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FORMULATION AND EVALUATION OF HERBAL GULAL: A NATURAL AND ECO-FRIENDLY ALTERNATIVE TO SYNTHETIC COLORS

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ABSTRACT

Concern over the pollution from floral waste and usage of the chemical synthetic gulal, mainly in Indian festivals, causes various health consequences. Floral waste turns into the reason for drainage blockage and also pollution in river. The aim of this paper is to convert these waste that came from temples, ceremonies, and other gatherings into herbal gulal using natural materials also evaluate the chemical and physical properties of herbal gulal collected floral waste used such as *Rosa indica (rose), Hibiscus rosa-sinensis (hibiscus),* and the *Tagetes erecta (marigold)* leaves of from temples and other public gatherings, as well as spinach as vegetable waste. By the applying laboratory techniques such as grinding and air-drying, we tested them to make a fine texture of it that does not have any side effects like allergies, skin infections, rashes etc. The paper concludes that the herbal gulal only consists of natural ingredients easily available in our kitchen, making it commercially formulated as a naturally derived herbal gulal in comparison to the synthetic gulal available in commercial market.
***Keywords*:** herbal gulal, *Tagetes erecta*, cornstarch, powder formulation, ecofriendly.

Introduction

Holi, the colored festival is used to celebrate as the victory of good over evil by splashing the color on others. It's not only part of our tradition but also conveys our joy (Rawat, 2008). Nowadays, these colors are made by different harmful chemicals, which turn it into a medication, are allergic to sensitive skin, consist of an oily texture, are not easy to remove, cause breathing difficulties, etc. The production of flowers in the commercial market increases day by day, leading the environment and us to think about it. Various papers highlight the pollution, and these chemically synthesized colors raise major concern for surrounding biotic components. These anthropogenic activity chemical-laden gulal powders can contaminate soil, water, and air, causing harm to the environment and wildlife. Therefore, there is a growing need for a sustainable and eco-friendly alternative to traditional gulal powders. In recent years, there has been a surge in interest in natural and herbal products, driven by consumer demand for safer and more environmentally friendly alternatives (MJ, 2024). Herbal gulal, made from natural materials, offers a promising solution to the environmental and health concerns associated with traditional gulal powders. India is a land of diverse cultures and religions, characterized by people with varying values, customs, and traditions based on their respective religions (Mishra, 2024). Holi, a major Hindu celebration in India, includes tossing colored powder into the air and splashing it on others to represent beauty, ritual, and tradition. Synthetic dye-based hues, on the other hand, have been linked to detrimental health effects (Geelani *et al*., 2024). To minimize pollution caused by flower waste, and business employed local people to earn from that waste. To produce natural-derived items such as herbal gulal, clothing colors, and natural food coloring, as well as to research alternative chemical products. This study aims to formulate an herbal gulal using natural material, providing a sustainable and eco-friendly alternative for Holi celebrations. The evaluation of the

physical and chemical properties of the herbal gulal also assesses the safety and efficacy for human skin.

The natural-based dye for the replacement of huge chemically derived gulal, the palash flower (the season's flower), beetroot, which provides its natural red color, and turmeric, the spice that holds lots of benefits turns them into fine dye powder for their various applications. Turmeric is an oil-soluble compound that also has absorptivity in ethanol (E1% = 1607 at 426 nm), replacing commercial dyes such as auramine, the malachite green series, rhodamine B, and methyl violet (Kapoor & Pushpangadan, 2002).

The review article covers recent developments in food, where advanced technologies are used to make food appetizing and more attractive, but the natural color also consists of things such as leaves, flowers, insects, and minerals. The paper appeals towards foods, thus influencing preference, pleasantness, and acceptability of food products. The color is an outstanding parameter to consume food nowadays. It emphasized the need to maintain the stability and health benefits of natural colors in food compared to synthetic once (Bora *et al*., 2019)

Gulal, traditionally made from natural substances like turmeric and flower extracts, has been replaced by synthetic alternatives due to the demand for vibrant colors. These synthetic colors often contain harmful chemicals like lead oxide and mercury sulfide, which can cause health issues like skin irritation, allergic reactions, eye infections, and respiratory ailments (Sharma, 2014). Additionally, these chemicals can contaminate soil and water bodies, affecting flora, fauna, and aquatic life.

Synthetic dyes in cosmetics pose health risks due to systemic absorption, especially in areas near mucous membranes like lips and eyes. Triarylmethanes can enter the bloodstream through dermal absorption, posing long-term health risks. This has led to a shift towards safer, natural, and herbal alternatives risks. These risks have triggered a shift in consumer preferences toward safer, natural, and herbal alternatives (Hemashenpagam & Selvajeyanthi, 2023).

In recent years, the use of natural dyes and herbal gulal has increased due to health and environmental concerns. These dyes, derived from flowers, fruits, and leaves, offer non-toxic, biodegradable solutions while maintaining cultural authenticity. Plant materials like *Rosa indica, Tagetes erecta, Hibiscus rosa-sinensis*, and *Aegle marmelos* are known for their vibrant pigmentation and skin-friendly properties, rich in natural pigments like anthocyanins, flavonoids, and carotenoids, which contribute to various colors and offer antimicrobial and antioxidant benefits (HATTA, 2023).

Dave *et al*. (2022) suggest natural dyes can replace synthetic ones in cosmetics, textiles, and festive products. The use of herbal gulal during Holi not only reduces synthetic dye's harmful effects but also promotes sustainable practices, encouraging responsible celebration. The paper aims to reduce pollution by turning flower waste into herbal gulal, a fine powder that can be used and beneficial, and also provides employment to local people. This is because flowers offered by devotees in temples often become waste, causing pollution and blockages in rivers and drainage pipes. India, a culturally vibrant nation, is a major source of floral waste, with millions of tones dumped into rivers and water bodies annually. This waste, which is considered an offering to God, is not conventionally converted into a byproduct of industrial production of herbal gulal. The process involves grinding, making it into fine powder, and dyeing, causing environmental degradation and choking the water bodies (Gupta *et al*., 2023).

Materials and Methods

Collection and preparation of plant material

Floral waste of *Tagetes erecta* (marigold) from Shitala Mandir temple near Govt. Digvijay Autonomous Postgraduate College, *Hibiscus rosa-sinensis* (hibiscus), *Curcuma longa* (turmeric), *Clitoria ternatea linn* (Aparajita flower) from local houses of Kaurinbhata, and *Beta vulgaris* (beetroot), *Spinacia oleracea (*spinach), and *Amaranthus cruentus* (lal bhaji) demonstrated in Table. 1 food waste from domestic waste are collected from Rajnandgaon, Chhattisgarh, India, in the month of January 2025.Figure.1 The floral parts were separated and weighed. The extraction of phytochemical and nanoparticles for making herbal gulal consists of several methods The methods of extraction used different techniques on the basis of flower, leaf, or tuber-based gulal. The flower-based gulal were floral parts such as the sepal, petal, stamen, and leaves, are separated from the flowers, and the diseased ones are removed. The drying process started when separated floral waste was air-dried in sunlight or pat-dried using an oven in 2-4 days until sepal parts and their leaves dried completely. To make leaves-based gulal or tuber-based gulal, boil leaves waste under 100°C for 1-2 hours to extract its phytochemical.

Development and Formulation of herbal gulal

The extraction is dried- based powder *Tagetes erecta* (marigold), *Hibiscus rosa-sinensis* (hibiscus), *Curcuma longa* (turmeric), *Clitoria ternatealinn* (Aparajita flower) mix the floral powder with a natural binder such as cornstarch or arrowroot powder. And the fragrance and essence onto it, such as rose water and perfume, for the better binding of those products and again shade- dried for 2-3days.Tuber-based powder *Beta vulgaris* (beetroot), *Spinacia oleracea (*spinach), and *Amaranthus cruentus* (lal bhaji) then formulated with Strained the waste of the vegetable waste, add corn flour and arrowroot powder, and dry it in shade for 2-3 days. Add rose water, essence, and a few drops of natural oil to the gulal. Avoid direct drying as it reduces its properties (not directly; it reduces phytochemical properties and its contents).

Results

The herbal gulal shows solubility in water is easy to absorb, and its fine texture does not show an effect with dermal contact. The various parameters used to determine herbal gulal are colors, texture, particle size, skin irritation, and eye irritation. The formulation of herbal gulal is measured and evaluated by different parameters (Table 2).

- **Color :** To assess the natural color of flowers, no extra color is added onto it; their natural color is retained, such as herbal gulal 1 (beetroot) in the color red, herbal gulal 2 (spinach) in the color green, herbal gulal 3 (marigold) in the color orange and yellow, and herbal gulal 4 (hibiscus) in the color red shade. Drying retains its natural color or phytochemical. Figure 2
- **Texture :** The texture of the gulal is smooth for flower- and tuber-based materials and fine for leaf-based material. Figure 4
- **Particles :** The particle size of this nanoparticle is a minimum of 50-100 micrometers and a maximum of 150-200 micrometers, which is easily formulated in skin, and having natural-based material causes no respiratory damage. Figure 3
- **Skin irritation :** The natural-based material or phytochemical has no negative impact on the skin of humans or animals and is also safer for children from 3 to 6 years old.
- **Eye irritation :** The natural composition of herbal gulal has no detrimental effects on the eyes.

Commercialization and Marketing

As the commercialization of herbal gulal shows major impact on the environment and the product as well, the biodegradable packaging uses ecofriendly materials that are appealing and brilliant in color to buyers. We used paper, cardboard, or bioplastics, ensuring that the packaging material is food grade and suitable for use with herbal gulal. Figure 5, Figure 6. To recruit this gulal, the marketing strategy uses both online and offline tactics made it affordable to locals by offering discounts and make it low-cost at Employment for local males and females, commission support for village industries, including the production of herbal gulal products, the National Rural Livelihood Mission (NRLM), self-employment opportunities, and the Ministry of Micro, Small, and Medium Enterprises all help small-scale entrepreneurs.

Discussion

The previous researcher also discusses the synthetic dyes or colors and provides useful studies to formulate herbal gulal from natural products but used rice flour, lead oxide, mercury sulfate potassium dichromate ($K_2Cr_2O_7$), and tapioca tubers. The previous research paper used $K_2Cr_2O_7$ to natural orange color for herbal gulal from palash flower, a seasonal flower that is difficult to extract. However, $K_2Cr_2O_7$ is a chemical that reacts with sensitive and dry skin types, increases water management risks. Using chemicals like potassium dichromate has a large-scale effect on biological oxygen demand and dissolved oxygen measurements. The large-scale production of gulal required large-scale manpower or setup for the preparation of it. In the future, the degradation of synthetic colors will pollute rivers, ponds, lakes, and even soil also. The usage of lead oxide and mercury sulfate used to give natural yellow color for flower or tubers like turmeric and marigold turns contaminant water bodies increases pollution for zooplanktons (Sharma, 2014). Other chemicals like malachite green are used for vibrant color, making them harmful to humans as well as plankton and also causing respiratory or skin diseases. The alternative of the synthetic material turns our research into a new creation where not only diseases can be cured but also pollution can be reduced to reduce such kinds of pollutants. The Triarylmethanes used in cosmetics products can enter the bloodstream through dermal absorption, posing long-term health risks

In the present work we have prepared the fine texture, good color, and easy to soluble in water Herbal gulal is a good alternative because some synthetic colors consist of chemical structures like rhodamine B and malachite green, and some industries use talcum powder for the texture, which are part of pollution and do not degrade easily in our surroundings. The substitution and alteration of these chemicals help to

reduce dermal effects, respiratory effects, and eye irritation.

Table 1: Showcased the collected flowers their scientific names and colors.

S.NO	Common Name	Botanical Name	Colours
1.	Beetroot	*Beta vulgaris*	Red
2.	Spinach	*Spinacia oleracea*	Green
3.	Turmeric	*Curcuma longa*	Yellow
4.	Aparajita	*Clitoria ternatea linn*	Blue
5.	Hibiscus	*Hibiscus rosa-sinensis*	Red
6.	Marigold	*Tagetes erecta*	Yellow/ Orange
7.	Lal Bhaji	*Amaranthus cruentus*	Red

Table 2: The measurement of different parameters of herbal gulal on the basis of their composition

S.No	Parameter	Herbal gulal 1 (Beetroot)	Herbal gulal 2 (Spinach)	Herbal gulal 3 (Marigold)	Herbal Gulal 4 (Hibiscus)
1	Colour	Red	Green	Yellow	Dark Red
2	Texture	Smooth	Fine	Smooth	Smooth
3	Particle Size	100-200 micro Meter	150-250micro Meter	50micro Meter	50-100 Micro Meter
4	Skin Irritation	-ve	-ve	-ve	-ve
5	Eye Irritation	-ve	-ve	-ve	-ve

-ve (negative)

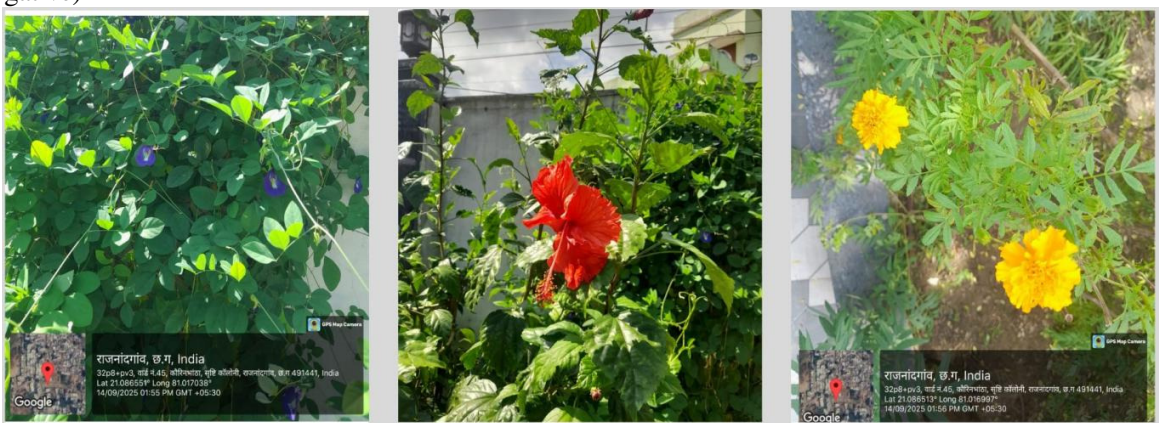

Fig. 1 : The different flower collected from different areas.

Fig. 2: Colored phytochemical extracts from tuber plants, such as beetroot and sepal extract.

Fig. 3: Depicts the extraction of various plant parts, such as sepals, petals and leaves and the subsequent production of fine powder.

Fig. 4: The finished herbal gulal following the addition of constrach, oil and essence.

Fig. 5 : Commercialization and packaging of herbal gulal.

Fig. 6 : The herbal gulal stall in Govt. Digvijay Autonomous College in Rajnandgoan, Chhattisgarh, India.

Conclusion

In this present work we have successfully formulated various types of herbal gulal using natural materials from different parts of the plants. Plants like marigold, Aparajita, hibiscus, rose, and beetroot and also the leaves of spinach are used, as well as natural essence or corn flour as a binding substance. Which is easily available, but the lifespan of the flower is less. We have prepared it using their natural colors, having no additive chemicals like $K_2Cr_2O_7$ or malachite green. Make it into a useful and sustainable compound called herbal gulal and use its properties to convert products that are useful. In this paper. The present study also evaluates desirable the physical and chemical properties including vibrant colors, smooth texture and acceptance pH and moisture contents of the plants. Naturally helps to reduce pollution and the drainage block also and does not cause any medication to health. The herbal gulal consists of various applications to reduce floral pollution and drainage blockage of excess waste and remediates itself easily; no use of synthetic or harmful chemicals gives no effects on humans, animals, and other plants; no excess hydrocarbon product is used and it turns useful products from plants. The natural and eco-friendly nature of the formulations makes the man attractive option for consumers seeking safer and more sustainable products.

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