Water Air Soil Pollut (2024) 235:605
https://doi.org/10.1007/s11270-024-07403-y

An Overview on Floral Waste Management, Conversion to Value-Added Products and its Effects on Environment

Anjana Goel · Sunanda Kulshrestha

Received: 16 March 2024 / Accepted: 29 July 2024 / Published online: 13 August 2024

Abstract India is a religious nation that is comprised of numerous temples in each of its states. These temples are able to attract powerful and heavenly vibrations from the surrounding environment having vibrant religions and occasion which accounts for large quantity of floral waste production. This makes disposal and management of floral waste, a tedious affair to deal for the regulatory authorities while managing them in a sustainable way. It has been estimated that total of ~5billion tons of floral waste from different sources, primary being the temples, are reported from different parts of country which surges at times of festivals. This in turn accounts for various types of pollutions. The flowers are used single time and then discarded. These unused flowers if not disposed properly, ends up into inappropriate places including water bodies and landfills and causes pollution. Once the flowers start decaying, they get converted into solid waste, and then comes the question of solid waste management on board. To this day, there is no strategic monitoring system in place, nor is there any awareness among the general public regarding the proper disposal of garbage and the numerous opportunities for its reuse. To make a better use of this valuable waste, many people have derived methods using traditional approaches which leads to conversion of this waste into useful products that adds to their value is including making of dyes, Holi colors, scents, etc. apart from this, on scientific front, production of platform molecules depicting a bioactivity, etc. has also been carried out. The idea is been preached and practiced by many organizations and should be propagated for the creating a sustainable environment and a great socio-economic culture as well. The paper aims to curate the important and trending approaches towards creating biomass volarisation of the floral waste.

Keywords Biomass · Flowers · Platform molecules · Solid waste management · Value-added products

A. Goel (✉) · S. Kulshrestha
Department of Biotechnology, GLA University, 17 Km stone, NH-2 Mathura-Delhi Highway, Chaumuhan, Mathura, UP 281406, India
e-mail: anjanagoel2000@gmail.com; anjana.goel@gla.ac.in

1 Introduction

The world has been dealing with issues related to pollution and its effects on the environment. Amongst them one is the improper waste disposal and management of solid waste. This is a major challenge to sustainable development. Improper disposal of waste leads to health hazards for living beings as it worsens the quality of the environment (Adhikary & Vishwavidyalaya, 2020). One of the major causes of such solid waste includes organic waste such as flowers, leaves and coconut shells from the temples (Kohli & Hussain, 2016; Swapna & Lakshmi, 2020).

Flowers are offered on different occasions from any happy moment to even a corpse and especially in a religious country like India. Flowers are also been offered in all kinds of religious practices and to the deities too (Chauhan et al., 2022). The idols are adorned in beautiful flowers enhancing the beauty and ethnicity, they are also used for decorations, other natural products like coconuts are also offered. In a country like India where flowers are been used on occasions including celebrations, marriages, prayers, decoration, and even for cremation ceremonies. Managing this kind of waste is an issue to deal with. The flowers have been dumped in tons all over the country per day from religious sites including temples, mosques, dargahs, etc. (Bhati et al., 2021; Sharma, Mahato, et al., 2017; Sharma, Varma, et al., 2017). In major religious cities like Varanasi, Mathura, Chitrkoot, Madurai, it is estimated that around 5 tons of floral waste is being produced in a year and dumped into nearby lands and water bodies including Ganges, Yamuna etc (Srivastava, 2021).

There are currently 2785,000 metric tonnes of flowers produced in India. From 2019 to 2024, the floriculture market is projected to grow at a CAGR of 20.1% (Sharma, 2021). This leads to foul smell, accumulation of waste in the water body, increase of BOD and release of fertilizers used in flowers in the water bodies, making the quality degrade and the water toxic for consumption or any other use (Waghmode et al., 2018). It is estimated in latest scores by Atal, 2022 that after a single use, a variety of religious and social programmes in India generate around 4.74 x 106 tonnes of floral waste every single day (Atal, 2022).

Such floral waste is eventually been discarded with the municipal waste and it get wilted at a much faster pace and produce foul smell (Reddy & Sirisha, 2024). The improper disposal of these waste flowers due to lack of strict laws plays and proper segregation into biodegradable and non-biodegradable acts as a trigger for other pollutions as well (Sharma et al., 2019). The waste dumped in open areas turn out to become a breeding ground for several insects and produce foul smell which degrades the aesthetic value of the place and is very unpleasant for the eyes (Jadhav et al., 2013). Apart from this, the floral waste dumped in landfills along with the municipal waste increase the amount of leachate which can percolate into the surrounding groundwater and cause pollution of drinking water (Ferronato & Torretta, 2019; Sharma, Mahato, et al., 2017; Sharma, Varma, et al., 2017). The leachate is supposed to end up in the leachate management system which includes Bioreactors, phytoremediation, and other biological treatments; physicochemical techniques, adsorption, advanced oxidation, flocculation, and membrane filtration are some examples of the latter (Kumar, Saurabh, et al., 2021; Kumar, Singh, & Chandra, 2021; Kumar, Ved, et al., 2021). But despite of efforts by the local government, it still becomes a challenge to deal with the leachate issue from all sorts of waste including the floral waste.

The flower waste in such a huge amount dumped every day, is an issue to be highlighted as it has many other potentials to be explored rather than just being dumped and let it get rotten and produce pollution. The flowers are very valuable part of plants and holds many properties in them including medicinal properties, contains high sugar, have aesthetic value, fragrance, etc which could be utilized in production of high-end molecules and other value-added products including dyes, compost, perfumes, rosewater, incense sticks, etc. Many researchers are also coming up with new and innovative ideas like production of media of general microbe culture (Srivastav & Kumar, 2021; Chauhan et al., 2024). It is estimated that over 11,060 MT of floral waste has been Flowercycled® giving employment to over 73 manual scavengers, 1260 females, 365 families and leading to saving 110MT of pesticides to get dumped in water bodies (Data produced by Phool.co) These quoted examples of help to better understand and lead to proper utilization of the waste leading to its sustainable management as well. A pictorial representation of various kinds of uses from floral waste has been shown in figure no. 1. Apart from these, as far as the goal of SDG suggested by UNSDG, 2015, is concerned, 12 goals are expected to be achieved with the floral waste management and contribute to global targets as shown in Fig. 1. The review gives a wider picture of all the trends that have been followed and are used in current for proper management of floral waste and how it can be utilized along with sustainable waste management while discussing about the socio-economic importance with generation of employment opportunities. A systematic way in which floral waste can be converted in to valuable products is shown in Fig. 2.

Fig. 1 The SDG goals achieved by floral waste management

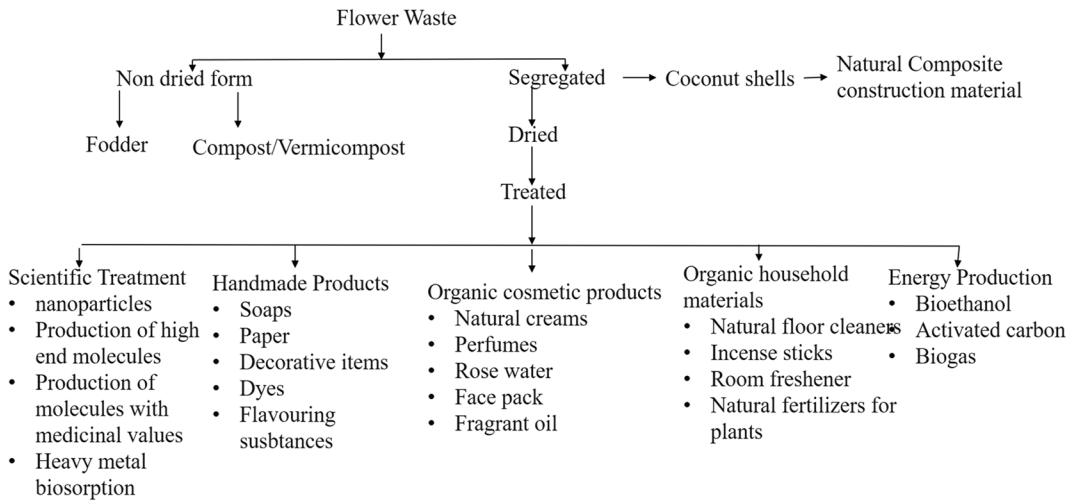

Fig. 2 Schematic presentation of floral waste processing and management to produce different types of utility materials

2 A Systematic Analysis of the Present Literature Available

The review is the practices been reported in literature till date by different workers in the field of floral waste management by using latest technology and production of platform molecules and products which will utilize the floral waste and add a value to the waste. The whole review was planned in sequential steps including collection of literature and critical analysis of the available data. The terms used for searching relevant papers included 'Floral waste', 'Floral Waste management', 'Floral Waste Utilization', 'Floral waste production' etc. After all the collection of papers, the focus was given on the application part and use of floral waste in field

of agriculture, biosorption studied, composting, cosmetics, food industry, etc, apart from this other search words included 'Biofuel', 'Dye', 'Vermicompost', 'Biofuel', 'Sugar from flowers' etc. All the data has been retrieved from relevant databases and search engines including 'Google Scholar', 'Pubmed', 'Science Direct', 'SCOPUS' and high impact journals from "Elsevier', 'Taylor and Francis', "Springer' etc. After the collection part for writing the present review paper, paper from 2010 till date were considered and only few classical examples were quoted as reference.

Papers were checked and marked as most appropriate and tried to include studies and genuine scientific data after study of some selected papers according to PRISMA analysis and suggested by Page et al., 2021 as given in Fig. 3.

3 Floral Wastes Disposal and its Impact on the Environment

Floral waste is mostly dumped in unsegregated form along with the municipal waste as mentioned above

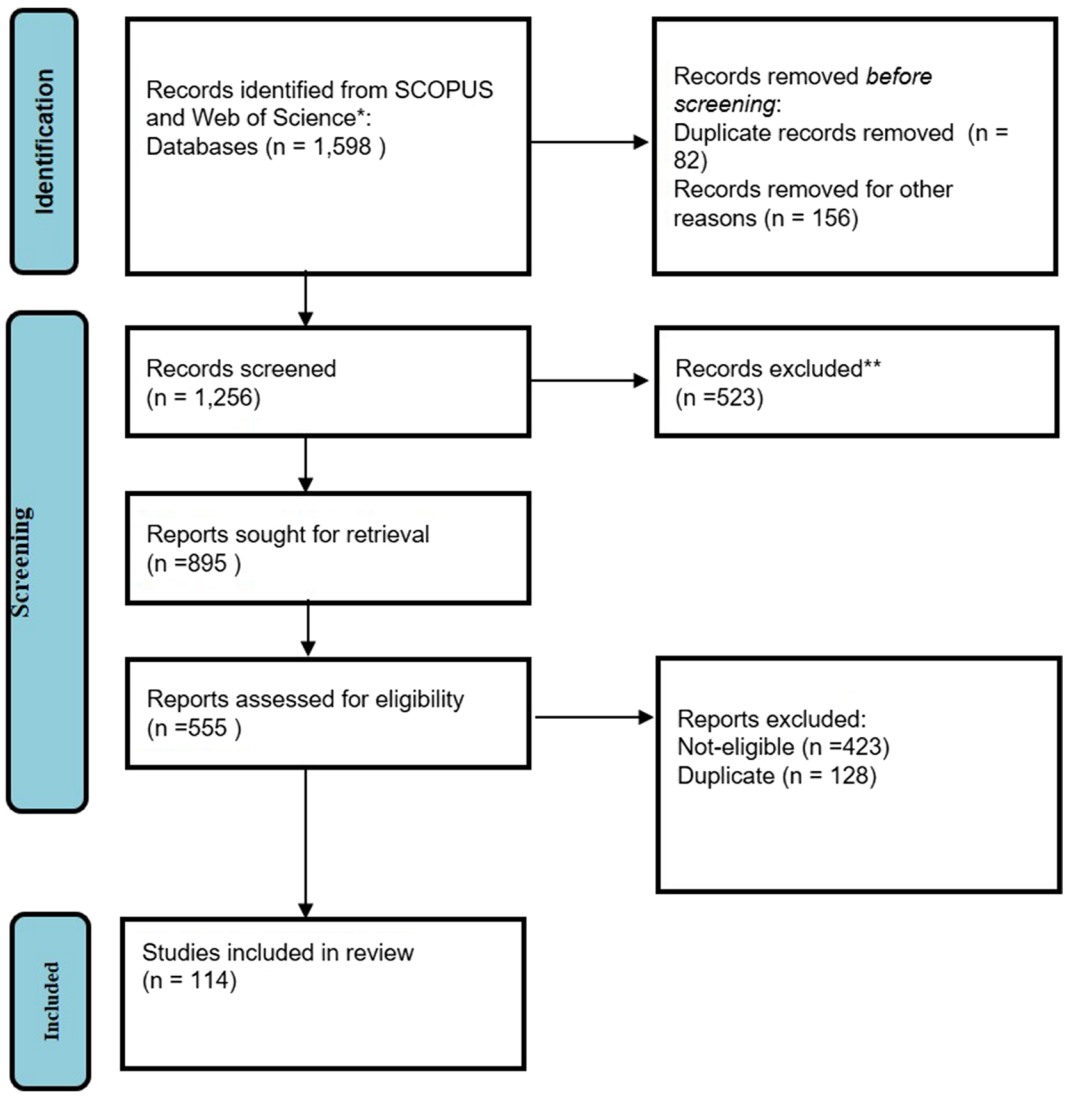

Fig. 3 PRISMA analysis of trends in floral waste management across search databases (SCOPUS and Web of Science)

and quoted by authors with same point of view including Pujara et al., 2019; Srivastav and Kumar, 2021; Dutta & Kumar, 2022. Proper waste disposal is the need which is to be checked to avoid any kind of pollution arising just due to lack of proper knowledge and stringent laws by the acting authorities. The types of pollutions are been depicted in Fig. 4. The dried and rotted blossoms are waste material and consequently, unloaded in landfills, different water bodies, and so forth.

According to the Horticulture—Statistical Year Book India 2016 (the country with the biggest land area under floriculture), India produced 477 lakh cut flowers and around 1641 t of loose flowers in 2014–15. Because of infrastructure issues, such as a lack of cold storage, forty percent of flower production in developing nations goes to waste. This includes Sri Lanka and India (Masure & Patil, 2014; Dutta and Kumar, 2022). Such accumulation of wastes leads to issues like eel and worm improvement, water and land contamination and foul smell. The flower squander produced gives a dingy look to the roads and streets and mutilates the picture of ghats along the waterways. They also release chemicals used in farming in water bodies making it unfit for utilization. The flowers as a pollutant are serious thereat for the quality and recreationalist of water bodies and soil (Singh et al., 2018). These could be utilized in a better way as shown in Fig. 5 which not only will help in sinking pollution caused by flowers but also help in producing economic and monetary benefit from them.

4 Socio-Economic Impact of Floral Waste Management

The use of circular methods within environmental management is gaining recognition all over the world as a result of the rapid depletion of resources and the harmful consequences of climate change. Under the canopy of a CE strategy, the integration of waste management and recycling policies would provide further impetus to the achievement of circularity and sustainable development within the Indian economy, which would be necessary for the successful management of floral waste (Priyadarshini & Abhilash, 2020). The socio-economic importance of floral waste management for a country like Indian is shown in Fig. 6.

5 Composition of Floral Waste

The composition of floral waste has been adapted from paper by Jain, 2016 and reviewed by Dutta & Kumar, 2022 as per shown in Table 1.

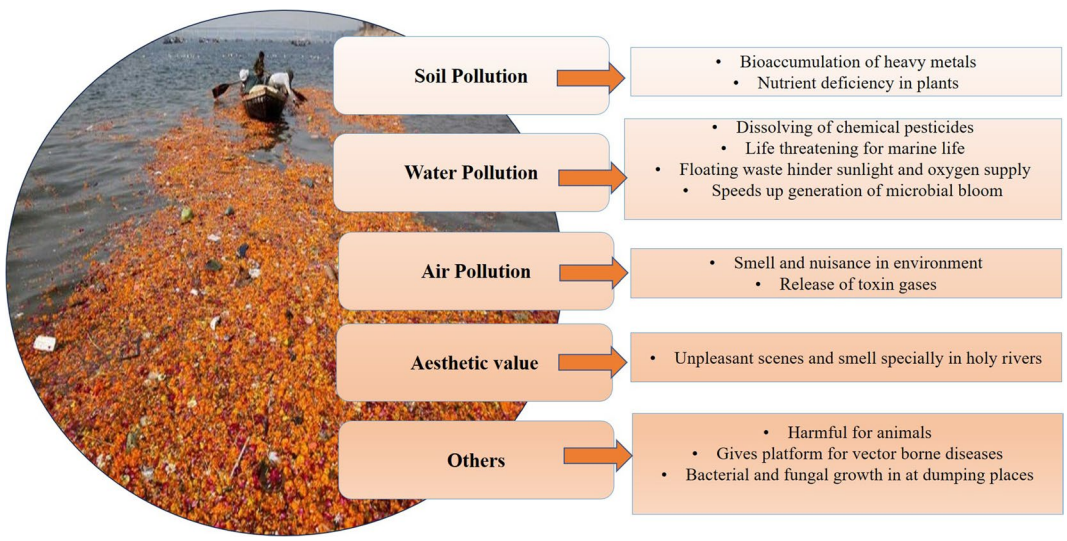

Fig. 4 Different types of pollutions lead by floral waste and its consequences

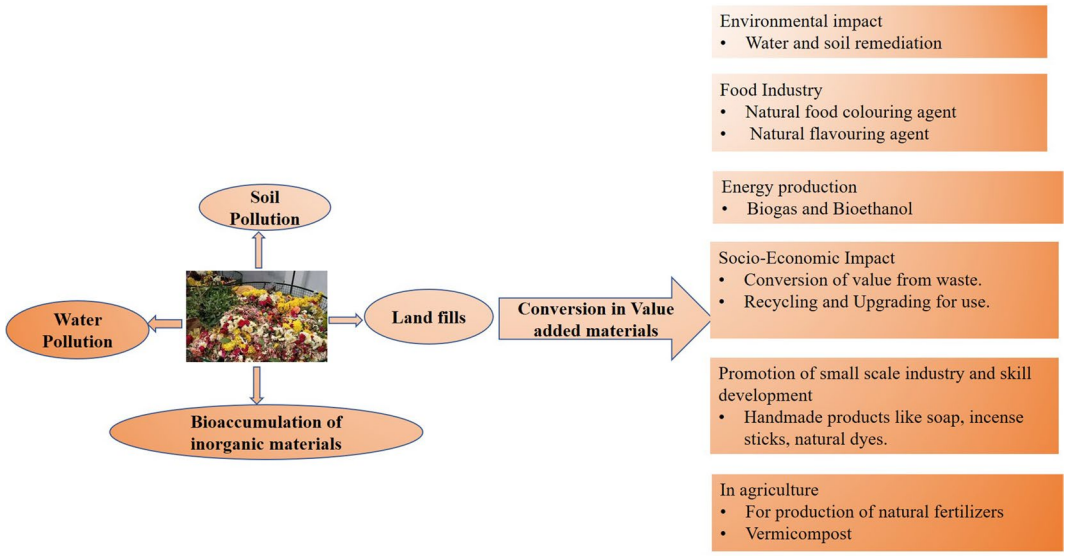

Fig. 5 Schematic representation of effective floral waste management for its conversion in value added products

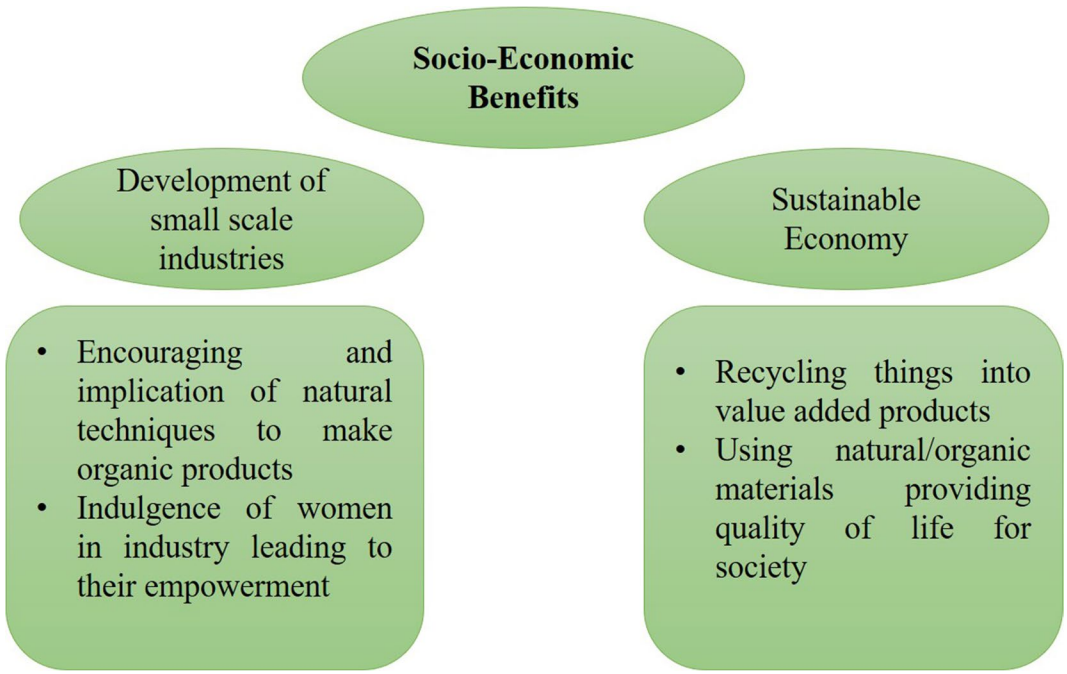

Fig. 6 Socio-economic impact of floral waste management

6 Methods to Utilize Floral Waste and Convert into Value-Added Products

6.1 Preparation of Compost for Agricultural Uses

6.1.1 Compost

Compost is rich in nitrogen, calcium, potassium etc. and in micronutrients including zinc, copper,

Table 1 Composition of floral waste

Property	Range in	References
pH	4.92-5.18 %	Tosun et al., 2004; Sharma and Yadav (2018)
Moisture content	70-80 %	Singh and Bajpai (2012), Kulkarni and Ghanegaonkar (2019)
Total solids	20-25 %	Kulkarni and Ghanegaonkar (2019), Ji et al. (2016)
Volatile solids	70-80%	Singh and Bajpai (2012)
Organic carbon	40.1-48.32%	Kulkarni and Ghanegaonkar (2019), Sharma and Yadav (2018)
Soluble carbohydrate	(mg/g) 212.5	Kulkarni and Ghanegaonkar (2019)
Crude protein	(g/100g) 6.05	Swain et al. (2007)
Mg	(g/kg) 2.25	Sharma and Yadav (2018)
Crude fiber	(g/100g) 10.8e15.3	Swain et al. (2007),
Total carbohydrate	(mg/g-VS) 555.5	Dutta and Kumar, 2022
Total Nitrogen	1.4e2.32%	Sharma and Yadav (2017), Kulkarni and Ghanegaonkar (2019)
Na	(g/kg) 0.85	Sharma and Yadav (2018)
Fe	(g/kg) 1.76	Sharma and Yadav (2018)
Mn	(g/kg) 98	Sharma and Yadav (2018)
Zn	(g/kg) 129	Sharma and Yadav (2018)
C/N ratio	20.7-33.47	Kulkarni and Ghanegaonkar (2019), Sharma and Yadav (2017)
Total phosphorous	(g/kg) 3.18	Sharma and Yadav (2017)
K	(g/kg) 17.3	Sharma and Yadav (2018)
Ca	(g/kg) 6.43	Sharma and Yadav (2018)
Cu	(g/kg) 36.17	Sharma and Yadav (2018)

magnesium, etc., these properties mark its great use as a biofertilizer (Sharma, Mahato, et al., 2017; Sharma, Varma, et al., 2017). There are many methods as suggested by researchers for preparation of compost including rotary drum, aeration method and pile method (aerated pile, agitated pile, etc.). Amongst them, the rotary drum method is the most feasible to use and could be set up in small areas too. The method could be implemented by temples and places which produce high floral waste and for production of compost (Sharma et al., 2018a). Similarly, Sharma et al., 2018b in their paper advocated for the floral waste compost using agitated pile method which yielded optimum nutrient concentration for plants which included use of cow dung, saw dust, floral waste in the desired amount which resulted in compost with 14 Carbon to Nitrogen ratio, 7.1 pH, about 32.98% 291 total organic carbon and electrical conductivity of 3.31 µS/cm (Sharma et al., 2018b). After this, same authors have made the use of rotatory drum technique for composting of floral waste along with sawdust, wheat bran and cow dung which resulted in superior quality of compost with germination index of 98% which better crop production as well (Sharma & Yadav, 2018).

6.1.2 Vermicomposting

Vermicomposting is a pool of macro and micronutrients, microbes, plant growth hormones, enzymes (Kashyap et al., 2023; Singh et al., 2013). It also holds nutrients and microflora for extended periods (Ndegwa & Thompson, 2001). Vermicomposting is proposed to deal with temple waste which mainly has *Aegle marmelos* leaves, *Datura stramonium* and *Hibiscus rosasinensis*, *Tagetes, Rosa indica* flowers. The mixture is prepared from the effluent from biogas digester which consists of waste and cattle dung and subjected to partial decomposition for 30 days at 30^0c. It should be enough to fill 2 kg capacity plastic tubs and then is subjected to *Eudrilus eugeniae* earthworm species. 25^0C temperature, pH 8.0, 1-2mm particle size and 80% moisture content were found to be optimum for vermicomposting. The vermicompost obtained by the method used was having rich percent of carbon, nitrogen, phosphorus and potassium content (Gurav & Pathade, 2011). The

composition of vermicompost from floral waste was found to be black in color as compared to normal soil with 22.8% moisture, 0.89 g/cm3 density, 7 pH and 19.4 % of organic carbon content as per the experiment by Jain, 2016 (adapted from Jain, 2016).

It is reported that the rate of growth of plants grown with vermicompost made from temple waste was more as compared to the respective control. In studies, nutrient status and microbiological activity of prepared vermicompost from flowers was found to be better than the contemporary one as it contains enzymes that stimulates plant growth and checks plant pathogens leading to good yield. Thus, vermicomposting of temple flower waste is a ecofriendly method to urge valuable products which can cause a healthier and waste-free environment. Other authors including Gurav & Pathade, 2011; Singh et al., 2011; Jadhav et al., 2013; Panday et al., 2014; Kohli & Hussain, 2016 Sharma, 2021 have also demonstrated vermicomposting of waste flowers in their papers.

The floral vermicompost that was prepared for the study had a dark black granular appearance, which indicated that the decomposition of flower waste had been successfully accomplished. This was due to the fact that earthworms consume the organic matter that is found in floral waste very quickly and then fragment it into finer particles by passing it through a grinding gizzard (Singh et al., 2013). They obtain their sustenance from the microorganisms that expand upon the wastes, and at the same time, they encourage additional microbial activity in the wastes. Additionally, there was no offensive odour during the process of compost formation due to the oxygen-rich haemoglobin circulation that occurred through the skin of the earthworms. Earthworms release an adequate amount of oxygen, which allows them to oxidise chemicals that produce a foul odour, such as H_2S, mercaptans, skatol, and others. A high bulk density was seen in the study as a result of an increase in porosity, which further enhanced the availability of nutrients for the growth of the crop during the study. mainly due to the fact that during this process, the essential plant nutrients that are contained in the wastes, in particular nitrogen, phosphorus, potassium, magnesium, sulphur, and calcium, are liberated and transformed by the action of microorganisms into forms that are significantly more soluble and accessible to plants than those that are present in the parent compounds. Despite the fact that the moisture content was variable, it was kept at between sixty and seventy percent by spraying water. In a similar manner, the temperature was kept below 35 degrees because the earthworms can be killed by temperatures that are higher than this, even for brief periods of time, and in order to prevent the earthworms from being overheated, careful management of the wastes was carried out. It was found that the pH of each of the four beds dropped from 7.9 to 6.9, which is equivalent to going from an alkaline state to a nearly neutral state. The volatilization of ammonical nitrogen and H+ that was produced as a result of the microbial nitrification process carried out by bacteria that nitrate could have been the source of this phenomenon. One possible explanation for the rise in EC is that it was caused by the discharge of various mineral salts in their accessible forms. It is possible that the decrease in EC was caused by the fact that the accessible salts were transformed into insoluble salts as the composting process continued to develop (jain, 2016)

6.2 Production of Energy

6.2.1 Biofuel, Bioethanol (fermentation), Biogas Production

Because of the severe energy crisis in today's world, ethanol is taken into account as best suited energy source amongst different fuels and is a competitive substitute for gasoline. For this, microbes are used to convert sugar into ethyl alcohol. From the normal and historical evidence, it's been reported that, in India, various parts of some states including Maharashtra, Andhra Pradesh, Chhattisgarh some tribals are occupied in the cultivation of mahua flowers (*Madhuca latifolia*) 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 (Abhyankar & Narayana, 1942; Benerji et al., 2010). Swain et al., 2007 has also reported use of immobilized yeast *Saccharomyces cerevisiae* for the fermentation of mahua flowers.

A study by Khammee et al., 2021 gave evidence of used and trash jasmine flower containing a lot of organic carbohydrate and acids, making it a good bioethanol substrate. This study estimated the potential of waste jasmine flower biomass pretreated with alkaline and thermal pretreatment on

samples for bioethanol production. Thus, pretreatment and enzymatic hydrolysis break the complex cell wall layer to increase polysaccharide fraction accessibility. Applying response surface technique methods to fermentative bioethanol production to analyse bioprocess variable interactions for higher bioethanol yield in batch small- and large-scale models is also covered. Immobilised yeast between jasmine utilised 50% sugar. Ethanol production from jasmine flowers was 6.54 g/L and 31.40 g/L following distillation at pH 4.5. Bioethanol production from waste jasmine flower was accomplished using immobilised yeast (Khammee et al., 2021).

Biogas is a mixture of gases including methane, carbon dioxide and other gases (40-70 vol.%, 30-60 vol.%, 1-5 vol.% respectively) including, hydrogen 0-1 vol.% and hydrogen sulphide 0-3 vol.% (Rani et al, 2020a). It originates from bacteria under anaerobic condition which turn the waste into biogas after the process of bio-degradation. Flowers from temples and other sources could be an excellent feedstock for biogas production (Tiwari & Juneja, 2016). Kumar & Swapnavahini, 2012 reported the production of biogas from rose flowers by anaerobic digestion in a batch reactor. The biogas from floral waste is often used for electricity generation and as a fuel. Studies by Quevedo-hidalgo et al., 2013 reported the ethanol production of 7.6 ± 0.24 g/l after 10 h using *Saccharomyces cerevisiae* and activity on *Chrysanthemum* waste.

Similarily, studies by Kumar, Kumari, & Kumar, 2020; Kumar, Singh, & Kumar, 2020, reported the production of biohydrogen using *Clostridium*, *Citrobacter* and *Enterobacter* using waste Table 2.

6.2.2 *Generation of Activated Carbon*

The method includes use of chipped-off blossoms to change them into activated carbon by the two cycles including direct pyrolysis with sulfuric corrosive and substance enactment with phosphoric corrosive. It is subjected to different physicochemical boundaries like pH, conductivity, moistness, debris content, and so on. The outcomes shows that the most productive and most affordable strategy for enactment was discovered to be the immediate pyrolysis measure and presumed that actuated carbon arranged from blossoms can be utilized as a compelling adsorbent by direct pyrolysis measure. Hence, it can be applied by adsorption technique to eliminate coloration and treat wastewater (Elango & Govindasamy, 2018). One more study came up claming the removal of commercial dyes was reported by Jagadeesh Babu et al., 2010 using activated charcoal made from male *Borassus flabellofer* flower and experimented of green malachite dye removal.

6.2.3 *Polyhydroxybutyrate-co-hydroxyvalerate Production*

Sugars, including sucrose and glucose, are the most widely recognized carbon sources utilized for polyhydroxybutyrate-co-hydroxyvalerate creation. Piece of the carbon substrate for maturation and use of bacterial strain could control the copolymer creation where substrate addresses almost 40% of all-out cost. Along these lines, as a substitute to this, mahua bloom is utilized for polyhydroxybutyrate-cohydroxyvalerate creation which is a modest carbon source. Study on

Table 2 Biogas produced/kg from some of the flowers contributing in floral waste

Name of plant	Part used	Biogas production/ kg	References
African wattle	Flower	10.92	Bennurmath et al., 2021
Roselle	Flower	5.18	Kulkarni & Ghanegaonkar, 2019.
Nile tulip flower	Flower	5.38	Kumar, Kumari, & Kumar, 2020; Kumar, Singh, & Kumar, 2020
Silk tree mimosa	Flower	23.73	Devi et al., 2022
Sunset flower	Flower	2.73	Kulkarni & Ghanegaonkar, 2019.
Jasmine	Flower	6.07	Khammee et al., 2021

bacterial blend of poly (hydroxybutyrate-co-hydroxyvalerate) utilizing sugar rich mahua (*Madhuca* sp.) blossoms. In this, mahua bloom is discovered to be less expensive carbon substrate and can be utilized for the creation of polyhydroxyalkonate (Mishra & Poonia, 2019).

6.3 In Biosorption Studies

Flowers can likewise be utilized for biosorption as dormant microbial biomass, a technique to tie and absorb hefty metals even from extremely weakened fluid arrangements. This will lead to environmental rehabilitation, aiding the wastewater and other modern effluents treatment and, in this manner, help to relieve contamination (Waghmode et al., 2018). Echavarria-Alvarez & Hormaza-Anaguano, 2014 utilized rose and daisy for the evacuation of Acid Blue 9 (AB9) as a potential option and minimal expense adsorbent by a group cycle. (Bhatti et al., 2009) concentrated on a blossom called rosagruss a teplitz (Red Rose) to eliminate hefty metals like Pb(II) and Co(II) from watery arrangements and the impact of different cycle boundaries on the biosorption capability of waste biomass were considered. The outcomes shows that the greatest biosorption of Pb(II) was found at pH 5 and Co(II) at pH 7. Similar studies have been reported by Biswas et al., 2021, using petals from *Shorea robusta* for fluoride removal present in groundwater from Indian state of West Bengal. The fluoride removal efficacy of 80.4% with an absorption of 5.465mg/g has been determined in the study. Durairaj et al., 2019 studied of bio absorption of turquoise blue and reactive re-HE7B dyes from aqueous solutions using *Nerium oleander* flowers. Other sources of floral waste including agricultural waste from sunflowers, saffron, etc can also be used for bioabsorbent studies of heavy metals, waste generated from rose oil processing unit can be used to for bioabsorption of radioactive thallium (Ti-201) with high absorption rate as per reported by Yapici and Eroglu, 2013. Table 3. clubs the related studies of bio absorbents as per reported by different researchers.

6.4 Biosurfactant Production

The biosurfactants have robust antifungal, antivirus, antibacterial activity and additionally play the function of anti-adhesive agents to pathogens making them beneficial for treating many sicknesses in

Table 3 Biosorption studies reported from floral waste

S.No	Flowers used	Targeted pollutant	Maximum adsorption capacity (mg/g)	Maximum removal efficiency (%)	References
1.	*Chrysanthemum indicum*	Co(II)	45.44	96.12	Vilvanathan and Shanthakumar (2015)
2.	*Saffron*	Pb	45.62		Khoshsang and Ghaffarinejad (2018)
3.	*Sunflower*	Cr(VI)	56.49	85.4	Jain et al. (2009)
4.	*Sunflower*	Cr(VI	7.2	90.8	Jain et al. (2016)
5.	*Alstonia scholaris*	Cr(VI)	4.4	94	Sharma and Kothiyal (2013)
6.	*Borassus aethiopum*	Cr(III	6.24	82.7	Elangovan et al. (2008)
7.	*Borassus aethiopum*	Cr(VI)	7.13	99.2	Elangovan et al. (2008)
8.	*Hibiscus rosa sinensis*	Cd2	103.093	67.82	Vankar (2009)
9.	*Hibiscus rosa sinensis*	Pb2þ	90.909	85.12	Vankar (2009)
10.	*Hibiscus rosa sinensis*	Zn	94.339	88.88	Vankar (2009)
11.	*Hibiscus rosa sinensis*	Cr(VI)		e 59.92	Vankar (2009)
12.	*Canna indica*	Cr(VI)	e 3.61		Vankar (2009)
13.	*Rosa centifolia*	Pb(II)	156 e		Javed et al. (2007)
14.	*Rosa centifolia*	Co(II)	27.15 e		Javed et al. (2007)
15.	*Hibiscus rosa sinensis*	As	1.938	96	Nigam et al. (2013)
16.	*Rosa rosa*	As	1.966	98	Nigam et al. (2013)
17.	*Tagetes erecta*	As, crystal violet	1.887, 1.95	90	Verma et al., 2022
18.	*Canna indica*	As	1.717	85	Nigam et al. (2013)
19.	*Mahua*				Tripathi et al., 2016

addition to their use as healing and probiotic agent. The manufacturing of surface-active compounds with the aid of using flower extract of *Madhuca latifolia* has been studied. The cell free supernatants of *Madhuca latifolia* flower extract medium with 20 micrograms per ml of anthracene decreased the surface tension to 35%. This confirms the use of *Madhuca latifolia* flowers may be a promising bioresource for the manufacturing of exopolysaccharides having surface lively properties (Waghmode et al., 2018).

6.5 Bio Insecticide Use

Insects and pests have always been notorious for causing damage to living things including crops and spreading of disease even in humans. They destroy crops, spread disease in the agricultural field which results in great loss for the farmers. The methods used for pest control in the field includes use of chemical pesticides which are harmful for longer use as they cause bioaccumulation and after a time, the insects and pests even go chemical resistant towards them and the synthetic ones become ineffective. In search for the better option for the control of such pests and other insects, natural sources having biocidal activity could be thought of. Amongst them, use of floral waste for production of such insecticides could be thought of and many researches have been reported that have such potential. One such study by Marotti et al., 2010, used extracts from *Tagetes* sp. which showed a great biocidal property due to presence of high amount of thiophene. The study further by Nikkon et al., 2009 showed the activity of such the *Tagetes* sp against *Tribolium castaneum* or the red bettle, responsible for damages in post-harvest crops. Other researchers also studied the biocidal activity of methanolic extract of *Chrysanthemum* flowers against *Tribolium confusum* which showed high insecticidal activity of 67% after 96hrs of consumption and topical application along with larvicidal property against *Spodoptera littoralis* (Haouas et al., 2010).

Other than application in field of agriculture, such techniques could also be applied on insects which act as vectors for diseases including malaria, dengue, yellow fever, etc. vector control is important for checking the spread of disease. For this, many flowers are found to be enriched in phytochemicals which have mosquitocidal properties. Hajra et al., demonstrated the activit of cadmium nanoparticle synthesized from petals of rose and marigold having 100% and 98.8% of mortality against *Aedes albinopictus* larvae after 72 hrs. Similarly, Kim et al., 2020, studied the larvicidal and mosquitocidal activity along with repellant and fumigant activity of *Magnolia kobus* flowers against Asian tiger mosquito (*Aedes albinopictus).* Presence of farnesense was accountable for the mosquitocidal activity of the flowers (Hajra et al., 2016).

6.6 Medicinal Value of Flowers

Flowers are also having medicinal values because of their metabolites present in them. The pool of phytochemicals present in the flowers and leaves that are been considered as the floral waste can be put to a better use. Examples includes, traditional uses Madhuca flowers utilized in the remedy of bronchitis and additionally to extend the milk production in feeding mothers (Khare et al., 2018). Rose oil is used frequently as a perfume aspect for pharmaceutical arrangements viz., ointments and creams and is significantly used as a fragrance ingredient in perfumes, lotions and soaps. Gulkand made from crushed rose petals is taken as a tonic and medicinal drug for diverse ailments (Waghmode et al., 2018). The solvent extraction of such floral waste after segregation using different extraction methods can help in exploring the medical activity. The Table 4 below depicted a detailed ethnomedicinal properties of the waste flowers.

6.7 In production Organic Acids, Dyes and Pigments

Using floral colors for dying is an old practice. Dutta & Kumar, 2022 have reported the use of marigold and rose as colors in Aurangabad and the practice has been used for ages. A similar report suggests the utilization of saffron bloom to extricate color for application on the Pashmina cloak. The flowers contain numerous pigments including crocin, lycopene, zigzantin, carotenoids, betalains and anthocyanins and so on (Grotewold, 2006). A large amount of waste from the temples could be used to make dyes and pigments by using suitable techniques. The most important feature of colors obtained from flowers is that they are Biodegradable, eco-accommodating and have no unfavorably susceptible activity on the skin.

Table 4 Medicinal importance and bioactivity possessed by flowers included commonly in floral waste

S.no	Botanical Name	Common name	Plant part as the floral waste	Medicinal properties	References
1.	*Piper betle*	Betel	leaves	Antimutagenic, antimicrobial	Gupta et al., 2023; Singh et al., 2023
2.	*Aegle marmelos*	Bael	leaves	Analgesic,anti-bacterial, antidiarrhoea	Sarkar et al., 2020
3.	*Saraca asoca*	Ashok	Leaves	Antioxidant. antifungal	Rasekar & Shahi, 2022
4.	*Musa acuminata*	Banana	leaves	Hepatoprotective, anti-ulcer	Kumar et al., 2023
5.	*Mangifera indica*	Mango	Leaves, Bark	Antidiabetic, anti-obesity,anti-inflammatory	Khumpook et al., 2019; Kumar et al., 2023;
6.	*Ocimum sanctum*	Tulsi		Immunomudulator, anti-cancer	Goel & Bhatia, 2022
7.	*Cocos nucifera*	Coconut	Shell, pulp	Antimicrobial	Mazaya et al., 2020
8.	*Nerium oleander*	Kaner		Antiparasitic, dermatologic effects	Bakir Çilesizoğlu et al., 2022
9.	*Cynodon dactylon*	Doob ghas	leaves	Antidiabetic, antimicrobial, antiviral	Ashokkumar et al., 2013
10.	*Tagetes erecta*	marigold	Flowers	Antioxidant, hepatoprotective activity, anti-inflammatory	Chitrakar et al., 2019; singh et al., 2020
11.	*Nelumbo nucifera*	Lotus	Flowers	Antiarrhythmic Antioxidant,antidiabetic	Lin et al., 2019; Paudel & Panth, 2015
12.	*Rosa damascena*	Rose	Flowers	psychological relaxation, analgesic and anti-anxiety	Mohebitabar et al., 2017
13.	*Nyctanthes arbor-tristis*	Harshingar	Flowers	Anti-inflammatory, anti-rheumatic	Wijayapala, 2013; Sharma et al., 2023
14.	*Hibiscus rosa sinensis*	Hibiscus	Flowers	antihypertensive, anti-dyslipidemic, hypoglycemic,	Missoum, 2018; Montalvo-González et al., 2022
15.	*Jasminum grandiflorum*	Jasmine	Flowers	Anti-fungal, anti-bacterial, anti-inflammatory, anti-cancerous,	Prakkash et al., 2019; Bharathi et al., 2020
16.	*Chrysanthemum indicum*	Chrysanthemum	Flowers	Anti-inflammatory, anti-bacterial, anti-cancerous, anti-oxidant,	Hodaei et al., 2021
17.	Lilium	Lily	Flowers	Anti-inflammatory, anti-tumor, hypoglycemic, antibacterial, antioxidant, and anti-depressant	Tang et al., 2021
18.	*Datura stramonium*	Dhatura	Fruit and flower	Anti-ulcer, anti-fungal, anti-bacterial, anti-inflammatory, anti-cancerous	Firdaus et al., 2020
19.	*Jasminum sambac*	Mogra		Flowers Anti-oxidant, anti-bacterial, skin lightening	Wu et al., 2021
20.	*Pandanus odoratissimus*	kewda	Flowers	antiallergy, antiplatelet, anti-inflammatory, anti-oxidant, and anticancer	Adkar & Bhaskar, 2014

Table 4 (continued)

S.no	Botanical Name	Common name	Plant part as the floral waste	Medicinal properties	References
21.	*Polianthes tuberosa*	Rajnigandha	Flowers	Anti-bacterial	Ghosh et al., 2014
22.	*Plumeria alba*	Frangipani	Flowers	Anti-bacterial, anti-oxidant	Sinaga & Jaya, 2022; Indrianingsih et al., 2023
23.	*Magnolia champaca*	champak	flowers	Anti-diabetic, anti-inflammatory, wound healing	Santhoshkumar & Shanmugam 2020; Hasan et al., 2020
24.	*Calotropis gigantea*	Madar	flowers	anti-inflammatory, anti-oxidant	Sivapalan et al., 2023
25.	*Butea monosperma*	Palash	flower	anti-inflammatory, wound healing, diarrhea, dyspepsia, flatulence, gonorrhea, and leprosy.	Mishra, 2013
26.	*Orchidaceae family*	Orchid	Flowers	Anti-microbial, anti-inflammatory, anti-tumour, anti-viral	Kotiloğlu et al., 2020
27.	Gomphrena globosa	globe amaranth		anti-inflammatory, ati-microbial, cytotoxic	Ningrum & Wijayanti, 2020

There is a report where patuletin color separated from marigold (*Tagetes erecta*) and French marigold (*Tagetes patula*) being utilized in material enterprises and in cell reinforcement treatment. Safflower colors viz. red (carthamin) also, yellow (carthamidin) are utilized as material for color (material shading) (Kulkarni et al., 2001). These shades are broadly utilized as stains, added substance in refreshments and beautifiers, printing, coloring, and as regular food colorant (Bennurmath et al., 2021). The carthamidin shade is utilized in readiness of ice creams and numerous other food items. African marigold (*Tagetes erecta* L.), a significant wellspring of carotenoids also, lutein, is developed as a cut blossom and a nursery bloom, in expansion to being developed for its restorative qualities. Marigold blossoms (*Tagetes*), which are yellow to orange red in shading, are a rich wellspring of lutein, a carotenoid shade. These days, lutein is utilized in the food business and material shading. There is a report on use of waste blossom *Tagetus erecta* for coloring of cotton, fleece and silk on the mechanical scale (Vankar, 2009).

The demand of such natural dyes has been increasing because they are non-toxic, eco-friendly and allergy-free. The natural dyes as an option for coloring clothes could be a game changer in the cloth industry and, especially in the place like Mathura, where most of the toxic dumps are from the saree printing and coloring industry flourishing in the city. The waste from this industry is dumped directly in the Yamuna River making it polluted and highly toxic, the use of natural dyes will help in overcoming the problem (Gupta et al., 2019).

Natural dyes from the flowers can easily be used to dye clothes as well as for mordanting which means fixing dye with fiber. The flowers are crushed and boiled in water where they drain their color and finally the cloth is dyed in the colored water. This is been followed by another process to fix the color (Rout & Jena, 2018).

6.8 In Food Industry

6.8.1 Food Products

The concentrate of Mahua blossoms is utilized in food ventures for making jams, jams, rolls and other food items due to its dietary parts. Also, nutrients, sugars, amino acids, natural acids, proteins viz., protease and other compounds (betaine, tannins and unrefined shades) and cancer preventive agents are also found in the same. (Bhattacharya et al., 2012. Marigold blossoms are the regular wellspring of xanthophylls and its concentrate is utilized as an added substance in numerous of food enterprises.

6.8.2 Sugar Syrup

Experiments have been carried out by many workers which lead to value addition to floral waste, one of them being noted of Trinh et al., 2018 who worked with flowers and reported on soluble sugars form the flowers. The team worked with camellia, rose and roselle flowers and found them to contain 40.5%, 24.3% and 11.5% soluble sugars and 66.0%, 58.7%and 40.3% of carbohydrates, respectively. The study concluded glucose to be the major sugar constituents with 24.7%, 30.8% and 20.0% in camellia, rose and roselle, respectively. There are covers planning of sugar syrup from dry mahua blossoms (Lungade & Karadbhajne, 2022). Similar study by Anil Kumar et al., 2007 on Mahua flowers reported high total sugar content of 45-48g/100g dry weight of the flower. The sugar syrup could be made after drying the floral waste and decolorizing after using agents like charcoal and then concentrated to form the sugar syrup.

6.9 Other Miscellaneous Uses

6.9.1 In the Production of Herbal Gulal

The utilization of flower pigments to make natural and allergy-free gulal colors used in Holi has been practiced by locals for many years. But adapting the idea at a commercial scale has been done by CSIR-NBRI, Lucknow. In the technology they have advocated the use of waste flowers from temples to make dry colors of gulal. This kind of gulal has commercial value in international and national markets and also has many benefits over synthetic dyes-based gulal including being environment friendly and allergy-free. The dry colors also have a cosmetic effect on the skin making it feel soft. The waste flowers from temples mainly consists of marigold, rose are rich in carotenoid- lutein and flavonoid- patulinin, which are rich colorants that have been isolated and used for dying as per the technology developed by CSIR-NBRI. It has been identified as social intervention and training has been given in the jail of Lucknow to extract dyes to make the gulal (https://www.csir.res.in/csirtechnologyshowcase/herbal-gulal-floral-temple-waste).

6.9.2 Handmade Paper

Paper is an essential piece of most parts of society; worldwide a sum of roughly 300 million tons of paper is delivered each day and 90% of this paper is created from developing mash wood. The creation of paper affects the environment and causes deforestation, water contamination from the inks and chemicals released from paper plants. The hand-tailored paper produced using bloom squander enjoys the benefit of being 100% wood free, it is liberated from all synthetic compounds and leaves no unsafe side-effects during the assembling which makes it the eco-accommodating type of paper around (Waghmode et al., 2018). Aside from being made of 100% reused squander, the actual paper is recyclable. Thus, the idea of lessening; reuse and reuse can be very much executed in carefully assembled paper making.

6.9.3 Herbal Products-Incense Sticks, Homemade soaps, Rose water

Burning incense sticks while praying has an adverse effect on the environment. Incense sticks are burnt at temples and families in the course of the spiritual festivals. Incense smoke (fumes) consists of particulate matter (PM), fueloline merchandise and lots of compounds. Methods were advanced to make natural incense sticks the usage of floral wastes. Flowers like Genda, are used to make incense sticks, whilst roses are transformed to rose water and also, rotten flower's petals may be assembled and used as natural homemade cleaning soap the usage of an appropriate cleaning soap substances along with sodium hydroxideorlyein crystal form (Sharma, Mahato, et al., 2017; Sharma, Varma, et al., 2017; Srivastava et al., 2023)

Chandrika Devi temple In Lucknow, a large number of flowers are offered to the deity every day. The women folk use this floral waste to form incense sticks and sell to the small shops withinside the village markets, which will become a supply of earnings for them (Waghmode et al., 2018)

In Shirdi, Maharashtra, approximately 2 million Tons of flower waste are treating each day to get 80 Kg of agarbatti and utilized in an equivalent premise of Shirdi Sansthan in Pooja to Shirdi Saibaba (CPHEEO, 2018).

Under a Project named Mission Sakshama initiated with the aid of using CSIR- CIMAP, Lucknow

aimed toward making use of waste flowers, the floral waste is transformed to Incense sticks. On a mean 1,500 agarbattis (incense) may be crafted from one kg raw material via this technology. Flowers like rose and marigold are used to make incense sticks. The approach has been mentioned below-

- Temple wastes are accrued in separate dustbins.
- The flowers are then segregated and got down to dry.
- The dried flowers are powdered and blended with binding powder and noticed dust.
- The charcoal is blended withinside the combination to make it combustible.
- Prepare distilled water and upload to incense combination slowly. The dough is Kneaded slowly.
- This combination is rolled over bamboo sticks to provide last product.

Binding substances used can also additionally be 'Gum Arabic' or 'Makko' (an incense powder fabric derived from tree bark (Rani et al., 2020b)

6.10 Utilization of Coconut Shells

Coconut is one of the commonly used offering in the temples and after doing away with its safe to eat portion, the shell normally ends up into the dustbins. These shells are dumped into water bodies or in open areas/locations thereby inflicting environmental issues. There is substantial scope of the usage of the coconut shell as a substitute material withinside the production industry. This can have double advantages of reducing the value of production material and fixing the disposal issue. Coconut shell may also be utilized to strengthened concrete production and its usage is price powerful and ecofriendly (Nagarajan et al., 2014).

6.11 Significance of Floral Waste in India

Floral waste management hold a significance in a developing country like India where their solid waste management is already an issue due to negligence and lack of proper disposal related laws and its impact of the environment. The Municipal Cooperation are responsible for dumping the waste in dump yards where segregation is totally ignored and a pile of mix waste is left for rottening in dumping yards outside the city. In such a scenario, proper floral waste management could help to segregate the organic waste from being decomposed naturally over a period of years and also to convert it into value added products. Some of the organizations, NGOs, Startups are flourishing in India related to floral waste management as given below.

6.11.1 Kashi Vishwanath Temple

It has its own framework for the removal of the many kilograms of waste coming about because of contributions by flowers, betel leaves and Datura is changed over into fertilizer (Waghmode et al., 2018).

6.11.2 Ajmer Sharif Dargah

Another situation where botanical waste administration has yielded great outcomes is that of Ajmer Sharif Dargah of Khwaja Moinuddin Chishti where around 15 to18 Quintals of blossoms, offered every day were unloaded in a well. Presently, the roses are reused, yet additionally, produce work for nearby ladies. With specialized help from CIMAP, Lucknow, the Dargah Committee has set up a rose water refining plant at the edges of Ajmer (Khyati, 2010).

6.11.3 Pushpanjali Prawah

Youth Fraternity Foundation (YFF), an association based out of Delhi, has attempted an undertaking PushpanjaliPrawah meaning the progression of blossoms. A holder named as Pushpanjali Prawah Patra has been kept at the public spots for the prompt removal of the blossoms, which were along these lines arranged by their volunteers at a proper spot. This colossally helped in the decrease of contamination in Yamuna River.

6.11.4 Temples in Walkeshwar, Mumbai

The blossoms offered each day are changed over into manure. This training kills their removal as well as gives fertilizer to the soil. These endeavors have been started by an association called Vishwa, which is focused on ecological preservation and maintainability. The association empowered sanctuaries in the distinguished zones to change over the Nirmalya (botanical contributions) into excrement by fertilizing the

soil it. During typical days, the number of blossoms offered went from 2-3 kilograms every day. During Shrawan, it came to as much as 7-8 kilograms. By treating the soil, the contributions got respect and, in the deal, the climate got advanced too (Rani et al., 2020a).

6.11.5 Temples in Pammal, Tamilnadu

Mangalam Balasubramanian, the originator of Exnora Green Pammal (EGP), has been associated with Temple squander the executives in Pammal town in Tamil Nadu. As a piece of the task, the natural waste produced at sanctuaries is currently arranged in a capable and eco-accommodating way. The two sanctuaries in Pammal, in particular, Arulmigu Aarkeshwarar and Vinayak sanctuary reuse the waste they make. They have set up a bio-gas plant that uses extras, products of the soil natural contributions to deliver biogas, which is utilized to make prasad at the sanctuary itself. The slop emerging from the biogas plant is utilized as compost for the sanctuary's nursery (Rani et al., 2020a).

6.11.6 Chandrika Devi Temple, Lucknow

The blossoms offered at renowned Chandrika Devi Temple, Mankameshwar Temple and Devan Sharif in Lucknow are used in various ways with the assistance of Central Institute of Medicinal and Aromatic Plants, a CSIR lab in Lucknow. The ladies from the towns around the space gather the blossoms from these spots and convert them into incense sticks and sell them at puja slows down in these spots. It creates the type of revenue for them. Such drives by CIMAP and Local Women have impressively decreased the contamination of Gomti stream (Pandey, 2018).

6.11.7 Help us Green –NGO

An association named Help Us Green in Kanpur gathers the floral waste from places of Kanpur. They convert these blossoms into bio-manures and in many values added items. The flowers are blended in with natural cow fertilizer and treated with regular parts like espresso buildup, corn cobs and earth warms are added. The finished result is a dim, scentless and supplement-rich material that works as an incredible soil conditioner. This item has been named Mitti and assists with improving soil surface for better development of plants. While 80% of the blossoms are utilized to make vermicompost, the rest are squashed and made into incense sticks and yajna/havan samgri. For assembling these things, the association has utilized ladies from various self-improvement gatherings in towns around Kanpur, subsequently giving them a type of revenue. Since individuals don't discard bundles that have pictures of Gods and Goddesses on them, so havan/yajna samgris are stuffed in seed paper installed with tulsi seeds. The disposed of parcels will develop into wonderful plants when they interact with the soil. The blossoms from ten sanctuaries and three mosques in Kanpur are being used. The items are sent out to Germany and Switzerland and are accessible online at Amazon, Flipkart and E-trade (Kanpur Startup Working to Cleaning Ganga." https://helpusgreen.com/media, 2020).

7 Conclusion

The production of untreated floral waste is a topic of concern for a sustainable environment and to protect it from irreversible damage. The huge quantity of flowers and other organic waste generated from the temples are dumped in water bodies or at landfills. This causes pollution and an unpleasant view as well. The floral waste dumped in water bodies accumulates and produces odor along with hindering in the functioning of the aquatic ecosystem. It also causes toxicity in the water bodies making it unfit for human use. The waste could be treated and converted into products that are better than the synthetic ones and also have biodegradability along with being natural friendly. Biomass volarization of the floral waste will help in exploring beneficial parts of the floral wastes. In substantial years, the attention of researches has been drawn towards proper utilization of the floral waste and production of high value end products which has led to increase in studies in the related area, invoking new and innovative ideas with scientific validation. Production of Bioethanol, biogas, activated carbon, biofertilizers, insecticides etc. are been reported in many studies. Along with this the indigenous knowledge of using flowers to develop into value-added products has been utilized by many NGOs and temple authorities. This is turn has also been taken up as small industry businesses and startups idea. They

convert floral offering in rose water, dyes, colors, compost, incense sticks thus, creating opportunities for small scale industries and employment leading to empowerment of women especially. There are a lot of untapped potential areas of study and research when it comes to floral waste as a valuable entity. For instance, there hasn't been enough high-level scientific work on biosorption studies or its use in cleaning up polluted water.

Acknowledgments The authors would like to extend their thankfulness to GLA University, Mathura, India.

Author Contributions Conceptualization, A.G.; *valida*tion, A.G. and S.K.; formal analysis, S.K.; investigation, A.G.; resources, S.K.; data curation, S.K.; writing—original draft preparation, S.K.; writing—review and editing, A.G.; supervision, A.G. All authors have read and agreed to the published version of the manuscript

Funding This research received no external funding.

Data Availability As this is a review article, no datasets were generated or analyzed during the current study. The articles, which are covered in this manuscript are included in the reference section with their DOI numbers.

Declarations

Competing Interests The authors have no competing interests and no relevant financial or non-financial interests to disclose.

References

Abhyankar, V. S., & Narayana, N. (1942). Reports on preparation of sugar syrup from dry mahua flowers which can be further use as a sweeting preliminary note on the preparation of syrup from mahua flowers. *Poona Agric Coll Mage, 33*, 168–172. https://doi.org/10.1108/NFS-12-2018-0358

Adhikary, K., & Vishwavidyalaya, M. (2020). Management of Temple Floral Waste and Utilization of Value Added Floral Waste Product: A Review. *International Journal for Environmental Rehabilitation and Conservation, 11*, 120–128. https://doi.org/10.1007/s12649-016-9763-2

Adkar, P. P., & Bhaskar, V. H. (2014). Pandanus odoratissimus (Kewda): A review on ethnopharmacology, phytochemistry, and nutritional aspects. *Advances in Pharmacological and Pharmaceutial Sciences, 2014*. https://doi.org/10.1155/2014/120895

Anil Kumar, P. K., Shamala, T. R., Kshama, L., Prakash, M. H., Joshi, G. J., Chandrashekar, A., et al. (2007). Bacterial synthesis of poly (hydroxybutyrate-cohydroxyvalerate) using carbohydrate-rich mahua (Madhuca sp.) flowers. *Journal of Applied Microbiology, 103*(1), 204–209. https://doi.org/10.1111/j.1365-2672.2006.03221.x

Ashokkumar, K., Selvaraj, K., & Muthukrishnan, S. D. (2013). Cynodon dactylon (L.) Pers.: An updated review of its phytochemistry and pharmacology. *Journal of Medicinal Plant Research: Planta Medica, 7*(48), 3477–3483. https://doi.org/10.5897/JMPR2013.5316x

Atal, H. L. (2022). Sustainable Management of Floral Waste to Produce Bioenergy and Valuable Products. *The Journal of Indian Association for Environmental Management, 42*(2), 26–34 https://or.niscpr.res.in/index.php/JIAEM/article/view/1041

Bakir Çilesizoğlu, N., Yalçin, E., Çavuşoğlu, K., & Sipahi Kuloğlu, S. (2022). Qualitative and quantitative phytochemical screening of Nerium oleander L. extracts associated with toxicity profile. *Scientific Reports, 12*(1), 21421. https://doi.org/10.1038/s41598-022-26087-0

Benerji, D. S. N., Ayyanna, C., Rajini, K., Rao, B. S., Banerjee, D. R. N., Rani, K. S., & Rajkumar, G. (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). DOI: https://doi.org/10.4172/1948-5948.1000022

Bennurmath, P., Bhatt, D. S., Gurung, A., Singh, A., & Bhatt, S. T. (2021). Novel green approaches towards utilization of flower waste: *A review. Environment Conservation Journal, 22*(3), 225–230. https://doi.org/10.36953/ECJ.2021.22327

Bharathi, P. R., Sripathi, S. K., & Lakshmi, A. N. (2020). Jasminum grandiflorum linn.-an update review. *International Journal of Pharmaceutical Sciences and Research, 11*(5), 1994–2010. https://doi.org/10.13040/IJPSR.0975-8232.11(5).1994-10

Bhati, M. I., Dubey, R. K., & Singh, S. (2021). Review on approaches to floral waste management for sustainable environment. *Climate Change and Environmental Sustainability, 9*(2), 110–116. https://doi.org/10.5958/2320-642X.2021.00012.0

Bhattacharya, A., Saini, V., & Gupta, A. (2012). Novel application of Mahua (Madhuca sp.) flowers for augmented protease production from Aeromonas sp. S1. *Natural Product Communications, 7*(10), 1359–1362.

Bhatti, H. N., Khalid, R., & Hanif, M. A. (2009). Dynamic biosorption of Zn (II) and Cu (II) using pretreated Rosa gruss an teplitz (red rose) distillation sludge. *Chemical Engineering Journal, 148*(2–3), 434–443. https://doi.org/10.1016/j.cej.2008.09.028

Biswas, S., Biswas, A., Das, A., & Banerjee, S. (2021). Phytosociological assessment and carbon stock estimation and valuation in the tropical dry deciduous forest of Bihar. *Ecofeminism and Climate Change, 2*(1), 2–16. https://doi.org/10.1108/EFCC-05-2020-0018

Chauhan, A. S., Chen, C. W., Singhania, R. R., Tiwari, M., Sartale, R. G., Dong, C. D., & Patel, A. K. (2022). Valorizations of marigold waste for high-value products and their industrial importance: A comprehensive review.

Resources, 11(10), 91. https://doi.org/10.3390/resources11100091

Chauhan, A., Chauhan, M., Sethi, M., Bodhe, A., Tomar, A., Shikha, & Singh, N. (2024). Application of flower wastes to produce valuable products. In Valorization of biomass wastes for environmental sustainability: Green practices for the rural circular economy (pp. 251–268). https://doi.org/10.1007/978-3-031-52485-1_14

Chitrakar, B., Zhang, M., & Bhandari, B. (2019). Edible flowers with the common name "marigold": Their therapeutic values and processing. *Trends in Food Science and Technology, 89*, 76–87. https://doi.org/10.1016/j.tifs.2019.05.008

CPHEEO. (2018). https://jalshakti-ddws.gov.in/en/cpheeo-manual-water-supply-and-treatment

Devi, N. S., Vandna, T., & N., & Tabing, R. (2022). Flower waste management: A review. *Environment and Ecology, 40*(2), 251–257. https://environmentandecology.com/wpcontent/uploads/2024/05/MS6-1.pdf

Durairaj, K., Senthilkumar, P., Velmurugan, P., Divyabharathi, S., & Kavitha, D. (2019). Development of activated carbon from Nerium oleander flower and their rapid adsorption of direct and reactive dyes. *International Journal Of Green Energy, 16*(7), 573–582. https://doi.org/10.1080/15435075.2019.1598419

Dutta, S., & Kumar, M. S. (2022). Characterization of floral waste as potential candidates for compost and biofuel production. *Biomass Conversion and Biorefinery*, 1–13. https://doi.org/10.1007/s13399-022-02353-z

Echavarria-Alvarez, A. M., & Hormaza-Anaguano, A. (2014). Flower wastes as a low-cost adsorbent for the removal of acid blue 9. *Dyna, 81*(185), 132–138. https://doi.org/10.15446/dyna.v81n185.37234

Elango, G., & Govindasamy, R. (2018). Analysis and utilization of temple waste flowers in Coimbatore District. *Environmental Science and Pollution Research, 25*, 10688–10700. https://doi.org/10.1007/s11356-018-1259-0

Elangovan, R., Philip, L., & Chandraraj, K. (2008). Biosorption of hexavalent and trivalent chromium by palm flower (Borassus aethiopum). *Chemical Engineering Journal, 141*(1–3), 99–111. https://doi.org/10.1016/j.cej.2007.10.026

Ferronato, N., & Torretta, V. (2019). Waste mismanagement in developing countries: A review of global issues. *International Journal of Environmental Research and Public Health, 16*(6), 1060.

Firdaus, N., Viquar, U., & Kazmi, M. H. (2020). Potential and pharmacological actions of Dhatura safed (Datura metel L.): as a deadly poison and as a drug: an overview. *International Journal of Pharmaceutical Sciences and Research, 11*(7), 3123–3137. https://doi.org/10.13040/IJPSR.0975-8232.11(7).3123-37

Ghosh, P. K., Bhattacharjee, P., & Das, S. (2014). Antimicrobial activity of supercritical carbon dioxide extracts of tuberose (Polianthes tuberosa Linn.) flowers against common pathogens. *International Journal of Pharmaceutical Sciences and Research, 5*(4), 1279. https://doi.org/10.13040/IJPSR.0975-8232.5(4).1279-89

Goel, A., & Bhatia, A. K. (2022). Ocimum sanctum: in vitro antiviral potential against animal viruses. *Indian Journal of Traditional Knowledge, 21*(1), 120–125 http://op.niscpr.res.in/index.php/IJTK/article/viewFile/32506/465480236

Grotewold, E. (2006). The genetics and biochemistry of floral pigments. *Annual Review of Plant Biology, 57*(1), 761–780. https://doi.org/10.1146/annurev.arplant.57.032905.105248

Gupta, R. K., Guha, P., & Srivastav, P. P. (2023). Phytochemical and biological studies of betel leaf (Piper betle L.): Review on paradigm and its potential benefits in human health. *Acta Ecologica Sinica, 43*(5), 721–732. https://doi.org/10.1016/j.chnaes.2022.09.006

Gupta, V. K. (2019). Fundamentals of natural dyes and its application on textile substrates. *Chemistry and Technology of Natural and Synthetic Dyes and Pigments, 2019*. https://doi.org/10.5772/intechopen.89964

Gurav, M. V., & Pathade, G. R. (2011). Production of vermicompost from temple waste (Nirmalya): A case study. https://www.environmentaljournal.org/1-2/ujert-1-2-11.pdf

Hajra, A., Dutta, S., & Mondal, N. K. (2016). Mosquito larvicidal activity of cadmium nanoparticles synthesized from petal extracts of marigold (Tagetes sp.) and rose (Rosa sp.) flower. *Journal of Parasitic Diseases, 40*, 1519–1527. https://doi.org/10.1007/s12639-015-0719-4

Haouas, D., Flamini, G., Halima-Kamel, M. B., & Hamouda, M. H. B. (2010). Feeding perturbation and toxic activity of five Chrysanthemum species crude extracts against Spodoptera littoralis (Boisduval)(Lepidoptera; Noctuidae). *Crop Protection, 29*(9), 992–997. https://doi.org/10.1016/j.cropro.2010.05.002

Haq, N. B., Rubina, K., & Muhammad, A. H. (2011). *Biosorption of Pb (II) and Co (II) on red rose waste biomass*. https://doi.org/10.30492/IJCCE.2011.6093

Hasan, M. M., Akter, M., Islam, M. E., Rahman, M. A. A., & Parvin, M. S. (2020). Evaluation of Antioxidant and Antibacterial Properties of Magnolia champaca L (Magnoliaceae) Stem Bark Extract. *Bangladesh Pharmaceutical Journal, 23*(2), 96–102. https://doi.org/10.3329/bpj.v23i2.48328

Hodaei, M., Rahimmalek, M., & Arzani, A. (2021). Variation in bioactive compounds, antioxidant and antibacterial activity of Iranian Chrysanthemum morifolium cultivars and determination of major polyphenolic compounds based on HPLC analysis. *Journal of Food Science and Technology, 58*, 1538–1548. https://doi.org/10.1007/s13197-020-04666-1

Indrianingsih, A. W., Windarsih, A., Noviana, E., Asari, S. M., & Pratiwi, S. I. (2023). In vitro evaluation of antioxidant, α-glucosidase inhibitor, and antibacterial activities of frangipani flower and the principal component analysis of its constituents. *Process Biochemistry, 130*, 347–357. https://doi.org/10.1016/j.procbio.2023.04.025

Jadhav, A. R., Chitanand, M. P., & Shete, H. G. (2013). Flower waste degradation using microbial consortium. *IOSR Journal of Agriculture and Veterinary Science, 3*, 01–04. https://doi.org/10.9790/2380-0350104

Jagadeesh Babu, P. E., Kumar, V., & Visvanathan, R. (2010). Equilibrium and kinetic study for the removal of malachite green using activated carbon prepared from Borassus flabellofer male flower. *Asia-Pacific Journal of*

Chemical Engineering, 5(3), 465–472. https://doi.org/10.1002/apj.327

Jain, M., Garg, V. K., & Kadirvelu, K. (2009). Chromium (VI) removal from aqueous system using Helianthus annuus (sunflower) stem waste. *Journal of Hazardous Materials, 162*(1), 365–372. https://doi.org/10.1016/j.jhazmat.2008.05.048

Jain, M., Garg, V. K., Kadirvelu, K., & Sillanpää, M. (2016). Adsorption of heavy metals from multi-metal aqueous solution by sunflower plant biomass based carbons. *International Journal of Environmental Science and Technology, 13*, 493–500.

Jain, N. (2016). Waste management of temple floral offerings by vermicomposting and its effect on soil and plant growth. *International Journal of Agriculture and Environmental Research, 2*(7), 89–94 https://ijoear.com/assets/articles_menuscripts/file/IJOEAR-JUL-2016-14.pdf

Javed, M. A., Bhatti, H. N., Hanif, M. A., & Nadeem, R. (2007). Kinetic and equilibrium modeling of Pb (II) and Co (II) sorption onto rose waste biomass. *Separation Science and Technology, 42*(16), 3641–3656. https://doi.org/10.1080/01496390701710794

Ji, X. Y., Lin, W. D., Zhang, W. D., Yin, F., Zhao, X. L., Wang, C. M., et al. (2016). Evaluation of methane production features and kinetics of Bougainvillea spectabilis Willd waste under mesophilic conditions. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 38*(11), 1537–1543. https://doi.org/10.1080/15567036.2015.1079569

Kashyap, S., Tharannum, S., Krishna Murthy, V., & Kale, R. D. (2023). Management of Biomass Residues Using Vermicomposting Approach. In Bio-Inspired Land Remediation (pp. 261–286). Cham: *Springer International Publishing*. https://doi.org/10.1007/978-3-031-04931-6_11

Khammee, P., Unpaprom, Y., Chaichompoo, C., Khonkaen, P., & Ramaraj, R. (2021). Appropriateness of waste jasmine flower for bioethanol conversion with enzymatic hydrolysis: sustainable development on green fuel production. *3 Biotech, 11*, 1–13. https://doi.org/10.1007/s13205-021-02776-x

Khare, P., Kishore, K., & Sharma, D. K. (2018). Medicinal uses, Phytochemistry and Pharmacological profile of Madhuca longifolia. *Asian Journal of Pharmacy and Pharmacology, 4*(5), 570–581. https://doi.org/10.31024/ajpp.2018.4.5.5

Khoshsang, H., & Ghaffarinejad, A. (2018). Rapid removal of lead (II) ions from aqueous solutions by saffron flower waste as a green biosorbent. *Journal of Environmental Chemical Engineering, 6*(5), 6021–6027. https://doi.org/10.1016/j.jece.2018.09.020

Khumpook, T., Saenphet, S., Tragoolpua, Y., & Saenphet, K. (2019). Anti-inflammatory and antioxidant activity of Thai mango (Mangifera indica Linn.) leaf extracts. *Comparative Clinical Pathology, 28*, 157–164. https://doi.org/10.1007/s00580-018-2809-z

Singh, R. P., Singh, P., Araujo, A. S., Ibrahim, M. H., & Sulaiman, O. (2011). Management of urban solid waste: Vermicomposting a sustainable option. *Resources, conservation and recycling, 55*(7), 719–729. https://doi.org/10.1016/j.resconrec.2011.02.005

S. Khyati, "With CIMAP Help, Flowers at Ajmer Dargah to Bring Jobs", The Indian Express, https://indianexpress.com/article/cities/lucknow. 2010, May 10. https://indianexpress.com/article/cities/lucknow/with-cimap-help-flowers-at-ajmer-dargah-to-bring-jobs/

Kim, H. K., Seo, J. W., & Kim, G. H. (2020). Various effects of volatile constituents from Magnolia kobus flowers against Aedes albopictus (Diptera: Culicidae). *Industrial Crops and Products, 145*, 112109. https://doi.org/10.1016/j.indcrop.2020.112109

Kohli, R., & Hussain, M. (2016, January). Management of flower waste by vermicomposting. In International Conference on Global Trends in Engineering, Technology and Management (ICGTETM-2016) (pp. 34-38). https://studylib.net/doc/12907972/management-of-flower-waste-by-vermicomposting%2D%2Dmr-ravinde...

Kotiloğlu, D., Acet, T., & Özcan, K. (2020). Phytochemical profile and biological activity of a therapeutic orchid from Anatolia: Dactylorhiza romana subsp. georgica. *Journal of Food Measurement and Characterization, 14*(6), 3310–3318. https://doi.org/10.1007/s11694-020-00566-2

Kulkarni, D. N., Kulkarni, K. D., & Tathe, S. B. (2001). *Studies on the extraction of safflower yellow B and carthamin red pigments from safflower florets as food colorant*. https://doi.org/10.1007/s11694-020-00566-2

Kulkarni, M. B., & Ghanegaonkar, P. M. (2019). Biogas generation from floral waste using different techniques. *Global Journal of Environmental Science and Management, 5*(1), 17–30. https://doi.org/10.22034/gjesm.2019.01.02

Kumar, A., Singh, A. K., & Chandra, R. (2021). Recent advances in physicochemical and biological approaches for degradation and detoxification of industrial wastewater. *Emerging Treatment Technologies for Waste Management*, 1–28. https://doi.org/10.1007/978-981-16-2015-7_1

Kumar, M., & Swapnavahini, K. (2012). Nutrient reduction and biogas production of rose residue by anaerobic digestion in a batch reactor. *International Journal of Advanced Research in Science and Technology, 1*(2), 125–129. https://www.ijarst.com/assets/backend/pdf/article/1_12_Nutrient%20Reduction%20and%20Biogas%20Production%20of%20Rose%20Residue%20by%20Anaerobic%20%20Digestion%20in%20a%20Batch%20Reactor_pdf

Kumar, M., Saurabh, V., Tomar, M., Hasan, M., Changan, S., Sasi, M., et al. (2021). Mango (Mangifera indica L.) leaves: Nutritional composition, phytochemical profile, and health-promoting bioactivities. *Antioxidants, 10*(2), 299. https://doi.org/10.3390/antiox10020299

Kumar, N., Ved, A., Yadav, R. R., & Prakash, O. (2021). A comprehensive review on phytochemical, nutritional, and therapeutic importance of Musa. *International Journal of Current Research and Review, 13*, 114–124. https://doi.org/10.31782/IJCRR.2021.13901

Kumar, S., Sogani, M., Syed, Z., Rajvanshi, J., Sengupta, N., & Kumar, P. (2023). The effects of waste jasmine flower as a substrate in a single chamber microbial fuel cell. *Biomass Conversion and Biorefinery*, 1–9. https://doi.org/10.1007/s13399-023-04196-8

Kumar, V., Kumari, S., & Kumar, P. (2020). Management and sustainable energy production using flower waste

generated from temples. *Environmental Degradation: Causes and Remediation Strategies, 1*, 154. https://doi.org/10.26832/aesa-2020-edcrs-011

Kumar, V., Singh, J., & Kumar, P. (Eds.). (2020). *Environmental Degradation: Causes and Remediation Strategies (Vol. 1)*. Agro Environ Media, Publication Cell of AESA, Agriculture and Environmental Science Academy. https://doi.org/10.26832/aesa-2020-edcrs

Lin, Z., Zhang, C., Cao, D., Damaris, R. N., & Yang, P. (2019). The latest studies on lotus (Nelumbo nucifera)-an emerging horticultural model plant. *International journal of molecular sciences, 20*(15), 3680. https://doi.org/10.3390/ijms20153680

Lungade, P., & Karadbhajne, S. V. (2022). Mahua flower (Madhuca Indica): approach of functional, nutritional characteristics and an accompaniment to food products. *Journal of Pharmaceutical Negative Results, 13*, 9093–9104. https://doi.org/10.47750/pnr.2022.13.S09.1064

Marotti, I., Marotti, M., Piccaglia, R., Nastri, A., Grandi, S., & Dinelli, G. (2010). Thiophene occurrence in different Tagetes species: Agricultural biomasses as sources of biocidal substances. *Journal of the Science of Food and Agriculture, 90*(7), 1210–1217. https://doi.org/10.1002/jsfa.3950

Masure, P., & Patil, B. (2014). Extraction of flower wastes. *International Journal of Engineering Research & Technology, 3*, 43–44. https://doi.org/10.17577/IJERTV3IS110067

Mazaya, G., Karseno, K., & Yanto, T. (2020). Antimicrobial and phytochemical activity of coconut shell extracts. *Turkish Journal of Agriculture - Food Science and Technology, 8*(5), 1090–1097. https://doi.org/10.24925/turjaf.v8i5.1090-1097.3282

Mishra, A., & Poonia, A. (2019). Mahua (Madhuca longifolia) flowers: review on processing and biological properties. *Nutrition & Food Science, 49*(6), 1153–1163. https://doi.org/10.1108/NFS-12-2018-0358

Mishra N., "Temple Waste, A Concern" Times of India, http://www.timesofindia.indiatimes.com. 2013. DOI: https://www.academia.edu/66899257/Temple_Waste_Utilization_and_Management_A_Review

Missoum, A. (2018). An update review on Hibiscus rosa sinensis phytochemistry and medicinal uses. *Journal of Ayurvedic and Herbal Medicine, 4*(3), 135–146. https://doi.org/10.31254/jahm.2018.4308

Mohebitabar, S., Shirazi, M., Bioos, S., Rahimi, R., Malekshahi, F., & Nejatbakhsh, F. (2017). Therapeutic efficacy of rose oil: A comprehensive review of clinical evidence. *Avicenna Journal of Phytomedicine, 7*(3), 206.

Montalvo-González, E., Villagrán, Z., González-Torres, S., Iñiguez-Muñoz, L. E., Isiordia-Espinoza, M. A., Ruvalcaba-Gómez, J. M., et al. (2022). Physiological effects and human health benefits of Hibiscus sabdariffa: a review of clinical trials. *Pharmaceuticals, 15*(4), 464. https://doi.org/10.3390/ph15040464

Nagarajan, V. K., Devi, S. A., Manohari, S. P., & Santha, M. M. (2014). Experimental study on partial replacement of cement with coconut shell ash in concrete. *International Journal of Scientific and Research Publications, 3*(3), 651–661.

Ndegwa, P. M., & Thompson, S. A. (2001). Integrating composting and vermicomposting in the treatment and bioconversion of biosolids. *Bioresource Technology, 76*(2), 107–112. https://doi.org/10.1016/S0960-8524(00)00104-8

Nigam, S., Vankar, P. S., & Gopal, K. (2013). Biosorption of arsenic from aqueous solution using dye waste. *Environmental Science and Pollution Research, 20*, 1161–1172. https://doi.org/10.1007/s11356-012-0966-1

Nikkon, F., Habib, M. R., Karim, M. R., Ferdousi, Z., Rahman, M. M., & Haque, M. E. (2009). Insecticidal activity of flower of Tagetes erecta L. against Tribolium castaneum (Herbst). *Research Journal of Agriculture and Biological Sciences, 5*(5), 748–753. https://www.aensiweb.net/AENSIWEB/rjabs/rjabs/2009/748-753.pdf

Ningrum, N. A., & Wijayanti, N. (2020). Antioxidant properties of Gomphrena globosa leaves extract. *AIP Conference Proceedings, 2260*(1) AIP Publishing. https://doi.org/10.1063/5.0015689

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International Journal of Surgery, 88*, 105906. https://doi.org/10.1016/j.ijsu.2021.105906

Panday, R., Basnet, B. B., Bhatt, P. S., & Tamrakar, A. S. (2014). Bioconcentration of heavy metals in vermicomposting earthworms (Eisenia fetida, Perionyx excavatus and Lampito mauritii) in Nepal. *Journal of Microbiology, Biotechnology and Food Sciences, 3*(5), 416–418. https://office2.jmbfs.org/index.php/JMBFS/article/view/7007

Pandey, S. (2018) Women Turn Waste Into Wealth. The Deccan Herald. https://www.deccanherald.com/specialfeatures/a-close-connect-893239.html

Paudel, K. R., & Panth, N. (2015). Phytochemical profile and biological activity of Nelumbo nucifera. *Evidence-based Complementary and Alternative Medicine*, 789124. https://doi.org/10.1155/2015/789124

Prakkash, M. J., Ragunathan, R., & Jesteena, J. (2019). Evaluation of bioactive compounds from Jasminum polyanthum and its medicinal properties. *Journal of Drug Delivery and Therapeutics, 9*(2), 303–310. https://doi.org/10.22270/jddt.v9i2.2413

Priyadarshini, P., & Abhilash, P. C. (2020). Circular economy practices within energy and waste management sectors of India: A meta-analysis. *Bioresource Technology, 304*, 123018. https://doi.org/10.1016/j.biortech.2020.123018

Pujara, Y., Pathak, P., Sharma, A., & Govani, J. (2019). Review on Indian Municipal Solid Waste Management practices for reduction of environmental impacts to achieve sustainable development goals. *Journal of Environmental Management, 248*, 109238. https://doi.org/10.1016/j.jenvman.2019.07.009

Quevedo-Hidalgo, B., Monsalve-Marín, F., Narváez-Rincón, P. C., Pedroza-Rodríguez, A. M., & Velásquez-Lozano, M. E. (2013). Ethanol production by Saccharomyces cerevisiae using lignocellulosic hydrolysate from Chrysanthemum waste degradation. *World Journal of Microbiology and Biotechnology, 29*, 459–466. https://doi.org/10.1007/s11274-012-1199-7

Rani, G., Nabi, Z., Banu, J. R., & Yogalakshmi, K. N. (2020a). Batch fed single chambered microbial electrolysis cell for the treatment of landfill leachate. *Renewable Energy, 153*, 168–174. https://doi.org/10.1016/j.renene.2020.01.118

Rani, S., Sharma, P. K., & Bhasin, M. (2020b). Technology for utilization of floral waste and corresponding products-A review. *International Journal of Scientific & Engineering Research, 11*(9).

Rasekar, V., & Shahi, S. (2022). Medical application of Ashok tree (Saraca asoca): A review. *International Journal of Health Sciences*, (II), 8752–8759. https://doi.org/10.53730/ijhs.v6nS2.7262

Reddy, C. O., & Sirisha, V. S. (2024). Management of Floral Waste, as Well as Various Techniques and Approaches for Converting the Floral Waste into Value-Added Products. In *From Waste to Wealth* (pp. 825–838). Springer Nature Singapore. https://doi.org/10.1007/978-981-99-7552-5_36

Rout, R. N., & Jena, B. (2018). Indian Temple Flower Waste Utilization and Sustainable Management. *Journal of Advance Nanobiotechnology, 2*(4), 21–27. https://doi.org/10.28921/jan.2018.02.23

Santhoshkumar, J., & Shanmugam, V. (2020). Green synthesis of copper oxide nanoparticles from magnolia champaca floral extract and its antioxidant & toxicity assay using Danio Rerio. *The International Journal of Recent Technology and Engineering, 8*, 5444–5449. https://doi.org/10.35940/ijrte.E6869.018520

Sarkar, T., Salauddin, M., & Chakraborty, R. (2020). In-depth pharmacological and nutritional properties of bael (Aegle marmelos): A critical review. *Journal of Agriculture and Food Research, 2*, 100081. https://doi.org/10.1016/j.jafr.2020.100081

Sharma, A., Goel, A., & Lin, Z. (2023). In Vitro and In Silico Anti-Rheumatic Arthritis Activity of Nyctanthes arbortristis. *Molecules, 28*(16), 6125. https://doi.org/10.3390/molecules28166125

Sharma, D., Pandey, A. K., Yadav, K. D., & Kumar, S. (2021). Response surface methodology and artificial neural network modelling for enhancing maturity parameters during vermicomposting of floral waste. *Bioresource Technology, 324*, 124672. https://doi.org/10.1016/j.biortech.2021.124672

Sharma, D., Varma, V. S., Yadav, K. D., & Kalamdhad, A. S. (2017). Evolution of chemical and biological characterization during agitated pile composting of flower waste. *International Journal of Recycling of Organic Waste in Agriculture, 6*, 89–98. https://doi.org/10.1007/s40093-017-0155-9

Sharma, D., Vimal Raj, C., & Yadav, K. D. (2019). Assessment of Maturity and Quality of Compost Through Evolution of Aerobic and Anaerobic Composting of Flower Waste. In Waste Management and Resource Efficiency: Proceedings of 6th IconSWM 2016 (pp. 543-554). Springer Singapore. DOI: https://doi.org/10.1007/978-981-10-7290-1_46

Sharma, D., & Yadav, K. D. (2017). Bioconversion of flowers waste: Composting using dry leaves as bulking agent. *Environmental Engineering Research, 22*(3), 237–244. https://doi.org/10.4491/eer.2016.126

Sharma, D., & Yadav, K. D. (2018). Application of rotary in-vessel composting and analytical hierarchy process for the selection of a suitable combination of flower waste. *Geology, Ecology, and Landscapes, 2*(2), 137–147. https://doi.org/10.1080/24749508.2018.1456851

Sharma, D., Yadav, K. D., & Kumar, S. (2018a). Biotransformation of flower waste composting: Optimization of waste combinations using response surface methodology. *Bioresource Technology, 270*, 198–207. https://doi.org/10.1016/j.biortech.2018.09.036

Sharma, D., Yadav, K. D., & Kumar, S. (2018b). Role of sawdust and cow dung on compost maturity during rotary drum composting of flower waste. *Bioresource Technology, 264*, 285–289. https://doi.org/10.1016/j.biortech.2018.05.091

Sharma, K., Mahato, N., Cho, M. H., & Lee, Y. R. (2017). Converting citrus wastes into value-added products: Economic and environmently friendly approaches. *Nutrition, 34*, 29–46. https://doi.org/10.1016/j.nut.2016.09.006

Sharma, K. R. (2021). Floral waste management and oppurutnities. *Just Agriculture, 1*(10), 113.

Sharma, S., & Kothiyal, N. C. (2013). Use of activated dry flowers (ADF) of Alstonia Scholaris for chromium (Vl) removal: Equilibrium, kinetics and thermodynamics studies. *Environmental Science and Pollution Research, 20*, 8986–8995. https://doi.org/10.1007/s11356-013-1853-0

Sinaga, H. Y., & Jaya, M. K. A. (2022). The potential of frangipani flower extract (Plumeria alba l.) as an antibacterial: a literature review. *Journal of Applied Pharmaceutical Science, 4*(1), 33–38. https://doi.org/10.24843/JPSA.2022.v04.i01.p05

Singh, A., Jain, A., Sarma, B. K., Abhilash, P. C., & Singh, H. B. (2013). Solid waste management of temple floral offerings by vermicomposting using Eisenia fetida. *Waste Management, 33*(5), 1113–1118. https://doi.org/10.1016/j.wasman.2013.01.022

Singh, P., & Bajpai, U. (2012). Anaerobic digestion of flower waste for methane production: An alternative energy source. *Environmental Progress & Sustainable Energy, 31*(4), 637–641. https://doi.org/10.1002/ep.10589

Singh, P., Singh, R., Borthakur, A., Madhav, S., Singh, V. K., Tiwary, D., Srivastava, V. C., & Mishra, P. K. (2018). Exploring temple floral refuse for biochar production as a closed loop perspective for environmental management. *Waste Management, 77*, 78–86. https://doi.org/10.1016/j.wasman.2018.04.041

Singh, T., Singh, P., Pandey, V. K., Singh, R., & Dar, A. H. (2023). A literature review on bioactive properties of betel leaf (Piper betel L.) and its applications in food industry. *Food Chemistry Advances, 3*, 100536. https://doi.org/10.1016/j.focha.2023.100536

Singh, Y., Gupta, A., & Kannojia, P. (2020). Tagetes erecta (Marigold)-A review on its phytochemical and medicinal properties. *Current Medical and Drug Research, 4*(1), 1–6. https://doi.org/10.53517/CMDR.2581-5008.41202020201

Sivapalan, S., Dharmalingam, S., Venkatesan, V., Angappan, M., & Ashokkumar, V. (2023). Phytochemical analysis, anti-inflammatory, antioxidant activity of Calotropis gigantea and its therapeutic applications. *Journal of*

Ethnopharmacology, 303, 115963. https://doi.org/10.1016/j.jep.2022.115963

Srivastav, A. L., & Kumar, A. (2021). An endeavor to achieve sustainable development goals through floral waste management: A short review. *Journal of Cleaner Production, 283*, 124669. https://doi.org/10.1016/j.jclepro.2020.124669

Srivastava, N. (2021). Temple Floral Waste Management in India. In *Handbook of Solid Waste Management: Sustainability through Circular Economy* (pp. 1–32). Springer Singapore. https://doi.org/10.1007/978-981-15-7525-9_37-1

Srivastava, R. K., Singh, A. K., Bansal, R. P., Pal, A., Khare, P., Sharma, R. S., et al. (2023). Innovative technique for management of offered floral bio-resources for protecting the environment and generating additional livelihood opportunities for women. *International journal of Environmental Science and Technology, 20*(3), 3361–3370. https://doi.org/10.1007/s13762-022-04021-1

Swain, M. R., Kar, S., Sahoo, A. K., & Ray, R. C. (2007). Ethanol fermentation of mahula (Madhuca latifolia L.) flowers using free and immobilized yeast Saccharomyces cerevisiae. *Microbiological Research, 162*(2), 93–98. https://doi.org/10.1016/j.micres.2006.01.009

Swapna, P., & Lakshmi, V. V. (2020). Effective Recycling of Flower Waste as Organic Manure. *Bioresource Utilization and Bioprocess, 3*, 253–265. https://doi.org/10.1007/978-981-15-1607-8_24

Tang, Y. C., Liu, Y. J., He, G. R., Cao, Y. W., Bi, M. M., Song, M., et al. (2021). Comprehensive analysis of secondary metabolites in the extracts from different lily bulbs and their antioxidant ability. *Antioxidants, 10*(10), 1634. https://doi.org/10.3390/antiox10101634

Tiwari, P., & Juneja, S. K. (2016). Management of floral waste generated from temples of Jaipur city through vermicomposting. *International Journal of Environment, 5*(1), 1–13. https://doi.org/10.3126/ije.v5i1.14561

Tosun, İ., Gönüllü, M. T., & Günay, A. (2004). Anaerobic digestion and methane generation potential of rose residue in batch reactors. *Journal of Environmental Science and Health, Part A, 39*(4), 915–925. https://doi.org/10.1081/ESE-120028402

Trinh, L. T. P., Choi, Y. S., & Bae, H. J. (2018). Production of phenolic compounds and biosugars from flower resources via several extraction processes. *Industrial Crops and Products, 125*, 261–268. https://doi.org/10.1016/j.indcrop.2018.09.008

Tripathi, V., Edrisi, S. A., & Abhilash, P. C. (2016). Towards the coupling of phytoremediation with bioenergy production. *Renewable and Sustainable Energy Reviews, 57*, 1386–1389. https://doi.org/10.1016/j.rser.2015.12.116

UNSDG. (2015). https://sdgs.un.org/goals

Vankar, P. S. (2009). Utilization of Temple waste flower-Tagetus erecta for Dyeing of Cotton, Wool and Silk on Industrial scale. *Journal of Textile and Apparel, Technology and Management, 6*(1), 3630170.

Verma, L., Sonkar, D., Bhan, C., Singh, J., Kumar, U., Yadav, B. C., & Nayak, A. (2022). Adsorptive performance of Tagetes flower waste based adsorbent for crystal violet dye removal from an aqueous solution. *Environmental Sustainability, 5*(4), 493–506. https://doi.org/10.1007/s42398-022-00250-9

Vilvanathan, S., & Shanthakumar, S. (2015). Biosorption of Co (II) ions from aqueous solution using Chrysanthemum indicum: kinetics, equilibrium and thermodynamics. *Process Safety and Environmental Protection, 96*, 98–110. https://doi.org/10.1016/j.psep.2015.05.001

Waghmode, M. S., Gunjal, A. B., Nawani, N. N., & Patil, N. N. (2018). Management of floral waste by conversion to value-added products and their other applications. *Waste and Biomass Valorization, 9*, 33–43. https://doi.org/10.1007/s12649-016-9763-2

Wijayapala, S. (2013). Utilisation of Sepalika (Nyctanthes arbor-tristis) Flowers, a Temple Waste as a Source for a Potential Colouring Agent for Textile Substrates Used in the Textile Industry. *Proceedings of International Forestry and Environment Symposium, 18*. https://doi.org/10.31357/fesympo.v18i0.1917

Wu, L. C., Lin, C. L., Peng, C. C., Huang, T. L., Tsai, T. H., Kuan, Y. E., & Chung, Y. C. (2021). Development from Jasminum sambac flower extracts of products with floral fragrance and multiple physiological activities. *Evidence-based Complementary and Alternative Medicine, 2021*, 1–12. https://doi.org/10.1155/2021/7657628

Yapici, S., & Eroglu, H. (2013). Batch biosorption of radioactive thallium on solid waste of oleum rosea process. *Journal of Chemical Technology & Biotechnology, 88*(11), 2082–2090. https://doi.org/10.1002/jctb.4076