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Formulation of herbal gulal and its assessment on stability and quality parameters

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Abstract

The present study entitled “formulation of herbal gulal and its assessment on stability and quality parameters” was conducted during 2024-2025 at the Department of Post Harvest Management, College of Horticulture and Research Station, Sankara-Patan, Durg (C.G.). Herbal gulal was formulated using natural extracts of bougainvillea, marigold, rose, hibiscus, amaltas, beetroot and turmeric blended with rice flour and 1% alum. Eight treatments, including a control, were evaluated under a Completely Randomized Design with three replications. The formulations were assessed for physical, biochemical, qualitative and sensory parameters under ambient conditions. Results indicated that storage duration significantly affected all quality attributes. Herbal gulal formulations performed better than the control in terms of solubility, washability, colour acceptability, texture and skin safety. Among all treatments, beetroot extract (T₆) (4.25) showed the best overall performance, followed by turmeric (T₇) (4.25) and marigold (T₂) (4.0). Amaltas extract (T₅) (3.70) recorded comparatively poor stability.

Keywords: Herbal gulal, natural colorants, storage stability, sensory evaluation, physico-chemical properties, plant-based extracts

Introduction

Gulal, also known as Abeer, is the traditional name given to the coloured powders used for the typical Hindu rituals, in particular for the Holi festival. Holi’ is the unique festival of colours celebrated in India. Holi, or the festival of colours, is celebrated by smearing colours on each other. Holi is a Hindu festival that takes place on the full moon day in the month of Phalgun. It is also recognized as the Spring Festival because it coincides with the arrival of spring.

In Ancient played Holi using Tessu flowers which are found in abundance during the season. colours for 'Holi' were prepared from the flowers and leaves of trees that bloomed in spring and traditionally the colours of Holi were derived from plants: green was made from ground neem leaves (*Azadirachta indica*), yellow, red from turmeric (*Curcuma longa*). Turmeric a popular spice is bright yellow at or Henna leaves as another shade of green, marigolds or chrysanthemums as yellow, flame of the forest (*Butea monosperma*), pomegranateas blue and charcoal as black were among the other plant-based colours used as pastes powders or in water.

Floral and herbal gulal are prepared from natural plant sources such as marigold, rose, hibiscus, turmeric, neem and beetroot, which are rich in natural pigments and free from toxic chemicals. These colours are biodegradable, non-toxic, skin-friendly and environmentally safe. Their use minimizes soil and water pollution, supports biodiversity and ensures human safety. Thus replacing synthetic dyes with herbal and floral gulal contributes to environmental conservation, promotes sustainable practices, and ensures a healthy balance between human activities and nature (Gardner and Lal, 2012; Sheetal *et al.*, 2012) [2, 4].

Modern times, these natural colours have been replaced by commercial industrial dyes prepared by chemical processes. Even products that claim to use organic colours, use synthetic pigments to enhance the brightness of hues. Such synthetic holi colours are sold as herbal colours in an unregulated manner in local markets and no checks can be enforced on the product composition. Also the quality and the amount of information about the ingredients of the particular packets are missing.

These colours sold in the local market often contain hazardous chemicals such as endotoxins and heavy metals like lead, potentially causing moderate to severe health problem (Goswami *et al.*, 2022) [5]. These gulal powder may lead to adverse health effects such as skin and eye irritation, as well as respiratory problems.

Thus, realizing the adverse effect of synthetic gulal and importance of herbal gulal different flowers and herbs were selected to formulate of herbal gulal from *Bougainvillea glabra*, *Tagetes erecta*, *Rosa indica*, *Hibiscus spp.*, *Cassia fistula*, *Beta vulgaris* and *Curcuma longa*. The aim of this work is to utilize these plant materials as an economical, natural source of colour that is herbal, eco-friendly and safe for skin without harmful effects.

Materials and Methods

The present study, "Formulation of Herbal Gulal and its Assessment on Stability and Quality Parameters", was conducted during the 2024-25. Department of Post-Harvest Management, College of Horticulture and Research Station, Sankara Patan, Durg (C.G.) during the academic year 2024-25. The experiment followed a Completely Randomized Design (CRD) with eight treatments replicated thrice.

Fresh flower petals were cleaned, cut into small pieces, and mixed with water (1000 ml/kg), then boiled at 100 °C for 20 minutes. Beetroot and turmeric were boiled for 1 hour for better pigment extraction. The extract was cooled, squeezed, filtered and about 500 ml was obtained. Alum (1%) was added to enhance colour. The extract was mixed with a carrier, shade-dried for 6-7 days with regular turning, then ground and sieved (8 mm) to obtain uniform powder. Finally, the herbal gulal was packed in transparent polythene bags.

Table 1: Treatment details are as follows

Notations	Treatment combinations
T ₀	Control
T ₁	Bougainvillea Flower Extract (500ml) + Rice flour (500g)
T ₂	Marigold Flower Extract (500ml) + Rice flour (500g)
T ₃	Rose Flower Extract (500ml) + Rice flour (500g)
T ₄	Hibiscus Flower Extract (500ml) + Rice flour (500g)
T ₅	Amaltas Flower Extract (500ml) + Rice flour (500g)
T ₆	Beetroot Extract Extract (500ml) + Rice flour (500g)
T ₇	Turmeric Extract Extract (500ml) + Rice flour (500g)

Evaluation of Herbal Gulal

Angle of Repose: To assess the sample's flow behaviour, the angle of repose was calculated using the funnel. The following formula was applied to arrive at the result:

$$\tan \alpha = H/R$$

where, α = angle of repose, H = height of the pile of powder, R = radius of the pile of powder

Moisture content: After proper drying and grinding, the moisture content of all the treatments were taken. The method is based on removing moisture by oven drying of the sample until the weight remains constant. The moisture content (%) is calculated from the sample weight before and after drying.

The formula used for calculating moisture content

percentage is as follows.

$$MC\% = \frac{IW-DW}{IW} \times 100$$

Where (IW) is the initial weight of the sample and (DW) is the dry weight of the sample.

pH: The pH of freshly extracted colour extract and after giving different treatments to it were recorded with the help of pH meter.

Solubility: To assess the solubility profile of the prepared formulation, a pre-determined amount of sample was placed in test tube, various solvents were added and test tube was shaken well and observed.

Colour Stability: The formulated herbal gulal samples were stored in airtight transparent containers under ambient conditions and observed daily for 7 days to assess colour stability. Changes in colour intensity, shade, or fading were compared with freshly prepared samples to evaluate pigment retention and overall stability.

Water washability: Water washability of the herbal gulal was tested by applying a small amount to the back of the hand, allowing it to adhere for a few minutes, and then rinsing with plain running water without soap. Residual staining was observed visually, and washability was categorized as easily, moderately, or poorly washable.

Fragrance: Fragrance of the herbal gulal was evaluated through sensory analysis by 10 selected volunteers under controlled conditions. Participants assessed the sample for nature, intensity, and pleasantness of aroma, classifying it as mild, strong, pleasant, pungent, or unpleasant. The test determined product acceptability and consumer appeal.

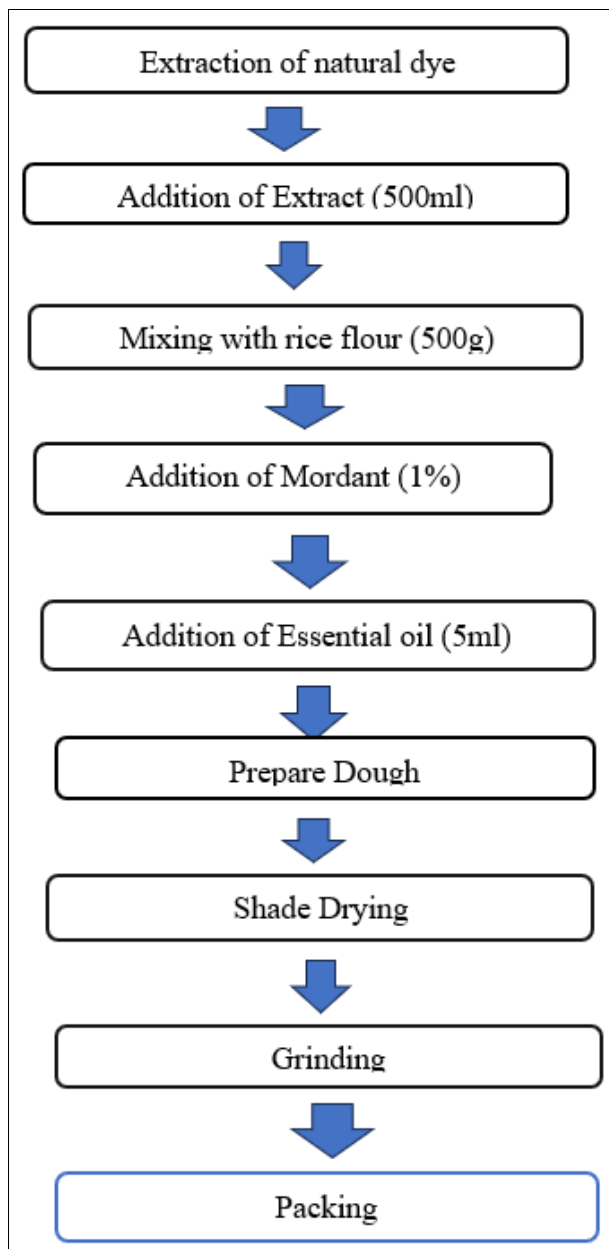
Texture: It was evaluated by feel method. After grinding the different treatment combinations of herbal gulal was felt and score out of 5 was allotted. It was divided into 5 categories i.e., very smooth (5 points), 3.9.4.3 smooth (4), medium (3), rough (2) and very rough (1).

Sensitivity: The skin sensitivity of the herbal gulal was evaluated using a patch test. A small quantity of the gulal was applied to the elbow crease of 100 participants and left for 24 hours. The test area was observed for any allergic reactions, including redness, itching, or irritation, to assess the product's dermal safety.

Overall acceptability: Overall acceptability the overall acceptability of herbal gulal was evaluated after the storage duration of 30 days under packaging materials. It was evaluated of using of Nine-point hedonic scale.

Statistical analysis

The data recorded on various parameters in the laboratory were subjected to statistical analysis using the analysis of variance (ANOVA) technique, as outlined by Gomez and Gomez (1985).



Preparation method

Result and Discussion

Angle of repose: The angle of repose indicates powder flowability, where lower values represent better flow. The results showed a gradual increase in angle of repose in all treatments during storage, indicating reduced flowability of herbal gual. Control (T₀) (29.00) consistently showed the lowest values (better flow), while Amaltas (T₅) (34.10) recorded the highest (poor flow). Marigold and turmeric treatments exhibited comparatively better flow than other plant-based samples. The increase in angle of repose may be due to moisture absorption, particle agglomeration, and increased inter-particle friction. Overall, the type of plant extract significantly affected the flow behavior during storage.

Moisture Content: The results showed a gradual increase in moisture content in all treatments during storage, indicating moisture absorption over time. Control (T₀) (8.55) recorded the lowest moisture content, while Amaltas (T₅) (13.20) showed the highest. Marigold and turmeric treatments exhibited comparatively lower moisture uptake,

suggesting better stability. The increase in moisture may be due to the hygroscopic nature of plant extracts and atmospheric moisture absorption. Overall, plant extract type significantly influenced moisture behavior of herbal gual during storage.

pH: The pH of herbal gual decreased gradually in all treatments during storage, indicating increasing acidity over time. Control (T₀) (7.10) maintained the highest pH, while Bougainvillea (T₁) (4.50) showed the lowest. Marigold and turmeric treatments retained comparatively higher pH values. The decline in pH may be due to the formation of organic acids and biochemical changes during storage. However, the pH remained within acceptable limits, indicating good stability of herbal gual.

Solubility: Solubility of herbal gual decreased gradually in all treatments during storage. Initially, herbal treatments especially Beetroot (T₆) (3.68), Hibiscus (T₄) (3.40) and Rose (T₃) (3.60) showed higher solubility than the control. This may be due to water-soluble pigments and hydrophilic compounds. The decline during storage is likely caused by moisture absorption, particle agglomeration and reduced surface area. At the end of storage, Beetroot (T₆) (3.68) maintained the highest solubility, while Control (T₀) (3.20) showed the lowest, indicating better stability in herbal treatments.

Colour stability: Colour stability of herbal gual decreased gradually with storage, indicating pigment degradation. Initially, the control showed the highest stability, while turmeric and marigold performed best among herbal treatments. A slight decline was observed up to 15 days, followed by a greater reduction at later stages due to oxidation and ageing. At the end of storage, turmeric and marigold retained higher colour stability, whereas beetroot showed the lowest. Overall, storage duration significantly affected colour stability, with turmeric (T₇) (3.85) and marigold (T₂) (3.80) showing better resistance to colour loss.

Washability: Washability of gual decreased gradually in all treatments during storage, indicating reduced removability over time. Initially, herbal treatments showed higher washability than the control, with beetroot (T₆) (3.38), hibiscus (T₄) (3.33) and rose (T₃) (3.30) performing best. The decline may be due to increased particle cohesion and pigment binding during storage. However, herbal gual maintained higher washability than the control (T₀) (3.20) throughout. At 60 days, beetroot-based gual showed the highest washability, confirming its suitability for safe and easy removal.

Fragrance: Fragrance of herbal gual decreased gradually during storage in all treatments. Initially, herbal treatments showed higher fragrance than the control due to natural aromatic compounds. Rose (T₃) (4.40) recorded the highest fragrance, followed by Turmeric (T₇) (4.35) and Hibiscus (T₄) (4.20). The decline in fragrance may be due to volatilization and oxidation of aromatic compounds. However, herbal treatments retained noticeable aroma even after 60 days, while the control lost fragrance rapidly, indicating better sensory stability of herbal gual.

Texture: Texture scores of gual decreased gradually in all treatments during storage, indicating slight loss of smoothness over time. Initially, herbal treatments showed higher texture scores than the control, with Beetroot (T_6) (4.23), Turmeric (T_7) (4.13) and Hibiscus (T_4) (3.98) performing best. The decline may be due to moisture absorption and particle aggregation. However, herbal formulations maintained better texture than the control (T_0) (2.90) throughout. At 60 days, beetroot-based gual retained the highest texture, indicating good sensory stability during storage.

Sensitivity: Patch test results confirmed that herbal gual did not cause any skin irritation or allergic reaction in any participant during storage. Sensitivity scores showed a gradual decline over time, but all herbal treatments remained significantly higher than the control. Beetroot (T_6) (4.61) recorded the highest sensitivity, followed by

Turmeric (T_7) (4.49) and Marigold (T_2) (4.44), indicating better skin compatibility. The decline may be due to moisture uptake and slight texture changes. Overall, herbal gual was found to be safe, skin-friendly and suitable even after prolonged storage.

Overall acceptability: Overall acceptability of herbal gual decreased gradually in all treatments during storage. Initially, all herbal formulations showed higher acceptability than the control, with Beetroot (T_6) (4.25), Turmeric (T_7) (4.20) and Marigold (T_2) (4.15) performing best. The decline may be due to colour fading, fragrance loss, texture changes and moisture absorption. However, herbal treatments maintained acceptable scores throughout the storage period. Beetroot- and turmeric-based gual showed the highest overall acceptability, while the control recorded lower values, indicating better sensory stability of herbal formulations.

Table 2: Assement of Formulation of herbal gual on stability and quality parameters

Treatment Notations	Angle of Repose	Moisture Content%	pH	Colour Stability	Solubility	Fragrance	Texture	Water wash ability	Sensitivity	Overall acceptability
T_0	29.00	8.55	7.10	3.90	3.20	2.53	2.90	3.20	3.37	3.40
T_1	33.87	11.90	4.50	3.65	3.57	3.97	3.03	3.27	4.25	4.00
T_2	31.60	9.90	5.17	3.80	3.52	4.10	4.18	3.22	4.44	4.15
T_3	32.70	11.40	5.70	3.50	3.60	4.40	4.06	3.30	4.36	4.10
T_4	34.10	12.40	5.30	3.40	3.63	4.20	3.98	3.33	4.40	4.12
T_5	34.53	13.20	5.00	3.70	3.54	3.87	3.90	3.24	4.30	4.05
T_6	32.60	10.20	4.95	3.35	3.68	4.94	4.23	3.38	4.61	4.25
T_7	32.07	9.60	6.00	3.85	3.50	4.35	4.13	3.20	4.49	4.20
SE(m) ($\pm$)	0.14	0.01	0.15	0.02	0.02	0.07	0.02	0.02	0.01	0.04
C.D. (@ 5%)	0.42	0.05	0.46	0.06	0.06	0.22	0.06	0.06	0.03	0.12

Conclusion

The study concluded that herbal gual formulations showed good physicochemical and sensory quality during storage. Among all treatments, (T_6) (4.25) beetroot extract performed best in terms of solubility, washability, texture, sensitivity and overall acceptability. (T_7) (4.25) Turmeric and (T_2) (4.0) marigold also exhibited satisfactory performance, while (T_3) (3.70) amaltas extract showed comparatively lower stability. All herbal gual samples remained acceptable up to 60 days under ambient conditions and were found to be safe, skin-friendly and eco-friendly alternatives to synthetic gual.

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