

## Comparative Study on Fungal Diversity at Different Stages of *Tagetes Spp.*

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### ABSTRACT

Marigold (*Tagetes spp.*) holds considerable religious, aesthetic, and ornamental significance in Indian culture. Due to its extensive use in religious ceremonies, cultural events, and decorations, large amounts of floral waste are generated daily. Improper disposal of this biodegradable waste contributes to environmental concerns. To explore potential bioconversion routes, the present study emphasizes the diversity and distribution of fungal flora involved in marigold flower decomposition. Flower waste samples were collected from ten different localities and classified into four physiological stages: Semi-opened Bud (S1), Open Bud (S2), Blooming Stage (S3), and Senescence Stage (S4). Fungi were isolated under controlled laboratory conditions and identified morphologically. A total of 44 fungal isolates were obtained, with *Aspergillus* species found to be the most prevalent across all stages, followed by genera such as *Penicillium*, *Fusarium*, *Cladosporium*, *Curvularia*, and *Rhizopus*. The fungal population density was highest during the bloom and senescent stages (S3 and S4), indicating greater microbial colonization during advanced flower degradation. Particularly, *Nigrospora oryzae*, *Fusarium fujikuroi*, and *Lasiodiplodia theobromae* showed dominant presence during the senescent phase. The abundance of saprophytic fungi reflects their ecological role in the natural degradation of floral biomass. These findings highlight the potential use of native fungal strains in the biodegradation and sustainable management of floral waste, especially marigold-based refuse

**Keywords:** *Tagetes spp.*, Flower Waste, Diversity, sustainable management

### INTRODUCTION

Floriculture is a vital branch of horticulture and a significant component of Indian agriculture. It has emerged as a highly profitable agribusiness compared to traditional crops. Floriculture contributes considerably to the Indian economy through both domestic consumption and exports. Among Indian states, Maharashtra is one of the leading producers of flowers. Flowers are in consistent demand due to their use in religious offerings, decorative purposes, and various cultural events. Among these, marigold (*Tagetes spp.*) plays a prominent role owing to its religious, ornamental, and aesthetic value. However, the extensive use of

marigold results in the generation of a considerable amount of floral waste, which poses a major environmental concern due to improper disposal practices. In India, with a population exceeding 1.38 billion, the management of such waste becomes increasingly challenging.

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As per estimates, around 960 million tonnes (MT) of municipal solid waste (MSW) are generated annually, including approximately 350 MT of organic waste, 290 MT of inorganic waste, and 4.5 MT of hazardous waste (Pappu et al., 2007).

Municipal waste is generally categorized into three types: (1) biodegradable or organic waste, (2) non-biodegradable or inert waste, and (3) recyclable waste. Organic waste comprises the largest proportion—about 52%—followed by 32% inert materials and 17% recyclable content (Ahluwalia & Patel, 2018). Major sources of waste include industrial activities, commercial establishments, agriculture, and domestic sectors (Mulay et al., 2020). Floral waste forms a significant component of organic waste, primarily originating from temples, weddings, hotels, and various religious and social events (Madalene et al., 2023).

Flowers offered during religious rituals are often discarded indiscriminately, contributing to the accumulation of waste (Waghmode et al., 2016). These flowers, revered as sacred, are usually dumped into rivers or onto land, leading to water and environmental pollution (Singh et al., 2013; Vijayapala, 2013; Vijayagiri et al., 2012). In cities with prominent pilgrimage centers, daily flower waste is estimated to range between 3.5 to 4.0 tonnes (Waghmode et al., 2016). According to the National Horticulture Board (2022), India's total floral production was estimated to reach 341.63 million tonnes. A considerable portion of this is wasted and often mismanaged, further contributing to pollution. The degradation of floral waste is relatively slow compared to that of kitchen waste due to its fibrous and lignin-rich structure (Jadhav et al., 2013).

Fungal communities play an essential role in the decomposition of floral waste. Among these, *Aspergillus spp.* has been found to be the most dominant genera involved in biodegradation (Anastasi et al., 2005; Shouche et al., 2013). Considering the growing floriculture sector—particularly with marigold as a key crop—efficient management of floral waste is imperative. This study is therefore focused on investigating the fungal diversity associated with floral waste decomposition. Furthermore, promoting scientific innovations and startup initiatives for floral waste upcycling can contribute meaningfully to a sustainable circular bioeconomy.

## MATERIALS AND METHODS

### Collection of samples

Floral waste was collected from different sites and stages of flower. Distinct locations like, Function halls, Community centers, Aesthetic places, Decoration sites, Market places, Function halls, Cultural programs. The collected floral waste was brought to laboratory in pre sterilized paper bags, afterward categorization in unlike stages were done similar to Semi Opened Bud (S1), Open Bud (S2), Bloom Flower S3), Senescence (S4).

### Isolation of fungi

To study associated fungi with sample, semisynthetic media like Potato Dextrose Agar (PDA), Czapek Dox Agar (CZA) were used to isolate fungi. Media are supplemented by adding a proper amount of antibiotics to avoid bacterial contamination. Collected flower separated based on their different stages Semi Opened Bud (S1), Open Bud (S2), Bloom Flower S3), Senescence (S4). Flower waste was allowed on the medium by inoculation method. Inoculated petry plates are incubated at 30°C. Fungal incidence were calculated by using formula. After seven days different fungi were grown in petry plates containing medium. To obtain pure cultures, fungi were again inoculated on each separate petry plate containing a sterilized CZA medium.

$$\% \text{ Incidence} = \frac{\text{No. Total occurred colonies} - \text{No. of replicates}}{\text{No. Total occurred colonies}}$$

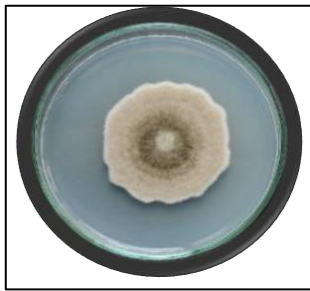
### Composition of media used in isolation Czapek Dox Agar (CZA)

Sucrose-30g, Sodium nitrate (NaNO<sub>3</sub>)-3g, Dipotassium phosphate (KH<sub>2</sub>PO<sub>4</sub>)- 1g, Magnesium sulphate (MgSO<sub>4</sub>.7H<sub>2</sub>O)- 0.5g, Potassium chloride (KCl)- 0.5g, Ferric sulphate (FeSO<sub>4</sub>.7H<sub>2</sub>O)- 0.01 g, agar- 15 g, Distilled water- 1000 ml, pH- 5.6.

### Potato Dextrose Agar (PDA)

Potatoes- 200 g (peeled and diced), Dextrose- 20 g, Agar- 15-20 g, Distilled water- 1000 ml, pH-5.6. Weighed out the potatoes and dextrose. Boiled the

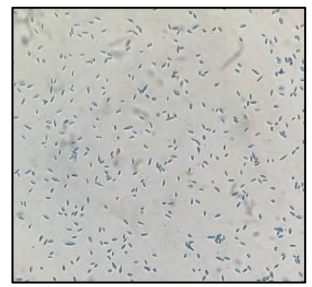
**Fig 1.** Pure culture and microphotograph of some fungi



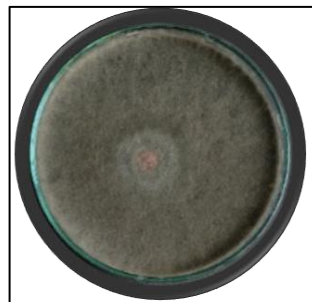
1. *Alternaria raphani*



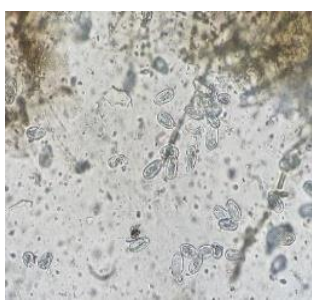
6. *Fusarium fujikuroi*



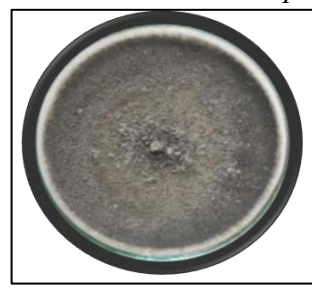
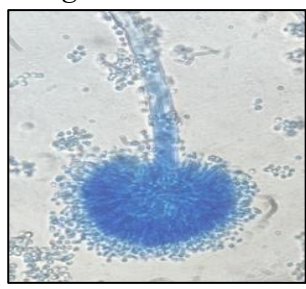
2. *Aspergillus niger*



7. *Lasiodiplodia theobromae*



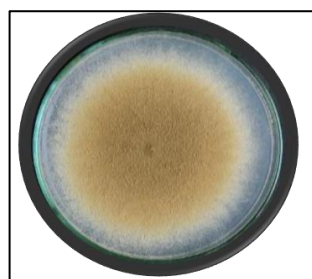
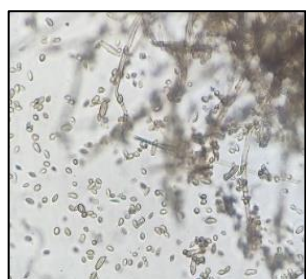
3. *Aspergillus terreus*



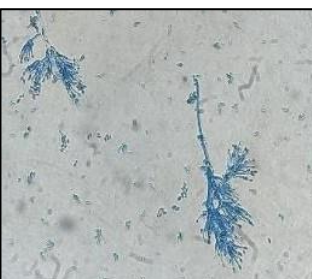
8. *Nigrospora oryzae*



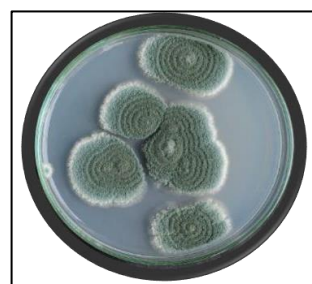
4. *Cladosporium cladosporioides*



9. *Penicillium lilacinum*



5. *Curvularia lunata*



10. *Penicillium echinulatum*



diced potatoes in 1000 ml of distilled water for 30-40 minutes, or until the potatoes were soft. Strained the potato infusion through muslin cloth to remove the potato solids. Added the dextrose and agar to the potato infusion. Heated the mixture until the agar and dextrose were dissolved. Autoclaved the medium at 121°C Temperature and 15 lb. Pressure. Allowed the medium to cool and solidify. Used the PDA medium for inoculation and cultivation of fungi.

### Identification/ Characterization of fungi:

For perfect identification, visual characters and microscopic characters were considered. Characters such as the growth pattern of fungi, colony diameter, texture, Color, mycelium, spores and sporophore was considered (Fig 1). The fungal identification was done with the help of different books and manuals (Gilman, 2001; Ellies, 1971; Mukadam, et. al.,2006) with the help of Agharkar Research Institute (ARI), Pune. All identified fungi's pure cultures are maintained on CZA medium.

## RESULTS AND DISCUSSION

### Fungal incidence on flower waste at different locations:

Table 1 During the study of fungal incidence on *Tagetes spp.* were studied on different media and localities like, Function halls, Community centers, Aesthetic places, Decoration sites, Market places, Function halls, Cultural programs. The floral mycoflora of *tagetes spp.* of some localities show heavy fungal load as compare to other localities. It was clear from table 1 genera *Aspergillus*, *Penicillium*, *Curvularia*, *Fusarium*, and *Cladosporium* exhibited higher incidence were founded at major localities. It was clear from the table among these five genera *Aspergillus niger*, *Penicillium lilacinum*, *Curvularia lunata*, *Fusarium fujikuroi* and *Cladosporium cladosporioides* were found dominantly during collection sites. Apart from these the incidence of *Lasiodiplodia theobromae* were distinctly seen from all localities except localities (L1, L7).

### Incidence of fungi on different stages of *Tagetes spp.*

Table 2 indicates the percentage incidence of various fungal species at four stages of *Tagetes* flowers: S1 Semi Bud, S2 - Open Bud, S3 - Bloom

Flower, S4 - Senescent Flower. Amid the recorded species, the following *Aspergillus niger*, *Penicillium lilacinum*, *Curvularia lunata*, *Lasiodiplodia theobromae*, *Fusarium fujikuroi* and *Cladosporium cladosporioides*, fungi showed dominant incidences at senescent stage (S4) had the maximum fungal diversity and incidence. At the Semi bud Stages of flower (S1) and Open bud stage (S2) recorded out of 44 fungi only 10 fungal species were observed. Semi bud flower stage shows the minimal occurrence amid the 44. It was clear from table 2 gradual increase in fungal infection were recorded as the flower matures. The observations at different flower stages dominant saprophytic genera such as *Aspergillus*, *Fusarium* and *Penicillium* were reported. Analysis of fungal occurrence during the different flower stages *Penicillium lilacinum* were found dominantly (88%) next that *Nigrospora oryzae* were found 86%, *Aspergillus niger* 86%, *Fusarium fujikuroi* 85%, recorded at senescent stage of the flower as compare to blooming stage it shows *penicillium lilacinum* 73%, *Aspergillus niger* 65%, *Nigrospora oryzae* 66%, occurrence *Fusarium fujikuroi* shows 50% fungal incidence. All fungal species appeared only from the Bloom Stage (S3) onward. S4 Stage (Senescent Flower) again showed peak fungal incidence across all listed species. The data highlights that fungal colonization begins primarily at the Bloom Stage (S3) and intensifies in the senescent stage.

## CONCLUSION

Datasets indicate that senescent stage afterword Bloom stage flowers are most vulnerable to fungal infections. *Alternaria raphani*, *Aspergillus niger*, *Aspergillus terreus*, *Cladosporium cladosporioids*, *Curvularia lunata*, *Fusarium fujikuroi*, *Lasiodiplodia theobromae*, *Penicillium lilacinum* and *Penicillium echinulatum* were found dominantly. The increased fungal incidence at the Senescent Stage (S4) may be attributed to weakening tissue integrity, higher moisture content, and sugar accumulation which favor fungal colonization. Early stages like S1 and S2 may possess natural defense compounds or less exposed floral surfaces, hence minimal infection. There is a need for advanced research focusing on the biodegradation processes of floral waste to develop sustainable and efficient floral waste management practices.

**Table 1.** Incidence of fungi on *Tagetes spp.* at different locations

Sl. No.	Name of fungi	Locations									
		L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
1	<i>Alternaria cheiranthi</i>	+	-	-	+	-	-	+	-	-	-
2	<i>Alternaria dianthicola</i>	-	-	+	-	+	-	-	+	+	+
3	<i>Alternaria dianthi</i>	+	+	-	+	-	+	-	+	-	-
4	<i>Alternaria limasiformis</i>	-	+	-	-	+	-	+	-	+	+
5	<i>Alternaria longipes</i>	+	-	+	-	+	-	-	-	+	+
6	<i>Alternaria raphani</i>	+	+	-	+	+	+	-	+	+	-
7	<i>Aspergillus acidus</i>	-	-	+	-	-	+	+	+	-	+
8	<i>Aspergillus aculeatus</i>	-	+	+	-	-	-	-	-	-	-
9	<i>Aspergillus brasiliensis</i>	-	-	+	-	+	-	-	-	-	-
10	<i>Aspergillus carbonarius</i>	+	-	+	+	-	-	+	+	-	+
11	<i>Aspergillus eucalypticola</i>	-	+	-	-	+	+	-	+	+	-
12	<i>Aspergillus flavus</i>	+	-	+	+	-	+	-	+	-	+
13	<i>Aspergillus fumigatus</i>	+	+	-	+	+	-	+	-	+	+
14	<i>Aspergillus nidulance</i>	+	+	-	-	+	+	+	+	-	-
15	<i>Aspergillus niger</i>	+	+	+	-	+	+	+	+	+	+
16	<i>Aspergillus oryzae</i>	+	-	-	+	-	-	+	-	+	-
17	<i>Aspergillus paraciticus</i>	+	-	+	-	+	+	-	+	+	-
18	<i>Aspergillus sydowii</i>	-	+	+	+	-	-	+	+	-	+
19	<i>Aspergillus terreus</i>	+	+	+	-	+	+	+	-	+	+
20	<i>Aspergillus tubengensis</i>	-	+	-	+	+	-	-	+	+	+
21	<i>Aspergillus ustus</i>	+	-	+	+	-	+	-	+	-	-
22	<i>Aspergillus versicolor</i>	-	+	+	-	+	-	+	-	-	-
23	<i>Cladosporium chlorocephalum</i>	-	-	+	-	-	+	-	-	+	+
24	<i>Cladosporium cladosporioids</i>	+	+	-	+	+	-	+	+	+	+
25	<i>Cladosporium sphaerospermum</i>	+	-	+	-	+	+	-	-	+	+
26	<i>Cladosporium oxysporum</i>	+	+	-	+	+	-	+	+	-	-
27	<i>Curvularia brachyspora</i>	+	-	-	+	-	+	-	-	+	-
28	<i>Curvularia lunata</i>	-	+	+	-	+	+	+	+	+	+
29	<i>Curvularia ovoidea</i>	+	+	+	+	-	+	-	-	+	-
30	<i>Fusarium fujikuroi</i>	-	+	+	+	+	+	+	+	+	+
31	<i>Fusarium oxysporum</i>	+	+	-	+	+	-	+	-	+	-
32	<i>Fusarium poae</i>	-	-	-	-	+	+	-	-	-	-
33	<i>Helminthosporium hawaiiensis</i>	+	-	-	+	-	-	-	-	-	-
34	<i>Lasiodiplodia theobromae</i>	-	+	+	+	+	+	+	-	+	+
35	<i>Microphomina phaseolina</i>	-	+	-	+	-	-	-	-	-	+
36	<i>Nigrospora oryzae</i>	+	+	+	+	-	+	+	+	+	+
37	<i>Nigrospora sphaerica</i>	-	+	-	-	+	-	+	+	-	+
38	<i>Penicillium echinulatum</i>	+	+	+	-	-	+	+	+	+	+
39	<i>Penicillium expansum</i>	-	+	-	+	+	-	+	-	-	+
40	<i>Penicillium crysogenum</i>	+	-	+	-	-	+	+	-	+	-
41	<i>Penicillium corylophilum</i>	+	-	-	+	+	-	-	+	-	+
42	<i>Penicillium lilacinum</i>	-	+	+	+	+	+	+	+	+	-
43	<i>Penicillium maximae</i>	+	-	+	-	-	+	-	+	+	-
44	<i>Rhizopus stolonifer</i>	-	+	-	+	-	-	+	+	+	+

(L1, L2=Function halls, L3=Community centers, L4, L5= Aesthetic places, L6= Decoration sites, L7=Market places, L8, L9=Function halls, L10=Cultural programs)

**Table 2.** Incidence of fungi on *Tagetes spp.* at different stages

Sl. No	Name of fungi	Semi Bud (S1)	Open Bud (S2)	Bloom Flower (S3)	Senescent Flower (S4)
1	<i>Alternaria cheiranthi</i>	-	-	15%	35%
2	<i>Alternaria dianthicola</i>	-	-	19%	50%
3	<i>Alternaria dianthi</i>	-	-	40%	52%
4	<i>Alternaria limasiformis</i>	-	-	35%	50%
5	<i>Alternaria longipes</i>	-	-	45%	54%
6	<i>Alternaria raphani</i>	1%	3%	60%	75%
7	<i>Aspergillus acidus</i>	-	-	42%	50%
8	<i>Aspergillus aculeatus</i>	-	-	15%	24%
9	<i>Aspergillus brasiliensis</i>	-	-	17%	25%
10	<i>Aspergillus carbonarius</i>	-	-	45%	57%
11	<i>Aspergillus eucalypticola</i>	-	-	34%	48%
12	<i>Aspergillus flavus</i>	-	-	55%	61%
13	<i>Aspergillus fumigatus</i>	-	-	45%	59%
14	<i>Aspergillus nidulance</i>	-	-	48%	63%
15	<i>Aspergillus niger</i>	2%	10%	65%	86%
16	<i>Aspergillus oryzae</i>	-	-	28%	42%
17	<i>Aspergillus paraciticus</i>	-	-	53%	61%
18	<i>Aspergillus sydowii</i>	-	-	55%	60%
19	<i>Aspergillus terreus</i>	1%	5%	58%	80%
20	<i>Aspergillus tubengensis</i>	-	-	45%	64%
21	<i>Aspergillus ustus</i>	-	-	27%	49%
22	<i>Aspergillus versicolor</i>	-	-	30%	45%
23	<i>Cladosporium chlorocephalum</i>	-	-	38%	45%
24	<i>Cladosporium cladosporioids</i>	1%	3%	60%	79%
25	<i>Cladosporium sphaerospermum</i>	-	-	54%	60%
26	<i>Cladosporium oxysporum</i>	-	-	36%	62%
27	<i>Curvularia brachyspora</i>	-	-	31%	45%
28	<i>Curvularia lunata</i>	2%	8%	68%	83%
29	<i>Curvularia ovoidea</i>	-	-	53%	60%
30	<i>Fusarium fujikuroi</i>	1%	5%	60%	85%
31	<i>Fusarium oxysporum</i>	-	-	41%	65%
32	<i>Fusarium poae</i>	-	-	17%	21%
33	<i>Helminthosporium hawaiiensis</i>	-	-	15%	23%
34	<i>Lasiodiplodia theobromae</i>	3%	7%	68%	82%
35	<i>Microphomina phaseolina</i>	-	-	26%	35%
36	<i>Nigrospora oryzae</i>	1%	5%	66%	86%
37	<i>Nigrospora sphaerica</i>	-	-	40%	51%
38	<i>Penicillium echinulatum</i>	3%	7%	78%	84%
39	<i>Penicillium expansum</i>	-	-	40%	55%
40	<i>Penicillium crysogenum</i>	-	-	40%	55%
41	<i>Penicillium corylophilum</i>	-	-	46%	55%
42	<i>Penicillium lilacinum</i>	1%	5%	73%	88%
43	<i>Penicillium maximae</i>	-	-	47%	55%
44	<i>Rhizopus stolonifer</i>	-	-	60%	65%

- = Absent (0%), + = Minimum (1-25%), ++ = Moderate (25-50%), +++ = Maximum (50-75%), Abundant ++++ (>75%)

## Conflicts of Interest

Authors declare that there is no conflict of interests regarding the publication of this paper.

## References

- [1] Ahluwalia, I. J., & Patel, U. (2018). *Solid waste management in India: An assessment of resource recovery and environmental impact* (Working Paper No. 356). Indian Council for Research on International Economic Relations (ICRIER).
- [2] Anastasi, A., Varese, G. C., & Marchisio, V. F. (2005). Isolation and identification of fungal communities in compost and vermicompost. *Mycologia*, 97(1), 33–44. <https://doi.org/10.1080/15572536.2006.11832861>
- [3] Ellis, M. B. (1971). *Dematiaceous Hyphomycetes* (1st ed.). CAB International.
- [4] Gilman, J. C. (2001). *A manual of soil fungi* (2nd Indian ed.). Biotech Books.
- [5] Jadhav, A., Chitanand, M., & Shete, H. (2013). Flower waste degradation using microbial consortium. *Journal of Agriculture and Veterinary Science*, 3(1), 1–4.
- [6] Joyce Madalene, P., Pavan Kumar, A., Raghavi, K. V., & Kiruthika, S. A. (2023). Degradation of flower waste using microbial consortium: An approach towards environmental sustainability and waste management. *International Journal of Creative Industries*.
- [7] Mukadam, D. S., Patil, M. S., Chavan, A. M., & Patil, A. R. (2006). *The illustration of fungi* (1st ed.). Akshar Ganga Prakashan.
- [8] Mulay, Y., Owai, S., Chougule, P., & Pandit, A. (2020). Composting of floral waste by using indigenously isolated microbial consortium: An approach towards environment sustainability and waste management. *International Journal of Environmental & Agriculture Research (IJOEAR)*. <https://ijoeear.com>
- [9] Pappu, A., Saxena, M., & Asolekar, S. R. (2007). Solid waste generation in India and their recycling potential in building materials. *Building and Environment*, 42(6), 2311–2320. <https://doi.org/10.1016/j.buildenv.2006.04.015>
- [10] Shouche, S., Bhati, P., Nema, Z., & Jain, S. K. (2014). Mycobiota of decomposing floral waste materials. *Asian Journal of Microbiology, Biotechnology and Environmental Sciences*, January.
- [11] Singh, J., & Kalamdhad, A. (2013). Effect of rotary drum on the specification of heavy metals during the water hyacinth composting. *Environmental Engineering Research*, 18, 177–189. <https://doi.org/10.4491/eer.2013.18.3.177>
- [12] Vijayagiri, R. C., & Mamidala, E. (2012). Ethnobotanical investigations among traditional healers in Warangal district of Andhra Pradesh, India. *Pharmacognosy Journal*, 4(34), 13–17.
- [13] 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/s12649-016-9788-8>
- [14] 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. In *Proceedings of the International Forestry and Environment Symposium* (pp. 65). Department of Forestry and Environmental Science, Sri Lanka.