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Review Article

Management of Temple Floral Waste and Utilization of Value Added Floral Waste Product: A Review

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A B S T R A C T

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 quantity. 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 river, 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 form. Techniques like vermicomposting, composting, dyes extraction, extraction of essential oils, making of Holi colours and bio-gas generation can be used. As most of the flower contains secondary metabolites which can be further used in essential oil extraction and food additives. Handmade paper can also made by utilizing these waste products. The review focuses on important application of floral wastes which, helps to cope up with energy crises and environmental pollution.

K E Y W O R D S

Floral waste | Vermicomposting | Essential Oils | Bio-Gas Generation | Handmade Paper

C I T A T I O N

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Introduction

Solid or semi-solid waste disposal is a chief concern in the world. Harmless discarding of floral waste has been a cause of concern for the temple management. Worsening of environmental quality, climate change, disposal and management of waste and sustainable development are the chief issues to human society. One of the main causes of environmental pollution is mis-management of organic waste including temple waste The floral waste is directly inclined into the rivers, oceans, etc. which has terrible impact on the water quality as well the living organisms present in the waters and its surroundings. Flowers or floral parts come as waste from hotels, wedding gardens, worship places and a spread of civilizing and sacred ceremonies, which make them a usual source of floral waste. Flowers are considered as holy entities and hence are offered by pilgrims to their idols. Every day these flowers offered in temples are left unexploited and therefore become solid-waste. This flower waste dump and gets accumulated at religious sites like Temples, Mosques and Gurudwaras (Mishra, 2013). In India, West Bengal is in 4th position to promote flowers after Andhra Pradesh, Karnataka and Tamilnadu. Indian is a city with many temples, being visited by a large number of devotees. These visitors or devotees come and offer floral garlands, fruits, coconut, sweets and other edibles to the God. The edibles are usually apart to be distributed among the devotees as Prasad and for consumption by priests, temple administrators and other staff. Non-consumable materials (floral garlands) are discarded as waste. There are lots of practical examples, where we can see the generation of floral waste near or vicinity places of holy places. Every day many devotees offer flowers in the temples of Chitrakoot. There are two main places where flowers are sold in Chitrakoot. One is situated in the Ramghat on the bank of river Mandakini and another major on the platform of Lord Kamtanathji. Total floral waste estimated in both places generated is 5.48 ton year-1. From the studies it has been found that the Varanasi Nagar Nigam estimates the quantity of floral waste to be 10 ton day-1 in the city (Jadhav *et al*., 2013). Kaur and Joshi 2002 reported that Huge amounts of flowers are offered in temples of Jaipur city (India) creating a large amount of flower waste, which creates stern environmental pollution and health hazards. It has been approximated that about 23000 temples are situated in Varanasi only. As the city is located at the bank of River Ganges, chiefly flower wastes are deserted in into the river which causes disagreeable effect on the river ecology, making a foul-smelling smell (Padmavathiamma *et al*., 2008; Wani *et al*., 2013; Murthy and Naidu, 2012).

To evade ill effects caused by disposal of floral related offerings, they can be used to make some valuables. The Hindu, Jan. (2013) reported that flowers like genda (Tagetes spp.) are used to make incense sticks, while roses are converted to rose water. Besides incense sticks and rosewater, the flowers can also be incorporated into herbal products such as herbal colours, natural dyes etc. We can also recycled these floral waste to reuse it for various purposes, like in case of Ajmer, where floral waste management has yielded good pay offs is that of Ajmer Sharif Dargah of Khwaja Moinuddin Chishti where nearly 15

to18 Quintals of flowers, offered each day were used to be dumped in a well.

Mainly temple waste consists of organic waste like flowers, leaves, coconut shells, fruits etc. which find their way ultimately into bins or some water bodies and thereby result in the pollution and hygiene problems. Therefore, the present paper has reviewed various methods reported for the utilization and value addition of temple waste in various sectors.

Flower waste as vermicompost

As far as research is concerned, lots of work has been done to utilize the flower waste in vermicomposting. Vermicomposting of temple waste (Nirmalya) obtained from Ganesh temple, Sangli, Maharashtra was done by Gaurav and Pathade (2011). They used effluent produced from biogas digester and mixed it with temple waste and cattle dung which was then allowed to decompose for a period of 30 days at 30°C. The arranged vermicompost was also used to for pot culture examination as a fertilizer with five flowering plants. They recorded good growth parameters in terms of height, flowering time as well as number of flowering time and the number of flowers produced as compared to the control sets, which were not treated with that vermicompost. In the experiment conducted by Singh *et al*. (2013), flower waste management was done by using vermicomposting technology which was then compared with kitchen waste and farm yard waste vermicompost. The physico-chemical analysis of the flower waste vermicompost showed improved result in comparison to both the other waste composts. Along with it, plant growth parameters were also studied for the above mentioned vermicompost which revealed that temple waste vermicompost should augment the growth parameters of plants as per the research. Tiwari, (2014) carried out a research with the aspire to utilize and manage floral waste obtained from ten popular temples of Jaipur city. To decrease the floral waste, vermicomposting technology was used. Marigold (floral waste) was collected, segregated and composted in earthen pots in different ratios. Various parameters like pH, temperature, moisture content, organic carbon, available phosphorus, etc. were evaluated for the vermicompost obtained. It was proved from the study that flowers can be very well used as substrate for vermicomposting. Similar study was done by (Shouche *et al*., (2011), where she also concluded the same results. Vermicomposting contains plant hormones like auxin and gibberellins and enzymes which supposed to arouse plant growth and downcast plant pathogens (Sailaja *et al*., 2013). In their study, they also studied nutrient status and microbiological enumeration of vermicompost prepared. In Thoothukudi, numerous dry flower industries are situated, which process flowers and export them to many countries. The waste produced from these industries contain large amount of organic waste, which mainly consists of flower waste. Silvuai and Aneeshia, (2014) worked on the making of precious compost of this waste. They used the fungal cultures viz. Ganoderma incidum, Pleurotus sapidus and Pleurot flabellatus. Pleurotus species was found to be very effective for decomposition of waste and producing cost effective compost.

Another experiment was done by Makhanial and Upadhyay (2015) they studied the physico-chemical parameters throughout the composting of floral waste collected from various temples of Surat city. They examine the parameters like temperature, pH, electrical conductivity, moisture content and volatile solid samples were analysed. They measured highest temperature at 4th day of heap composting and also proved that composting is effective "zero –waste" method for treating of organic waste like flowers. Kashi Vishwanath temple which draws greatest devotees all round the year, especially in the month of Shrawan, has its own system for the disposal of the hundreds of kg of waste resulting from offerings by devotees, where floral waste is converted into manure (Mishra, 2013). It has been found from one research that the vermicompost obtained was rich in carbon (28%), nitrogen (1.58%), phosphorus (0.33%) and potassium (0.28%). The vermicomposting has been carried to convert floral waste into useful organic fertilizer (Shouche *et al*., 2011). Another work was conducted in Nirmalya a temple in South Mumbai, which was pre-composted at 30oC and used as a substrate for vermicomposting by earthworm species Eisenia foetida for 90 days. Furthermore, from the chemical analysis of the vermicompost showed its pH (7.2), the organic carbon content (8.57%), N (0.49%), and total P (0.5%), K (0.16%), C: N ratio (17.489) and also contained ample concentration of microelements like zinc, manganese, iron and copper. After analysis it was observed that the total bacterial count of vermiwash was 3×109 cfu/ml. It also contains some nitrogen fixing bacteria like Azotobacter and Rhizobium. Similarly, Jain (2016) analyzed the prepared floral vermicompost and checks its application over the tomato plants. Pot culture experiment was conducted with Solanum lycopersicum L. plants and a variety of growth parameters like mean stem diameter, mean plant height, yield/plant showed good enhancement of growth .The results point towards that built-in effect of all the nutrients present in flower waste vermicompost results in the augmented growth and yield of tomato plants.

Biogas productions

Generally, microorganisms or microbes are used as a tool by fermentation biotechnologists for the conversion of sugar into ethyl alcohol. Because of stern energy crisis in today's world, ethanol is well thought-out most suitable energy source amongst different fossil fuels. From the traditional and historical evidences it has been reported that, in India, various parts of Andhra Pradesh, Maharashtra, Chhattisgarh, some tribal communities are occupied in cultivating and harvesting mahua flowers for alcoholic beverages using traditional methods. The exploitation of mahua flower as a substrate for the manufacture of ethanol through submerged fermentation is of immense economic advantage (Benerji *et al*., 2010). Observation has been done on biogas production using floral wastes as raw material (Singh *et al*., 2012). Another report was found on biogas production from rose by anaerobic digestion in a batch reactor. The biogas from floral waste can be used for electricity generation and as a fuel (Kumar *et al*., 2012). The scheme representing flower as fermentable substrate in fermentation for bio fuels production is shown fig-1. (Ranjitha *et*

al., 2014) reported various Amount of biogas kg-1 substrate from flower wastes in Kenya (Table 1). (Kumar and Swapnavahini, 2012) had collected a study which proposed to produce biogas and analyze nutrient reduction potential of rose residue by anaerobic digestion in a batch reactor. They used a 2.5 L batch reactor which was packed with rose residue and allowed for digestion for 30 days preservation period at room temperature. Various parameters like Total Solids (TS), Volatile Solids (VS), Chlorides, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Total Kjedal Nitrogen (TKN) were analyzed at 5 days interval. The process could eliminate up-to 73%, 45%, 82%, 42%, 58% of TS, VS, chloride, BOD, TKN respectively along with the production of biogas.

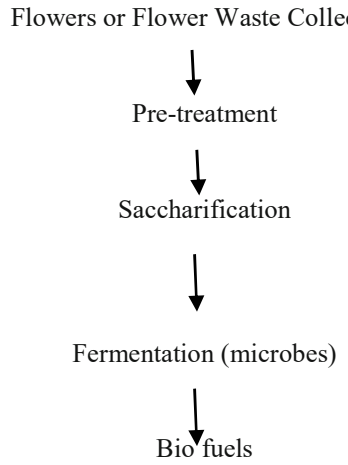

Fig 1: Scheme representing flower as fermentable substrate in fermentation for bio fuels production.

S. No.	Substrate Biogas	Kg-1 Substrate
1.	African wattle	10.92
2.	Roselle	5.18
3.	Nile tulip flower	5.38
4.	Silk tree mimosa	23.73
5.	Sunset flower	2.73
6.	Jasmine	6.07

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

Extraction of Dyes and Essential Oils from floral waste

Commonly in India, chief raw material for oxalic acid is sugarcane. In outlook of the amount of more sugar in mahua flowers, it constitutes an alternate potential to oxalic acid production (Das, 2010). This Oxalic acid is mostly used as a preservative and chelating agent in various aspects. There is a report where marigold and rose flowers from temples of Aurangabad have been used for the preparation of dyes (Karolia and Dilliwar, 2004). Now a day, biodegradable dyes have emerged as significant substitute to synthetic dyes. There is a previous research article on use of petal part of the saffron flower to extract dye for application on the Pashmina shawl (Raja *et al*., 2012). The possible employ of Hibiscus as a natural dye in textile coloration has been reported by (Teli *et al*., 2013). The common extraction of dyes from floral wastes is represented in Fig 2.

(Jadhao and Rathod, 2013) reported patuletin dye extracted from marigold (Tagetes erecta L.) and French marigold floral wastes (Tagetes patula L.) is used in textile industries and also having anti- oxidant properties. From the carried experiment, it has been recorded that, Safflower pigments *viz*. red (carthamin) and yellow (carthamidin) are used as material for dye (textile coloration). Safflower petals hold about 30% yellow and 0.83% red (Nagaraj *et al*., 2001). These pigments are extensively used as stain, stabilizer in beverages and cosmetics, printing, dyeing and as natural food colorant. (Khan and Rehman, 2005) conducted an experiment on the extraction and analysis of essential oil of Rosa species; they observed various parameters

like oil yield, colour and other physical and chemical properties of two different species that are Rosa demascena and Rosa centifolia. They concluded from their examination that there was quantitative and qualitative difference in chemical composition, aroma constituents of essential oil of two species. From the study done by (Vankar *et al*., 2009) had also recorded that vast amount of flower waste is produced in temples of India which can be utilized in making dyes for dyeing of cotton, wool and silk. They used (marigold) Tagetes erecta petals which chiefly consists of carotenoids-lutein and flavonoid-patuletin, these colorants have been identified, isolated and used for dyeing textiles.

Work was conducted by (Perumal *et al*., 2012) in and around five temples of Chennai, Tamil Nadu to assess the amount of flowers offered there. They observed that round 2350 kg of flowers were offered every day and the common flowers were rose, marigold, chrysanthemum and jasmine. Out of all flowers offered there, they collected rose petals and air dried them to extract essential oils from them by using steam distillation process. The chemical components of rose oil were analyzed by GC-MS technique. 54 compounds were recorded out of which phenyl ethyle alcohol (23.19%) was recorded as major component followed by octadecane (10.49%), hexadecane (7.76%), phenyl ethyl decylester (5.77%) and tetra methyl trisilocen decanol (3.45%). Similar survey was conducted by (Ravishankar *et al*., 2014), they reported that 1450 tonnes of flowers are being offered to the deities in various temples all over the country. Rose, jasmine, marigolds, chrysanthemum, hyacinth, hibiscus and tuberose are the major flowers being offered in Indian temples. After the proper chemical analysis, they observed that every flower contains some essential oil as a secondary metabolite.

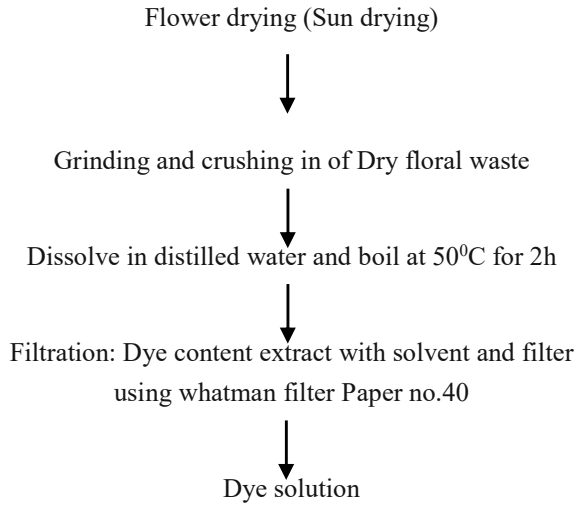

Fig 2: Representation of common extraction of dyes from floral wastes.

Other Applications of Floral Wastes

Out of the previous utilization, flower waste management from temples can provide as a sustainable source of raw material for handmade paper production (Yeboah, 2011). This method not only minimize the generally discarded waste produced by city temples, but also recycles and reuses it as an environment friendly paper. The handmade paper made from flower waste has many rewards viz., 100% free from wood and all chemicals; leaves no harmful by-products during the manufacturing (Dermitrescue *et al*., 2004).

As we know that flowers are also having medicinal values due to their metabolites present inside their body. Lots of research paper concluded that the calendula oil (olive oil infused with dried calendula flowers) is a high-quality font of massage oil, which is a value added product of floral waste after pre-treatment. Passionflower helps to lessen anxiety, stress and insomnia; Lily to heal

jaundice, respiratory and gastro intestinal disorders and Rhododendron flower juice is used to manage high blood pressure. Chamomile essential oil is used for remedial of skin disorders like eczema and also to relieve muscular cramps (Waghmode *et al*., 2016).

Conclusion

From the presented review paper, it can be concluded that floral waste can be recycled and reused in various ways. Review article focusing on various methods of utilizing temple waste for one or the other practical product like vermicomposting, biogas, dyes, incense sticks, etc. put forward that the temple waste can not only be disposed safely in an environmental friendly manner but can also be utilized for making diversified products. This study will offer a substitute approach to waste management since the waste will neither be land but would be used as a resource that will be recycled. The value-added products obtained from floral wastes viz; compost can be used for a range of plant growth; biogas for electricity generation; food products as additives. The dyes and pigments can have applications in various textile industries; while bio fuels and bio ethanol can solve the problem of energy crisis.

References

Benerji, D. Ayyanna, C. Rajini, K. Rao, B. and Banerjee, D. (2010): Studies on physico-chemical and nutritional parameters for the production of ethanol from mahua flower (Madhuca indica) using Saccharomyces cerevisiae—3090 through submerged fermentation (smf). J. Microb. Biochem. Technol., 2: 46–50.

Das, B. (2010): Identification of abiotic and biotic factors causing deterioration during storage and development of storage techniques for mahua (Madhuca indica Syn. Bassia latifolia) flowers. Agric. Conspec. Scientificus, 75: 119–125.

Dermitrescue, I. Visileanu, E. and Marilena, M. (2004): Naturla dyes obtained from plant wastes. Colourage, 51: 121–129.

Gaurav, M. V. and Pathade, G. R. (2011): Production of Vermicompost from Temple Waste (Nirmalya): A Case Study. Universal Journal of Environment and Research Technology, 1 (2): 182-192.

Jadhao, N. and Rathod, S. (2013): The extraction process and antioxidant properties of patuletin dye from wasted temple French marigold flower. Asian J. Plant Sci. Res., 3: 127–132.

Jadhav, A. Chitanand, M. and Shete, H. (2013): Flower waste degradation using microbial consortium. J. Agric. Vet. Sci., 3: 1– 4.

Jain, N. (2016): Waste Management of Temple Floral offerings by Vermicomposting and its effect on Soil and Plant Growth International Journal of Environmental & Agriculture Research, 2(7): 89.

Karolia, A. and Dilliwar, S. (2004): Natural yellow dyes from marigold flowers for leather. Colourage, 51: 31–38.

Kaur, S. and Joshi, N. (2002): Solid Waste Generation During Normal Days in Haridwar City. Him. J. Environ. Zool.,16(2): 267-270.

Khan, M. A. and Rehman, S. U. (2005): Extraction and analysis of essential oil of rose species. International journal of agriculture and biology, 7(6): 973-974.

Kumar, M. S. and Swapanavahini, K. (2012): Nutrient reduction and biogas production of rose residues by anaerobic digestion in a batch reactor. International Journal of Advanced Research in Science and Technology, 1(2): 125-129.

Waghmode, M. S. Gunjal, A. B. Nawani, N. N. and Patil, N. N. (2016): Management of Floral Waste by Conversion to Value-Added Products and Their Other Applications, Waste Biomass Valor.

Makhanial, M. and Upadhyay, A. (2015): Study of Flower Waste Composting to Generate Organic Nutrient. International Journal of Innovative and Emerging Research in Engineering, 2(1): 145-149.

Mishra, N. (2013): Unholy mess: temple waste: a concern. Times of India.

Murthy, P. S. and Naidu, M. M. (2012): Sustainable management of coffee industry by-products and value addition - A review. Resources, Conservation and Recycling, 66: 45–58.

Nagaraj, G., Devi, G. and Srinivas, C. (2001): Safflower petals and their chemical composition. In: Proceedings of the 5th International Conference on Safflower, Williston, Montana, North Dakota and Sidney, 301–302.

Padmavathiamma, P. K., Li, L. Y. and Kumari, U. R. (2008): An experimental study of vermin biowaste composting for agricultural soil improvement. Bioresour. Technol., 99: 1672–1681.

Perumal, K. Sambanda, T. and Savitha, J. (2012): Characterization of essential oil from offered temple flower Rosa damascena mill. Asian J. Exp. Biol. Sci., 3: 330–334.

Raja, A., Pareek, P., Shakyawar, D., Sarfaraz, A., Nehvi Wani, F. and Sofi, A. (2012): Extraction of natural dye from saffron flower waste and its application on Pashmina fabric. Adv. Appl. Sci. Res., 3: 156–161.

Ranjitha, J., Vijayalakshmi, S., Vijayakumar, P. and Ralph, N. (2014): Production of biogas from flowers and vegetable wastes using anaerobic digestion. Int. J. Res. Eng. Technol., 3: 279–283.

Ravishankar, R., Raju, A. B., Abdul, B. M., Mohpatra, A. K. and Kumar, M. (2014): Extraction of useful products from temple flower wastes. Journal of Chemical Engineering and Research, 2(1): 231-239.

Sailaja, D., Srilakshmi, P., Shehanaaz, H., Priyanka, H., Bharathi, D. and Begum, A. (2013): Preparation of

vermicompost from temple waste flower. Int. J. Innov. Sci., 3: 367–375.

Shouche, S., Pandey, A. and Bhati, P. (2011): Study about the Changes in Physical Parameters during Vermicomposting of Floral Wastes. Journal of Environment and Research, 6(1): 63-68.

Siluvai, C. and Aneeshia, K. (2014): Fungal degradation of dry flower industrial waste and evaluation of dye level by HPLC. Journal of Microbiology and Biotechnology Research. 4(3): 40-50.

Singh, A., Jain, A., Sharma, B., Abhilash, P. and Singh, H. (2013): Solid waste management of temple floral offerings by vermicomposting using Eisenia fetida. Waste Manag., 33: 1113–1118.

Teli, M. D., Valia, S. P. and Kolambkar, D. (2013): Flower waste from temple for dyeing of cotton and cotton/silk. Journal of the Textile Association, 210-214.

Tiwari, P. (2014): Utilization and Management of Floral Waste Generated in Popular Temples of Jaipur City: The IIS University, Jaipur.

Vankar, P. S., Sanker, R. and Wijayapala, S. (2009): Utilization of Temple Waste Flower- Tagetus erecta for Dyeing of Cotton, Wool, Silk on Industrial Scale. Journal of Textile and Apparel Technology Manage. 6(1): 1-15.

Wani, K. A., Mamta, K. and Rao, R. J. (2013): Bioconversion of garden waste, kitchen waste and cow dung into value-added products using earthworm Eisenia fetida. Saudi Journal of Biological Sciences, 20: 149–154.

Yeboah, R. (2011): Waste fabrics that can be used to produce handmade papers when combined with the paper mulberry bark. Report onThesis Submitted to the School of Graduate Studies, Kwame Nkrumah University of Science and Technology, Kumasi.