PRODUCING ORGANIC FERTILIZER FROM RESTAURANT FOOD WASTE USING COMPOSTING METHOD

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DECLARATION

I declare that this thesis entitled "Producing Organic Fertilizer from Restaurant Food Waste Using Composting Method''is the results of my own research except as cited in the references.

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Producing Organic Fertilizer From Restaurant Food Waste Using Composting Method

ABSTRACT

Restaurant produced food wastes every day and this caused a problem in waste management system. It used up a large amount of land, water and fertilizer only to be buried in a landfill. The food in landfill decomposes and emits methane gas which contribute to global warming. Three proportion of mixture was made such as 100% soil, 75% soil + 25% compost, 100 % compost. Next, the physicochemical properties were analysed in the compost which are colour, texture, odour, humidity and bulk of density. To compare the physicochemical content in 100% soil, 75% soil + 25% compost, 100 % compost using one-way ANOVA analysis. The food waste was collected from the restaurant area Jeli, Kelantan and the location to carry the process of composting is located at Tanah Merah, Kelantan. The physical characteristic for compost-like smell and dark brown in colour which means it is matured enough to be used. For the humidity of compost was 66% and bulk density of compost was 0.55 g/cm^3. Moreover, the physicochemical content was compared in 100% soil, 75% soil + 25% compost, 100 % compost. The pH value for 100% soil, 75% soil + 25% compost, 100 % compost are 7.30, 7.38, 7.34. In this study, the Nitrogen content for soil, soil + compost, and compost is 0.11%, 0.21% and 2.44%. Phosphorus is the other primary nutrients for plant. Lastly, after conducting the composting, the value of potassium for compost, soil + compost and soil are 33.03, 4.28 and 0.88.

Keywords: one-way ANOVA analysis, bulk of density and humidity.

Menghasilkan Baja Organik Dari Restoran Sisa Makanan Menggunakan Kaedah Pengkomposan

ABSTRAK

Restoran menghasilkan buangan makanan setiap hari dan ini menyebabkan masalah dalam system pengurusan sisa. Ia menggunakan sejumlah besar tanah, air dan baja sahaja untuk di ke bumikan di tapak pelupusan. Makanan di tapak pelupusan mengurai dan mengeluarkan gas metana yang menyumbang kepada pemanasan global. Tiga bahagian campuran telah dibuat seperti tanah 100%, tanah 75% + 25% kompos, kompos 100%. Seterusnya, sifat fizikokimia dalam kompos yang berwarna, tekstur, bau, kelembapan dan sebahagian besar ketumpatan telah dianalisis. Untuk membandingkan kandungan fizikokimia dalam tanah 100%, kompos 75% tanah + 25%, kompos 100% menggunakan analisis ANOVA sehala. Sisa makanan dari kawasan restoran Jeli, Kelantan telah dikumpulkan dan lokasi untuk menjalankan proses pengkomposan terletak di Tanah Merah, Kelantan. Ciri fizikal untuk bau kompos- seperti dan warna coklat tua yang bermaksud ia cukup matang untuk digunakan. Untuk kelembapan kompos adalah 66% dan ketumpatan pukal kompos adalah 0.55 g/cm^3. Selain itu, kandungan fizikokimia dalam tanah 100%, tanah 75% + 25% kompos, kompos 100% telah dibandingkan. Nilai pH untuk tanah 100%, tanah 75% + kompos 25%, kompos 100% adalah 7.30, 7.38, 7.34. Dalam kajian ini, kandungan Nitrogen untuk tanah, tanah + kompos, dan kompos adalah 0.11%, 0.21% dan 2.44%. Fosforus adalah nutrient utama lain untuk tumbuhan. Akhir sekali, selepas menjalankan pengkomposan, nilai kalium untuk kompos, tanah + kompos dan tanah adalah 33.03, 4.28 dan 0.88.

Kata kunci: analisis ANOVA sehala, sebahagian besar ketumpatan dan kelembapan

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

Food waste is generated everyday due to living nature of human beings through industrial, agriculture and domestic activities. There are three different type of food waste sources which are food losses, unavoidable food waste and avoidable food waste (Thi et al., 2015). There is approximately one-third of food produced for human consumption is wasted or lost which reached the amount of 1.3 billion tonnes per year (FAO, 2015). According to Alias (2010), municipal solid waste (MSW) produced in Malaysia was 7.34 million tons in 2005, and it is predicted to increase to 10.9 million tons in 2020. At Korea, food waste is about 60% of yhe MSW. Hence the estimated amount of food waste produced in 2005 was 4.404 million tons and was estimated to increase to 6.54 million tons in 2020 (Lee et al., 2007).

In addition, Malaysia is trying to solve the problem during management of MSW and finding the most environmental-friendly solution which can be easily accepted by the public. In Malaysia, there is no separation for food waste management system and food waste is treated as part of MSW. Since food waste is the largest contributor to MSW, solution for MSW should be taken (Kathrivale et al., 2003). Hence, the food waste disposal is categorized under MSW disposal, which under the Malaysia Solid Waste and Public Cleansing Management Act 2007 (Act 672) (Ngapan et al., 2012). The most common method for food waste disposal is sending them to landfill. This is because it is a cost-effective, simple application and widely accepted solution for managing food waste. As many landfill have reached their maximum capacity, food waste management through landfill has become more difficult in Malaysia (Moh and Manaf, 2014). The large amount of food waste produced is main factor to issues that related to landfill such as toxic leachate, foul odor, vermin infestation and the emission of greenhouse gases (Lee et al., 2007).

In oder to reduce food waste, composting can be applied as part of food waste management. Composting is biological decomposition of organic matter into a stable, dark humus product in aerobic condition. Compost consists of the by-products of this decomposition, the biomass of both dead and living microorganisms, and the undergrad able parts of the raw materials make up the end product. The organisms that responsible for composting need standard nutritional and environmental conditions such as temperature and pH to survive and function. Besides, they also require suitable amount of macro and micro-nutrient, oxygen and water (Robert, Gwendolyn & Donald, 2000). By composting, the food waste can be turned into fertilizer which is giving benefits to the plantation and at the same time reducing the amount of food waste to landfill.

Therefore, this research aims to produce organic fertilizer derived from food waste collected from restaurant at Jeli, Kelantan.

1.2 Problem Statement

Increased generation of food waste is a global problem (Mason, Boyle, Fyfe, Smith &Cordell, 2011). According to Pleissner and Carol (2013), there is around 1.3 billion tonnes of food waste generated by a population of 30 million every years in the word. This include all type of food such as vegetable and fruits, eggs and seafood.

Based on the Food and Agriculture Organisation's (FAO) research, it stated that food is lost and waste from the production of agriculture activity to the hands of consumer. Food waste is a waste that can decomposed and recycle in dominant composition of municipal solid waste generated in Malaysia (The Sun Daily, 2014). Currently, there are some type of technologies applied in the waste management system of Malaysia such as recycling, composting, sending to the inert landfill or sanitary landfill and other disposal sites. However, the main waste disposal method in Malaysia is disposing all type of waste into landfill without any pre-treatment. The landfill that operated in this country are in bad condition such as poor leachate treatment, gas ventilation and lining system (Ismail and Manaf, 2013). It is estimated that the emission of greenhouse gases will be increased up to 50 % by 2020 if the country still depends on landfill as waste disposal on method. There are many environment problem associated with landfills such as groundwater contamination, air and soil pollution. By converting the food waste into organic fertilizer via composting, the amount of food waste in the environment can be reduce.

1.3 Objectives

1) To make three proportions of mixture such as 100% soil, 75% soil + 25% compost, 100 % compost.
2) To analyse the physicochemical properties in the compost.
3) To compare the physicochemical content in 100% soil, 75% soil + 25% compost, 100 % compost using one-way ANOVA analysis.

1.4 Scope of Study

This study focuses on the production of organic fertilizer by using food waste from restaurant in Jeli, Kelantan such as vegetable, fruits, chicken bones, fish bone and eggshell. Next, threepropotion of mixture are produce. In this study also to analyze the physicochemicals properties in in the organic fertilizer and also to compare the physicochemicals content in the organic fertilizer, soil and partials mixture of organic fertilizer using one-way ANOVA analysis.

1.5 Significances of Study

There are too much food waste generated from the restaurant in Jeli, Kelantan every day. This include vegetable, fruits, chicken bones, fish bone and eggshell. The workers are just disposing the food waste into bins without any treatments. Hence, the food waste that used in this research was collected from restaurant, Jeli. The production of organic fertilizer using food waste such as vegetable, fruits, chicken bones, fish bone and eggshell can be made at home and anytime. By using organic fertilizer, the amount of food waste generated from cafeteria can be reduced. Hence, the environment problem related to landfill such as greenhouse gases emission can be reduce.

CHAPTER 2

LITERATURE REVIEW

2.1 Process In Production Of Organic Fertilizer

There is some process that transform the food waste into organic fertilizer such as fermentation, solid state fermentation, submerged fermentation and composting. In this project, i choose the composting process. Composting is the process of controlled biological maturity in the presence of oxygen, where the organic matter is decomposed to the materials that posed shorter molecular chains (Sequi, 1996). This process were explained in the next sub-section.

2.1.1 Composting

Composting is separated into two phase which are degradation and maturation. First phase is degradation of the most easily degrading organisms by aerobic microorganisms to produce carbon dioxide and energy. It happen in the presence of oxygen. The next phase of the composting process is maturation of the materials in order to produce humus and aromatic compound. Temperature and pH are crucial in production of compost but the optimum temperature for composting will be change during the process. There are three phase that can be differentiated which are mesophilic (moderate temperature), thermophilic (high temperature) and cooling and maturation phase. The optimum pH range for compost microorganisms is between 5.5 and 8.5. As the pH is reduced, the microbial activity will be limited if it is an anaerobic condition. Composting brings many advantages such as improving soil tilt condition and structure, supporting living soil organisms and helps to dissolve minerals forms of nutrient (Oreopoulou& Russ, 2007).

2.2 Fertilizers From Food Waste

Organic fertilizer are the by-product of daily life from using organic materials such as manure, agricultural waste and food waste (Singh., 2012). There are some advantage of using organic fertilizer such as enhancing soil biological activity, increasing the organic matter content of the soil, releasing the nutrient slowly and hence reducing the nitrogen leaching loss and phosphorus fixation (Chen, 2008).

2.2.1 Food Waste

Food waste is define as the waste that produced during processing of industry, distribution and final consumption (Buchner et al., 2012). Food waste are produced in homes, institution and camps and these food waste should be remove in order to provide a clean environment. Through composting, these waste can be reduce and hence produce compost which helps in better crop productivity (Okareh, Oyewole&Taiwo, 2014). Food waste has high energy content and it seems to achieve waste stabilization and energy production (Sun-Kee& Hang-Sik, 2004).

Nitrogen elements in organic materials cannot be absorb directly by the plant, so it need to mineralize to nitrate or exchangeable ammonium with the help or microorganisms in solis. Microbe utilize the carbon for cell building and nitrogen for the synthesis of protein. The optimum C:N ratio is on the range 20:1, The organisms will absorb nitrogen and transform the excess organic nitorgen into ammonium if the C:N ratio is less than 20:1. The microbial activities increase and microbes will uptake the plant-available sources of nitogen of the C:N ratio is more than 20:1. This will bring the deficiency symptoms to the plants when a high C:N ratio compound is add to the soil (Lin, 2008).

2.2.2 Production of fertilizer using food wastes of vegetables and fruits

According to Tan (2015), the objectives of the study are to produce organic fertilizers by using food wastes such as vegetables and fruits, to determine the fungi involved during fermentation for production of fertilizer and to evaluate the effectiveness of produced organic fertilizers on water spinach's growth. In the study, the brown sugar was added in the sample in order to test the effectiveness of brown sugar in the fermentation. The fungi were isolated from solid and liquid samples of fertilizer during the fermentation in order to test the types of fungi that present in the fertilizer. From the findings, she found that the liquid organic fertilizers that 14 produced from food wastes showed higher plant height and percentage of dry matter when compared to the plants that grown in commercial fertilizer.

2.3 Benefits Of Organic Fertilizers From Food Waste

The application of organic fertilizer as a source of nutrients to add into the soil for improving the plant growth. It contribute to high level of organic matters and diverse microorganisms. It offers more significant advantage such as increasing organic matter in soil, improving drainage in clay soils and thus controlling soil erosion . Hence, environment impacts are reduce such as waterlogging, nutrient loss, eutrophication of waterways and surface crusting. All pf this problem solve by improving water rentention in soil, soil properties and associate plant growth. It also can replace the application of chemicals fertilizer. This is very crucial for the production of good quality agricultural product for food industry (Oreopoulou& Russ, 2007)

To be sustainable, organic agriculture must also be profitable (Reganold et al.,2011). The factors that determine the profitability of organic agriculture include labor costs, crop productivities, potential for reduce income during the organic transition period and potential cost saving from the reduce use of purchase inputs (Zentner et al., 2011). The chemicals fertilizer and herbicides can be replace and the compost by using the waste materials can be use for providing nutrients to plants and soil (Oreopoulou& Russ, 2007).

CHAPTER 3

MATERIALS AND METHODS

3.1 Materials

3.1.1 Collection Of Food Waste.

Food waste were collected from restaurant in Jeli, Kelantan, Malaysia. Plastic bag was used to collect the food waste and weight using weighing balance scale in certain amount of 3 kilogram for composting method. The saw dust was used as a bulking agent that bought from wood factory at Tanah Merah, Kelantan, Malaysia. The equipment such as plastic linear, mesh wire, polyethylene bags were bought at supermarkat.

3.2 Production Of Organic Fertilizer.

3.2.1 Accumulation Of Food Waste

The food waste from wet restaurant was used in this study that collected using plastic bag from wet restaurant in Jeli, Kelantan, Malaysia. The materials food waste that collected were composed of leftovers of raw fruit, chicken, fish and vegetable. The improper materials such as plastic and paper were manually separated. Saw dust was provided bulking agent in this procedure that will use because it is the most common materials easily materials. The materials of bulking agent were collected separately in

Tanah Merah, Kelantan, Malaysia which is at wood factory in order to use in composting process.The food waste was weight in a certain amount of 3 Kilogram for composting method.

3.2.2 Process Of Composting

The location to carry in this method was located at Tanah Merah, Kelantan. The composting site must in good condition and clear from weed and vines. Plastic linear and moveable mesh wire was needed to form compost bin. The wire mesh was required to increase air flow through the material and provide protection animals pest and heavy rains can covered with plastic linear on the ground. The food waste will shredded or cut into small piece around 10 to 15 cm to ease the composting process. The small piece of food waste will placed in compost bin at the size 41 x 41. Shredded food waste is layered into a pile with an amount of sawdust in approximately 2 inch of food waste and 5 inch of sawdust. This step was repeated until the compost become thick layer. The layer was water up by sprayed with water to constant the moisture structure. In this process, moisture was controlled by adding water to keep the moisture structure and the moisture content not less than 50%. The composting process was in 30-40 days to allow it being mature compost for further analysis.

3.2.3 Composting Mixture Output

The composting mixture will be produced. Three types of composting were divided which have different mixture.

Pile 1 (P1): 100% soil.

Pile 2 (P2): 75% soil + 25% compost.

Pile 3 (P3): 100 % compost.

3.3 Physical Characterization Of Compost

The pyhsical characterization include: colour, texture, odour, humidity and bulk of density.

Colour was observed to identify the colour of each sample of pile compost in dark brownish-black. For the smell change from rotten food wastes to an earthy soil-like smell. Then, the texture must change from particle of sawdust into tiny dark pebbles that indicate a mature a high-quality compost product.

Next, for moisture content for this study, each of pile was take and weight using digital scale balance, then the sample was placed into the Petri dish to facilitate and faster the drying process to constant weight at 105˚C for 48 hours. The percentage of humidity was calculated using the following equation:

$$Humidity = \left(\frac{(freshweight - dryweight)}{(freshweight)}\right) \times 100\%$$

Bulk density was measured using approximately tools by using a steel ring for example a tin with 10 cm height x 7 cm diameter of container. The steel ring was pushed or gently hammer into soil. The steel ring must full of pile compost, the pile compost was slightly compact to ensure the absence of a large void space. Excavate around ring without disturbing or loosening the soil contains and it was removed carefully. The pile compost was poured into seal plastic bag and take the weight of sample pile compost using digital scale balance. To calculate the bulk density, soil volume and dry soil weight was needed to get the result. Soil volume can be determined by the steel ring volume and dry soil weight cam determine with the weight of sample before dry (W_1) - the weight after dry (W_2) which is the sample pile compost was dried for 2 hours in a conventional oven at 105˚C. The bulk density (g/cm^3) will calculate as:

$$Bulk\ density\ \left(\frac{g}{cm^3}\right) = \left(\frac{Dry\ soil\ weight\ (g)}{Soil\ volume\ (cm^3)}\right)$$

3.4 Chemicals Characterization Of Compost

The following parameter was measured or analysed for the each compost pile: pH level of soil, compost + soil and compost, total nitrogen, available phosphorus and available potassium.

3.4.1 pH Level Of Compost

Each of the pile compost was measured the pH contain using pH meter. The sample of each pile compost was placed in 50 mL of beaker. The reading of each sample was recorded as for result.

3.4.2 Total nitrogen

The Kjeldahl method was used to determine the nitogen content in each sample of proportion. There are three major steps in Kjeldahl procedure which is digestion, distilation and titration. First, 1.0g of sample was weight into 50 mL Kjeldahl digestion tube. Measuring cylinder was used to add 12 mL of concentrated sulphuric acid (H_2SO_4) into digestion tube. A tablet of Kjeldhal Cu catalyst added to each tube. Next, the sample were heated at 400˚C for 3 hours in digestive block untill the sample were colourless. The sample were allowed to cool down for 15 minutes. In the cooling process, 80 mL distilled water and 50 mL of 40% sodium hydroxide NaOH (e.g 40% NaOH= (400 g NaOH/ 1000 mL distilled water) × 100) was added to proceed for the distillation process. For the distillation process, receiver solvent was prepared with 30 mL of 4% boric acid, 1.75 mL of methylred and 2.5 mL bromocresol green in 250 mL conical flask. A 4% boric acid was prepared by weighing 10 g boric acid (H_3BO_3) and adding 250 mL of distilled water. It was swirled until the boric acid dissolves. The receiver tank was placed in the right position and during the distillation process, the colour of receiver tank was changed from red to green colour. A 0.01 M of H_2SO_4 (0.54 mL of concentration H_2SO_4 in the volumetric flask was diluted up tp 1 L) was titrated against until the colour change from green to pink (Unkell, 2018). Percentage of Nitrogen in the sample was calculated as:

$$\% \, Nitrogen = \left(\frac{(T - B) \times N \times 14.01}{\mathrm{W_t} \times 10}\right)$$

Where: T = Volume of 0.001 M H_2SO_4 titrated for the sample (mL)

B = Digested blank titration volume (mL)

N = Molarity of H_2SO_4

14.0 = Atomic weight of N

W_t= Weight of sample (g)

3.4.3 Available Phosphorus

Each of compost pile sample was taken accurate weight about 2g and transfer to a 250 mL conical flask, 80 mL of HCL and H2SO4 (ratio of 3 to 1) was added and shaked in mechanical shaker for 45 minutes. The digestion was taken about 7 hours. The digestion was filtered using filter paper. Next, 20 ml of filter digestion was taken and added with 4 mL of ammonium molybdate, 3 ml hydrazine sulphate and keep in water bath for 30 minutes. The blue colour will observe by measured with spectrophotometer according (Adelowo et al, 2016). This sample was analysed in triplicates.

3.4.4 Available Pottasium

Place 2.5 g of fertilizer in a 250-mL volumetric flask. Add 150 mL of distilled water and boil for 30 minutes. Cool dilute to volume with water and mix thoroughly. Filter through a dry filter or allow standing overnight. For sample containing less than 20% K2O, transfer a 25-mL aliquot to a 100-mL flask, dilute to volume, and shake throughly. For sample containing more than 20% K2O, use a smaller aliquot. Determine the concentration of potassium in the sample using the condition listed on the "Standard Condition" pages. A less sensitive potassium wavelength , 404.4 nm, should be used.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Physical Characterization Of Compost

4.1.1 Colour, Texture And Odour

This suggested that the compost was mature but not all compounds get fully broken down into simple ions. The microorganisms in the composting were able to join some of the chemical breakdown products together into long chains called polymers. These resist further decomposition and become part of the complex organic mixture called humus and the formation of humic compounds (Graves and Hattemer 2000). The matured compost product was brownish-black in colour, soft, coarse and had a good smell compared to the vegetable wastes.Compost-like smell and dark brown in colour which means it is matured enough to be used.

4.1.2 Humidity

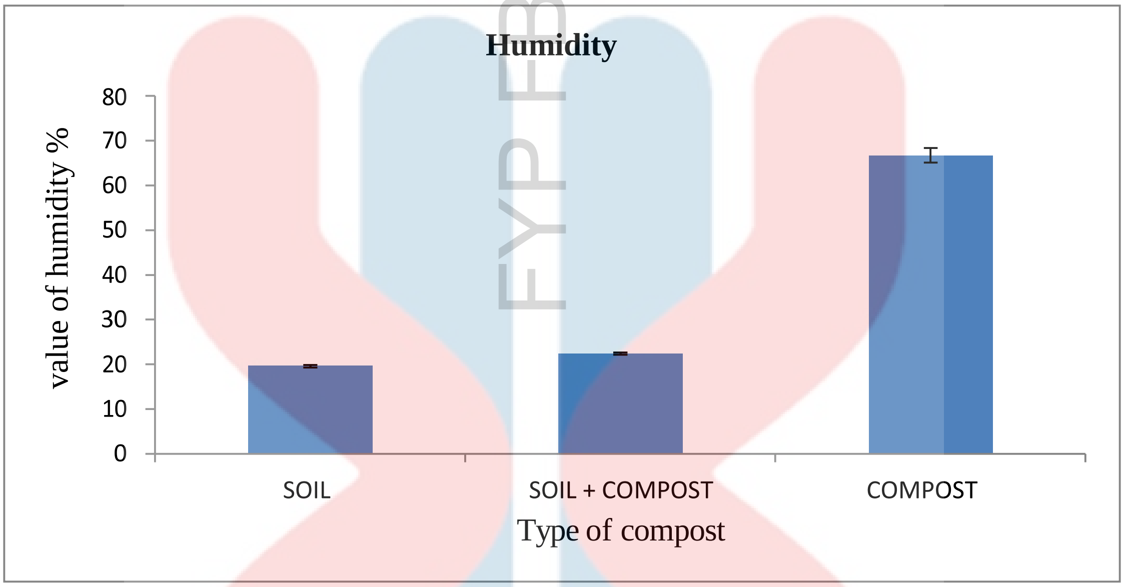

Figure 4.1: Value of humidity soil, soil + compost and compost

Table 4.1: The ANOVA of humidity

ANOVA

m.content

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3204.648	2	1602.324	1.767E3	.000
Within Groups	4.535	5	.907		
Total	3209.183	7			

Based on the Table 4.1, the humidity for three treatment is significant because <0.05

The humidity is defined as the content of water in the compost with respect to any matter that is in the interior. Is most often expressed in percentage, it will indicate what proportion of water to the entire mass of compost. Water is essential for the survival and activity of the creatures, including microbes, required for composting. The organic material being decomposed has to moist but not too wet. Biological activity will slow if the compost heap starts to dry and will virtually cease if it dries out as most of the desirable compost creatures become dormant or die.

Figure 4.1 shows the value of humidity for soil, soil + compost and compost are 19%, 22% and 66%. The optimal humidity for composting process was ranged between 40 – 60% (Khair et al., 2015). Therefore, the suitable value of humidity for compost is optimum which is 66%. Within the optimum in this range a thin water film will cover the particles of material being composted but will not fill the air spaces (pores) between and around the particles. The air spaces allow air and water to circulate through the organic material. When humidity below 40% causes the reduction of microbe activities, so that anaerobic fermentation will occur.

4.1.3 Bulk Density

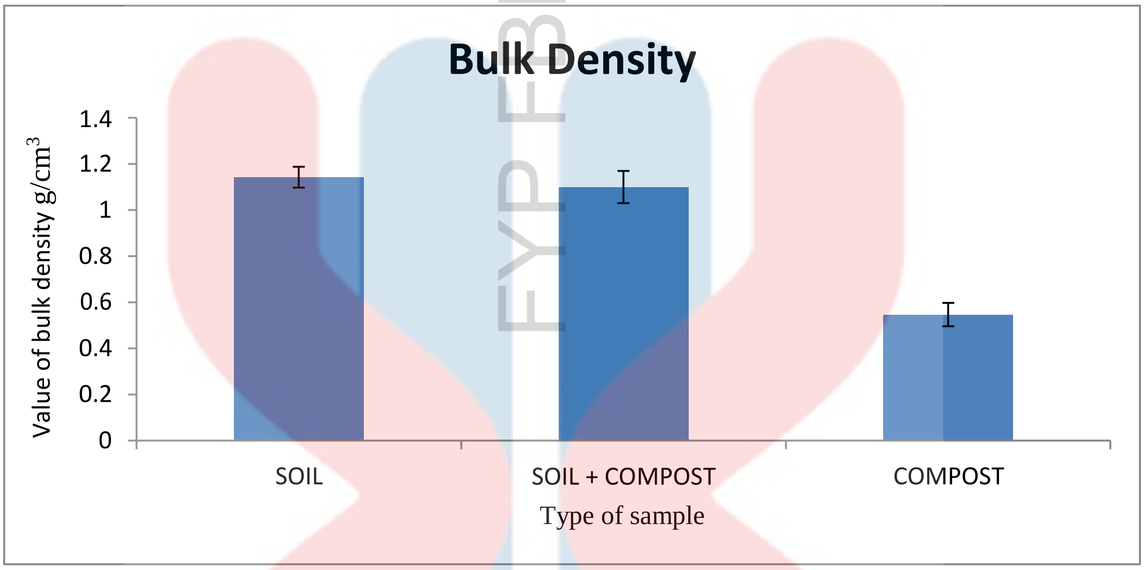

Figure 4.2: Value of bulk density soil, soil + compost and compost

Table 4.2: The ANOVA of bulk density

ANOVA

bulkdensity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.664	2	.332	105.222	.000
Within Groups	.019	6	.003		
Total	.683	8			

Based on the Table 4.2, the bulk density for three treatment is significant because <0.05

Bulk density is an indicator of soil compaction. It is calculated as the dry weight of soil divided by its volume. This volume includes the volume of soil particles and the volume of pores among soil particles. Bulk density is typically expressed in g/cm3. Bulk density reflects the soil's ability to function for structural support, water and solute movement, and soil aeration. Bulk densities above thresholds indicate impaired function based on (Figure 4.2). Bulk density is also used to convert between weight and volume of soil. It is used to express soil physical, chemical and biological measurements on a volumetric basis for soil quality assessment and comparisons between management systems. This increases the validity of comparisons by removing error associated with differences in soil density at time of sampling.

Figure 4.2 shows the value of bulk density for soil was higher which is 1.14 g/cm^3 compare to soil + compost and compost. High bulk density is an indicator of low soil porosity and soil compaction. It may cause restrictions to root growth, and poor movement of air and water through the soil. Compaction can result in shallow plant rooting and poor plant growth, influencing crop yield and reducing vegetative cover available to protect soil from erosion. By reducing water infiltration into the soil, compaction can lead to increased runoff and erosion from sloping land or waterlogged soils in flatter areas. In general, some soil compaction to restrict water movement through the soil profile is beneficial under arid conditions, but under humid conditions compaction decreases yields. Therefore, bulk density of compost is suitable for planting because the value is lower than others which is 0.55 g/cm^3.

4.2 Chemicals Characterization Of Compost

4.2.1 pH Of Soil, pH Soil + Compost And pH Compost.

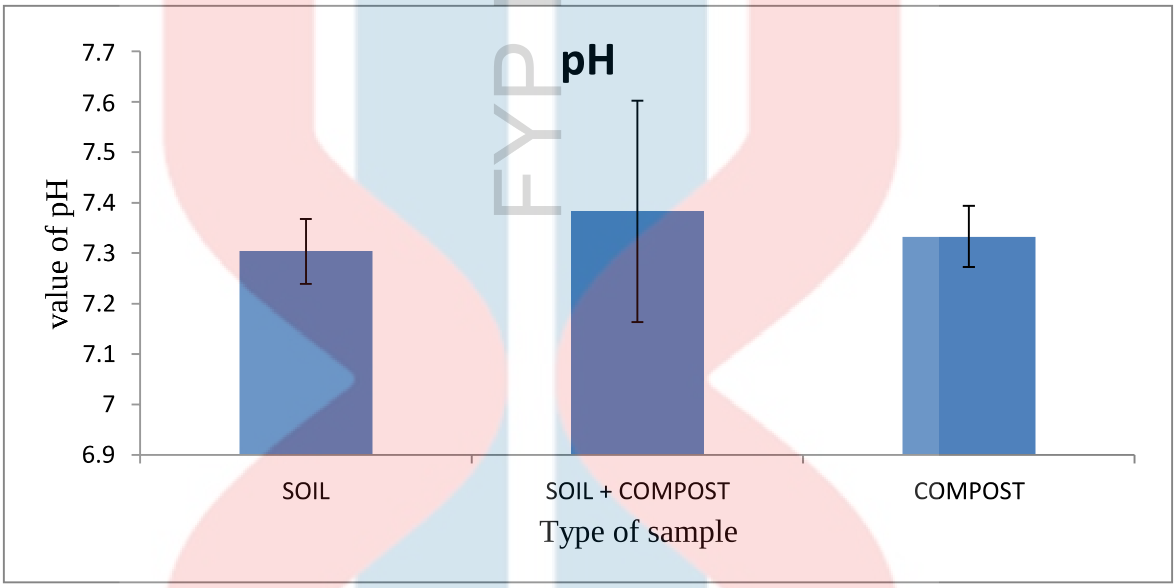

Figure 4.3: Value of pH soil, soil + compost and compost.

Table 4.3: The ANOVA of pH

ANOVA

pH

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.013	2	.006	.320	.738
Within Groups	.120	6	.020		
Total	.133	8			

Based on the Table 4.3, the pH for three treatment is not significant because >0.05

Figure 4.1 shows the pH of the soil, soil + compost and compost. The average soil pH during the test (T1- T3) was 7.3. The pH value of the soil was 7.3 which was neutral. The soil pH level near 7 are optimal for overall nutrient availability, crop tolerance, and soil microorganism activity. Next, the average soil + compost pH during the test (T1-T3) was 7.38 and also neutral. The pH rise also can be explained by the generation of ammonia from ammonification and mineralization of organic nitrogen through microbial activities. For the average compost pH during (T1-T3) was 7.33. The pH of compost also neutral which is 7.33 due to the acids were decomposed, the pH of the compost increased during successful composting (Beck-Friis et al., 2003).

4.2.2 Nitrogen

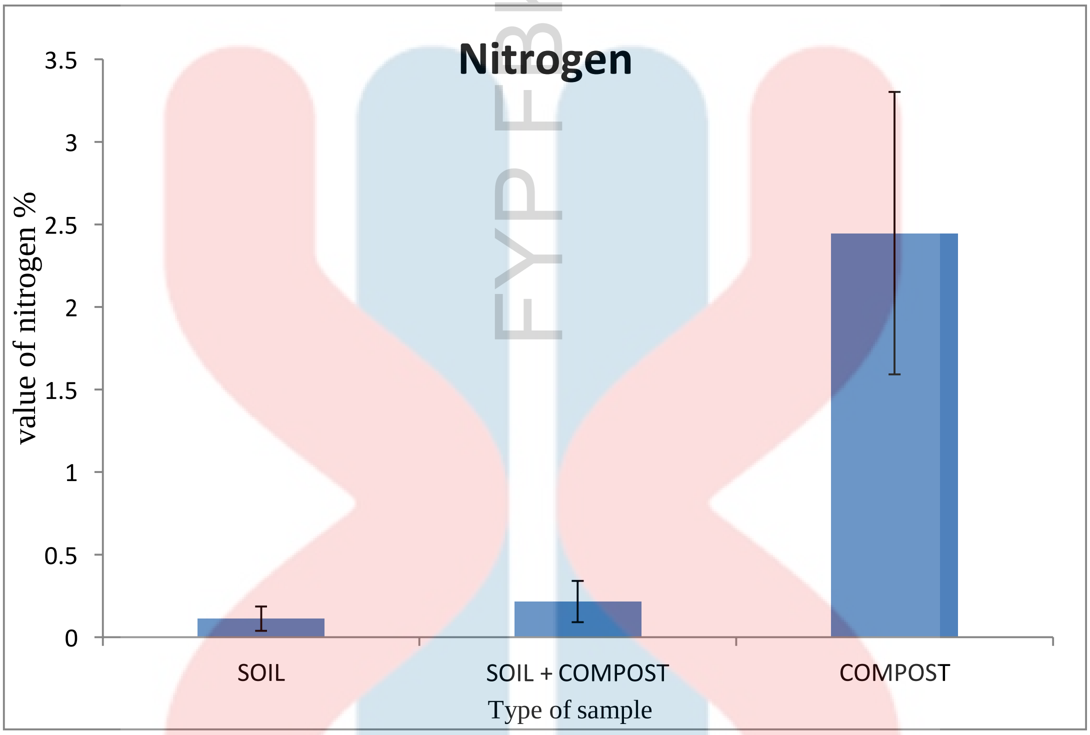

Figure 4.4: Value of nitrogen soil, soil + compost and compost.

Table 4.4: The ANOVA of nitrogen

ANOVA

nitrogen

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.433	2	6.216	38.161	.000
Within Groups	.977	6	.163		
Total	13.410	8			

Based on the Table 4.4, the nitrogen for three treatment is significant because <0.05

Nitrogen is the most commonly used mineral nutrient. It is important for protein production. It plays a pivotal role in many critical functions such as photosynthesis in the plant and it is a major component of amino acids, the critical element constituent component of proteins. These amino acids are then used in forming protoplasm, the site of cell division and plant growth. Nitrogen is necessary for enzymatic reactions in plants since all plant enzymes are proteins. If there is lacking of Nitrogen and chlorophyll means the plant will not utilize sunlight as an energy source to carry on essential functions such as nutrient uptake. For organic composting, the mature phase is which the organic materials continue to decompose and are converted to biologically stable humic substance. The increase in the Nitrogen value at the end of the composting period might occur due to the usage of Nitrogen by microorganism to build up cells, thus reducing the Nitrogen, and some of the organisms will eventually die, which is recycled as Nitrogen and thus contribute to increase. In this study, the Nitrogen content for soil, soil + compost, and compost is 0.11%, 0.21% and 2.44%.

4.2.3 Phosphorus (P2O5)

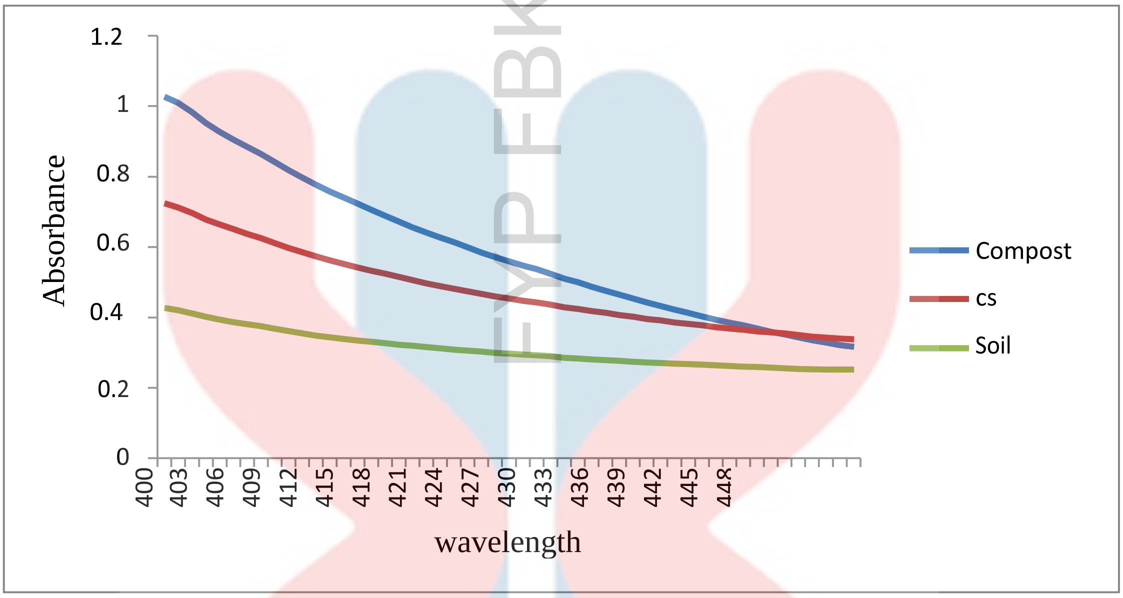

Figure 4.5: Value of phosphorus soil, soil + compost and compost.

Phosphorus is one of the 16 essential plant nutrients, and is considered one of the three major plant nutrients along with nitrogen and potassium. Phosphorus is not only important in root development, but also in encouraging rapid root growth during establishment of turf, landscapes and many other plants, improving flower and seed development, and hastening maturity in food crops. Furthermore, phosphorus is an essential component of adenosine triphosphate (ATP), which is involved in most biochemical processes in plants and enables them to extract nutrients from the soil. Next, it plays a critical role in cell development and DNA formation (Cornell Co-op Extension, 2005). In this cases, keeping soils at a neutral (7.3) or slightly acidic pH will keep P in more water soluble forms. However, inorganic P can become unavailable when it reacts with oxides of iron, aluminium, manganese (in acid soils), or calcium (in alkaline soils) to form phosphate minerals (Cornell Co-op Extension, 2005). This makes the P less available for plant uptake and leaching.

4.2.4 Potassium

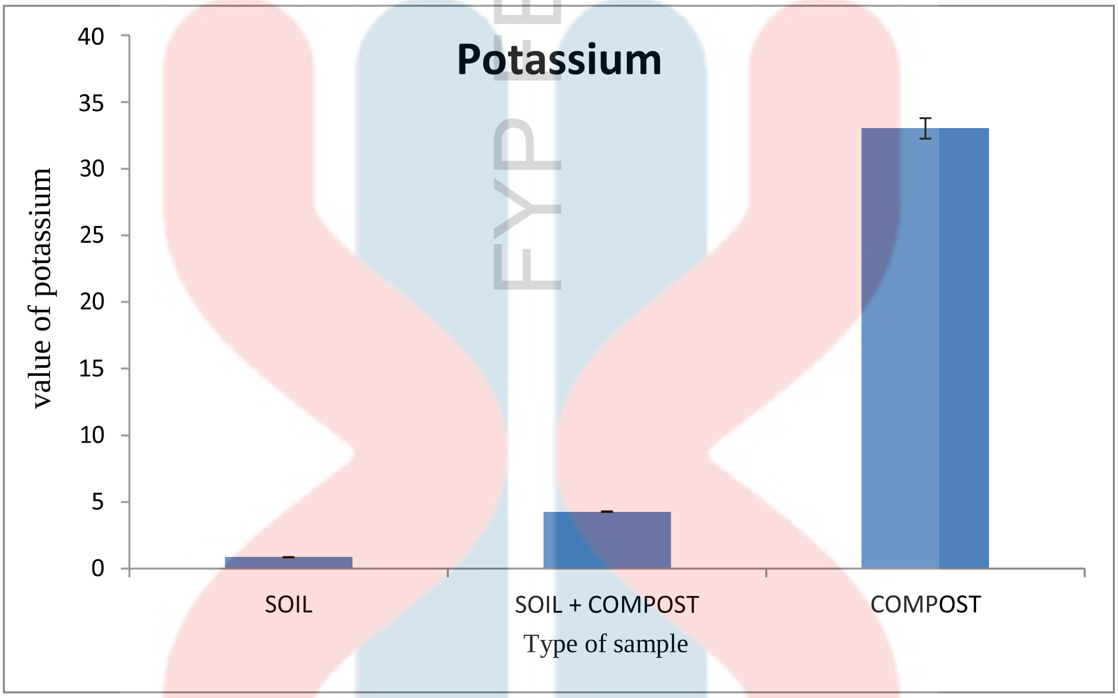

Figure 4.6: Value of potassium soil, soil + compost and compost

Table 4.5: The ANOVA of potassium

ANOVA

potassium

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1421.761	2	710.881	3.379E3	.000
Within Groups	1.052	5	.210		
Total	1422.813	7			

Based on the Table 4.5, the potassium for three treatment is significant because

<0.05

Potassium is vital to photosynthesis, protein synthesis and many other functions in plants. It enhances many enzyme actions aiding in photosynthesis and food formation. It builds cellulose and helps translocation of sugars and starches. Potassium is known as the "quality nutrient" because of its important effects on factors such as size, shape, color, taste, shelf life, fiber and other quality-related measurements. Other than that, Potassium can increase root growth and improves drought tolerance. After conducting the composting, the value of potassium for compost, soil + compost and soil is 33.03, 4.28 and 0.88.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The objectives of this research was to make three proportions of mixture such as 100% soil, 75% soil + 25% compost, 100 % compost. Next, to analyse the physicochemical properties in the organic fertilizer which are colour, texture, odour, humidity and bulk of density. For humidity, the optimal humidity for composting process was ranged between 40 – 60% (Khair et al., 2015). Therefore, the suitable value of humidity from the research for compost is 66%. Furthermore, the bulk density of compost is suitable for planting because the value is lower than others which is 0.55 g/cm3. This is because when high bulk density is an indicator of low soil porosity and soil compaction. It may cause restrictions to root growth, and poor movement of air and water through the soil. Moreover, to compare the physicochemical content in 100% soil, 75% soil + 25% compost, 100 % compost using one-way ANOVA analysis.This research is considered a success as the organic compost from food waste composting can be used as the fertilizer because the content of it is in the acceptable range for mature fertilizer.

The final product has soil-like smell and dark brown in colour which means it is matured enough to be used.

5.2 Recommendations

As for recommendation, this study can be further for making compost in less time and of better quality by get the optimal balance of compost materials and turn the compost more often. This method can adding fresh oxygen into the compost pile by turning it more frequently will help the compost break down faster. Many of the bacteria that break down your compost need air to survive. Next, check the moisture level of compost to achieving the correct moisture content. This is an important factor in keeping a compost pile working efficiently.

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APPENDIX A

	SOIL	SOIL + COMPOST	COMPOST
MEAN	19.6333333	22.4333333	66.71333
S.DEVIATION	0.25166115	0.2081666	1.669291

	SOIL	SOIL + COMPOST	COMPOST
MEAN	1.143333	1.1	0.546667
S.DEVIATION	0.045092	0.07	0.050332

	SOIL	SOIL + COMPOST	COMPOST
MEAN	7.303333	7.383333	7.333333
S.DEVIATION	0.064291	0.219621	0.061101

	SOIL	SOIL + COMPOST	COMPOST
MEAN	0.113333	0.216667	2.446667
S.DEVIATION	0.073711	0.125033	0.854478

	SOIL	SOIL + COMPOST	COMPOST
MEAN	0.875	4.278333	33.02667
S.DEVIATION	0.001732	0.015948	0.769177

	absorbance		
wavelenght	Compost	cs	Soil
400	1.027	0.725	0.427
401	1.009	0.713	0.421
402	0.982	0.697	0.412
403	0.952	0.679	0.402
404	0.927	0.665	0.394
405	0.905	0.652	0.387
406	0.884	0.638	0.381
407	0.864	0.626	0.375
408	0.842	0.612	0.368
409	0.819	0.598	0.362
410	0.797	0.586	0.355
411	0.777	0.574	0.349
412	0.758	0.563	0.344
413	0.741	0.553	0.339
414	0.723	0.543	0.335
415	0.706	0.534	0.331
416	0.689	0.525	0.327
417	0.672	0.516	0.323
418	0.656	0.507	0.32
419	0.641	0.498	0.316
420	0.627	0.49	0.313
421	0.614	0.483	0.309
422	0.599	0.475	0.306
423	0.585	0.468	0.303
424	0.572	0.461	0.3
425	0.56	0.455	0.298
426	0.548	0.449	0.295
427	0.537	0.444	0.293
428	0.524	0.437	0.29
429	0.511	0.43	0.286
430	0.5	0.425	0.284
431	0.487	0.419	0.281
432	0.476	0.414	0.279
433	0.465	0.408	0.277
434	0.454	0.403	0.275
435	0.443	0.397	0.273
436	0.433	0.393	0.271
437	0.423	0.387	0.269
438	0.413	0.383	0.268
439	0.403	0.379	0.266
440	0.394	0.374	0.264
441	0.386	0.37	0.263
442	0.378	0.366	0.261
443	0.369	0.362	0.26
444	0.36	0.359	0.258
445	0.352	0.356	0.256
446	0.344	0.351	0.254
447	0.336	0.347	0.253
448	0.329	0.344	0.252
449	0.322	0.341	0.252

APPENDIX B

ANOVA

m.content

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3204.648	2	1602.324	1.767E3	.000
Within Groups	4.535	5	.907		
Total	3209.183	7			

ANOVA

pH

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.013	2	.006	.320	.738
Within Groups	.120	6	.020		
Total	.133	8			

ANOVA

nitrogen

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.433	2	6.216	38.161	.000
Within Groups	.977	6	.163		
Total	13.410	8			

APPENDIX C

ANOVA

potassium

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1421.761	2	710.881	3.379E3	.000
Within Groups	1.052	5	.210		
Total	1422.813	7			

ANOVA

bulkdensity

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.664	2	.332	105.222	.000
Within Groups	.019	6	.003		
Total	.683	8			