PRODUCTION OF ORGANIC FERTILIZERS FROM SOLID WASTES AND DETERMINATION OF THEIR EFFICIENT NUTRITIVE VALUES

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ABSTRACT

Nowadays, people are facing many waste issues in their environments, such as vegetable wastes, solid wastes, water waste, sedimentation wastes and bio wastes. Among them, this research extracted organic fertilizers from natural solid waste materials . A series of production of four different conditions of organic compost fertilizers was carried out by the use of vegetable wastes, chicken dung, peanut meal cake and other organic materials were collected from the local markets and then, prepared EM solutions was added with lime and without lime conditions under aerobic and anaerobic digestion methods. Moreover, the nutritive values, pH, moisture content, organic carbon contents and organic matter were measured by AOAC and Walkey Black method whereas the elemental content of each composite fertilizer under four different conditions was analyzed by EDXRF (Energy Dispersive X Ray Fluorescence) method. According to the EDXRF analysis and nutritive valuesmeasurement, prepared organic fertilizers without lime had the highest contents of organic carbon and organic matter that would be one of the confirmations indicating the good quality of prepared composite fertilizers which are reliable to be used as a natural safely organic fertilizer for human health.

Key words: organic fertilizer, composite, solid waste, EDXRF, nutritive values

1 INTRODUCTION

In present century, urbanization and industrialization produces enormous amount of urban solid wastes. The wastes qualitatively and quantitatively, contaminate environment and present a potential health risk for humans and domestic animals. Improving waste management is recognized as a major environmental challenge. The proper management of solid waste minimizes adverse effects on environment and improves resource efficiency. The concept of prevent and minimize waste and minimize reuse, recycling and use of environmentally friendly alternative materials (Ingle, P.M. *et al*., 2017). Municipal solid waste management is becoming a critical problem which leads to loss of resources and increased environmental risks. Urban solid waste consists of more than 40 % of organic waste, so composting most of this waste would be the 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 substance which can enhance physical, chemical and biological soil properties. For the assurance of an effective solid waste management, implementations of appropriate solid waste treatment

strategies are vital. This can be enhanced through the utilization of technologies that are most economically efficient, sustainable and eco- friendly (Ingle, *et al*. 2017).

A fertilizer is any material, organic or inorganic, natural or synthetic, that supplies plants with the necessary nutrients for plant growth and optimum yield. Organic fertilizers are natural materials of either plant or animal origin, including livestock manure, green manures, crop residues, household waste, compost, and woodland litter. Inorganic (or mineral) fertilizers are fertilizers mined from mineral deposits with little processing or industrially manufactured through chemical processes (e.g., urea) (Website 10).

2 METHODS and MATERIALS

2.1 Materials

Vegetable wastes , chicken dung, rice straw, peanut meal cake and lime powder were used through out the research work. Sodium hydroxide, sulphuric acid, sodium bicarbonate, potassium di-hydrogen phosphate, Ammonium moly date were purchased from ABEL chemical company and distilled water was used from the Department of Chemistry, Mandalay University, Myanmar.

2.1.1 Sample Collection and Preparation

The natural waste materials such as vegetable wastes, chicken dung, peanut meal cake, lemon and lime powder were collected for the production of biogas and effective microorganism solution. Vegetable waste and lemon were collected from the market, Maharaungmya Township, Mandalay Region. Chicken dung was collected from Taung Pyone Village, Madaya Township, Mandalay Region. Peanut meal cake was bought from local market, Mandalay Region, Myanmar.

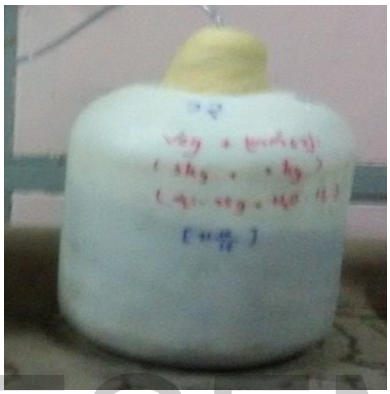
Vegetable waste samples were cut into small pieces and washed with pure water and then used throughout experiment. Chicken dung was dried under the sunlight and pounded seived with 60 mesh seive to get the size of powder sample. Peanut meal cake also ground to get the powder sample. Lemon juice was prepared from lemon. Rice straw samples were cut into small pieces about one inch. EM solution was prepared in January, 2017.

Vegetable Waste

Chicken Dung

Peanut Meal Cake

Lime Powder



EM Solution

Rice Straw

Figure (1) Vegetable Waste, Chicken Dang Powder, Peanut Meal Cake, Lemon Juice, Slaked Lime Solution and Rice Straw

2.2 METHODS

Determination of total nitrogen, total potassium and phosphorous contents in prepared organic fertilizer was determined by AOAC method. The elemental contents of each prepared organic fertilizers were analyzed by Energy Dispersive X Ray Fluorescence (EDXRF) method and pH, moisture content, organic carbon contents and organic matter were measured by Walkey Black method.

2.3 Preparation of Organic Fertilizer in Aerobic Condition

To know the effect of adding lime powder on the properties of organic fertilizers where as two Organic Fertilizers,(1) Prepared Organic Fertilizer with Lime (POFA1) and (2) Prepared Organic Fertilizer without Lime (POFA2), were prepared in aerobic condition.

2.3.1 Preparation of POFA1 (Vegetable Waste, Chicken Dung, Peanut Meal Cake, Prepared EM Solution and Lime Powder)

2 kg of rice straw, 2 kg of peanut meal cake, EM solution, 2 kg vegetable wastes, 2 kg of chicken dung, EM solution and 2 kg of rice straw were put layer by layer successively into an aerobic digester. 50 g of lime powder was spread on each layer. Finally, prepared aerobic organic fertilizer was obtained.

2.3.2 Preparation of POFA2 (Vegetable Waste, Chicken Dung, Peanut Meal Cake, Prepared EM Solution without Lime)

2 kg of rice straw, 2 kg of peanut meal cake, EM solution, 2 kg vegetable wastes, 2 kg of chicken dung, EM solution and 2 kg of rice straw were put layer by layer successively into an aerobic digester and this layering was done for two times for two months. Finally, prepared

aerobic organic fertilizer was obtained. Preparation of organic fertilizer under aerobic condition is shown in Figure (2).

Figure (2) Serial Preparation processes (A to F) of Organic Fertilizer Under Aerobic Condition

2.4 Turning Over Layers in Aerobic Conditions

Three layers were turned regularly first turning over was done after two weeks. Second turning over was done after two weeks and each turning over was after one week. Water was sprinkled over the top layer if it is necessary. After two month, decomposition was completed and prepared organic fertilizer under aerobic condition was obtained. Changes of the colour of the organic fertilizers are shown in Figure (3).

Figure (3) The Color of Composed Fertilizers Changes According to Time

2.5 Preparing the Barrel for Anaerobic Conditions

11.5" diameter and 13.5" height of plastic containers with lids were used for anaerobic digester. There were no holes in the digesters, as shown in Figure (4). 1 kg of straw, 1 kg of peanut meal cake, EM solution, 1 kg vegetable wastes, 1 kg chicken dung, EM solution and 1 kg straw were put layer by layer into anaerobic digester. It was tightly sealed and they were

composting for two months. Prepared organic fertilizers in anaerobic condition (a) with lime and (b) without lime were obtained.

Figure (4) Prepared Organic Fertilizers with lime (a) and without lime(b) in Anaerobic Conditions

3 RESULT AND DISCUSSION

3.1 Preparation of Organic Fertilizers

Organic fertilizers were prepared by using vegetable waste, chicken dung and peanut meal cake under aerobic condition and anaerobic condition. While processing to reduce the bad smell, lime powder was used. To know the effect of lime powder on the quality of organic fertilizers, two sub conditions, with the use of lime powder and without use of lime powder, were performed.

3.2 Determination of Yield Percent of Prepared Organic Fertilizers

The yield percent of prepared organic fertilizers were determined based on the total weight of materials that were used. The results are shown in Table (1).

Table (1) Yield Percent of Prepared Organic Fertilizers

No.	Organic fertilizer	Total weight of added material (kg)	Dried weight of prepared organic fertilizer	Yield (%)
1	POF A1	28.0	11. 75	48.95
2	POF A2	28.0	12..60	45.71
3	POF An1	7.0	5.50	78.57
4	POF An2	7.0	5.30	75.71

POF A1 = Prepared organic fertilizer in aerobic condition with lime

POF A2 = Prepared organic fertilizer in aerobic condition without lime

POF An1 = Prepared organic fertilizer in anaerobic condition with lime

POF An2 = Prepared organic fertilizer in anaerobic condition without lime

According to Table (1), the yield percent of prepared organic fertilizer under anaerobic conditions were greater than that of aerobic conditions. Among the two anaerobic conditions, POF An1 with the use of lime powder gave the highest yield (78.57 %).

3.3 **Determination of pH Values of Prepared Organic Fertilizers**

The pH values of prepared organic fertilizers were determined by using pH meter. The results are described in Table (2).

Table (2) pH Value and Moisture Content of Prepared Organic Fertilizers

Organic fertilizer	pH	Moisture (%)
POF A1	8.0	11.52
POF A2	7.5	12.34
POF An1	8.0	20.14
POF An2	6.0	22.01

According to Table (2), the pH values of prepared organic fertilizers under both aerobic and anaerobic conditions with lime were higher than those of without lime. It was found that POF A1, POF A2 and POF An1 gave alkaline whereas POF An2 showed little acidic character. The moisture values of prepared organic fertilizer under anaerobic conditions were higher than those of aerobic conditions.

3.4b**Determination of Elemental Contents of Four Prepared Organic Fertilizers**

Elemental contents of prepared organic fertilizer were determined by EDXRF spectroscopic method and the results are presented in figure (5).

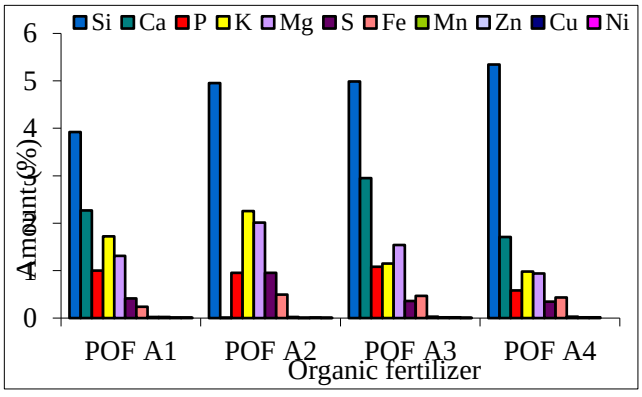


Figure (5) Elemental contents of prepared organic fertilizers

According to figure (5), the essential elements for plants growth such as silicon, calcium, potassium, manganese, aluminum, sulfur, iron, magnesium, zinc, copper, chromium, nickel and strontium were found in POF A1, POF A2, POF A3 and POF A4. According to elemental analysis by EDXRF, silicon was found to be the highest in all prepared organic fertilizers. Calcium was found to be the second highest in POF A1, POF A2 and POF A3. Potassium, sulfur, phosphorus, iron, manganese, copper and zinc were found with some extent in all prepared organic fertilizers.

3.5 Determination of the Amount of Nutrients of Prepared Organic Fertilizers

The amount of nutritive values of prepared organic fertilizers were analyzed as chemical properties. Total nitrogen, total phosphorus and total potassium were determined by AOAC method. Organic carbon and organic matter were determined by Walkey Black method. The results were shown in figure (6).

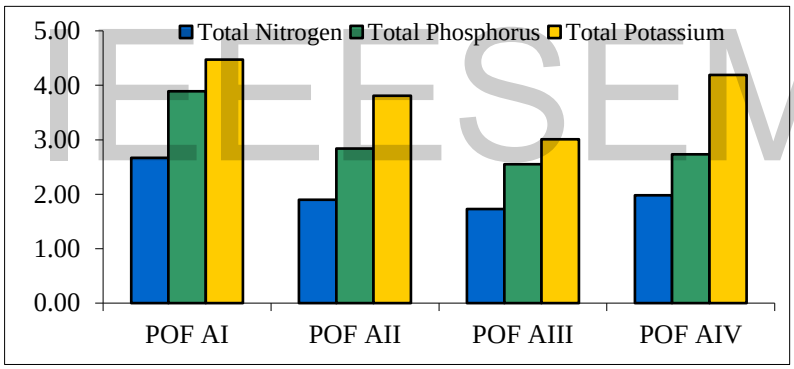


Figure (6) Total Nitrogen, Total Phosphorus and Total Potassium Contents of Prepared Organic Fertilizers

According to figure (6), the amount of total potassium in organic fertilizers under aerobic conditions were higher than that of anaerobic condition. The amount of organic carbon and organic matter in prepared organic fertilizer under anaerobic conditions were greater than that of aerobic condition in figure (7). Moreover, total phosphorus content of POF An2 was the highest.

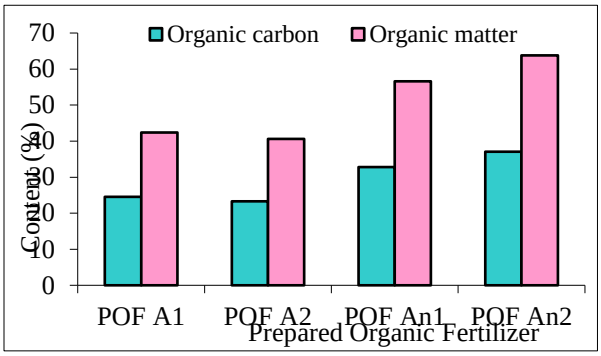


Figure (7) Organic Carbon and Organic Matter Values of Prepared Organic Fertilizers

4 CONCLUSION

Organic fertilizers were prepared from the wastes of vegetables, chicken dung, pea nut meal cake, the prepared EM solution and rice straw in aerobic conditions and anaerobic conditions. To know the effect of lime on the prepared fertilizers, quick lime powder was used. Four kinds of organic fertilizers were prepared. The yield percent of the prepared organic fertilizers were found to be 45.71-48.95 % for aerobic conditions and 75.71-78.57% for anaerobic conditions based upon the total weight of used materials. The pH of the organic fertilizers were found to be alkaline (6.0-8.0) in which anaerobic condition without lime is slightly acidic as well as the moisture content was in the range of 11.52-22.01%. From the elemental analysis, the essential trace elements such as silicon, calcium, potassium, aluminum, phosphorous, sulfur, iron, titanium, manganese, zinc and copper were found in the prepared organic fertilizers. Furthermore, the total nitrogen content of the prepared organic fertilizers was found to be 2.82-2.85% for aerobic conditions and 2.72-2.89% for anaerobic conditions and total phosphorus content was found to be 3.12-3.58% for aerobic conditions and 1.25-5.63% for anaerobic conditions. The total phosphorus content for anaerobic conditions was higher than aerobic conditions.

The total potassium content of the prepared organic fertilizers was found to be 3.19-3.29 % for aerobic condition and 1.54-1.57 % for anaerobic condition. Moreover, the amount of organic carbon and organic matter were 24.58 % and 42.38 % for POFA1, 23.29 % and 40.59 % for

POFA2, 32.82% and 56.59% for POFAn1 and 37.02% and 63.83% for POFAn2. The critical point of this research informs that the excellent amount of organic carbon and organic matter contents of prepared organic fertilizers show how these fertilizers are effective for organic plantation.

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