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Production of Paper and Natural Incense Sticks Using Flower Waste

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Abstract: The increasing amount of floral waste generated from religious and cultural activities presents a significant environmental challenge. This study explores an eco-friendly approach to repurposing flower waste into incense sticks and handmade paper, promoting sustainable waste management and circular economy principles. The research investigates processing techniques, physical properties, and quality assessments of the resulting products. The study demonstrates that flower pulp can be a viable alternative to traditional wood pulp, reducing deforestation and chemical usage. Additionally, incense sticks produced from floral waste burn efficiently and release natural fragrances. This study highlights the economic and environmental benefits of utilising biodegradable waste to create value-added products while reducing pollution and resource depletion.

Keywords: *Floral Waste, Sustainability, Incense Stick.*

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I. INTRODUCTION

In India, a country renowned for its rich cultural and religious heritage, daily celebrations of festivals and devotion take place at temples, mosques, churches, dargahs, gurudwaras, hotels, banquets, and homes. India is home to numerous temples that draw in a large number of devotees. The pilgrims in India present flower garlands, vegetables, coconuts, sweets, and other edibles as offerings to the gods. This practice holds great significance and is deeply rooted in devotion. Non-consumable materials like flower garlands are usually discarded after being offered to God. It's a way to show reverence and respect for the divine presence. India is a land of incredible diversity, with a rich tapestry of cultures and religions. It's fascinating how each religion has its own unique ideologies, traditions, and rituals. There are countless places of worship scattered throughout the country, representing the diverse range of religions practised in India. Flower waste is a major component of biodegradable waste, primarily produced from religious offerings, floral markets, weddings, and social events. Improper disposal methods, such as dumping in rivers and landfills, contribute to water pollution, greenhouse gas emissions, and loss of biodiversity (Dutta & Kumar, 2021). In India, temples alone generate over 800 million tons of floral waste annually (Rani et al., 2020). As a result, a significant amount of flower waste is generated and discarded. It's important to find sustainable ways to manage this waste. Since flowers are offered to God, they are not typically disposed of in the regular waste management system. Due to this practice, the flowers are often thrown into rivers and streams, which unfortunately leads to further pollution of the already contaminated water bodies. It's crucial to find eco-friendly alternatives for flower disposal to protect our environment. The KR flower market in Bengaluru alone generates 15 - 20 tonnes of floral waste daily (Rani et al., 2020).

II. MATERIALS & METHODS

- *Plant Material for Intense Stick*

Flowers were collected from the local temple at Lower Parel and were segregated based on their colour. Petals were separated and placed in a clean tray. Petals were washed thoroughly 2 to 3 times with tap water to eliminate dust and impurities. After removing excess water, petals were kept for air drying for 2 days on clean newspaper. Petals were transferred to the clean petri plates. These plates were kept in the oven for 4 days at 60°C. Petals were ground and sieved to get fine powder. This powder is then used for further incense stick making and to perform tests.

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Fig 1 Shows the Processing of Waste Flowers.

➢ *Production of Incense Sticks*

Flaxseed were boiled to form a slimy liquid. The slimy liquid was filtered out. This slimy liquid is used as a binding agent and mixed with the powder of dried petals. Dough was formed. This dough was then rolled around the round bamboo sticks. A triangular shape was given to the dough, and incense sticks were formed.

➢ *Ash Content*

An empty dry crucible was weighed, and the initial weight was recorded as W1. 5g of flower powder was added to the crucible. The crucible was then placed in an incinerator at 100 ºC for 1 hour till the powder turned into ash. The crucible was immediately transferred to the desiccator and was allowed to cool for another 1 hour. The sample was weighed again, and the final weight (W2) was recorded.

➢ *Burning Time*

The burning time of the incense stick was compared with the marketed incense stick. Then the sticks were placed on a stainless-steel stand and were lit at the same time. The amount of time taken by the incense sticks to burn was recorded.

➢ *Moisture Content*

The stick was kept in the oven at 60 ºC for 24 hours. The next day, the weight of the incense stick was weighed on the weighing balance, and the difference in the moisture was recorded.

➢ *Plant Material for Paper Production*

Flower petals were weighed on the balance. The petals were transferred, containing 8 g % sodium hydroxide and sodium sulphate. The mixture was allowed to boil for four hours on a boiling water bath. Once cooled, the NaOH was filtered out of the mixture, and the resulting pulp was washed using distilled water. The pulp was blended with distilled water in a blender to make a fine paste, and the paste was filtered to get an even consistency. Chlorine was added to the paste as a bleaching agent and was kept at room temperature for 30 min, and washed again with distilled water. A sieve was placed in a tray filled with distilled water, and paste was added to the sieve. The sieve with paste was dipped in water several times to form a uniform layer of paste. After the formation of a uniform layer, excess water is soaked up with the help of a clean piece of dry cloth. This formed layer of paper was kept for air drying at room temperature.

Fig 2 Shows the Preparation of Paper

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➢ *Brightness Test*

The brightness of the paper was estimated using a colourimeter. There were in total of 6 papers having different chemical constituents. The resultant strips were placed in a clean cuvette, and their absorbance was recorded at 420nm.

➢ *Water Absorption Test*

Beakers were filled with distilled water. Paper strips were cut and placed in a beaker for 1 minute

➢ *pH*

Paper was added to a beaker filled with a strong acid and a strong base. Samples were evaluated using a pH paper in order to compare their pH and appearance in various solutions.

➢ *Water Retention*

The amount of time taken by the water to traverse the paper was estimated. A similar procedure was followed for cardboard and regular white paper, and a comparison study was done on the same.

➢ *Bulk Density*

The beaker was weighed, and the initial weight was recorded. To this beaker, the sample was added and kept in the oven at 80 ºC for 24 hours.

➢ *Grease Prof Test*

The test involves a similar procedure to that of the water retention test. The oil was allowed to traverse through the paper, and the time needed for the oil to pass down was recorded.

➢ *Moisture Content*

The paper was first weighed, and the initial weight was recorded. The paper was kept in the oven at 60 ºC for 24 hours. The next day, the paper was weighed again, and the moisture content was noted.

III. RESULTS

Table 1 Results

Parameter	Flower-based Paper	Regular Paper	Cardboard
Burn Time (Incense)	30 minute	28 minute	-
Ash Content	6%	9-12%	-
Water Retention	8.49 minute	2.45 minute	0.21 minute
Water Absorption	0 cm	2 cm	1.5 cm
Grease Resistance	30.52 minute	4.32 minute	0.28 minute
Brightness (Na_2CO_3 treatment)	Highest	Moderate	Low
Bulk Density	1.8 g/cm³	1.6 g/cm³	1.2 g/cm³

IV. DISCUSSION

One of the primary indicators of incense stick quality is burn duration, which determines its efficiency and practicality for consumers. This increased burn time suggests that flower-based incense sticks provide a longer-lasting fragrance and a slow, controlled release of aroma. Unlike charcoal-based incense sticks, which burn quickly and produce heavy smoke, flower-based incense sticks generate minimal soot, making them a cleaner alternative. A longer burn time makes flower-based incense sticks more economical and environmentally friendly, reducing the frequency of use and minimising airborne pollutants.

The amount of ash left after burning determines the purity and efficiency of an incense stick. Lower ash content suggests that flower-based incense sticks burn more efficiently, leaving behind minimal non-combustible residues. Lower ash generation reduces indoor air pollution and surface contamination, making flower-based incense sticks ideal for indoor use.

The scent throw (how well the incense spreads aroma) and fragrance retention were evaluated. Flower-based incense sticks released a mild, pleasant aroma. The natural essential oils absorbed by the flower-based incense sticks enhanced scent longevity and diffusion. The absence of synthetic fragrances ensures a non-toxic aromatic experience. Flower-based incense sticks are safer for individuals with respiratory conditions such as asthma or allergies.

Water retention determines the capacity of paper to hold moisture. Flower-based paper contains fibrous flower cellulose, which enhances water-holding capacity. Improved water retention makes flower-based paper suitable for packaging applications, artistic projects, and biodegradable materials. The natural resins present in flower waste contribute to the hydrophobic nature of the paper. The pulping process involving NaOH treatment and bleaching modifies the fibre structure, reducing absorption.

The flower fibres and pulping method create a dense surface, preventing oil penetration. Regular paper lacks hydrophobic characteristics, making it susceptible to grease stains. Greaseresistant paper can be used for food packaging, oil-absorbing pads, and eco-friendly disposable products.

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V. CONCLUSION

The utilisation of flower waste in making paper and incense sticks represents a sustainable and innovative approach towards waste management and product development. The cellulose and Fibre-rich composition of flower waste, obtained from discarded petals and other floral parts, lends itself well to the production of high-quality paper products. By incorporating flower waste into the papermaking process, not only are natural resources conserved, but also the environmental impact of paper production is significantly reduced. The uses of paper and incense sticks made from flower waste extend beyond mere functionality. They serve as tangible examples of circular economy principles, where waste materials are repurposed into valuable goods. Additionally, these eco-friendly products appeal to environmentally conscious consumers, driving demand for sustainable alternatives in various industries. In conclusion, the utilisation of flower waste in making paper and incense sticks embodies a harmonious blend of environmental stewardship and creative ingenuity. By harnessing the potential of discarded floral materials, we not only minimise waste but also create value-added products that align with sustainable practices and consumer preferences.

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- *Conflict of Interest*

We declare that we don't have any conflict of conflict.

- *Background*

The objective of this study was to utilise Non-consumable flowers from temples to create Sustainable and Eco-friendly Incense sticks and Paper.

- *Research Frontiers*

The study undertaken to utilise Non-consumable flowers from temples to create Sustainable and Eco-friendly Incense sticks and Paper

- *Innovation and breakthroughs*

This study has shown that the water retention, grease resistance and pH stability are superior to regular paper in eco-friendly applications.

- *Applications*

The findings of this study suggested that flower-based paper is suitable for packaging, oil-absorbing pads, high-quality printing of notebooks and in luxury packaging. Flower-based Incense sticks are ideal for indoor use, minimising air-borne pollutants and safer for individuals with respiratory conditions.

FUTURE PROSPECTS

The prospects of using flower waste for making paper and incense sticks are quite promising, aligning with sustainability goals and innovative approaches to waste management.

Eco-friendly Paper Production: Flower waste can be used as a raw material in the production of eco-friendly paper products.

Artisanal and Speciality Papers: Flower waste-based papers can be targeted towards niche markets, such as artisanal and speciality paper products. These papers can be used for stationery, packaging, and greeting cards.

Aromatherapy and Wellness Products: Incense sticks made from flower waste can be positioned as aromatherapy and wellness products.

Research and Development: Continued research and development efforts can lead to innovations in processing flower waste more efficiently and cost-effectively for paper 59 and incense stick manufacturing. This includes exploring new techniques for extracting essential oils or aromatic compounds from flower waste to enhance product quality and market competitiveness.

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