



“Utilization Of Floral Waste For Eco-Friendly Value-Added Products: A Circular Economy Approach”

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ABSTRACT: Floral waste generated from temples, religious activities, weddings, and social functions forms a considerable portion of biodegradable waste in India. Due to cultural and religious beliefs, flowers offered during rituals are often disposed of in rivers, ponds, or open areas rather than through organized waste management systems. Such practices contribute to environmental problems including water pollution, foul odour, soil contamination, and emission of greenhouse gases during decomposition. Although floral waste is biodegradable, its slow degradation rate and improper handling make it an environmental concern. At the same time, discarded flowers contain valuable natural components such as pigments, organic matter, and aromatic compounds, which remain largely underutilized. The present study focuses on the utilization of floral waste for the preparation of eco-friendly value-added products, supporting the concept of a circular economy. Floral waste was collected from nearby temples, manually segregated, and processed using simple, low-cost, and environmentally safe methods. Various products such as natural pigments, Holi colours, herbal lip balm, incense (dhoop), cloth tags, seeded paper, handmade paper, diary, and compost were prepared from discarded flowers. The prepared products were qualitatively evaluated based on colour, texture, fragrance, and usability. The findings indicate that floral waste can be effectively reused as a useful bio-resource instead of being treated as waste. This approach not only reduces environmental pollution but also promotes resource recovery, waste minimization, and sustainable waste management practices. The study highlights the potential of small-scale floral waste utilization as a practical step towards circular economy and environmental sustainability.

I. INTRODUCTION

The rapid increase in population, urbanization, and socio-cultural activities has led to a significant rise in the generation of municipal solid waste. A major portion of this waste is biodegradable and originates from households, markets, agricultural activities, and religious places. Among various organic waste streams, floral waste is one of the most commonly generated yet least managed forms of waste. In India, flowers are extensively used in temples, religious rituals, festivals, weddings, and decorative purposes. After a very short period of use, large quantities of flowers are discarded on a daily basis

Due to religious and cultural beliefs, flowers offered to deities are often considered sacred and are not disposed of through regular waste management systems. Instead, they are commonly immersed in rivers, lakes, or dumped in open areas near temples and marketplaces. Such disposal practices contribute to serious environmental problems including water pollution, foul odour, blockage of drains,

and degradation of soil quality. Decomposing floral waste increases biological

oxygen demand in water bodies and creates favourable conditions for the growth of disease-causing microorganisms. In addition, flowers cultivated for commercial use often contain residues of pesticides and chemical fertilizers, which further add to environmental contamination when discarded improperly.

Although floral waste is biodegradable, its degradation process is relatively slow due to the presence of fibrous and lignocellulosic components. Improper handling and accumulation of floral waste lead to the generation of greenhouse gases such as methane during anaerobic decomposition. Despite these concerns, floral waste remains largely underutilized and is often treated as a disposal problem rather than a potential resource. Discarded flowers contain valuable natural components such as pigments, aromatic compounds, organic matter, and micronutrients,

which can be recovered and reused through suitable processing methods.

The concept of circular economy focuses on reducing waste generation and promoting reuse, recycling, and recovery of resources to extend their life cycle. In contrast to the conventional linear model of “use and dispose,” a circular economy approach aims to convert waste materials into useful products. Utilization of floral waste for the preparation of eco-friendly value-added products aligns well with this concept, as it helps in minimizing environmental pollution while creating economic and social benefits. Small-scale and decentralized floral waste management practices can play an important role in achieving sustainable waste management, particularly in developing countries.

In recent years, growing attention has been given to sustainable and eco-friendly alternatives to synthetic products, especially in areas such as dyes, cosmetics, paper, and organic fertilizers. Natural products derived from plant-based sources are considered safer for human health and the environment. Floral waste, being abundantly available and renewable, offers a suitable raw material for the preparation of such products.

The present study aims to explore the utilization of floral waste for the preparation of eco-friendly value-added products following a circular economy approach. Discarded flowers collected from nearby temples were processed to develop products such as natural pigments, Holi colours, herbal lip balm, incense (dhoop), dyed cotton fabric, cloth tags, seeded paper, handmade paper, diary, and compost. By demonstrating multiple applications of floral waste, this study highlights a practical and sustainable method for waste reduction, resource recovery, and environmental protection.

II. MATERIAL AND METHODS

Collection and Segregation of Floral Waste

Table 1: Steps for Collection and Segregation of Floral Waste

Step	Description
Source	Floral waste was collected from nearby temples and local sources.
Types of Flowers	Rose, marigold, hibiscus, jasmine, and other commonly used temple flowers were collected.
Segregation	Non-biodegradable materials such as plastic threads, wrappers, and pins were removed manually.
Cleaning	Flowers were washed thoroughly with distilled water to remove dust and pesticide residues.
Pre-treatment	Darkened, infected, or highly decomposed petals were discarded. Clean petals were shade-dried before use.

1. For Pigment Extraction:

A) Requirements:

Flower petals were used as the primary material for pigment extraction. Distilled water, mortar and pestle, and acidified ethanol (95% ethanol with 1% citric acid) were used during the extraction process. A boiling water bath, muslin cloth, maltodextrin, and a glass flask were used for processing and filtration.

Method:

a) Cleaning and Preparation:

Fresh flower petals were washed thoroughly to remove dust and impurities. The petals were then moderately ground using a mortar and pestle.

b) Extraction:

Take 10 g of ground flower material in a flask. Add 50 ml acidified ethanol (1% citric acid + 95% ethanol) and shake well to ensure proper mixing.

c) Heating and Mixing:

The mixture was placed in a boiling water bath and heated gently to enhance pigment extraction.

d) Cooling and Settling:

After heating, the mixture was allowed to cool and settle so that the pigment could separate properly.

e) Collection of Pigment:

The dark-coloured extract (pigment) was collected and stored in a cool and dry place for further use.

2. For incense sticks (Dhoop):

A) Requirements:

Dried and crushed flowers were used as the primary material for preparation of incense sticks (dhoop). Charcoal powder, cow dung powder, tamarind powder, corn starch, water, and essential oil were used for mixing, binding, and fragrance. A hot air oven was used for drying the prepared dhoop.

B) Method:

a) Preparation of Base Material:

Dried flowers were powdered and 60 g of the powder was weighed for further processing.

b) Addition of Binding Materials:

10 g charcoal powder and 10 g cow dung powder were added to the flower powder and mixed thoroughly.

c) Addition of Fragrance and Binder:

12 g tamarind powder, 6 g corn starch, and essential oil were added to provide binding and fragrance.

d) Mixing:

Water was added gradually and the entire mixture was mixed to form a uniform paste.

e) Shaping and Drying:

The mixture was shaped into dhoop cones and dried in a hot air oven until fully dry. After drying, the dhoop was ready for use.

3. For Holi Colour

A) Requirements:

Dried flowers were used as the primary material for the preparation. Corn starch was used as a base material, while a mixer grinder and fine sieve were used for grinding and obtaining a fine powder.

B) Method:

a) Collection and Cleaning:

Flowers were collected and cleaned properly to remove dust and impurities.

b) Drying:

The petals were separated and dried under shade or in a hot air oven for 2–3 days.

c) Grinding:

After complete drying, the petals were finely ground to prepare flower powder.

d) Sieving:

The powder was sieved to obtain a smooth and fine texture suitable for colour preparation.

e) Mixing:

The fine powder was mixed with a base material such as corn to improve texture and usability.

f) Storage:

The prepared eco-friendly Holi colour was stored in a dry, airtight container for further use.

4. For lip balm:

A) Requirements:

Rose petals were used as the main ingredient for lip balm preparation. Shea butter, Vitamin E oil, distilled water, and natural fragrance (essential oil) were used in the formulation. A glass beaker or heat-resistant bowl and a double boiler or boiling water bath were used for heating. A blender or stirrer, fine muslin cloth or filter paper, spatula, and sterile glass jars or cosmetic tins were used for mixing, filtering, and storage.

B) Methods:

a) Preparation of flower infused oil:

- i) Add dried petals into coconut or almond oil.
- ii) Heat gently using double boiler for 20 to 30 minutes on low flame
- iii) Cool and strain the oil using muslin cloth to separate petals

b) Preparation of lip balm base:

- i) In clean bowl, add 1tbsp beeswax, 1tbsp shea butter or cocoa butter and 2tbsp of flower infused oil.
- ii) Melt the mixture slowly in a double boiler while stirring continuously.
- iii) Once melted, remove from heat.

c) Enrichment and fragrance:

- i) Add 1 Vitamin E capsule (pierce and squeeze the oil into the mixture)
- ii) Add 2-3 drops of essential oil (optional).

iii) Mix thoroughly.

d) Pouring and settling:

- i) Quickly pour the melted mixture into lip balm containers.
- ii) Allow to cool and solidify at room temperature for 30-60 min.
- iii) Once hardened, close the lid and label the lip balm.

5. For Decorative or Seed paper:

A) Requirements:

Flowers and old newspaper were used as the primary materials for preparing decorative or seeded paper. Water and natural binder (starch) were used for pulp formation, while natural dyes and essential oils were added for colour and fragrance. Dried petals were included to improve texture and appearance. A mixer grinder, sieve, tub or tray, sponge, cloth or felt sheets, and a hot air oven were used during preparation and drying.

B) Methods:

a) Pre-treatment:

- i) Tear waste newspaper into small pieces (around 2-3cm)
- ii) Soak the paper pieces in warm water overnight to soften the fibres.
- iii) After soaking, transfer the soaked paper into a blender.
- iv) This pulp contains fine cellulose fibres that will form the structure of the paper.

b) Preparation of flower Base:

- i) Take waste flowers and separate petals from stalks.
- ii) Wash gently to remove dirt and dust.
- iii) Sun-dry the petals for a few hours if they are too wet.
- iv) Grind the petals coarsely in a blender with little water to a flower pulp.

c) Mixing of pulp:

- i) Mix newspaper pulp and flower pulp together in a large or tub.
- ii) Add 1-2 tbsp of glue or starch to improve bonding
- iii) Stir well to get a uniform, thick slurry.

d) Sheet formation:

- i) Take a sieve mesh, wire screen or photo frame with a fine net fixed on it.
- ii) Pour the pulp mixture evenly over the frame, spreading to form thin layer
- iii) To make a paper with seeds add them with the mixture to get submerged into the thin paper layer.
- iv) Let excess water drain out naturally.

e) Drying:

- i) Carefully invert the frame onto a clean cotton cloth or blotting paper
- ii) Lift the frame gently so that the wet paper layer remains on the cloth
- iii) Let it dry into the hot air oven for 1-2 days.
- iv) Once dry peel of the paper slowly from the cloth.
- v) Press under heavy books or use a rolling pin to make it a smooth and flat.

6. For Compost:

A) Requirements:

Floral waste was used as the primary material for compost preparation. Dry waste bulking material and an organic activator were added to support decomposition. A suitable container was used for composting, and gloves and a mask were used for safe handling.

B) Methods :

a) Segregating:

Remove non-biodegradable materials.

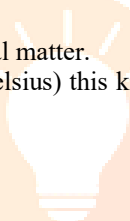
b) Shredding: Shred or chop large flower parts and stems into small pieces to speed up decomposition.

c) Mixing and layering

- i. Prepare compost layers in bin or pit.
- ii. Base layer – Dry leaves or sawdust.
- iii. Second layer – Floral waste.
- iv. Activator layer – Sprinkle cow dung slurry or EM solution
- v. Repeat the layers till the bin/pit is full.

d) Moisture and aeration

- i. Microorganisms will break down the floral matter.
- ii. The temperature rises (up to 55° to 65°Celsius) this kills harmful microbes
- iii. Decomposition time:
 - a. 1.5 -2 Months (in warm climate)
 - b. 2-3 months (in cooler climates)



III. RESULT AND DISCUSSION:

1. Pigment Extraction

Natural pigments were successfully extracted from floral waste using acidified ethanol. The pigments obtained from marigold petals showed yellow to orange coloration, while rose and hibiscus petals produced pink to reddish shades. The extracted pigments appeared visually stable and showed good solubility, making them suitable for further applications such as Holi colours, textile dyeing, and cosmetic formulation.



Fig 1: Pigment

When compared to synthetic pigments available in the market, the floral pigments were less intense in colour but free from artificial chemicals and heavy metals. Similar studies reported in earlier research also observed moderate colour intensity in natural pigments extracted from floral waste, confirming that natural dyes prioritize safety and sustainability over brightness. The results of the present study are consistent with findings reported by other researchers who highlighted the potential of temple flower waste as a source of eco-friendly pigments.

2. Dhoop (Incense) Preparation

Dhoop prepared from dried floral residues produced a mild and pleasant fragrance during burning. The combustion was uniform and generated minimal smoke. The product maintained its shape and did not crumble easily after drying, indicating good binding properties.



Fig 2: Dhoop

Commercial incense sticks available in the market often contain synthetic fragrances and release dense smoke, which may cause respiratory irritation. In contrast, the floral waste-based dhoop prepared in this study showed lower smoke emission and a natural fragrance. Previous research on incense preparation from flower waste also reported similar results, stating that natural incense products are safer and more environmentally friendly than market alternatives. The present results support these observations.

3. Holi Colour Preparation

Natural Holi colours prepared from dried floral pigments exhibited fine texture, uniform colour distribution, and smooth consistency. The colours were easy to apply and washable with water. Marigold-based colours produced yellow-orange shades, while rose and hibiscus-based colours resulted in pink to light red shades.



Fig 3: Holi Colours

Market-available Holi colours are often made using synthetic dyes, metal oxides, and chemical fillers, which can cause skin irritation and eye problems. The floral-based Holi colours prepared in this study were non-irritating and skin-friendly during handling. Similar outcomes have been reported in previous studies, where natural Holi colours prepared from temple flowers were found to be safer alternatives to synthetic products. Although the colour intensity was lower than commercial products, the environmental and health benefits were significantly higher.

4. Lip Balm Preparation:

The herbal lip balm prepared using floral pigments and natural ingredients showed smooth texture, uniform colour, and good spreadability. No phase separation was observed, and the product remained stable during short-term storage. The natural pigments provided light and natural coloration to the lip balm.



Fig 4: Lip Balm

Commercial lip balms often contain synthetic colourants, preservatives, and artificial fragrances. In contrast, the lip balm prepared in this study used plant-based ingredients and floral pigments, reducing the risk of adverse skin reactions. Earlier studies on herbal cosmetic formulations have also reported similar advantages of natural pigments over synthetic additives. The results obtained align with previous findings supporting the use of natural ingredients in cosmetic products.

5. Paper and Seeded Paper Preparation:

Handmade paper prepared using floral fibres and recycled paper pulp exhibited improved texture and aesthetic appearance. The presence of flower petals enhanced the visual appeal of the paper. Seeded paper prepared using the same method supported plant growth when moistened and planted, demonstrating its functional sustainability.

Market paper products are commonly manufactured using wood pulp and chemical treatments, contributing to deforestation and environmental pollution. Compared to commercial paper, the handmade and seeded paper prepared in this study was eco-friendly, biodegradable, and chemical-free. Similar research studies have reported that paper made from floral waste reduces dependency on wood-based raw materials. The present findings are in agreement with earlier work highlighting the environmental benefits of handmade paper from organic waste.

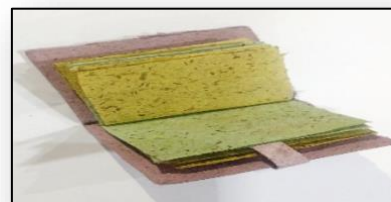


Fig 5.1: Dairy using Seeded Paper



Fig 5.2: Cloth Tags using Seeded Paper

6.

Compost Preparation:

Compost prepared from residual floral waste matured within 30–45 days and showed dark colour, crumbly texture, and earthy smell, indicating proper decomposition. The compost was free from foul odour and suitable for use as organic manure.



Fig 6: Compost

Chemical fertilizers commonly used in agriculture provide quick nutrient release but may degrade soil quality over time. In contrast, compost prepared from floral waste improves soil structure and adds organic matter. Previous studies on composting of temple flower waste have also reported similar maturity characteristics and nutrient-rich compost. The results of this study confirm that floral waste composting is an effective and sustainable waste management practice.

Overall Product Comparison and Sustainability Impact:

All products prepared from floral waste demonstrated satisfactory quality and usability. While market products generally offer higher durability and colour intensity, the products developed in this study provided significant environmental and health advantages. Compared to similar products reported in earlier research, the outcomes of this study were consistent, reinforcing the idea that floral waste can be effectively converted into multiple eco-friendly value-added products. The integrated utilization of floral waste supports waste reduction, resource recovery, and circular economy principles.

Observation Table:

Product	Observed Result	Comparison with Previous Research
Pigment	Natural pigments with yellow–orange (marigold) and pink–red (rose/hibiscus) shades; good solubility and stability.	Similar colour shades and moderate intensity reported in studies on pigment extraction from temple flower waste.
Dhoop	Mild natural fragrance; uniform burning; minimal smoke generation.	Previous studies also reported reduced smoke and pleasant aroma in incense made from floral waste.
Holi Colour	Fine texture; smooth consistency; easily washable; non-irritating to skin.	Comparable results observed in earlier studies highlighting safety of natural Holi colours from flowers.
Lip Balm	Smooth texture; uniform colour; good spreadability; stable during storage.	Similar stability and safety of herbal lip balms reported in earlier cosmetic research.
Paper / Seeded Paper	Improved texture and aesthetic appearance; seeded paper supported plant growth; diary and cloth tags were usable and durable for practical use.	Previous research confirms floral waste paper as eco-friendly alternative to conventional paper.
Compost	Dark, crumbly compost with earthy smell; matured in 30–45 days.	Earlier studies reported similar maturity and quality in compost prepared from temple flower waste.

Table 2: Observation Table**IV CONCLUSION:**

The present study demonstrates that floral waste, which is commonly discarded after religious and social activities, can be effectively utilized for the preparation of various eco-friendly value-added products. Discarded flowers collected from temples were successfully converted into natural pigments, dhoop, Holi colours, herbal lip balm, handmade and seeded paper, diary products, and compost using simple and low-cost methods. The prepared products showed satisfactory quality in terms of appearance, texture, fragrance, and usability.

Comparison with commercially available products indicated that although market products often exhibit higher colour intensity or longer shelf life, the floral waste-based products offer significant advantages such as safety, biodegradability, and absence of harmful chemicals. The results obtained in this study were also comparable with findings reported in earlier research, confirming that floral waste is a reliable raw material for sustainable product development.

The complete utilization of floral waste, including conversion of residual material into compost, followed a zero-waste approach and supported the principles of circular economy. By reducing waste disposal and promoting resource recovery, this study highlights a practical and

environmentally responsible method for floral waste management. Overall, the findings suggest that small-scale floral waste utilization can contribute meaningfully to sustainable waste management practices, environmental protection, and community-level awareness towards eco-friendly alternatives.

V. FUTURE PROSPECTS:

The present study highlights the potential of floral waste as a useful raw material for sustainable product development. Future research can focus on improving pigment extraction efficiency and product quality by optimizing processing conditions. Advanced analytical methods may be used to study the chemical composition of floral pigments and aromatic compounds.

Scaling up the preparation of eco-friendly products such as Holi colours, incense, handmade paper, and compost can support small-scale entrepreneurship and provide livelihood opportunities, particularly near temples and flower markets. Standardization of production methods and improved packaging can enhance market acceptance.

Further applications of floral waste in biofertilizers, essential oil extraction, and biodegradable materials can also be explored. Integration of floral waste utilization with local waste management systems can help reduce environmental

pollution and promote circular economy practices in the future.

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