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Composting of Municipal Solid Waste of Kampung Bako Sarawak

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Abstract
A preliminary study was conducted to assess the feasibility of composting of source separated organic matter of municipal solid waste (MSW) generated in areas of Kampung Bako, Kuching, Sarawak with a population over 3000. Results of MSW analysis indicate the presence of high percentage of biodegradable organic matter, acceptable moisture content and C/N ratio. On windrow composting, not only the volume of the waste was reduced but also produced a crumbly earthy smelling soil-like, compost material. All quality parameters in the compost samples were found to be within the acceptable limits set by international standard. The compost quality could further be improved by adding rice husk, poultry manure or yard waste etc. Its use in plant production or land reclamation may be helpful to maintain soil fertility and improve moisture holding capacity. MSW Composting could be adapted country wide to recycle/reuse the organic residue as solid waste management option.

Keywords: Municipal solid waste (MSW); Composting analysis; Rice husk

Introduction

The increasing amount of waste may create several problems to populations in the world. It requires application of several effective strategies for proper disposal of municipal solid waste (MSW). Composting is a process of microbial based aerobic which is now considered as an environmentally way to reduce organic waste and at the same time produce organic fertilizer or as a soil conditioner (Gautam et al., 2010). The average generation of MSW from urban cities in India estimated to have approximately 40 to 60 % organic matter could be recycled as compost. Malaysia generates about 0.5–1.9 kg/capita/day of MSW; a total of about 25,000 tonnes/day of MSW is currently generated and is estimated to exceed 30,000 tonnes/day by 2020. Malaysian MSW is mainly composed of 45 % food waste, 24 % plastic, 7 % paper materials, 6 % metal, 4 % wood and 3 % glass, which are commingled, and is thus characterised by 52–66 % moisture content. Currently, 80–95 % of collected MSW is landfilled and 5 % is recycled (Aja and Al-Kayiem, 2013). Some reasons associated are growing population, changes in consumption patterns and the expansion of trade and industry in urban centres. Developing countries striving to become industrial nations are generating MSW at an alarming rate.Composting is a natural biological process that been held under controlled conditions whereby it hastens the decomposition of MSW over time and reduces its volume, creating stable and high nutrient humus (Mutairi et al., 2014). Over past years, there have been a lot of approaches taken which have been used in order to investigate composting processes such as the study of thermodynamic and physicochemical changes taking place during composting processes (Ahmed et al., 2007), the microbial community dynamics and stability assessment during composting (Gazi et al., 2007). Apart from that, a study on characterization of MSW compost inoculated with effective microorganisms also conducted (Bakari et al., 2016). The inoculation of waste with microorganisms that produce extracellular enzymes such as cellulase, amylase, protease, pectinase and lipase at optimum level increase waste degradation, thus reducing waste dumping (Saha and Santra, 2014). This shows the MSW composting is being practiced throughout the world and researchers have experienced the benefits of using MSW compost in the field. This study aimed to analize the compost by municipal solid waste in Kampung Bako, Sarawak in terms of pH, moisture content, potassium, natrium, kalsium, and magnesium.

Materials and methods

The investigation was conducted at Pusat Pemrosesan Baja Kompos at Kampung Bako, located in Kuching, Sarawak and Makmal Sains Tanah, Jabatan Sains Tanaman, Fakulti Sains Pertanian dan Makanan, Universiti Putra Malaysia Kampus Bintulu in the month of February 2019. With the help from people in the village of Kampung Bako, MSW were collected. The organic material mainly vegetable, fruit and kitchen waste etc., were separated from other materials subjected to build windrows of compost. The weight of each windrow were recorded before and after composting. During the composting process, required operation conditions of composting were maintained. This windrow method will reduce particle sizes by frequent number of turning (Basnayake and Karunarathne, 2004) . A heap of manually separated mixed MSW of 4’ high, 8’long was placed on ground on composting windrow type. The windrow was watered everyday to maintain moisture level between 50-60% and turned manually using scoop every 3-5 days for the first six weeks of composting cycle. From the seventh week, the moisture was allowed to drop when optimum

biosolids decomposition was achieved. The process was completed in about 8-9 weeks. After this period the compost was allowed to cure for additional three weeks without turning. The finished compost was then screened out and weighed. A representative compost sample was taken from the homogenized compost heap for the sequential physicochemical analyses. Sub-samples (250 g) were taken from 4 different points of the compost heap (bottom, surface, side and centre). It was brought to the laboratory for further analysis. The following physical parameters pH, moisture, potassium, natrium, magnesium were measured.

Potentiometric Method were used to determine the pH content in the compost. 10g of air-dried compost were weighed and added with 25 ml distilled water, stopper it and shake at 180 rpm for 15 minutes. The sample were stayed overnight. The pH meter used in this experiment were calibrated with two buffer solutions which are pH 4.0 and pH 7.0. Meanwhile to determine moisture content, the Gravimetric Method were used. This method basically give the measurement of the amount of water lost before and after oven-dried. 10g of sample were weighed, oven dried it at 105 and 110°C overnight then the latest weight were measured. This method expresses the result in the form of percentage of water by using the equation below (Fathi et al., 2014);

Dry mass (%) water = (mass of water/mass of oven dry soil) x 100

To determine the amount of Potassium in the compost, Ammonium Acetate – Shaking Method were used. A volume of 1000ml of 1M ammonium acetate (NH_4OAc) solution with pH 7.0 were prepared. 10g of compost were weighed and placed in the flask. Then, 100ml of the solution were added into the flask and stayed for 5 to 6 hours. The sample were shaked using orbital shaker 180rpm for 1 hour. The sample were filtered and marked up to the volume of 1M ammonium acetate (NH_4OAc). Atomic Absorption Spectrometry (AAS) is a technique which is helpful in measuring the amount of trace elements available in compost. (Mishra, 2018) . The reading of P were measured in percentage. This method can also be used to determine Na, Ca, Mg, and most micro-elements. The calcium and magnesium concentrations in compost are important for growth of microbes.

Results and discussion

Table 1 listed the average of pH, moisture content, potassium, natrium, magnesium, and calcium. The result was compared to the standard values using Ohai- EPA standards and Canadian Council of Ministers of the Environment (CCME) standards (Manohara and Belagali, 2014). Based on the result, pH and moisture content were in the standard range values suitable for composting. Meanwhile the amount of potassium, natrium, magnesium, and calcium were all below the standard range value. However, in order to obtain high quality compost, the macronutrients and micronutrients level in the waste can be adjusted to an acceptable level by adding garden waste, cow manure, poultry manure, etc. As the study conducted by other researchers before that successful preparation of MSW composts depended upon the nature of the organic materials, the proportion of nitrogenous compound to carbohydrates, the temperature of decomposition and the microbial population involved in the process. For example, the study of MSW in India and New York City resulting different amount of nutrients contained in the compost. A study in Mysore, India determined the pH of 7.65, moisture content of 48%, potassium 0.27%, natrium 0.13%, magnesium 0.21%, and calcium 0.72% (S.P. Gautam, 2010). Meanwhile a study in New York City showed the pH of 7.5, moisture content of 23.5%, potassium 0.3%, natrium 0.56%, magnesium 0.38%, and calcium 2.6% (Robert, 2004).

Table 1: Average chemical composition of biofertilizer composted from municipal solid waste of Kampung Bako, Sarawak

S.No	*Parameters*	*Avg. Values*	*Standard values suitable for composting*
1.	pH	8.29	6.9-8.3
2.	Moisture (%dry basis)	62.80	45-65%
3.	Potassium	0.39	0.6-1.7%
4.	Natrium	0.66	NA
5.	Magnesium	0.12	0.2-0.4%
6.	Calcium	0.38	1.0-4.0%

Note: NA – Not Available

Conclusion

Based on the study it can be concluded that municipal solid waste is suitable for composting. It is because of the presence of acceptable percentage of biodegradable organic matter, acceptable moisture, and pH in the waste. However, the composting process and compost quality could further be improved in the future by adding inoculating agent like yard waste etc. in the municipal solid waste. Furthermore, the application of compost would be an investment in the long term for the health of soils and plants. Finally, it is concluded that a module of this type for the recover of hight value and economical organic fertilizer- the compost, can be applied to recycle the organic residues as one of waste management options.

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