Management of Temple Flowers: A step towards Environmental Sustainability

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Abstract— *India is a diverse country with many religions, and worship and offerings to deities play a significant role in people's daily lives. Floral offerings are commonly used in religious ceremonies and are a symbol of devotion and respect, therefore, temples generate a large amount and variety of flower waste. When not properly disposed of, temple waste, including floral waste, can end up in landfills or water bodies, where it can cause environmental problems. Discarded floral waste can also harm wildlife, clog drainage systems, and contribute to water pollution. Here we will discuss about the temples of Ayodhya, Uttar Pradesh. The majorly offered flowers in temples are marigold, rose, jasmine, chrysanthemum, hibiscus, etc. Tagetes erecta commonly called marigold is offered in tremendous amounts, so there is an urgent need to manage it sustainably. The primary product we extracted is the essence named 'Pushpsar' and secondarily essential oil from it. These flowers contain secondary metabolites, so the essential oil has significant medicinal value. Furthermore, the slurry by-product is used to make bio fertilizers, overall the flower waste which was disposed off earlier in the Holy Saryu River, now used as valuable products in sustainable modus.*

Keywords— Essential Oil, Flower Waste, Marigolds, Steam Distillation, Temple waste.

I. INTRODUCTION

In India, the most populated nation, religion is a way of life, and various religious festivals are celebrated occasionally. Various religious rituals are performed in temples, gurudwaras, churches, dargahs, mosques, hotels, banquets, and houses, in which a variety of items, including sweets, garlands (flowers), fruits (edible and non-edible), etc., are offered to gods (Yadav et al., 2015; Samadhiya et al., 2017). In these ceremonies, floral waste has considerable fractions, which have been discarded after a single use. These flowers are disposed into water bodies, thereby polluting them (Burnley, 2007), or dumped onto open lands, causing environmental pollution (Wijayapala, 2013). Being an offering to God, flowers do not find their way to the conventional waste disposal system because of religious beliefs.

According to Puranik, (2019) it is a wrong assumption that flower waste is biodegradable in nature, so it can be discarded anywhere for decomposition. Dumping of flowers in water bodies or open landfills consequence in environmental hazards (Singh et al., 2013). Dumping of flower waste in rivers/ponds/lakes results in a threat to the aquatic ecosystem as it decreases the amount of dissolve oxygen. Such kind of activity significantly affect the aquatic organisms (Mahindrakar, 2018). Some of the major harmful effects are as follows:

- Drainage system and waterways connected to the water bodies get clogged (Maity and Kumar, 2016)
- Dumping of floral waste on roadsides and open places gives murky look to an area and distorts the image (Waghmode et al., 2018)
- Flower waste disposal initially increases the organic load which may tend to enhance the growth of weeds and microorganism in the aquatic ecosystem (Makhania and Upadhyay, 2015).
- Decomposing flowers releases several kinds of nutrients which trigger algal growth resulting in eutrophication.

- Places of devotion apart from flower waste generate a lot of single-use plastic waste in terms of plastic bottles and plastic bags (Bhatia, 2018; Mehta, 2013).
- Floral waste can create a hideous appearance in public spaces and negatively impact the natural beauty of areas like Ghats.

Due to the availability of high organic content as well as the lack of proper handling strategies the degradation of flowers is a very slow process (Jadhav et al., 2013). Every year approximately 80,00,000 tons of flowers are dumped in the rivers in India choking them to death (Maity and Kumar, 2016). With the increase of the human population, the number of visitors is also increasing which consequentially contributes to the generation of an enormous amount of flower (Samadhiya et al., 2017). Disposal of temple flowers are a major challenge throughout India (Padmavathiamma et al., 2008; Murthy, and Naidu, 2012; Wani et al., 2013).

Temple waste causes a foul odor after degradation which creates air, water, and land pollution. Human health is also affected by the generation of pollution (Vankar et al., 2009). Thus, there is a necessity for a proper and eco-friendly process for floral waste disposal. Flowers like Marigold (Tagetes spp.) and rose (Rosa damascene) are used to make incense sticks and rose water. Moreover, various other products such as herbal colors, natural dyes, medicine, decorative items, paper, food production, sugar syrup, pigments, biosurfactants, biofuels, compost, bioethanol can also be incorporated from these flowers (Bhattacharya, et al., 2012; Ranjitha, et al., 2014; Waghmode, et al., 2016). Several value-added goods can be prepared from the flowers which is being dumped simply. Figure 1 shows the list of different items prepared from flower waste as waste to wealth concept. At present management of floral waste is being done to reduce the pollution load. Environment friendly methods are adapted to manage and treat these floral wastes in a cost-effective way. The net result of such practices is to develop useful products on sustainable manner (Bundela, et al., 2010; Jain, 2016). The present study aims to explore the different pathways for the sustainable utilization of flower waste being generated in the various temples of Ayodhya. Furthermore, to aware and generate income to the farmers and job opportunities to local peoples.

FIGURE 1: Flower waste to value added products.

II. MATERIAL AND METHODS

Ayodhya: Ayodhya is counted as one of the seven sacred cities in the Hindu faith. As we all know that many times large gatherings, leftover the footprint of pollution of the environment. This is due to the lack of awareness and mismanagement. Ayodhya is situated on the banks of River Saryu is a spiritual Centre also known as Saket an ancient city of India. Ayodhya is historical and religious and its peaceful Ghats and various temples attract thousands of devotees to visit this city and to take a holy dip in the river Saryu.

2.1 Set up of Pilot Project:

The distillation unit is set up on a pilot scale at the premises of Dr. Rammanohar Lohia Avadh University Ayodhya, U. P. This pilot project is established as "Pilot Cum Demonstration Project Distillation of Flowers from Temples of Ayodhya". This pilot project was started as a joint venture with the technical support of "Fragrance & Flavour Development Centre (FFDC), Kannauj, Uttar Pradesh" a Government of India, autonomous body under the Ministry of MSME. A large steam distillation unit is fabricated with the help of M/S Swaraj Herbals Machinery Private Limited, Barabanki U. P. which is completely made of SS grade 304. This steam distillation unit contains one large container for cooking flowers, one condenser, one collecting tank, and a recycling pipe that connects the pipes of the collection tank and cooking tank to avoid overflow. The cooking tank is fitted with three immersion rods supplied with three-phase electricity, to cook the flower at a high temperature. A line diagram of the steam distillation unit has been shown in Figure 2.

2.2 Collection of flowers:

Ayodhya is recognized as a major pilgrim place, attracting a great number of devotees from all around the country. The increase in the number of visitors contributes to the generation of enormous flower waste. The majorly offered flowers in temples are marigold, rose, jasmine, hibiscus, etc. along with some leafy and edible and non-edible fruits. Marigold is offered in tremendous amounts in almost all the temples. Every day these flowers offered in temples are left idle and therefore, become a problem for waste management. The floral waste is directly disposed into the ponds & rivers, etc. which has an adverse impact on the water quality, as well the aquatic organisms.

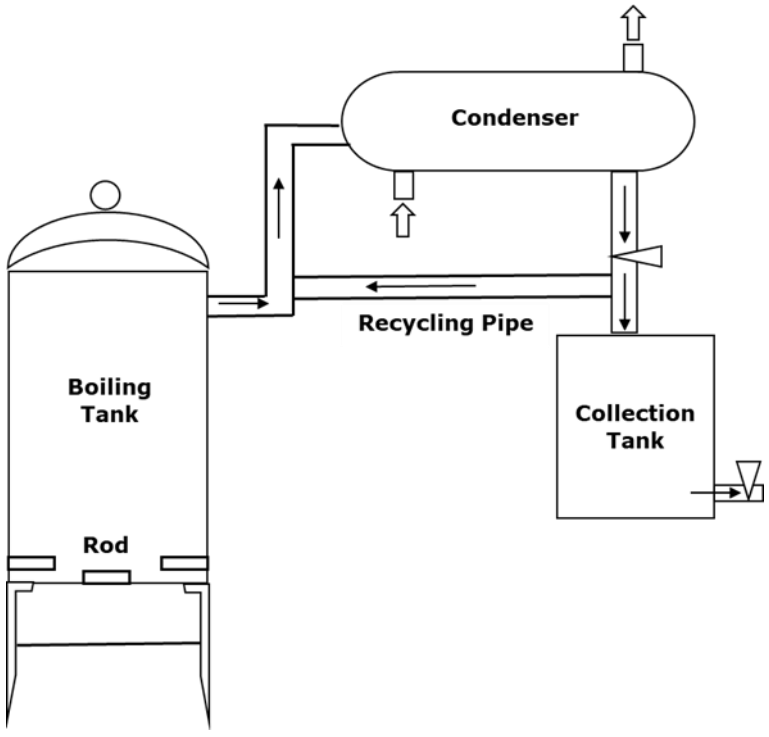

FIGURE 2: Steam Distillation Unit

The flower waste was collected from major temples such as Hauman Gadhi, Naka, Hanuman Gadhi Ayodhya, Saryu Mata Mandir, Chireshwar Nath Mandir. The flowers from different temples were collected with the help of trucks of Nagar Nigam, Ayodhya and unloaded at the segregation point near the pilot plant. After the collection of flowers, non-biodegradable part like plastic, and coconut shell was removed by hand sorting and only good quality flowers are segregated. The degraded flowers are disposed of in nearby composting pits for further degradation by microorganisms to produce compost.

2.3 Distillation:

The distillation starts with the loading of segregated flowers into the cooking tank. The tank is filled with water as per the standard ratio of flower and water. As the machine is turned on the immersion rod fitted in the cooking tank starts heating the water leading to boiling and ultimately vaporization. It is well known that under high temperature and pressure the flavonoids and secondary metabolites of the flowers come out. In the next step of distillation, as the vaporization starts the vapors are directed to the condenser unit. In this part, the volatiles get condensed and collected to the collecting tank with the help of interconnected pipes. By this, the final product is collected as flowery water.

FIGURE 3: Transportation vehicle and segregation of flowers.

2.4 Oil extraction:

The steam distillation unit ends with the production of flowery water. This flowery water is again repeated for the extraction of essential oil from it. For this process, we filled 500 ml of separating funnel with the freshly made essence from the plants, and put it stable for 24 to 48 hours, within this duration the oil from the essence separates easily forming a top dense layer in the separating funnel. The water and essential oil were collected separately. After separating the oil part from the essence, we used the centrifugation process (4000 RPM for 10 minutes) for further refining of the oil. After the essential oil was extracted, we performed an HPLC analysis of the oil to know about the secondary metabolites and phenolic compounds.

III. RESULT AND DISCUSSION:

3.1 Essence Estimation:

HPLC analysis was performed in the extracted oil of flowers. To identify and quantify the secondary metabolites and phenolic compounds present in it. (TABLE 1)

TABLE 1
THE IDENTIFICATION OF PHENOLIC COMPOUND(S)

Wavelength	Compound	Standard RT (min)	Sample RT (min)
280 nm	Gallic acid	6.68	7.12
	Catechin	12.51	Not found
	Syringic acid	20.57	20.61
	Cinnamic acid	24.37	24.25
3030 nm	Resveratrol	22.82	22.87
330 nm	Chlorogenic Acid	15.46	Not found
	Ferulic acid	20.30	Not found
	Caffeic acid	22.37	22.34
360 nm	Rutin	22.51	22.45
	Quercitin	23.76	23.71

After the essential oil was extracted, we performed HPLC analysis of the oil to know about the secondary metabolites and phenolic compounds present in it, the qualitative determination of the chemical compounds analysed was accomplished by the comparison of the retention times (RT) of the phenolic compounds determined in the standard mixture chromatogram to the compounds found in the sample chromatogram at each compounds' specific wavelength. The wavelength used for identification for cinnamic acid, syringic acid and gallic acid were 280 nm, 303 nm for resveratrol and 330 nm for caffeic acid, ferulic acid and chlorogenic acid and 360 nm for the detection of quercetin and rutin. Thus, several compounds, like quercetin, chlorogenic acid, caffeic acid were not detected.

IV. CONCLUSION

Improper management and dumping of flowers change the soil, water, and air quality of the environment of the temple of Ayodhya. This study proposes an alternative approach for the waste management since the waste could be used as a resource for manufacturing useful products. It would further help temples in generating additional revenues. Floral waste utilization would eventually be beneficial to society as individuals would get to live in a cleaner and healthier environment.

Earlier the flowers gathered at the temples of Ayodhya, were directly disposed of in River Saryu or nearby open areas thereby causing water pollution. Diverting temple flowers to the pilot project for the extraction of flowery water and essential oil is ultimately reducing water pollution load of the river Saryu. This pilot project converts the flower waste into different useful products. The primary product we obtained from our distillation plant is the essence of the flower named PUSHPSAR and secondarily we extracted Essential oil. The remaining is being converted into biofertilizer, so these three products are being formed at the present time. The essential oil and the flowery water are of great economic value. The main objective of this pilot project is to develop the skills of temple flower management and earn money form this waste as well as generating empowerment for the youth.

Hence awareness campaign is being created among the pilgrims, authorities of temple, and municipality to adopt this practice to have a clean and healthy environment and financial independence. The generated floral waste can used for making natural colors, rose water, essence, natural dyes, incense sticks, handmade papermaking too. This will help in reducing the problem of the overburdened waste disposal. The eco-friendly (“green temple concept”) can prove to be helpful in Government policy formulation for waste management and in promoting a sustainable development approach toward temples.

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