

Composting The Organic Waste From The Households Using Black Soldier Fly

S. SHOBANA* and V.SARASVATHY

ICAR Krishi Vigyan Kendra, Ariyalur district, TamilNadu – 612902
Email ID – shobi.bhuvi619@gmail.com

ABSTRACT

India is facing challenges in managing household waste due to an inadequate infrastructure and awareness. About 60-70% of kitchen waste that is generated in Indian homes consists of food scraps and vegetable/fruit peels. The process of converting kitchen waste into fertilizer is known as composting. Black Soldier Fly (BSF) larvae are great at consuming kitchen waste and turning it into nutrient-rich frass. An experimental study was conducted by collecting kitchen waste of thirty seven households of Ariyalur district. The study was conducted in a same locality and all the families selected were middle income group. Out of 153.031 kg of collected kitchen wastes for 12 days, 48.05 kg of compost was produced i.e. 31.4% from waste. The research has a strong evidence on association of the two variables($P \leq 0.01$) i.e., family size and waste collected from households. The BSF larvae were then transferred to a container to attain its pupil stage which will be used as a protein rich feed for the poultry. This model of composting ecologically enriches the soil productivity and stands as a viable source of income for the farming community.

Key words: Kitchen waste, compost, poultry, organic waste, black soldier fly.

INTRODUCTION

Household waste management in India is a major issue due to the lack of proper waste segregation and inadequate solid waste management practices (Kumar et al., 2017). In Indian landfills, about 60% of the waste is organic, such as leftover food, peelings of vegetables, and livestock manure (Rochaeni, 2021). The improper management of solid waste causes pollution, fires,

landslides, and contributes to the spread of illness, malnutrition, and tuberculosis in people living near dumpsites. Processes such as composting, vermicomposting, and biomethanation of biodegradable waste are being used as the main Municipal Solid Waste (MSW) disposal methods in India (Barragan et al., 2017). Kitchen waste can be used as an excellent fertilizer for plants. Composting is a natural process that involves the decomposition of organic matter. Kitchen waste can include vegetable and fruit scraps, eggshells, tea bags, and coffee grounds. By composting kitchen waste, we can reduce the amount of waste going to landfills and also create a nutrient-rich fertilizer for your plants. Composting is done at home using a compost bin or pile, or through a community composting program. It is a simple and effective way to reduce waste and help the environment.

Organic waste that decomposes without the presence of oxygen produces methane. Indian landfills, about 60% of the waste is organic, such as leftover food, peelings of vegetables, livestock manure, etc. However, the lack of segregation of organic material at the source and the failure to use the waste for composting is a massive setback in solid waste (Agarwal and Nag, 2013). It is estimated that 0.3 to 0.4 million metric tons of solid waste are generated in rural areas per day. Organic waste constitutes about 60–80 per cent of this waste (Arivazhagan et al., 2012).

Making kitchen waste into compost is important for several reasons. Firstly, it reduces the amount of waste going to landfills, which helps to reduce greenhouse gas emissions and pollution. Secondly, composting is a natural process that turns organic waste into nutrient-rich fertilizer that can be used to enrich soil and promote healthy plant growth. This reduces the need for chemical fertilizers, which can harm the environment and human health (Dutta, 2017). Additionally, composting can be done at home, making it a cost-effective and convenient way to manage household waste. Overall, composting is a sustainable and eco-friendly way to manage kitchen waste. BSF larvae are voracious eaters and can consume up to twice their body weight in food every day. They also have a high protein content, making them a viable source of animal feed.

Composting is a great way to manage household waste, especially kitchen waste. It not only helps to

reduce the amount of waste that goes to landfills but also produces a nutrient-rich fertilizer that can be used in gardens and farms. In rural areas, women have traditionally been the ones responsible for managing household waste. By making compost at home using waste, they can not only contribute to a cleaner and healthier environment but also produce their own fertilizer for their farms or gardens (Mudgal, 2015). Composting is a simple process that involves layering kitchen waste with dry leaves, soil, and water, and letting it decompose over time. With proper management, composting can be done in small spaces and can benefit both the environment and the community.

India is among the top five chicken and egg producers in the world. One of the factors that determine sustainability of the sector and economic viability of the business for small poultry farmers, is the quality, quantity and cost of feed. Feeds account for up to 70 per cent of the entire cost of poultry production (Abd El-Hack et al., 2020). The larvae of black soldier fly (*Hermetia illucens*), have a high nutritional value and are easy to raise for poultry feed.

METHODOLOGY

The study was conducted from February 2021 to March 2021 in ICAR Krishi Vigyan Kendra of Ariyalur district. Forty households in a similar locality were selected for the study using purposive sampling method. The criterion on selection of household was all the samples chosen for the study belong to middle income group with minimum of one to maximum of four members in the family. Among the forty households selected only thirty seven households cooperated for the study regularly by collecting wastes from households. Thus, thirty seven samples were presented in the study. Information on the characteristics of households was gathered along with primary data collection with regards to the kitchen waste generated in each of the selected household in the study area. An experimental research was conducted to understand and assess the bioconversion of kitchen waste into compost using Black Soldier Fly. The association between family size and waste generated was analyzed using chi-square test. Variables used for testing this hypothesis are number of members in the families (independent) and waste collected (dependent). Chi square test was formulated in testing the association

between two variables. The study comprises of testing of the hypothesis.

H0: The number of family members has no effect on the wet waste collected from the households.

H1: The number of family members has a positive effect on the wet waste collected from the households .

RESULT AND DISCUSSION

Table 1 depicts the general detail of the family heads in the thirty seven households. The mean age of the respondents was 36 years old. All were literate and ninety two percent of them had completed graduation. Among them ten percent completed under graduation course followed by sixty eight percent completed post graduation and fourteen percent completed doctoral degree. This showed that the researcher had focused on specifically selecting households with educated background to perfectly conduct the experiment with more conscious group. Fifty nine percent of the households had four members in their family, twenty five percent of the families had more than four members in their households and sixteen percent had less than two family members.

The monthly income of the households ranged from Rs.35000- Rs.100000. In which, eighty one two percent of the households had a monthly income of more than Rs.60000, eleven percent had income of Rs.40000-60000 and eight percent had income of less than Rs.40000/month. This shows that all the households belonged to middle income group families.

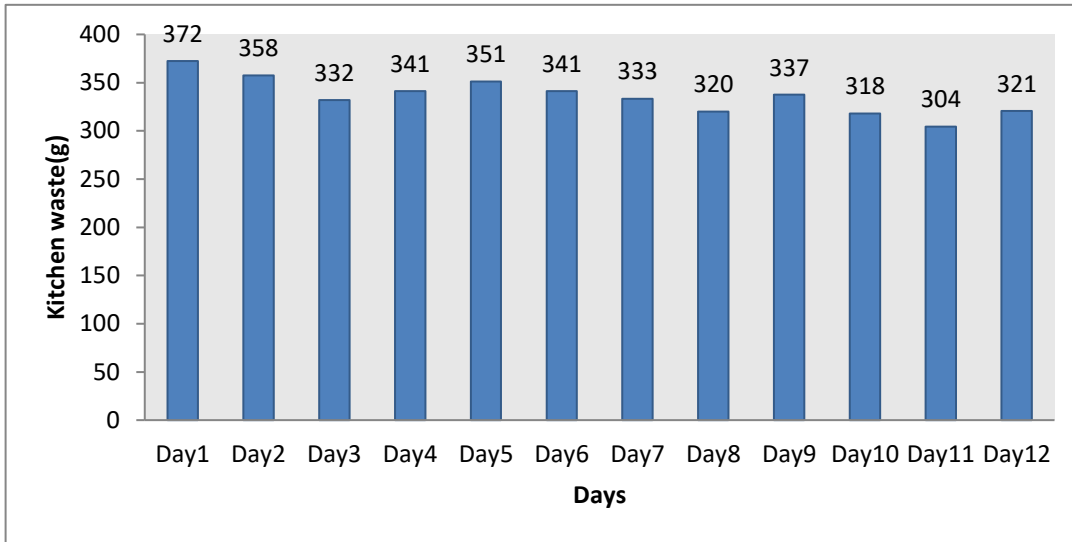


Fig 1: Average kitchen wet waste collected in households

Twelve day duration was selected for the study in collecting kitchen waste in the households. The types of kitchen wastes collected were both cooked and raw wastes that includes onion peels, egg shell, garlic peel, vegetable waste, citrus fruit waste, cooked curry leaves, tomato, onion left overs, non vegetarian wastes like fish, chicken bones, spoiled vegetables, cooked food.



Fig 2: Kitchen wastes collected into the barrel

Daily waste was collected in the bin and initially measured using a weighting scale before collecting in the plastic container. The data showed that the waste collected ranged from 3.04 kg to 3.72 kg on day basis and on an average household with 2-4 members had maximum of 450 g /day as waste households with more than four members had maximum of 600g/day as waste

and family with less than two members had very minimal wastes of 75 g/day and some days they did not cook and waste generated was zero. The total wet waste collected for the 12 day duration was 153.031 kg wet waste from kitchen in all the thirty seven households in the study.

The family size was categorized as less than 2 members, 2-4 members and more than four members and the average wet waste collected was grouped as less than 100g, 100-300g, 301-500g and more than 500 g as presented in the table 2. These two categorical variables were analysed for association and it was found that there was a highly significant association ($P < 0.01$) between the two variables i.e., the family size and the wet waste collected from the households. It was also observed that there is a highly significant increase (positive correlation) in the waste collected as the family size increased. This provides that rejection of null hypothesis (H_0) and concludes that the research has a strong evidence on association of the two variables i.e., family size and waste collected from households.

Method of producing compost using the waste generated at households

Producing compost using kitchen waste generated at households is a simple and natural process, and using Black Soldier Fly (BSF) larvae it is made viable. BSF larvae are great at consuming kitchen waste and turning it into **nutrient-rich frass**, (the excrement of insect larvae) which can be used as fertilizer. A container or bin was set up with holes for ventilation as shown in figure 3 a). The bin was filled with kitchen waste, such as fruit and vegetable scraps, eggshells, and coffee grounds as in figure 2. The total waste wet waste collected from the households for duration of 12 days was pooled in a plastic container. On the 15th day, a batch (100 larvae) of 15 days old BSF larvae (figure 3 b) with a growth length of 1cm – 2cm was introduced into the bin.



- a) Composting container
- b) BSF larvae

Fig 3: Mini set up for collecting waste and composting using BSF

The waste with the larvae was stirred well. After 15 days of experimentation treatment with the BSF larvae, the wastes had decomposed into crumbling, soil like substrate (figure 4). It was ensured that the plastic bin was kept moist and in a warm, shaded area. This compost produced can be used to enrich soil and promote healthy plant growth.



Fig 4: Compost produced on 15th day

There was a significant amount of compost produced from 153.031 kg of wastes. 48.05 kg of compost was harvested in the experiment accounting to 31.4 percent gain. It is economically substituting a huge amount of gain for the consumers mainly for the farm women who use compost in their farm lands in order to enhance the soil productivity. The cost of organic compost is Rs.20/kg in local markets of Ariyalur district. This method of producing compost stands as a viable income generating method for farming community and thereby initiating an enterprise of compost marketing in future.

Viable feed for poultry



Fig 5: Pre-pupae of BSF collected in transfer container after composting

Using BSF larvae to produce compost from kitchen waste is a natural and sustainable way to manage organic waste and reduce the amount of waste going to landfills. In rural areas, women can make compost at home using waste, contributing to a cleaner and healthier environment and producing their own fertilizer for their farms or gardens. As the compost production was completed, the BSF larvae crawled out and entered into the transfer container provided it gets transformed into its next stage, namely pre-pupal stage as shown in figure 5. This can be used for poultry as a rich supplementary protein feed.

CONCLUSION

Organic compost production through kitchen waste enhances the soil productivity when used as fertilizer in agriculture. This experimental study on the production of compost using BSF larvae in thirty seven households of Ariyalur district is a model in developing organic compost. All the households belonged to middle income group and the experiment was conducted by collecting kitchen waste of 153.031 kg for 12 days. The collected waste was introduced to BSF larvae and compost of 48.05 kg was formed by a fifteen day treatment. There was 31.4 percent gain in production of compost through this method. The BSF larvae thus developed to a pre-pupal stage forming a viable feed for poultry. This experimental study stands as a strong evidence to self reliant society method of compost production for own lands by farmers. In addition to it, it supports that farm women to produce own feed for poultry and thus leading to a sustainable income generation through waste management.

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