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RESEARCH ARTICLE

EFFICIENCY OF THE KITCHEN WASTE COMPOST AS ORGANIC MANURE

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ABSTRACT

The present study was under taken to assess the efficiency and self suitability of the kitchen waste compost as organic manure, through the estimation of its typical physical and chemical characteristics. To assess the physical and chemical parameters, kitchen waste compost was collected from a self designed compost bin. The visual inspection showed that the sample was physically uniform, free flowing, no hard lumps, blackish brown in color, free from objectionable odor and it was found to have 51.2 % moisture with bulk density 450.2 kg m-3, particle size less than 3 cm and 42% volume reduction. The results obtained from chemical analysis of the generated compost include: pH value 6.15; Electrical Conductivity 647 µS/cm; Total Organic Carbon 5.55%; Total Nitrogen 0.23%; Total Phosphate 0.15%; Total Potash 0.3% and C/N ratio 24.1. The results indicate that the physical and chemical parameters more or less lie at par with standard and thus indicate the good quality of the composts. Composting of solid urban wastes could be adapted country wide to transform garbage to enriched organic manure and also a better solid waste management option.

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INTRODUCTION

The problem of waste disposal threatens to become a serious problem of pollution with growing magnitude of waste production (Batool and Nawaz, 2009). Of the total solid waste generated, only 60% is actually collected in most cities, while the uncollected waste lies in topographic depressions, vacant plots, along streets, roads and railway lines, drains, storm drains and open sewers within overall urban limits (Shyamala and Belagali, 2012).

Disposal of solid waste, most specifically kitchen waste, which contains about 80% of moisture to the landfills, causes various problems like easy putrefaction, offensive odour and pollution of ground and surface water by leachate (Wang *et al*., 2003). These risks can be reduced considerably by reducing the amount of waste that is dumped or left uncollected. This can be achieved by following onsite composting of kitchen waste. The composting of kitchen waste not only reduces the amount of waste entering the waste management system but it also provides a beneficial end product (compost – a good organic manure) free of cost (Sajjad and Junnaid, 2011).

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Composting is a biological process of decomposition of biodegradable wastes carried out under controlled conditions of ventilation, temperature, moisture wherein the organisms within the waste can convert waste into humus like material by acting on the organic portion of the solid waste (Bary *et al*., 2002). If carried out effectively, the final product is stable, odour free, does not attract flies and a good soil conditioner (Garg *et al*. 2006). Realizing the significance of composting as one of the appropriate technologies that serve as both effective waste management strategy as well as good source of fertilizer for urban home gardeners, the research was undertaken with the following objectives

- To find the physical and chemical property of the kitchen waste compost.
- To evaluate the manural qualities of the kitchen waste compost
- To compare kitchen waste compost with standard organic compost.

MATERIALS AND METHODS

The current study focuses on experimenting the organic kitchen waste that is generated from the households. A self designed plastic compost bin was used in this study.

The wastes used were kitchen waste such as vegetable and fruit peels, cereal remains, cooked food remains and spoilt foods. The compost bin was filled with 500 gms of kitchen wastes. 20 ml of sour curd was sprayed on the top of the waste as a starter and as an enhancer to speed up the decomposition of waste and 2 ml of neem oil was also added to prevent the odour formation. Every day the waste was manually mixed for aeration with a wooden spatula and it was continued for 15 days. At the end of 15th day the kitchen waste compost was collected from the bin and its physical and chemical characteristics were analyzed. Colour, odour and texture of the kitchen waste compost were examined visually. The collected sample was given to Armats Biotek laboratory to analyze the physical parameters such as moisture, bulk density, particle size, % reduction by weight and the chemical parameters. The compost composition will determine its quality. The analyzed physical and chemical parameters were compared with the standard organic compost quality.

RESULTS AND DISCUSSION

This research was carried out to find the effectiveness of kitchen waste compost as organic manure. The physical parameters such as colour, odour, texture, moisture, bulk density and particle size were identified. The chemical parameters such as P^{H}, total organic carbon, total nitrogen, total phosphate, total potash and C:N ratio were also analyzed.

Physical characteristics

Table 1 shows the physical characteristics of the kitchen waste compost such as colour, odour, texture, moisture, bulk density and particle size.

Colour

Different composting stages show different colour. Raw compost samples have light colours because of partially degraded materials and partially matured compost has dark colour due to incomplete degradation (Lekammudiyanse and Gunatilake, 2009). The colour of the generated raw kitchen waste was greenish yellow and it turned into blackish brown at the end of the 15th day of composting process as it matures.

Odour

Odour of compost is associated with the release of carbon in gaseous form, volatile organic acids or other chemical compounds (He *et al*., 2005). The generated kitchen waste compost had ammonia and hydrogen sulphide odour due to aerobic decomposition of nutrients present in it.

Texture

Visual inspection of the compost gives an idea about its texture and maturity. During the composting period, a gradual change of texture from large fibrous lumps to tiny lumps with flowing particle texture occurred which showed the development of humus.

Moisture

Moisture is a key influencing factor for microbial activity (Anastasi *et al*., 2005), as low moisture contents inhibit the growth of beneficial microorganisms, while excess moisture can create anaerobic conditions, leading to the production of unpleasant odors and toxic volatile substances (Saidi *et al*., 2008). The moisture content of the kitchen waste compost was found to be 51.2% which could support the metabolic processes of the micro-organisms and it also provides the media for chemical reactions.

Bulk density

The results indicate that the bulk density value of the generated compost was 450.2 kg m^{-3}. Hurerta *et al*. (2010) found that the bulk density values for different compost types were between 447 and 502 kg m-3, as agreed with (Romeela *et al*., 2008) results.

Particle size

Microbial activity occurs on the surface of the organic particles. Decreasing particle size of compost with increased surface area encourages microbial activity and increases the rate of decomposition (Lekammudiyanse and Gunatilake, 2009).

Table 1. Physical characteristics of kitchen waste compost

Parameters	15 days kitchen waste compost	Compost standard*
Colour	Blackish brown	Brown/grey to dark black
Odour	Ammonia and hydrogen sulphide	No unpleasant odours
Texture	Tiny lumps with flowing particle texture	Tiny lumps with free flowing particle texture
Moisture	51.2%	45%-65%
Bulk density	450.2 kg m^{-3}	300 – 600 kg m^{-3}
Particle size	3 inches	0 - 2.5 inches
% reduction by weight	42%	Not less than 25%

*Compost standard recommended by The United States Environmental Protection Agency (USEPA)

Table 2. Chemical characteristics of kitchen waste compost

Parameters	15 days kitchen waste compost	Compost standard*
P^{H} (1:10 Ratio) @ 25ºc	6.15	6.9-8.3
Conductivity (110 Ratio) @ 25ºc	647 µS/cm	200-600 µS/cm
Total Organic Carbon	5.55%	30%-40%
Total Nitrogen as N	0.23%	1.3%
Total Phosphate as p2o5	0.15%	0.2% -0.5%
Total Potash as k2O	0.3%	0.5%
C:N Ratio	24.1	<25

*Compost standard recommended by The United States Environmental Protection Agency (USEPA)

The particle size of the compost was observed to be 3 inches, which found to be ideal for proper air flow. These results agreed with those obtained by Ahn *et al*. (2008).

Volume reduction

Weight loss was observed during the compost formation process. The volume of kitchen waste reduced considerably to 42%. The reduction in weight was more significant during the composting period, which is a similar research result to those observed by Andrea *et al*. (1998), who measured a weight loss of 39%, and Gautam *et al*. (2010) who observed weight loss over a 17-day composting period.

Chemical characteristics

The chemical parameters such as P^H, total organic carbon, total nitrogen, total phosphate, total potash and C:N ratio are given in the Table 2.

P^H

P^H is a measure of acidic or alkaline nature of the compost as composting progresses. The pH of the generated kitchen waste compost was found to be 6.15. Saidi *et al*. (2008) identified that the decomposition of organic wastes at pH values of 6.0 or below can slow down the decomposition process, while pH values above 8.0 can cause the release of unpleasant smells associated with ammonia. They also added that microbial activity enhanced the likelihood of achieving a suitable pH range of 5.5–9.0; while the composting process is most effective at pH values between 6.5 and 8.0

Electrical conductivity

Electrical conductivity is used to measure the amount of nutrients in the compost that are in the form of salt. The salt content of compost is due to the presence of sodium, chloride, potassium, nitrate, sulphate and ammonia salts. The electrical conductivity of the compost was 647 µS/cm., in comparison with recommended standard the electrical conductivity found to be higher than the standard value (Table 2). These high values could be due to the effect of the concentration of salts as a consequence of degradation of organic matter (Brinton, 2003).

Organic content

Organic content of the compost includes the total organic carbon, nitrogen, phosphorus and potash content. Data recorded in Table 2 clearly indicates that the test sample were at par with the standard quality of compost. Determination of Total Organic Carbon provides a direct estimate of the biologically degradable carbon in the compost. During composting, carbon is transformed into more complex organic compounds such as humus and mineralized and lost as carbon dioxide. The total organic carbon in compost includes forms of organic matter at different stages of degradation, some resistant to further decomposition and some remaining biologically active (Compost Maturity Index, 2001). Regarding the Total Organic Carbon, the compost sample was found to have 5.55%. These results are in agreement with (Batjes, 1996) who found that the optimum value of total organic carbon higher than 10%. Reduction in Total Organic Carbon indicates the continuous mineralization of the compost. The total nitrogen value of the sample compost was 0.23%. The obtained result is low when compared with standards due to increased volatilization of ammonia during the composting period. The total phosphorus and total potash values ranged from 0.15% and 0.3%, respectively, for the generated kitchen compost types. Umsakul *et al*. (2010) opined that a decrease in the phosphorous and potash value may be attributed to the microbial activities in the composting material as they are very much essential for their metabolic activities.

C/N ratio

C/N ratio is one of the most important parameters that determine the extent of composting and degree of compost maturity. If carbon and nitrogen values are too far out of balance, the microbial system will suffer. A ratio higher than 30:1 may slow down the composting process and a ratio lower than 15:1 may lead to loss of nitrogen causing neither growth nor multiplication of micro organisms (Yousuf, 2005). The generated study sample was found to have C/N ratio 24.1 which is within the acceptable limits. From the data viewed form Table 2, the chemical characteristics indicate the good quality of the composts, the completion of the degradation process and compost maturity as suggested by Benito (2003). It can be thus agreed that the compost prepared during the present study was found to be as good soil conditioner and eco friendly safe and cheap and best as compared to chemical fertilizer.

Conclusion

It is apparent that the investigated kitchen waste composts were free from most of the physical constraints. The chemical parameters of the compost are within the acceptable limits of standard quality of compost. Data presented in Table 1 and 2 showed that composting of kitchen waste at household level was more effective and economical in transforming garbage to enriched organic composts. Considering the high volume of urban waste, composting may be considered as an important solid waste management technique. Finally, it is concluded that kitchen waste composting is an excellent way to recycle the organic residues of kitchen waste to nutrient rich organic manure.

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