

Seed Embedded Organic Gulal: A Post Holi Greening Concept

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ABSTRACT

Holi, the festival of colours, produces a large volume of organic waste in the shape of discarded gulal and this gulal is usually washed after the celebrations, adding very little worth to ecology. This paper presents and considers a new seed embedded organic gulal as a post-Holi greening intervention which combines cultural practice and city ecological regeneration. The gulal has been made with different plant material and natural binders, with light weighted small sized natural plant seeds embedded in it. Different characteristics of the gulal, such as the size of particles, pH and stability of color were tested to determine the safety and utility. The potential of germination and early growth of plants were evaluated at controlled and field conditions after simulated application of Holi. The findings showed a high seed-viability with an equivalent percentage germination as compared to the conventionally sown seeds and did not have any inhibitory effect of the organic color matrix. The use of seed-embedded gulal showed the possibility of converting the post-festivals residues into an effective seed distribution vehicle, which will enhance a green cover within urban areas. The current strategy provides a new culturally-oriented sustainable festival practice, waste management and community-based greening strategy.

Keywords:- seed-embedded gulal, organic gulal, post-Holi greening intervention

INTRODUCTION

Holi is among the hottest festivals in India and gaining popularity in the world as a whole as it is the festival of joy, renewal and social harmony expressed in a playful way with the use of colours. During the ancient period the colors used to make holi were made using different portions of the trees, including flowers, leaves, fruits etc [1]. The colours in holi were made at ancient times using various flowers which bloomed in spring. With the urbanisation, loss of trees and mass production, the natural colours were replaced by commercial industrial dyes that were made through chemical processes [4]. Nonetheless, contemporary commercial gulal tends to be non-biodegradable, synthetic and damaging the environment and is a source of concerns due to the soil contamination, water pollution and human health. The artificial dye that is used in the holi powder may lead to dermatitis, respiratory complications and allergies and a long term use may lead to cancer [2]. Chemical colours bring beautiful satisfaction to the eyes but in the process can be very harmful pollutants. In India, the preparation of these colours is done on small scale and does not have any quality control [3]. Gulal which is commonly available in the market today is often full of industrial dyes and non food grade chemicals most of which are used in the textile, paper and leather industries. These synthetic colors contain heavy metals and toxic substances and this raises the question of whether they may cause skin irritation, allergies, eye infections, respiratory complications and in worst case, cancer [6]. Even when it is made using organic gulal, the material is generally washed off once the celebration is done which is a lost chance to contribute towards ecology.

Over the last few years, the increased consciousness of sustainable development and the environmentally friendly cultural process has stimulated the redefinition of festivals as the areas of ecological intervention. The idea of post-festivals greening is going to be an encouraging strategy to transform celebratory waste materials into resources to restore the environment especially in urban and semi-urban environment where vegetation cover is diminishing. Seed-embedded materials have also been investigated in other processes such as seed papers, biodegradable packaging and soil amendments and have been proven to be effective as passive systems of seed dispersal. By incorporating plant seeds in biodegradable paper cups may support green initiatives and involve communities in environmental sustainability initiatives [5]. Introduction of seeds in organic gulal is a new development of this method, taking advantage of the broad usage and distribution of colour powders during holi. When washed into soil, open grounds or road verges, gulal seed-embedded has the potential to both act as a carrier medium and a microenvironment that facilitates seed hydration and early germination.

Although there is a gradual rise in the supply of organic gulal in the market, there is a scarcity of scientific research on its functional alteration to achieve an environmental sustainable outcome. The current paper will design and test an organic gulal seeded in order to be used in the post-Holi greening applications. The research objectives will be:

- (i) development of biodegradable gulal with native and pollinator-friendly seeds
- (ii) description of different properties and safety parameters of this gulal
- (iii) evaluation of seed germination and seed growth of the plants under the conditions of a controlled environment and a field.

This work aims to add to the ecological resilience in urban environment and sustainable innovation in festivals by aligning cultural celebration and ecological restoration.

MATERIALS AND METHODS

Materials

The preparation of organic gulal was done using biodegradable and plant based raw materials. Starch powder (rice and corn starch) was milled to a fine state, used as the main carrier material as the base. Plants like *Tagetes erecta* (marigold petals) and *Butea monosperma* (yellow palash petals) used to produce yellow colour, *Beta vulgaris* (beetroot) used to produce red and *Spinacia oleracea* (spinach leaf) used to produce green colour as natural colorants. Food colour can also be used to enhance the vibration of every colour.

The seeds of native and pollinator-friendly plant species were chosen because of their ability to adapt to the city environment and germinate well. These species were *Amaranthus cruentus*, *Amaranthus viridis* and *Trigonella foenum-graecum*. All the seeds were obtained through certified organic suppliers and kept in a dry condition before they were used. Seeds of some trees can also be used.

Procedures

Preparation of seed-embedded organic gulal is shown below:

To obtain the organic gulal base, starch powder was fully mixed with the natural colorant, which is basically extract of selected plant materials in a ratio of 4:1 (w/w). The concentration of seeds was 2 percent (w/w), which was put in the gulal matrix with minimal mechanical damage. The blend was dried by air (25°C) over 24 hours and then sieved to give a fine and light powder.

Physicochemical Character

The size distribution of the prepared gulal was done in terms of particle size by standard sieve analysis. The content of moisture was determined by drying samples in the oven at 105°C until all the moisture was lost. The pH of gulal leachate was measured using calibrated digital pH meter and 1g of gulal was suspended in 10 mL of distilled water. The value of pH ranges from 6.5 to 7.2 (in case of 3 different coloured gulal). The stability of colours was also measured.

Seed Viability and Germination Assessment

The viability of the seed in the gulal medium was determined by a standard germination test. In the treatment group, samples of the gulal seeds were taken in 50 samples and uniformly seeded in the sterilized soil pots and sprinkled with water to imitate the post-Holi washing situations. The control group had 50 untreated seeds planted in soil. All experimental units were kept under regulated environmental conditions 25°C, 60-70% relative humidity and 12 hours of photoperiod. After 14 days, germination was observed and the percentage of germination determined. Mean germination time was calculated to compare the rate of emergence and the index of seedling vigour was calculated using the measure of root and shoot length after the 14th day.

Field Simulation Study

A field simulation was also done to identify the real world applicability in open soil plots. Gulal was seed-embedded and uniformly spread on prepared surface of soil and lightly irrigated. The emergence and growth of seedlings in plots were observed after 21 days. Success and establishment of germination and plant were compared to control plots which were subjected to conventional sowing of seeds.

RESULTS AND DISCUSSION

Physicochemical Characteristics of Seed-Embedded Organic Gulal

The seed-impregnated organic gulal that was prepared had a fine and free-flowing texture just like commercially produced organic gulal. The sieve analysis showed that most of the particles fell in the desirable range to be applied smoothly making the user accept it when celebrating Holi. Water level was also low and this is an important factor in avoiding premature germination of seeds and microbial growth in storage. The gulal leachate was determined to be almost neutral and this shows that the formulation was non-toxic and could be applied on the soil directly. The colour stability analysis showed that there were very little fading or aggregation in the colour stability with the environmental conditions present in the ambient environment. Plant pigments and natural binder gave sufficient colour fixation and allowed the pigment to be biodegraded. Noteworthy, there was no negative effect of the colour condition on the embedded seeds, which indicates that there is a possible harmony between aesthetic and biological activities.

Going Seed Performance and Vitality

The use of organic gulal in containment of the seeds did not affect their viability during the formulation and drying process. Germination tests indicated that percentages of germination of seed-embedded gulal were similar to the percentages in the control treatments of seed sowing directly. There were some slight delays in first germination which may have been caused by the time it takes to dissolve the gulal and watering the seeds. The seedling vigour analysis showed that all the species studied had healthy root and shoot growth. It was also observed that the organic gulal matrix was in a good position to offer a good microenvironment in the initial stages of growth, through preserving moisture and allowing a slow process of seed-soil contact. These results are in line with other studies on seed-embedded biodegradable materials, which also show the same buffering effect in germination.

Greening Post-Holi Field Simulation and Potential

Seed-embedded gulal was used and proved to be effective in dispersing and establishing seeds in open soils. Seed germinations were experienced within 7-10 days of the application, the expected post-Holi environmental conditions. The spatial distribution of seedlings was more heterogeneous than under conventional sowing, as it is based on the natural pattern of dispersion of seeds caused by gulal application and washing.

The findings of the field test reveal the feasibility of seed-embedded gulal as a post-festival greening method in practice, especially in the outdoor areas of cities, roadside and community areas. The strategy does not necessitate much behavioural modification of the participants and it is based on a given cultural practice to advance the regeneration of the environment.

Environmental and Socio-Cultural Implications

In addition to agronomic performance, the seed-embedded gulal concept is one of the new cross-breeding of tradition and sustainability. The system ensures that issues of waste and resource inefficiency associated with festivals are eliminated because the system transforms celebratory residue into a utilizable ecological input. Use of native species and pollinator friendly species also promote biodiversity and services of urban ecosystems.

Socio-culturally speaking, seed-embedded gulal presents a practical way of engaging the community to take care of the environment. Its use would also promote environmentally friendly celebrations without affecting the authenticity of the culture. The outcome of this research offers scientific justification of scaling such products and incorporating them into larger sustainable festival systems.

PICTURE PLATE

		
<p>Figure-1</p>	<p>Figure-2</p>	<p>Figure-3</p>
		
<p>Figure-4</p>	<p>Figure-5</p>	<p>Figure-6</p>
		
<p>Figure-7</p>	<p>Figure-8</p>	<p>Figure-9</p>
		
<p>Figure-10</p>	<p>Figure-11</p>	<p>Figure-12</p>

Figure 1-6:- Preparation of organic gual using different plant parts.

Figure 7-9:- 7 days after the seed embedded gual falls on soil

Figure 10-12:- 14 days after the seed embedded gual falls on soil

Conditions are necessary to determine the survival of plants, ecological performance, and seasonal performance. Further applications in the future can also include the optimization of loading rates of seeds, improved species variety and consumer safety considerations to substantiate commercialization and the adoption of policies.

CONCLUSION

The current research was able to prove the design and testing of a seed-infused organic gual as a new post-Holi greening initiative. The developed gual which was all made of biodegradable products and natural colorants, retained

the desired physicochemical characteristics whilst ensuring the viability of the seed. The performance of organic color matrix did not interfere with biological functionality as germination and early growth results of embedded seeds were similar to conventional sowing procedures. The outcomes of field simulation also confirmed the practical usefulness of seed-embedded gulal and emphasized the possibility of this substance to promote passive dispersal of seeds and the development of a green cover in cities and semi-urban areas after festival events. With this solution, the ecological and cultural continuity can be met since it will turn a popular cultural product into a practical ecological one. All in all, seed-embedded organic gulal is a scalable and culturally integrated method to address the problem of waste during festivals and increase the benefits of community-based environmental restoration. This research study can be used as a scientific basis to further optimize in future, conduct large-scale field testing and implement sustainable festival material on policy levels in order to contribute to green urban ecosystems and eco-friendly cultural behaviors. Probably, this is the first work on the preparation of seed embedded gulal, which has a great side towards the environment but few more studies are needed to make it more impactful.

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