Public Healthcare and Ancient Science

Volume: 4 Issue: 1
(January-March), 2024
(ISSN:2791-2590)

KMF Publishers

www.kmf-publishers.com/phas/

PUBLIC HEALTHCARE AND ANCIENT SCIENCE
Volume: 4, Issue: 1, 2024

DOI: https://doi.org/10.5281/zenodo.10973307

Article

KMF Publishers
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OPEN ACCESS

Preparation of herbal products from waste flower of the Temple of Bhilwara, Rajasthan, India

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ABSTRACT

India is a country with lots of different religions where, worshiping is the way of living and people offer various offerings to the deities, out of which floral offerings are found in huge quantities. Therefore, temple waste has an exceptional share of flower waste in the total waste. After gratifying their purpose, flowers along with other waste, find their way into the garbage or are discarded into rivers, sea, or oceans causing various environmental problems. The majorly offered flowers in temples are marigold, rose, jasmine, chrysanthemum, hyacinth, hibiscus, etc. This floral waste can be properly managed and utilized in various value-added forms. Techniques like vermicomposting, composting, dyes extraction, extraction of essential oils, making of holi colours and bio-gas generation can be used. Most of the flowers contain secondary metabolites which can be further used in essential oil extraction and food additives. Handmade paper can also be made by utilizing these waste products. The review focuses on the important application of floral wastes which, helps to cope with energy crises and environmental pollution.

ARTICLE HISTORY
Received 4 January 2024
Revised 18 February 2024
Accepted 20 March 2024

KEYWORDS
Floral waste, Vermicomposting, Essential Oils, Bio-Gas Generation, Handmade Paper Waste Flower

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INTRODUCTION

Internationally, disposing of solid waste is a big problem. Its decrease is hampered by the variety of substances found in debris. Handling the irresponsible disposal of floral waste presents a challenge for the official temple administration. The purity of the water and the wellbeing of living things are both negatively impacted when flower waste is thrown straight into bodies of water like rivers, ponds, lakes, and seas. Flowers are a never-ending source of floral rubbish since they are frequently released from hotels, wedding gardens, religious sites, and other developing and sacred events. Flowers are used by people as tributes to their idols. Worshippers bring a lot of flowers to places of worship every day, but most of them are thrown away after being used. This

substantial quantity of floral waste is gathered from residential areas, social centres, and other locations in addition to religious locations including mosques, gurudwaras, and temples.

Rajasthan ranks sixth in India for flower promotion, behind Tamilnadu, Karnataka, West Bengal and Andhra Pradesh. India is a city full of temples that receive a lot of visits from enthusiasts. These guests, also known as devotees, present the god with foodstuffs such as fruits, coconuts, flowers, candies, and other culinary garlands. Typically, the delicacies are divided into separate portions for priests, temple officials, and other staff members to consume as well as for distribution among the devotees as Prasad. Garlands made of flowers that are non-consumable are thrown away as garbage. There are numerous real-world instances when the creation of floral waste occurs at or close to locations of sacred sites. Many devotees in the Balaji, Krishna and Shivay temples offer flowers daily.

In Bhilwara, flowers are mostly offered in two locations. One is located in Sadar Bazar's main market at the Balaji Temple, and the other is a huge platform dedicated to Lord Ganesha. 5.48 tonnes of floral waste are thought to be produced annually in both locations. According to research, the Nagar Nigam calculates that the city produces 10 tons of floral waste per day (Jadhav et al., 2013). According to Kaur and Joshi's 2002 assessment, Jaipur, India's temples get enormous amounts of flower offerings, which results in a significant amount of floral waste and serious environmental pollution as well as health risks. It is estimated that Varanasi alone is home to over 23000 temples. Given that the city is situated on the banks of the Ganges River, floral wastes are typically abandoned into the river, which has a negative impact on the ecosystem of the river and produces an unpleasant stench.

It is estimated that Varanasi alone is home to over 23000 temples. Because the city is situated on the banks of the Ganges River, a lot of flower waste is dumped into the river, which has a negative impact on the ecology of the river and produces an unpleasant stench (Padmavathiamma et al., 2008; Wani et al., 2013; Murthy and Naidu, 2012). They can be employed to create some treasures in order to avoid the negative impacts of disposing of offerings related to flowers. According to a Jan. 2013 Hindu article, roses are used to manufacture rose water, but other flowers, such as Genda (*Tagetes* spp.), are used to make incense sticks. In addition to being used in incense sticks and rosewater, the blossoms can be added to herbal items like natural dyes and herbal colours.

Organic debris, such as fruits, leaves, flowers, and coconut shells, makes up the majority of temple waste. These materials eventually wind up in trash cans or near bodies of water, which causes pollution and hygienic issues. As a result, the current research has analyzed numerous approaches that have been documented for the use and value of including temple waste in various industries.

USING FLORAL WASTE FOR VERMICOMPOST

Many studies have been conducted to find ways to use floral waste for vermicomposting. Gaurav and Pathade (2011) conducted the vermicomposting of temple garbage (Nirmalya) from the Ganesh temple in Sangli, Maharashtra. The biogas digester effluent was combined with animal manure and temple waste, and the mixture was left to degrade for 30 days at 30°C. Five flowering plants were grown in pots and the prepared vermicompost was utilized as fertilizer. When comparing the growth characteristics (height, flowering time, number of flowers produced, and flowering time) to the control sets (which did not receive the vermicompost treatment), they saw good results. In the Singh et al. (2013) experiment, vermicomposting technology was used to handle flower waste, and the results were compared to vermicompost made from kitchen trash and farm yard waste. When the floral waste vermicompost was compared to the other two waste composts, the results of the physico-chemical analysis were better. Additionally, plant development factors were examined for the aforementioned vermicompost, and the results showed that vermicompost made from temple waste should improve plant growth parameters in the research.

Tiwari (2014) conducted a study to manage and repurpose flower waste from ten well-known Jaipur city temples. Vermicomposting technology was employed to reduce the amount of floral waste. Floral waste, or marigold, was gathered, divided, and composted in various proportions in earthen pots. The vermicompost that was produced was assessed for several characteristics, including pH, temperature, moisture content, organic carbon, accessible phosphorus, etc. The study demonstrated how well flowers work as a vermicomposting substrate. Shouche et al. (2011) conducted a comparable study.

According to Sailaja et al. (2013), vermicomposting contains plant hormones like auxin and gibberellins as well as enzymes that are meant to stimulate plant development and suppress plant diseases. They also looked at the nutritional status and microbial count of the processed vermicompost in their investigation. Thoothukudi is home to several dry flower companies that process flowers for exportation to other nations. A significant portion of the organic waste produced by these sectors is made up primarily of floral waste. In order to create valuable compost out of this garbage, Silvuai and Aneeshia (2014) worked. *Pleurotus sapidus*, *Pleurotus flabellatus*, and *Ganoderma incidum* were the fungi cultures that they employed. It was discovered that the Pleurotus species is highly efficient at breaking down waste materials and creating economical compost.

In 2015, Makhanial and Upadhyay conducted another experiment in which they examined the physico-chemical characteristics of floral waste that was gathered from several Surat city temples during the composting process. Temperature, pH, electrical conductivity, moisture content, and volatile solid sample analysis are among the

factors they check. The greatest temperature was recorded on the fourth day of heap composting, and the effectiveness of composting as a zero-waste approach for handling organic waste, such as flowers, was also demonstrated. The Kashi Vishwanath temple, which attracts the largest number of devotees year-round, particularly in the month of Shrawan, has a mechanism in place for getting rid of the hundreds of kg of waste that comes from devotee offerings. This technique turns floral waste into manure (Mishra, 2013).

An additional study was carried out at the Nirmalya temple in South Mumbai. The material was pre-composted at 30 0C and utilized as a substrate for the 90-day vermicomposting process by the earthworm species *Eisenia foetida.* Additionally, the vermicompost's chemical analysis revealed that it had a pH of 7.2, an organic carbon content of 8.57%, a N content of 0.49%, a total P of 0.5%), K of 0.16%, a C: N ratio of 17.489, and a high concentration of microelements like zinc, manganese, iron, and copper. Following examination, it was found that 3×109 cfu/ml was the total number of bacteria in vermiwash. It also includes certain bacteria that fix nitrogen, such as Rhizobium and Azotobacter. Comparably, Jain (2016) examined and evaluated the application of the prepared floral vermicompost on tomato plants. *Solanum lycopersicum* L. plants were used in a pot culture experiment, and growth measures such as mean stem diameter, mean plant height, and yield/plant showed good growth promotion. The findings suggest that tomato plants develop and yield more when the whole range of nutrients found in floral waste vermicompost is integrated into the mix.

BIOGAS GENERATION

Fermentation biotechnologists typically use microorganisms or microbes as a technique to convert sugar into ethyl alcohol. Given the severe energy situation of our day, ethanol is the most carefully considered and practical energy alternative when compared to other fossil fuels. It has been documented from historical and traditional sources that some tribal people in Andhra Pradesh, Maharashtra, and Chhattisgarh, India, cultivate and gather mahua flowers for alcoholic beverages using traditional ways. There are significant financial benefits to using mahua flowers as a substrate for submerged fermentation-based ethanol production (Benerji *et al.*, 2010).

Research has been conducted on the production of biogas from floral wastes (Singh et al., 2012). An additional report about the anaerobic digestion of roses in a batch reactor to produce biogas was discovered. According to Kumar et al. (2012), the biogas produced from floral waste can be used as fuel and to generate energy. Figure 1 illustrates the plan for using flowers as a fermentable substrate in the fermentation process to produce biofuels. Different amounts of biogas kg-1 base from flower wastes were reported by Ranjitha et al. (2014) in Kenya (Table 1). In 2012, Kumar and Swapnavahini gathered research suggesting the production of biogas and the examination of rose residue's capacity to reduce

nutrients through anaerobic breakdown in a batch reactor.

They employed a 2.5 L batch reactor that was filled with leftover rose petals and left to digest for 30 days at room temperature before being preserved. At intervals of five days, several characteristics were examined, including Total Solids (TS), Volatile Solids (VS), Chlorides, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), and Total Kjedal Nitrogen (TKN). Together with the creation of biogas, the procedure may remove up to 73%, 45%, 82%, 42%, and 58% of TS, VS, chloride, BOD, and TKN, respectively.

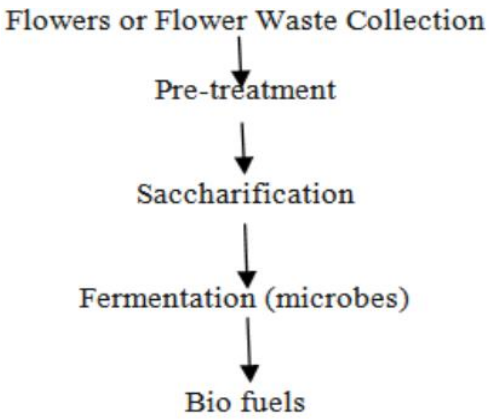

Fig-1 Scheme representing flower as fermentable substrate in fermentation for biofuel production

Table-1 Amount of biogas kg-1 substrate from flower wastes in Kenya. (Source: Ranjitha et al., 2014)

Substrate Biogas	(kg-1 substrate)
African wattle	10.92
Roselle	5.18
Nile tulip flower	5.38
Silk tree mimosa	23.73
Sunset flower	2.73
Jasmine	6.07

ESSENTIAL OILS AND DYES REGENERATED FROM FLORAL WASTE

Sugarcane is commonly used as the primary raw material for oxalic acid in India. Regarding the additional sugar content in mahua flowers, this represents a potential substitute for the generation of oxalic acid (Das, 2010). The main applications for this oxalic acid are as a chelating agent and preservative in a variety of settings. According to a source, dyes have been made from marigold and rose blossoms from Aurangabad temples (Karolia & Dilliwar, 2004). Biodegradable dyes have become a major alternative to synthetic dyes in modern times. A prior study on the extraction of dye for use on Pashmina shawls from the petal portion of saffron flowers is available (Raja et al., 2012).

It has been claimed that Hibiscus may be used as a natural dye for textile colouring (Teli et al.,

2013). Fig. 2 shows the standard process of extracting colours from flower debris.

According to Jadhao & Rathod (2013), patuletin dye, which is also utilised in the textile industry, is derived from French marigold flower wastes (*Tagetes patula* L) and marigold (*Tagetes erecta* L). According to the results of the experiment, safflower pigments, specifically red (carthamin) and yellow (carthamidin), are employed as raw materials for textile colouring. About 30% of sunflower petals are yellow, and 0.83% are red (Nagaraj et al., 2001).

These pigments are widely utilized as natural food colouring, printing, dyeing, stain, and stabilizer in beverages and cosmetics. In an experiment on the extraction and analysis of Rosa species essential oil, Khan and Rehman (2005) examined a number of characteristics, including oil yield, colour, and other physical and chemical characteristics of two distinct species, *Rosa demascena* and *Rosa centifolia*. After conducting their investigation, they concluded that the chemical makeup and fragrance components of the essential oils of the two species differed both quantitatively and qualitatively.

A significant amount of flower waste is created in Indian temples, as studied by Vankar et al (2009). This waste can be used to make dyes for cotton, wool, and silk colouring. The carotenoids lutein and patuletin, which are the main components of *Tagetes erecta* petals—which have been found, separated, and utilized for textile dyeing—were utilized by them. To gauge the quantity of flowers offered at Chennai, Tamil Nadu's five temples, Perumal et al. (2012) performed research there. They noted that approximately 2350 kg of flowers were presented daily, with the most prevalent varieties being jasmine, chrysanthemum, marigold, and roses.

They selected rose petals from among all the flowers on display and allowed them to air dry before employing the steam distillation method to extract the essential oils. Using the GC-MS method, the chemical components of rose oil were examined. Phenyl ethyle alcohol (23.19%) was the most abundant component among the 54 compounds found, followed by tetra methyl trisilocen decanol (3.45%), octadecane (10.49%), hexadecane (7.76%), and phenyl ethyl decylester (5.77%). Similar research was done in 2014 by Ravishankar et al., who found that 1450 tons of flowers are offered to the gods at different temples around the nation. The most common flowers offered in Indian temples include roses, jasmine, marigolds, chrysanthemum, hyacinth, hibiscus, and tuberose. Following the appropriate chemical examination, they discovered that each bloom had some essential oil present as a secondary metabolite.

OTHER APPLICATIONS OF FLORAL WASTES

According to Yeboah (2011), flower waste management from temples can serve as a sustainable source of raw materials for the creation of handmade paper, aside from its prior use. By using this process, municipal temples can reduce the amount of waste they throw while

simultaneously recycling and reusing it to create environmentally friendly paper. Handmade paper manufactured from flower waste has several benefits, including the fact that it is completely devoid of wood and chemicals and produces no hazardous byproducts in the process (Dermitrescue *et al*., 2004).

Flowers, as we all know, have therapeutic properties as well because of the metabolites that they contain. Numerous studies have found that calendula oil, which is olive oil infused with dried calendula flowers, is an excellent type of massage oil that is a valuable byproduct of pre-treated floral waste. Passionflower relieves tension, anxiety, and sleeplessness; lilies treat jaundice, and respiratory, and gastrointestinal issues; and rhododendron flower juice lowers blood pressure. Muscle cramps and skin conditions like eczema can both be treated with chamomile essential oil (Waghmode *et al*., 2016).

CONCLUSION

Floral waste can be recycled and utilized in a variety of ways, according to the review article that was presented. A review article that focuses on different ways to use temple waste for one or more useful products—vermicompost, biogas, dyes, incense sticks, etc.—makes the case that temple waste can be used to make a variety of products in addition to being safely disposed of in an environmentally friendly way. This research will provide an alternative method of managing waste because the waste will not be land but rather a resource that can be repurposed.

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