

Breakdown of Disposable Face Mask Waste mixed with *Lagerstroemia speciosa* Leaves to Analyse the Growth of *Eisenia fetida*, Reproduction rate, and NPK level in the various compost media

Comment [AT1]: Too long for a title. Consider reducing it to a shorter and simpler, but still captures the main idea of the paper.

ABSTRACT

The *Lagerstroemia speciosa* is an ornamental and medicinal plant commonly known as crape myrtle, comes under the family Lythraceae. It is popularly known as Poomaruthu. Wearing a disposable non-medical mask is one of the preventive measures recommended by health organisations to reduce the spread of COVID-19. There are some practical difficulties with the decomposition of face masks. These practical difficulties arise due to the presence of synthetic materials in the masks, which can take hundreds of years to decompose and can release harmful chemicals into the environment during the process. *Eisenia fetida* are the most common and widely used composting worms. Red wigglers eat most kinds of food scraps, including fruits and vegetables. It is important to note that red wigglers do not consume meat or dairy products. Before composting, the facemask was cut into small pieces and mixed with BioMonas and Shield Plus. The main aim of the experiment is to reduce the soil Eco-toxicity, and the study was made to study the medicinal and composting properties of *Lagerstroemia speciosa* on a facemask, the increased degradation rate, and the effect of the compost on plant growth. The experimental design was set up for 65 days. The results showed that the medicinal plant had a significant effect on the growth and reproductive rate of red wigglers, and this effect was positively correlated with the NPK level in the soil.

Comment [AT2]: Need revisions in terms of:

- 1.Statement of the main objective or research question.
- 2.Should provide a concise summary of the methods used.
- 3.Should highlight the main results and findings.
- 4.Should end with a brief discussion of the implications or applications of the results.

Key words: *Lagerstroemia speciosa*, COVID-19, *Eisenia fetida*, eco-toxicity.

Comment [AT3]: Keywords should be a minimum of five for a more indexing and browsing purposes.

1. INTRODUCTION

Medicinal Plants contain high amounts of specific minerals that are used to enrich the fertility of the soil. Waste materials of medicinal plants help to increase the specific mineral content. The plants used were Neem cake, Citrus lemon (Dawoud & Eweis, 2006), Eucalyptus and Lemon grass (Abd-El-Khair & Omima 2006). These medicinal plants contain many substances as antibiotics, antiseptics, phenolic compounds, alkaloids (Bhonde *et al.*, 1999), tannins, volatile oils, triterpenoids (Johnson *et al.*, 1999), antibacterial, antifungal (Steinhauer, 1996; Murthy & Sirsi, 1957) and antiviral compounds (Rao *et al.*, 1969). The ornamental and medicinal plant commonly known as crape myrtle, *Lagerstroemia speciosa* comes under the family Lythraceae. It is popularly known as Poomaruthu and is native to Southeast Asia, but has been introduced to many other parts of the world due to its attractive flowers and usefulness in traditional medicine.

Wearing a disposable non-medical mask is one of the preventive measures recommended by health organisations to reduce the spread of COVID-19. Bacteria, skin flakes, and toxic substances are found inside the dirty masks. There are some practical difficulties with the decomposition of face masks. These practical difficulties arise due to the presence of synthetic materials in the masks, which can take hundreds of years to decompose and can release harmful chemicals into the environment during the process. Therefore, proper disposal and recycling of face masks are crucial for minimising their negative impact on the environment. For safety purposes, we use the unused facemask for our experimental work. Additionally, the facemask should be disposed of properly after use to prevent contamination.

Eisenia fetida are the most common and widely used composting worms. Red wigglers eat most kinds of food scraps, including fruits and vegetables. It is important to note that red wigglers do not consume meat or dairy products. A mature worm produces one cocoon on every third day and one to three baby worms emerge from each cocoon for hatching after three to four weeks of incubation. *E. fetida* is an earthworm which grows rapidly (Neuhauser *et al.*, 1980), reproduces prodigiously (Hartenstein *et al.*, 1979), and is potentially deployable for management of wastes rich in microbial biomass (Hartenstein, 1981). The increase of temperature resulted from rapid breakdown of readily available organic matter and nitrogenous compounds (Chan *et al.*, 2016). Vermicomposting has also been found to have positive effects on some aromatic and medicinal plants (Anwar *et al.*, 2005; Prabha *et al.*, 2007).

2. MATERIALS AND METHODS

2.1 Collection and identification of the experimental plant

The experimental plant *Lagerstroemia speciosa* is collected at Golpalapuram village, Chittur block, Palakkad district of Kerala state, India. The *L. speciosa* was identified and authenticated at Botanical Survey of India, Coimbatore – 03. (No: BSI/SRC/5/23/2020/Tech/ 237).

2.2 Processing of Experimental Plant

The collected leaf samples were completely chopped, dried for seven days and weighed. After scorching, the leaf was weighed again, and the dry weight was 2.200 kg. The dried leaf was used in T4 and T5 Trials.

2.3 Collection of Kitchen waste

Kitchen waste is organic in nature that decomposes quickly, producing foul odours and attracts rodents and insects. Management of kitchen waste reduces or eliminates adverse impacts on land, contamination of the atmosphere, soil and water. Kitchen waste collected from the ladies' hostel and college canteen, Government Arts College, Coimbatore - 18. The collected kitchen wastes were prepared for compost. The total trash weight was 7kg.

2.4 Pre-composting of Experimental Sample

Comment [AT4]: It could be improved to make the study more significantly contributing to the existing knowledge and to make the research question clearer and more appropriate.

For example:

1. Mention the global scale and impact of face mask waste on the environment and human health, and the need for finding effective and sustainable solutions for its disposal and recycling.
2. The research question can be, how does adding *Lagerstroemia speciosa* leaves to different compost media containing face mask waste affect the growth and reproduction of *Eisenia fetida* earthworms, and the nutrient content and quality of compost?
3. Use references not later than ten years.

Comment [AT5]: Methods section of the research paper has some strengths but also many weaknesses that could affect the validity and reliability of the results. It could be improved by providing more details such as:

1. Specify the exact amount and ratio of the compost materials used in each trial.
2. Explain the methods of measuring the weight, length, cocoon production, and hatching success of the earthworms.
3. Mention the tools or instruments used for measuring the pH, temperature, moisture, nitrogen, phosphorus, and potassium levels of the compost.
4. Provide the sources or references for the Bio Monas, Shield Plus, and VAM products used for pre-composting.

The experimental methods are not adequately described and replicable, as some important information is missing or unclear, such as:

1. The criteria or procedure for selecting and sorting the earthworms before adding them to each trial.
2. The frequency and method of sprinkling water to maintain the moisture content of the substrate.
3. The method of hand sorting and weighing the earthworms every 15 days.
4. The method of transferring and incubating the cocoons for hatching success measurement.

The statistical analysis is appropriate for comparing the mean values of different parameters among different trials. However, some details or explanations are lacking or incorrect, such as:

1. The use of one-way ANOVA for comparing more than two groups is correct, but it should be followed by a post-hoc test (such as Duncan's Multiple Range Test) to identify which groups are significantly different from each other.
2. The use of mean \pm SEM (standard error of mean) is correct for expressing variability within each group, but it should be accompanied by sample size (n) to indicate how many observations were used to calculate each mean value.
- 3.

The experimental Sample was taken into two types of unused facemask. The total weight of the mask bits is around 250g. For simple composting the mask cut into small pieces and then soaks into the plain water for 24 hours. The soaked mask bits are mixed with BioMonas and Shield Plus. This was allowed for pre-composting for 40 days. The partially composed mask bits were used in Trial T3 and T4.

2.5 Collection of bedding materials

For composting purpose, the collection of coir pith, cow dung and yard soil are used as a bedding material.

2.6 Experimental animal

Earthworms are considered as natural bioreactors which proliferate along with other microorganisms and provide required conditions for the biodegradation of waste. The earthworm *Eisenia fetida* was purchased from the Vermigold organics (ESTD. 2004) (G5GC+W63) Aanaimalai - Dhali road, Udumalpet, Tamil nadu 642132, India. The *Eisenia fetida* is commonly called red wriggler or red worm. The *E. fetida* is a well-adapted, short-life span species with a high reproduction rate.

2.7 Rice Wash Water

Rice wash water can be beneficial for simple composting because it contains minerals and nutrients. Fermenting the rice water can also help to promote healthy bacterial growth to increase the moisture in the compost.

2.8 Experimental Design

The control is T1, which consists of yard soil, and the kitchen waste (KWCO) along with compost bedding materials is placed in T2. Likewise, T3 (KWCU) contains mask bits and trash. The substrates for vermicomposting were prepared by mixing 250 g of *L. speciosa* in the two types of trials: T4 consisted of experimental plants mixed with compost bedding material (LSCO), and T5 consisted of experimental plants mixed with experimental samples (LSCU) along with compost bedding materials. The rice wash water is used to maintain the moisture content of the substrate at 60–65% for a period of time to facilitate the preliminary decomposition of materials. After an undisturbed 7-day composting period, the content in the replicates was mixed, and moisture content was checked along with earthworm activity. After that period, 20 adult worms were added to each trial. All the experimental setup was carried out at the PG and Research Toxicology Lab, Department of Zoology, Government Arts College, Coimbatore.

2.9 Growth and Reproduction Rate

Every 15 days over a period of 65 days, the worms were hand sorted and weighed. The weight of earthworms was measured weekly in each container to decide the growth performance. Earthworms were hand sorted and weighed weekly to measure their growth performance. Cocoon production was observed weekly and the total number of cocoons was recorded. 10 freshly laid cocoons were transferred to plastic boxes to determine hatching success.

2.10 Parameters

Composting requires moisture, microbial activity, aerobic conditions, temperature, pH, and the weight method to determine the fertility rate of the soil.

2.11 Statistical analysis

Statistical significance ($P=0.05$) is determined by one-way ANOVA, and values are shown as the mean \pm SEM. The earthworm growth and reproduction were compared with using one way analysis of variance.

3. RESULTS

3.1 Result 1

Pre-composting: The experimental sample is an unused face mask made of polypropylene. It also consists of micro plastics. Before experimental work, the mask bits are mixed with BioMonas and

Comment [AT6]: Use descriptive labels for the subsections rather than simply numbering them as "Results 1," "Results 2," etc. Descriptive labels provide more information about the content of each subsection and make it easier for readers to navigate and understand the results.

Shield Plus, and allowed to decompose for 15 days. This helps to avoid overheating in the vermicomposting system.

3.2 Result 2

Growth and Reproduction: The length and weight of the worms determine the growth rate. At that time, worm pairs attained an average weight of about 1.69 g. The growth rate of *Eisenia fetida* was significantly higher ($P < 0.05$) in T4. The reproduction rate of each trial varies; it depends on the compost materials. The reproduction rate is greater in T4 and lower in T1. The T5 shows a high level but is a little lower than the T4. The juveniles are low numbers in T2 and T3 trials.

3.3 Result 3

NPK Level: The nitrogen level $413.2 \pm 2.90^{**}$ is highest in T4 and T3 is 404.3 ± 1.78 . Low in T1 336.6 ± 2.84 trial, moderate in $376.3 \pm 3.13^{**}$ T2 trial and T5 consist of $372.3 \pm 2.59^{**}$. The Phosphorus is commendably high in T5 $1011.3 \pm 2.59^{**}$ and T1 contains 992.3 ± 3.06 . The moderate amount is in T4 $894.3 \pm 2.22^{**}$. The lowest level of P $623 \pm 2.94^{**}$ is in T2 and T3 contain $676.6 \pm 2.88^{**}$. The potassium amount is varies in each trials. T1 is the most prominent amount of Potassium, and the level of K is 1900.3 ± 1.18 . The kitchen waste T2 trial produced $1840.6 \pm 2.37^{**}$ and the amount of K is in $1670.3 \pm 1.18^{**}$ T4. The most important face mask blue and black colour samples is mixed with kitchen waste T3 produces $1700 \pm 3.77^{**}$ and medicinal Plant T5 which produces $1569.3 \pm 2.84^{**}$.

3.4 Result 4

Parameters: The optimum level of pH is in T2 and T4. The pH of T2 consist kitchen waste and trash produce 7.17 ± 0.04 and the medicinal plant of *L. speciosa* dried leaf produces 7.21 ± 0.01 pH in T4 Trial. The Yard soil T1 produce 7.42 ± 0.08 pH, the experimental samples of T3 and T5 produces 7.32 ± 0.04 and 7.31 ± 0.02 pH level. In the initial stage the oxygen demand is higher, so the development of microorganism is high. Temperature is an essential component of composting. As organic material decomposes, heat is produced. Increased temperature results in increased rate of biological activity. The moisture content of 70%–80% was retained by sprinkling water daily in the beddings.

3.5 Result 5

Quality and Quantity of Organic Manure: The quality of the compost determines the fertility rate of the soil. The weight method is used to calculate the quantity of the compost. Vermicomposting is the conversion of organic waste through the synergistic actions of epigeic earthworms and bacteria. Co-composting with cattle dung helped to improve their acceptability for *E. fetida* and also improved their physico-chemical characteristics. The highest survival, maximum weight, and population build-up of *E. fetida* were determined by observing growth rate, weight, mortality, cocoon production rate, and population build-up.

Table 1. Reproduction rate of different compost media

Comment [AT7]: Table label should be left aligned

Trails	Before	After
I	25±1.53	380±2.52
II	25±3.79	451±4.00
III	25±2.08	419±4.51
IV	25±2.65	563±5.51
V	25±2.08	508±3.51
SEd		2.80079
CD (p<0.05)		5.84237**

Values are mean ± SD of three values in each column

** - Significant at 1% level (p<0.01)

Fig. 1. Reproduction rate of different compost trails

Comment [AT8]: Figure label should be situated under the figure

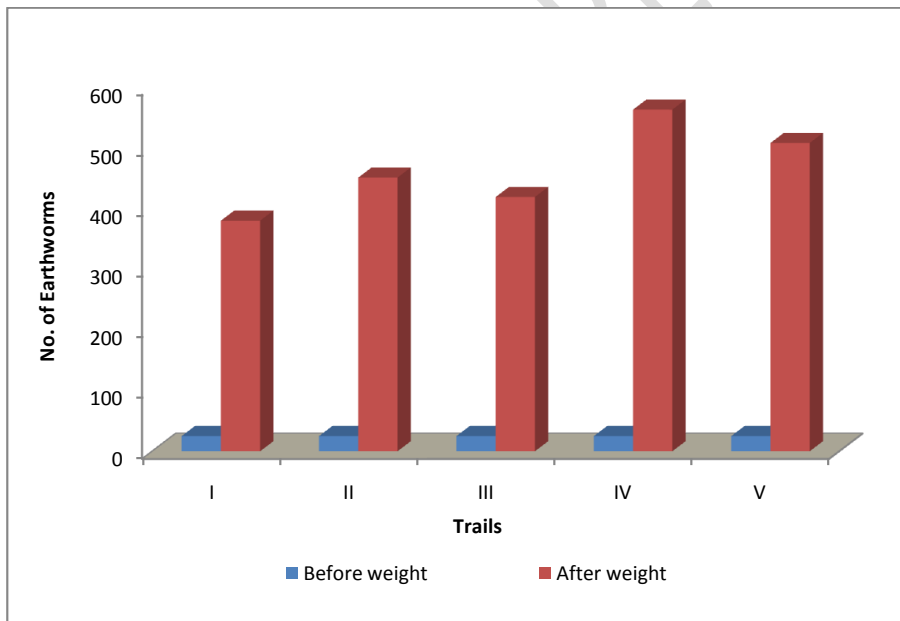


Table 2. pH and NPK analysis of compost media

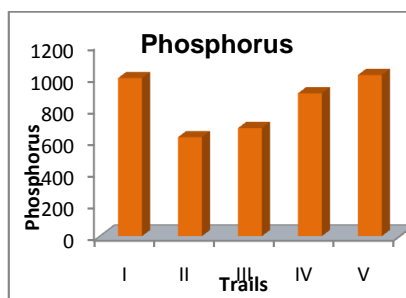
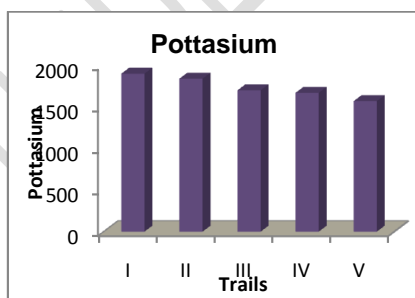
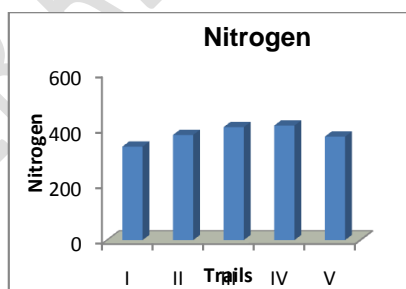
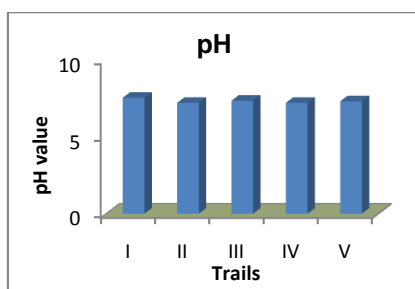
Comment [AT9]: Follow the same instruction for as commented for the table labels format

Trails	pH	Available 'N'	Available 'P'	Available 'K'
I	7.53±0.40	336±3.51	992±2.52	1900±3.51
II	7.2±0.30	378±4.51	621±2.52	1840±3.00
III	7.34±0.35	406±3.00	678±3.00	1700±3.51
IV	7.2±0.30	411.6±5.01	896±2.52	1670±3.51
V	7.3±0.35	372±4.51	1011±2.52	1570±3.51
SEd	0.2802	3.4082	2.1396	2.7889
CD (P<0.05)	0.6243 ^{ns}	7.5940 ^{**}	4.7673 ^{**}	6.2140 ^{**}

Mean ± SEM. Mean in a column followed by a same letter (s) are not significantly (P>0.05) different according to Duncan's Multiple Range Test. ** Significant at P<0.05 respectively; ns – non significant

Fig. 2. pH and NPK analysis of compost media

Comment [AT10]: Follow the same instruction for as commented for the figure labels format



4. DISCUSSION

Pre-composting of organic waste (Nair et al. 2006; Frederickson et al. 2007) for ten days was done by mixing the organic material with cattle manure. This process partially digests the material and avoids the thermophilic stage. Pre-composting is a process to sanitise and reduce the production of heat during the decomposition process. The experimental sample is an unused face mask made of polypropylene. It also consists of micro plastics. Before experimental work, the mask bits are mixed with VAM and allowed to decompose for 15 days. This helps to avoid overheating in the vermicomposting system. For simple composting, the unused face mask is allowed 15 days to decompose. The weight gain was followed by weight loss by the time of the study's completion. The weight loss might be associated with the depletion of food (Radaei M., 2016). Jesikha and Lekshmanaswamy (2013) reported a related pattern of weight loss when earthworms attained sexual maturity because earthworms utilise the energy for reproduction purposes such as copulation, cocoon formation, and egg laying. Earthworm's bio accumulates toxic organic residues into their tissue, feeding on organic waste material.

Master of Variable is called Soil pH, it is the third and last component of healthy soil, and affects the availability of nutrients and minerals in the soil, as well as how well a plant can access, absorb, and regulate these materials. A very high or very low soil pH will result in nutrient deficiency or toxicity, leading to poor plant growth. A pH ranging from 6.0 to 7.0 is ideal for most garden vegetables. The soil test results will make recommendations to adjust the soil pH. If your soil pH is too low (acidic), add garden lime to the bed. If your soil pH is too high (alkaline), add powdered sulphur to the soil. A soil conditioner that helps soil retains water. Nitrogen (N) promotes strong leaf and stem growth and a dark green colour. Phosphorus (P) promotes root and early plant growth. Potassium (K) promotes plant root vigour, disease and stress resistance, and enhances flavour. The optimum moisture content is between 50 and 60%. Higher moisture content may be required for composting straw and strong fibrous material. The nutrient balance is expressed as a carbon-to-nitrogen ratio (C/N ratio). Moisture is essential for composting, and rice wash water is used to maintain it. Temperature is a critical parameter, and the pH changes several times during composting. The quality of compost determines the fertility rate of the soil. Moisture content should be low to prevent anaerobic conditions, and a soil test will tell you the fertility of the soil. Compost should be black, crumbly, pH neutral, not dry, and contain more than one percent nitrogen, phosphate, and potassium (NPK).

5. CONCLUSION

Eisenia fetida's growth and reproduction depend on the availability of food sources. The dried leaf of *L. speciosa* is the best source due to its high volume of NPK and good growth and reproductive rates. Other parameters such as temperature, moisture, pH, and C/N ration also play a role. This study found that using earthworms to promote soil amelioration can significantly improve soil quality and fertility by accelerating the decomposition process and enhancing nutrient availability. The findings have implications for sustainable agriculture and environmental management practises.

REFERENCES

1. Abd-El-Khair H, Hafez OM. Effect of aqueous extracts of some medicinal plants in controlling the green mould disease and improvement of stored "Washington" Navel Orange Quality. *Journal of Applied Sciences Research*. 2006; 2(10): 664-674.
2. Bhonde SB, Deshpande SG, Sharma RN. In vitro evaluation on inhibitory nature of some neem formulations against plant pathogenic fungi. *Hindustan Antibiotic Bulletin*. 1999; 41(1-4): 22-24.
3. Dawoud MEA, Eweis M. Phytochemicals control of edible mushrooms phyto-genic bacteria. *J. Food, Agri. Environment*. 2006; 4(1): 321-324.
4. Johnson S, Morgan ED, Peiris CN. Development of the major triterpenoids and oil in the fruit and seeds of neem (*Azadirachta indica*). *Ann. Bot.* 1996; 78: 383-388.
5. Steinhauer B. Fungicidal activity of commercial neem products. Proc. 4th Workshop on Practice Oriented Results on Use and Production of Neem Ingredients and Pheromones (Bordigherra, Italy, 1994) 1996; pp. 105-108.

Comment [AT11]: 1.13 out of 16 references are obsolete.
2. Citations in the texts are not numbered, so the lists of references must not be numbered also for consistency.

6. Murthy SP, Sirsi M. Pharmacological studies on *Melia azadirachta*- Part I. Antibacterial, antifungal and antitubercular activity of neem oil and its fractions. Symp. Utilization Indian Med. Pl. 1957; Lucknow. 55 p.
7. Rao AR, Sukumar S, Paramsivam TB, Kamalakshi S, Parashuraman AR, Shantha M. Study of antiviral activity of tender leaves of Margosa tree (*Melia azadirachta*) vaccinia and variola virus. A preliminary report. Indian J. Med. Res. 1969; 57: 495.
8. Hartenstein F, Hartenstein E, Hartenstein R. Gut load and transit time in the earthworm, *Eisenia fetida*. Pedobiologia. 1981; 22: 5-20.
9. Hartenstein R, Neuhauser EF, Kaplan D. Reproduction potential of earthworm, *Eisenia fetida*. Oecologia. 1979; 43: 329-340.
10. Chan MT, Selvam A, Wong JW. Reducing nitrogen loss and salinity during 'struvite' food waste composting by zeolite amendment. Bioresour. Technol. 2016; 200, 838-844.
11. Anwar M, Patra DD, Chand S, Kumar A, Naqvi AA, Khanuja SPS. Effect of organic manures and inorganic fertilizer on growth, herb and oil yield, nutrient accumulation, and oil quality of French basil. Communications in Soil Science and Plant Analysis. 2005; 36 (1-14), 1737-1746.
12. Prabha ML, Jayraay IA, Jayraay R, Rao DS. Effect of vermicompost on growth parameters of selected vegetable and medicinal plants. Asian Journal of microbiology, Biotechnology and Environmental Sciences. 2007; 9(2), 321-326.
13. Nair J, Sekiozoic V, Anda M. Effect of pre-composting on vermicomposting of kitchen waste. Bioreso Technol. 2006; 97:2091-2095.
14. Frederickson J, Howell G, Hobson AM. Effect of pre-composting and vermicomposting on compost characteristics. Eur J Soil Biol. 2007; 43:S320-S326.
15. Radaei M, Izadi M. Response of earthworm's biomass and soil properties in different afforested type areas in the North Iran. Eurasian J Soil Sci. 2016; 5(1):47-52.
16. Jesikha M, Lekeshmanaswamy M. Effect of pongamia leaf medium on growth of earthworm (*Eudrilus eugeniae*) Int J Sci Res Publ. 2013;3(1):1-4.