PREPARATION OF ORGANIC FERTILIZERS FROM KITCHEN WASTES AND MEAL CAKES

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Abstract

Organic fertilizers are easily biodegradable and do not affect environmental pollution. They are carbon-based compounds that can increase the productivity and growth quality of plants. They have various benefits over chemical fertilizers. In this research, four organic fertilizers were prepared using kitchen vegetable wastes with peanut meal cake (OF-1, OF-2) and kitchen vegetable wastes with sesame meal cake (OF-3, OF-4) under aerobic and anaerobic conditions. The physicochemical properties of prepared organic fertilizers such as pH value, moisture content, available phosphorus content, available potassium content and organic carbon content were determined. The available nitrogen content in prepared organic fertilizers was measured by alkaline permanganate method. The results from determination were compared with two commercial organic fertilizers. The amount of available nitrogen in OF-1, OF-2, OF-3 and OF-4 were 1.67 %, 1.57 %, 1.45 % and 0.88 % respectively. The available nitrogen content of all prepared organic fertilizers was found to be higher than those of two commercial organic fertilizers. The carbon- nitrogen ratios of the prepared organic fertilizers were calculated. The results from prepared organic fertilizers showed that aerobic condition gave high efficiency. Furthermore, the elemental analysis of four prepared organic fertilizers was examined by EDXRF (Energy Dispersive X-ray Fluorescence) spectroscopy. Silicon was found to be the highest value in all prepared organic fertilizers.

Keywords: Organic fertilizers, chemical fertilizers, kitchen vegetable wastes, meal cake, aerobic condition,

Introduction

Fertilizers are sources of plant nutrients that can be added soil as supplement for its natural fertility. There is usually a very dramatic improvement in both quantity and quality of plant growth when appropriate fertilizers are added. Proper use of fertilizer leads to the production of more nutritious food. Overuse of chemical fertilizer changes the acidity of soil (Secth and Arama, 1986).

Kitchen waste is defined as left-over organic matter from restaurants, hotels and household (Li *et al*., 2009). Tons of kitchen wastes are produced daily in highly populated areas. Kitchen wastes entering the mixed-municipal waste system are difficult to process by standard means, such as incineration, due to the high moisture content (Kuo and Cheng, 2007). Organic matter from kitchen waste can be transformed into useful fertilizer and biofuel (Ma *et al*., 2009).

Meal cakes resulted after extraction of oil from oil seeds were used in food processing, animal food and fertilizer. Meal cakes contain about 50 percent of protein and other functional components.

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Organic fertilizers may contribute substantially to improving yield, soil quality and reducing the environmental impacts of conventional farming. These components have been used in sustainable agriculture and to provide nutrients for plant growth and development.

In this research, organic fertilizers were prepared using some kitchen wastes, meal cakes, chicken dung, soil and straw. Then, some physicochemical properties of prepared organic fertilizers were determined by standard methods.

Materials and Methods

Samples Collection

Vegetable wastes were collected from local market, Maha Aungmyae Township, Mandalay Region. The peanut and sesame mealcakes, chicken dung and rice straw were collected from Taung Pyone Gyi Village, Patheingyi Township, Mandalay Region. Soil was also collected from Shangalay Kyune Village, Mandalay Region.

Vegetable wastes were cut into small pieces and rotten in the plastic bag for about one day and then used throughout experiment. The chicken dung was dried under the sunlight. Dried chicken dung were pounded and sieved with 60 mesh sieve to become chicken dung powder. This condition was ready to use. Soil was ground and sieved with 60 mesh sieve to get soil powder. Straws were cut into small pieces. Two different kinds of commercial organic fertilizers, Shwe Zeewa and Naychi (denoted as commercial 1 and commercial 2 respectively) were purchased from agricultural shop. Figure 1 shows the materials for preparing organic fertilizers.

Preparing the Barrel for Aerobic Condition

The plastic containers with lids were taken. Three holes (1 cm in diameter) were made around the top third and the bottom third of the barrel, at a distance of 6 cm from each other. Another hole (1 cm in diameter) was made in the base of the barrel to seep the liquid from the decomposing organic matter from the barrel.

Preparing the Barrel for Anaerobic Condition

Plastic container with lid having same capacity as used in barrel for aerobic condition was taken. There was no hole in the container.

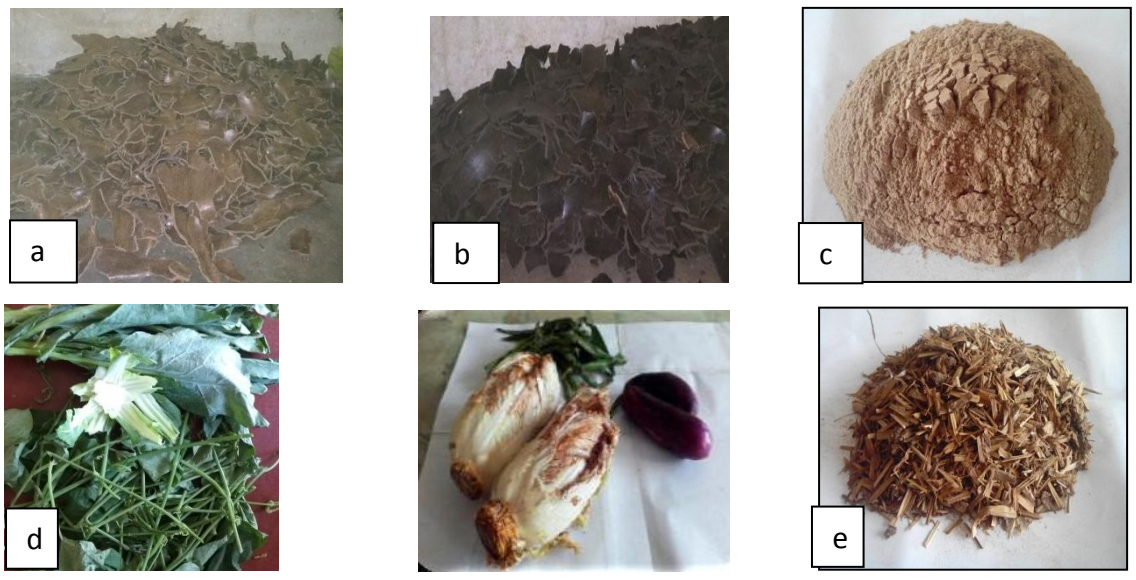

Figure 1 (a) Peanut meal cake (b) sesame meal cake (c) soil (d) kitchen waste and (e) rice straw

Preparation of Effective Microorganism Solution

Effective microorganism (EM) solution was prepared from vegetable waste with chicken dung at room temperature. The fermentation time took about one month to obtain effective microorganism (EM) solution. This EM solution was prepared before doing the organic fertilizers.

Preparation of Organic Fertilizer

Four different kinds of organic fertilizers were prepared, such as

(i) aerobic and anaerobic conditions by using selected kitchen wastes and peanut meal cake (Prepared Organic Fertilizers, OF-1 and OF-2).

(ii) aerobic and anaerobic conditions by using selected kitchen wastes and sesame meal cake (Prepared Organic Fertilizers, OF-3 and OF-4).

The layer for compost

For composing in layers, the following successive layers were piled on top to this.

1. A layer of 1 kg of straw
2. A layer of 1 kg of kitchen wastes
3. A layer of 1 kg of meal cake
4. A layer of 1 kg of soil
5. A layer of 1 kg of EM solution

These types of layers were repeated three times. Finally 1 kg of the straw was put on these layers. The water was sprinkled over the layers for anaerobic condition, and plastic container was enclosed. They were allowed to decompose for two months.

Turning over for the sample under aerobic conditions

During decomposition the layers were turned over regularly, in order that it remained well aerated and all the materials were converted into compost. The first turning over was done after two weeks. The second turning over took place after two weeks. Then each turning over was done after one week. If necessary, water was sprinkled over the container during the process. After two months, decomposition was complete because the plant materials were changed into an unrecognizable crumbly dark mass. However, some straws do not decompose completely.

Determination of Yield Percent of the Prepared Organic Fertilizers

The prepared organic fertilizers were dried and the yield percent of these were determined based upon the total weight of selected materials used.

Determination of Some Physicochemical Properties of the Prepared Organic Fertilizers

Some physicochemical properties of prepared organic fertilizers and another two commercial organic fertilizers were determined by standard methods as shown in Table 1 (AOAC, 1990; AOAC, 2000; Emerson, 1997; Vogel, 1961).

Table 1 Methods for Determination of Some Physicochemical Properties of the Prepared Organic Fertilizers

No.	Parameter	Method
1	pH	Using pH meter
2	Moisture content	Oven drying method
3	Available nitrogen	Alkaline permanganate method
4	Available phosphorus	Olsen's method
5	Available potassium	Atomic absorption spectroscopic method
6	Organic carbon	Walky and Black's method
7	Elemental contents	EDXRF method

Results and Discussion

The Yield Percent of Prepared Organic Fertilizers

The yield percent of the prepared organic fertilizers were calculated based upon the total weight of used materials and shown in Table 2. The yield percent were found to be in the range of 35.54-64.52 %. The yield percent is good for preparation of organic fertilizer.

Table 2 Yield Percent of the Prepared Organic Fertilizers

No.	Prepared Organic Fertilizers	Yield percent (%)
1	OF-1(prepared organic fertilizer with peanut meal cake under aerobic condition)	35.54
2	OF-2 (prepared organic fertilizer with peanut meal cake under anaerobic condition)	64.52
3	OF-3 (prepared organic fertilizer with sesame meal cake under aerobic condition)	39.08
4	OF-4 (prepared organic fertilizer with sesame meal cake under anaerobic condition)	59.30

The pH and Moisture Values of the Prepared Organic Fertilizers

Table 3 shows pH and moisture values of the prepared organic fertilizers. According to the values of pH, prepared organic fertilizers under aerobic condition using both meal cakes were slightly alkaline, but under anaerobic condition were nearly neutral. The results of moisture in all prepared organic fertilizers were significantly lesser than two commercial organic fertilizers.

Table 3 The pH and Moisture Values of Prepared Organic Fertilizers and Commercial Organic Fertilizers

No.	Organic Fertilizer	pH	Moisture (%)
1	OF-1	7.85	3.53
2	OF-2	7.17	6.20
4	OF-3	7.79	3.67
5	OF-4	7.18	4.86
6	Commercial-1	7.67	35.23
7	Commercial-2	7.46	42.76

Elemental Composition of the Prepared Organic Fertilizers

The elemental composition of prepared organic fertilizers was determined by EDXRF spectroscopy and the results are shown in Table 4. The elemental analysis indicates that prepared organic fertilizers contain a number of minerals. The amount of silicon was the highest in all prepared organic fertilizers. EDXRF results give only the relative abundance of elements present in prepared fertilizers.

Table 4 Relative Abundance (%) of Elemental Composition of Prepared Organic Fertilizers (EDXRF method)

No	Elements	Relative Abundance (%)			
		OF-1	OF-2	OF-3	OF-4
1	Al	2.223	2.970	3.080	4.376
2	Si	11.02	12.05	11.970	12.230
3	P	0.556	0.566	0.458	0.286
4	S	0.137	0.127	0.095	0.046
5	Cl	1.536	1.520	1.636	1.429
6	K	2.603	2.001	2.891	2.098
7	Ca	2.011	2.084	1.174	1.176
8	Ti	0.244	0.246	0.259	0.359
9	V	0.006	0.006	0.006	0.007
10	Cr	0.005	0.005	0.005	0.007
11	Mn	0.063	0.066	0.068	0.057
12	Fe	2.547	2.567	2.665	3.254

Available N, P, K of Prepared Organic Fertilizers

The determination of available nitrogen, phosphorus and potassium values of prepared organic fertilizers was performed using standard methods and results are shown in Table 5.

Table 5 Available N, P, K Values of Prepared Organic Fertilizers and Commercial Organic Fertilizers

No.	Organic Fertilizer	Available N (%)	Available P (%)	Available K (%)
1	OF-1	1.67	1.06	2.27
2	OF-2	1.57	1.04	1.18
3	OF-3	1.45	2.03	1.93
4	OF-4	0.88	1.14	1.14
5	Commercial-1	0.86	0.55	0.46
6	Commercial-2	1.43	0.41	0.68

According to the results from the determination of N, P and K values, it can be observed that available N, P and K contents of all prepared organic fertilizers were higher than those of both commercial organic fertilizers. Therefore, all prepared organic fertilizers can supply more amount of N, P and K. These could be used for leaf crops like cabbage which required abundant nitrogen. Moreover, the prepared organic fertilizers using peanut and sesame meal cakes under aerobic condition contained higher amount of potassium and phosphorus. These are good for seed bearing plants and root crops which required a good amount of potassium and phosphorus.

Organic Carbon Value and Carbon-nitrogen Ratio of the Prepared Organic Fertilizers

The examination of amount of organic carbon and carbon-nitrogen ratio of prepared organic fertilizers were carried out. The results are shown in Table 6. The carbon-nitrogen ratios of prepared organic fertilizers under aerobic condition were higher than those of anaerobic condition.

For preparing organic fertilizer under aerobic condition is good to yield more amount of organic carbon.

Table 6 Organic Carbon Value and Carbon-nitrogen Ratio of Prepared Organic Fertilizers and Commercial Organic Fertilizers

No.	Organic Fertilizer	Organic Carbon (%)	Carbon-nitrogen ratio
1	OF-1	13.45	8.05
2	OF-2	8.33	5.31
3	OF-3	14.27	9.84
4	OF-4	5.38	6.11
5	Commercial-1	4.88	5.67
6	Commercial-2	11.89	8.31

Conclusion

In this research work, organic fertilizers were prepared under two conditions (aerobic and anaerobic) using vegetable wastes, peanut and sesame meal cakes, soil and rice straw. EM (effective microorganism) solution was also supplied.

The yield percent of prepared organic fertilizers were found to be 35.54-64.52 %. From the determination of pH value, it can be seen that prepared organic fertilizers under anaerobic condition were nearly neutral but under aerobic condition were slightly alkaline. All prepared organic fertilizers were found to be less moisture content.

The elemental analysis indicates that prepared organic fertilizers contain a number of minerals. The amount of silicon was the highest value in all prepared organic fertilizers.

According to the results from the determination of N, P and K values, it can be observed that available N, P and K contents of all prepared organic fertilizers were higher than those of both commercial organic fertilizers. Moreover, the amount of potassium in OF-1(2.27 %) and phosphorus in OF-3(2.03 %) show that aerobic condition is good efficiency for preparation of organic fertilizer. Carbon-nitrogen ratios of prepared organic fertilizers were found to be in the range of 5.31-9.84.

The organic fertilizer should be used widely in agriculture instead of chemical fertilizer or mixing with chemical fertilizer because of their low cost, good fertility of the soil and supplying more trace elements. The obvious advantages of prepared organic fertilizers over other organic fertilizers are economically viable, convenient and effective. Therefore, prepared organic fertilizers have great potential for applications and can also help in waste management and keeping environment clean.

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