. K., Bandyopadhyay, D., Agarwal, M. and Rudra, O. 2016. Dermatoses among children from celebration of -Holi, the spring festival, in India: across sectional observational study. Indian J of Dermatology. 61: 525-528.
11. Jha, C.K., Kumar, R., Venkat, S.K. and Devi Rajeswari,V. 2015. Extraction of natural dye from marigold flower (*Tageteserectal.*) and dying of fabric and yarns: A focus on colorimetric analysis and fastness properties. Scholar Research Library (Der Pharmacia Lettre). 7(1): 185-195.
12. Suman Sahu, Shashikant Tiwari and Trishla Sahu, 2020.A Review on Preparation of Natural Dye and Herbal Gulal from *Beta vulgaris* and Study of its Dyeing Properties. Int. J. Curr. Microbiol. App. Sci SpecialIssue-11: 3830-3839
13. Tiwari, S.K. 2020. Extraction of natural dye and preparation of herbal gulal from beetroot (*Beta vulgaris*) Journal of Pharmacognosy