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Research Article

UTILIZATION OF HOUSE HOLD REFUSE-LAB SCALE COMPOST DEMONSTRATION

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ABSTRACT

The process of composting house hold refuse- fruits, vegetable and food waste (FVFW) has been studied using four different combination condition for formation of the compost; Perforated plastic vessel was designed as a complete house hold Aerobic Compost Reactor(ACR) - Aerobic compost reactor covered by plastic bins provided with insect screen fixed for ventilation with lid. First group ACR – for composting FVFW with compost accelerator microbes (ACR-CA), second group FVFW with cow dung (ACR-CD) and Third group FVFW- cow dung with soil mixture (ACR-CDS), and fourth group FVFW with water sprinkled (ACR-W). The ACR were loaded with FVFW waste for 7 days and then allowed for 65 days for compost maturation. Composting is a controlled process comprises mesosphilic and thermophilic phases involving numerous microbial communities. All the four combinations of ACR values of temperature ranged from 22.8*c to 68.6*c, maximum temperature was recorded on twentieth day in ACR-CD and ACR-CDS. The compost/mulch was analyzed at two stages, on 30th and 65 days, the physical and chemical characteristics of compost are determined. The results suggests ACR-CA, ACR-CDS found more efficient combination for producing FVFW compost; Thus it proves efficient, cost effective, eco-friendly and nuisance free and ideal for residential areas for the management of house hold waste.

Keywords: Fruits, Vegetable, Food Wastes, Composting.

INTRODUCTION

Indian agriculture is among the most important sectors in the economy of country where synthetic fertilizers play a key role for enhancing the crop yield. Now-a-days, dependent on the chemical fertilizers for agricultural growth leads to unattainable Burden on the Environment Government of India has been trying to promote environmentally friendly approach for sustainable agriculture among which organic farming is one of the relatively inexpensive and convenient methods (Senthilmurugan *et al*., 2018). Waste is the outcome of human activity; waste management has become critical area of practice and research due to the increasing concerns environmental pollution and resources shortage (Brewer, 2001). The soil is one topmost thin and composite layer of earth and it was made up of many things like weathered rock particles, decayed plant and animal matter with varying ratios of minerals, air, water and organic material (Kamaraj Yoganathan, 2017; Vijayan *et al*., 2018).

The amount of house hold wastes in India increased rapidly, the collection and disposal of solid house hold wastes becoming one of the major unsolved problems of urban, as well as semi urban areas in India. For a small community, solid waste disposal of an average of 0.2-0.3kg of refuse per person per day presents less of problem than its collection (Adeneye & Benebo, 2008; Iyengar & Bhave, 2006) for the large metropolitan cities like Chennai, Mumbai, New Delhi, however, the problem of disposal as well as collection is subject to multiplier that in most cases is in millions (Iyengar & Bhave, 2006). It is estimated per capital waste generation in major cities ranges from 0.2 to 0.6kg per day/ person (HCPOEE,2000). Municipal solid waste consists of more than 40 percent of organic waste, composting most of the waste would be the best way to reduce quantity to one fourth resulting in nutrient rich soil

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amendment (Atalia, *et al*., 2015; Seo, *et al*., 2004). In vessels composting for house hold waste a small area required for operation and maintenance. Composting as the controlled biological decomposition of organic substrates carried out by successive microbial populations combining both mesosphlic and thermophilic activities leading to production of fertile compost without adverse environmental effects. Hence, the present study has been attempted to collect house hold waste from residential complexes and segregating fruits, vegetables and food waste (FVFW), To compost FVFW and to determinations of different combinations for composting, which includes FVFW with compost accelerating microorganisms, cow dung slurry, cow dung with soil to achieve substantial and rapid volume reduction of bio waste by producing compost. Analyzing the compost / mulch thus formed at various stages and assessing elemental nutrients required to fertile soil and assessing compost efficiency of the combinations also formed a part of the study.

MATERIALS AND METHODS

Waste Sources

The FVFW was collected from a group of volunteers from student hostels and the residential complexes in and around Annamalainagar, Tamilnadu, India. Each item of waste was weighed before being placed in the reactor so that overall using ventilated plastic vessal used as (Figure1) Aerobic Compost Reactor (ACR) for the formation of compost; A laboratory study was conducted first vessel ACR - FVFW using the compost accelerator culture (*Trichorus spirallis, Paecilomyces sp., Chaetomium, Aspergillus sp, Trichoderma viridea, T. harzianum.*) grown on *Sorghum vulgar* grains as inoculum. The culture was obtained from the Department of Microbiology, Faculty of Agriculture, Annamalai University, Annamalai Nagar, India. The reactors were designed for having provision for the mixing of compost and functioning aerobically (Figure 1).

The loading of the reactor was performed by initially spreading FVFW at the bottom of the container. These FVFW were sprinkled with compost accelerator inoculums (ACR-CA); second reactor a layer of FVFW and Cow dung slurry 1.0-1.5cm sprinkled over the FVFW/ (ACR-CD); Third reactor a layer of Cow dung plus soil (approximately 1.0-1.5cm) (ACR-CDS) was placed over the FVFW; fourth group FVFW were sprinkled with only water to impart moisture within the reactor (ACR-W).During composting period temperature was recorded in all four combinations ACR.

For the wet compost / mulch samples, moisture content was immediately analyzed and pH was measured. All of the other properties were evaluated after samples were dried at 105°C and finely ground. Moisture was determined using the "percent of dry weight" method by drying at 105°C to constant weight and total organic carbon by loss on ignition (600°C for 2h.). The pH (1:50 w/v) was measured using a pH electrode (Systronics), total phosphate (acid digest) and soluble phosphate distilled water extraction using vanadomolybdophosphoric acid method, sulpur (acid digest) using barium sulphate precipitation method and soluble nitrate using nitration of phenoldisulphonic acid method by employing UV-Vis spectrophotometry (Eleco) at 420 nm. Total potassium (acid digest), sodium (acid digest) and soluble potassium (distilled water extraction) were determined by flame photometry fitted with element specific filters (Syntronics).

RESULTS AND DISCUSSION

In all the mixtures (ACR-CA, ACR-CD, ACR-CDS and ACR-W) temperature values showed rapid increase during first and second week of composting due to microbial proliferation, reaching heist temperature on 10^{th} day (59°C, 61.8°C, 62°C and 55°C respectively for ACR-CA, ACR-CD, ACR-CDS and ACR-W (Figure 2.) Other authors have also reported this quick rise in the temperature values during the composting of food and vegetable waste (Ali *et al*., 2012; Jara Samaniego et al., 2017).

The volume reduction observed in all four reactors (ACR-CA; ACR-CD; ACR-CDS; and ACR-W) after 30 and 60 days is shown in (Table 2). In the ACR-CA and ACR-CDS combination reactors, the volume reduction observed more than 80% during second phase under laboratory conditions; the volume changes may differ depending upon the inputs. Organic waste composting would be a best way to reduce the quantity to one fourth resulting in nutrient rich soil amendment. Composting is an age old practice for the biological conversion of organic waste to humus like substances which can enhance physical, chemical and biological soil properties. Considerable changes in pH value occur during the composting process. The pH of compost material influences the type of organisms involved in the composting process, fungi tolerate wider pH range than bacteria do. The optimum pH range for most bacteria is between 6.0 and 7.5, the fungi it can be between 5.5 and 8.0.

The compost formed in all the reactors except the ACR-W had a musty / earthy odour. PH of composting material dropped during the initial period of composting due to the formation of organic acids. The pH values in the reactor are an important parameter. Variations of ACR-CA; ACR-CD; ACR-CDS and ACR-W is presented in Table 1. In the two phased (30 days and 60 days) the pH values of the reactor in the range of 5.18-7.53 (ACR-CA; ACR-CD; and ACR-W) in ACR-CDS ranged from 6.20-7.85. This drop in PH values observed during the initial period, which in agreement with observations of then during the maturation phase, the pH subsequently rose, which can be attributed to the production of CO_2, simple organic acids and loss of nitrogen (Janakiraman *et al*., 2014). However, composing an optimum pH of 5.5 to 8.5 with little variation is recommended in most of the literature, similar observations recorded in the presents study (Atalia *et al.*, 2015).

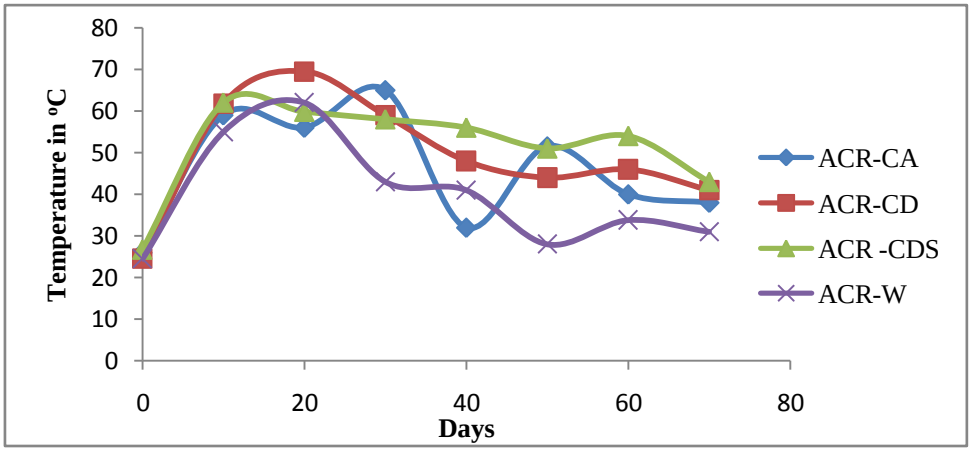

Figure 2. Temperature profiles of the composting FVF-Waste

Table 1. Comparison of final quality of compost formed in four combinations of ACR

S No.	Parameters	ACR-CA	ACR-CD	ACR-CDS	ACR-W
1.	pH	5.89-7.48	5.18-7.35	6.2-7.85	5.23-7.53
2.	Electrical conductively (dsm^{-1})	6.15-7.94	5.15-7.19	6.72-9.35	4.82-5.91
3.	Total organic carbon content (%)	26.5 - 21.8	36.5 -29.0	35.0-32.8	27.18-25.0
4.	Ammonia nitrogen	0.14-0.10	0.21-0.115	0.162-0.112	0.23-0.15
5.	Soluble nitrate (%)	1.65-1.9	1.38-2.05	1.92-4.18	1.35-1.78
6.	Phosphorous (%)	0.86-0.91	0.69-0.865	0.50-0.758	0.430-0.85
7.	Soluble phosphate content (%)	0.38-0.5	0.39-0.87	0.48-0.79	0.15-0.290
8.	Potassium content (%)	0.165-0.170	0.128-0.165	0.161-0.359	0.106-0.152
9.	Soluble potassium content (%)	0.085-0.95	0.068-0.072	0.07-0.88	0.07-0.078
10.	Moisture content (%)	43.5	46.78	42.19	58.75

The comparison of the results for compost/mulch analyzed for a period of 60 days (ACR-CA; ACR-CD; ACR-CDS, and ACR-W) is presented in table 1. The analysis of compost / mulch formed in all reactors except ACM-W had musty / earthy odour, brownish to black in colour, soil like colour after maturation period. The mulch from ACM-W showed a decaying odour, brownish yellow in colour and appeared to have high moisture content; even after maturation period.

Table 2. Volume reduction achieved in the reactors percentage of volume reduction rate.

S No.	Days	ACM – CA (%)	ACM-CD (%)	ACM-CD (%)	ACM-W (%)
1.	30	52.31	9.5	45.68	38.0
2.	65	82.95	78.58	84.15	76.8

The electrical conductivity in matured aerobic compost from ACR-CA; ACR-CD; ACR-CDS increased as the days progressed in maturation of compost, minimum values observed with ACR-W and maximum EC recorded with ACR-CDS in the range of 6.72-9.35 dsm^{-1}. Ammonia nitrogen content of compost / mulch decreased in all four combinations in reactors, while Nitrate showed a rise (Table 1) in time. Total nitrate with time of composting were 1.65 in ACR-CA, 1.38 in ACR-CD, 1.92 ACR-CDS and 4.18 percent in ACR-CDS and 1.78 percent in ACR-W respectively. The increased amount of mineralized nitrogen that the make available for the plant growth (Tweib *et al*., 2011). During maturation of compost, the ammonia is nitrified to become nitrate in the compost mulch formed in reactors (Kaosol & Wandee, 2009). In the present study ACR-CDS combination soluble nitrate content increased from 1.92 to 4.18 percent. Changes in the total organic carbon content during the composting period is shown in Table 1 with respect to total organic carbon content there is a decrease from 26.5 - 21.8 , 36.5 - 29.0, 35.0 - 32.8 and

27.18 - 25.0 percent from ACR - CA; ACR - CD, ACR - CDS and ACR - W respectively. All the other parameters, phosphorus content significantly increased during the maturation composting process, soluble nitrate content gradually increased in all four combinations, minimum level in ACR-W and maximum level in ACR-CDS combination in the reactor. Water soluble phosphate, potassium is the important element that can be easily leached out, the potassium content in the compost were from 0.165-0.170; 0.128-0.165; 0.161-0.359 and 0.106-0.152 percent from ACR-CA; ACR-CD, ACR-CDS and ACR-W, respectively (Table 2). Compared to the recommended 1% for composts, may be attributed to its draining out in the form of lechates (Iyengar & Bhave, 2006). Total potassium and soluble potassium content was found to increase during the maturation of compost. Nitrate, phosphorus and potassium (NPK) has been recognized as three important major plant nutrient maximum levels with ACR-CDS; followed by ACR-CA; since, soil was added with cow dung slurry in ACR-CDS combination proves to be an efficient than ACR-CD, ACR-W in terms of the quality of compost produced. Composting process in the ACR works on increase in phosphorous, soluble phosphate, potassium and soluble potassium. ACR – composter method is useful, to convert organic waste to useful compost, to fertilize soil.

CONCLUSION

Based on the above, comparison of ACR-CA, ACR-CD, ACR- CDS and ACR-W, ACR-CA and ACR-CDS combination can achieve 45.68 – 84.15% in volume reduction in the house hold FVFW. The mulch / compost generated from the combinations of ACR-CA, ACR-CD and ACR – CDS could be used as compost, since it was found to be rich in nutrients. ACR occupies small area, very simple operation and maintenance, cost effective, ecofriendly for the management of house hold solid wastes and compost used to fertilize plants.

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REFERENCES

Adeneye, A. A., & Benebo, A. S. (2008). Protective effect of the aqueous leaf and seed extract of Phyllanthus amarus on gentamicin and acetaminophen-induced nephrotoxic rats. *Journal of Ethnopharmacology, 118*(2), 318-323.

Ali, M., Bhatia, A., Kazmi, A., & Ahmed, N. (2012). Characterization of high rate composting of vegetable market waste using Fourier transform-infrared (FT-IR) and thermal studies in three different seasons. *Biodegradation, 23*(2), 231-242.

Atalia, K., Buha, D., Bhavsar, K., & Shah, N. (2015). A review on composting of municipal solid waste. *IOSR Journal of Environmental Science, Toxicology and Food Technology, 9*(5), 20-29.

Brewer, L. J. (2001). Maturity and stability evaluation of composted yard debris. *Waste Management and Research ,28(6),*489-496.

HCPOEE. (2000). *Manual on municipal solid waste management*: Central Public Health and Environmental Engineering Orgnisation, Ministry of Urban Development, Government of India.

Iyengar, S. R., & Bhave, P. P. (2006). In-vessel composting of household wastes. *Waste Management, 26*(10), 1070-1080.

Janakiraman, S., Thenmozhi, K., Rayappan, J. B. B., & Amirtharajan, R. (2014). Compiler optimization and plain text pre-processing to hoist the height of HIGHT in AVR platform. *Research Journal of Information Technology, 6*, 356-367.

Jara Samaniego, J., Pérez Murcia, M. D., Bustamante, M. A., Paredes, C., Pérez-Espinosa, A., Gavilanes-Terán, I., Moral, R. (2017). Development of organic fertilizers from food market waste and urban gardening by composting in Ecuador. *PloS one, 12*(7), e0181621.

Kamaraj Yoganathan, P. Ganesh., Vairakannu Tamizhazhagan. (2017). Impact of organic and conventional (chemical) fertilization on soil quality and its seasonal variation. *International Journal of Zoology and Applied Biosciences, 2*(6), 348-355.

Kaosol, T., & Wandee, S. (2009). Cellulolytic microbial activator influence on decomposition of rubber factory waste composting. *Journal of Environmental Science and Engineering, 4*(3), 41-47.

Senthilmurugan, S., Sattanathan, G., Vijayan, P. P. K., & Tamizhazhagan, V. (2018). Evaluation of different concentration of vermiwash on seed germination and biochemical response in Abelmoschus esculentus (L.). *International Journal of Biology Research, 3*(1),228-231.

Seo, J., Heo, J., Kim, T., Joo, W., & Crohn, D. (2004). Effect of vermiculite addition on compost produced from Korean food wastes. *Waste management, 24*(10), 981-987.

Tweib, S. A., Rahman, R. A., & Khalil, M. S. (2011). Composting of solid waste from wet market of Bandar Baru Bangi Malaysia. *Australian Journal of Basic and Applied Sciences, 5*(5), 975-983.

Vijayan, P., Senthilmurugan, S., Pugazhendy, K., & Tamizhazhagan, V. (2018). Analysis of physicochemical parameters water samples from Cauvery River in Thanjavur district, Tamil Nadu. *International Journal of Biological Research, 3*(1),223-227.