

Utilization of Food Waste in producing compost Materials Using Effective Microbe (EM)

Haris Akmal Rosmadi^a, Nur Qistina Mohamad Kamarul Azman^a, Qamarul Uzair Sebera^a,
Mohamad Abdullah^a, Dr Hafiz Puteh^b

^a*Faculty of Chemical Engineering, UiTM Pasir Gudang,*

^b*Faculty of Civil Engineering Universiti Teknologi Malaysia*

Abstract

Food waste are one of the waste that are being generated about every day. It would be a waste if the generated waste is being ignore, neglect and just being dispose away without using the benefits that are in the food waste. The aim of this study to find the best way for food waste recovery by using effective microbes (EM). There are three different parameters are used in this study. The parameters are method of drying the food wastes, the presence of Effective Microbes (EM) after the drying of food wastes and the addition of wheat pollard. Effective microbe is a combination of anaerobic microorganisms in a liquid. The effective microbe is activated by mixing the EM 1 with molasses and water with the ratio of 1:1:20 and been left for a week. Molasses is a thick liquid of sugar from plant as an example sugarcane. The food waste went through three processes for it to be recover which are drip the food waste leeching water at the designated table, grinding of the food waste and lastly drying the food waste. Before grinding the food waste was added with coconut pulp. The food waste is analyse based on four analyses. The four analyses are moisture content, protein analysis, e-coli analysis and Fourier-transform infrared spectroscopy analysis (FTIR). Moisture content was being done to analyse the amount of water in the food waste by using the weight before the drying process and the weight after the drying process. Based on moisture content the best drying method is by using the oven. The result shows that the moisture content is 28% when the drying method is using an oven compared to using a conventional fan (51.4%). However, after a month of observation the most preferred drying method is by using fan. This is because after approximately about a month the food waste that used the drying method of an oven have the presence of moldy and about to be spoilt. Protein analysis and E-Coli analysis are being done to find amount of protein and e-coli respectively in the sample. Fourier-transform infrared is an analyzing process to check the absorption spectra of the food waste to find the functional group of the sample.

1. Introduction

In daily life, human eat food to stay alive however more food that been produced end up become as a waste as it become unfinish (Johari et al., 2012).. Fish bone and chicken bone are the usual type of food waste that been throw into the dustbin. Increasing number of human living in this world lead to increasing amount of food waste. Food waste has become a new serious problem in this era. There were a lot of industrial that produce junk food and frozen food. Food waste produce a lot because of people attitudes and so that it can become toxic chemicals and has become the worldwide problems nowadays because it was too many to be buried. Food waste is estimated to be buried in landfills in the United State (Levis et al., 2010). In Japan, land filling of food waste has been banned and this has led to food waste separation from the municipal solid waste (MSW) (Kim et al., 2011). Food waste also produce aromatic compounds halogenated compounds, phenols and heavy metals and these pollutants give a bad effect on aquatic life (Kadir et al., 2013). The aim of our study is to recover food waste as a safe food for animal.

The suitable method in managing food waste is composting as it produces bio-fertilizers, low operational cost and have the ability to generate income for their products (Taiwo, 2011; Lleo et al., 2013; Li et al., 2013). The composting process decomposed organic matter by using microorganism on some moisture, aerobic or anaerobic conditions to produce a product in a form of powder which are stable, low in moisture and free from pathogen (Soares et al., 2013). The product from composting process can be use as soil as bio-fertilizer that contain nutrients such as potassium, nitrate, sodium, calcium, magnesium, and chloride for plant to grow and as animal foods. However, in composting process duration of time two hour to complete the process by using grinder. Another issue with composting is the emission of unpleasant odors because of the organic compounds and fine aerosols arising as a consequence of volatilization of compounds contained within kitchen wastes formed during decomposition process (Chen et al., 2012; Sundberg et al., 2013). Food waste is fully content of food, so it is basically having high protein and safe to be eaten by animals and use them as fertilizers. Process on composting the food waste, one of them is dripping off water from it. The leaching water collected is good for growth of animals. Plants also will grow healthily when we use the leeching water to provide nutrients on them . (Salemdeeb et al., 2016)

Effective microbe or microorganisms (EM) is a type of pro biotic microbial developed by Teruo Higa (1970s). The application of EM in compost production achieve the requirement to accelerate composting process (Saravanan et al., 2013; harma et al., 2014; Mbouobda et al., 2014). The ratio of activation of EM is 0.5 L molasses, 0.5 L of EM1 and 10 L of water. After EM is activated we spray the EM on the food compose to be use in agriculture and as animal food. Usually they will use EM1 because it is a friendly microbial product. EM1 can be used for agriculture, livestock and microbial composition that is safe for human and animal life and for nature. EM1 is a living culture, therefore the container with EM1 may expand or shrink and white flakes may appear on the surface. Some sediment at the bottom of bottle is natural. EM1 is produced under the license of EMRO Japan. EM greatly accelerated the break-down (mineralization) of the organic matter in the Bokashi in the soil more nutrients get into the soil as nutrients to plants for growth (Mbouobda et al., 2014). Microorganisms that are found in EM suspension is fermenting fungi and actinomycetes (Talaat, 2014). The function of those microorganisms is that, lactic acid produces and inhibit the growth of pathogenic microorganisms and other various microorganisms by reducing the pH through lactic acid production.

The major problem that we have faced through this experiment is the presence of Escherichia Coli. As we need to find the suitable condition such as the proper moisture content for the sample that will prevent Escherichia Coli from reproduce. If the sample have high moisture content the sample will easily be contaminate by bacteria like Escherichia Coli and thi pathogen will spread to animals and maybe it will cause a harmful for animals ingested feed and cause infection disea e that can affect human being. Besides that, another problem that we faced during the study is the odor produce from the food waste. As the longer the time we kept the food waste the pungent the smell of the food waste. o, the function of EM is to keep the smell away from pungent.

The aim of the study is to ensure the conversion of food waste into animal feeds is safe to be used and to reduce the development of pathogens in the food waste during the process. The objectives is to investigate the effectiveness of conventional fan drying method of food waste processing site based on the quality of its end product. To evaluate quality of end product by alternative drying method of heat treatment by oven and drying. To compare the amount of bacteria presence in the end product of fan and heat treatment which is solar and oven.

2. Methodology

2.1 Food Compost preparation

Activating effective microbes are the most important things in preparing food compost. About 0.5 L of molasses was added in a container. Then the container was filled with 5 L of water and been left for about 30 minutes. Lastly 0.5 L of effective microbes in the container with 5L of water. The mixture is left for a week for the effective microbes to be activated. After three days, the container needed to be open to release the gas. The food waste is collected every day from the cafeteria at Universiti Teknologi Malaysia. The food waste was sent by truck with bulk amount. The food waste was place into a designated table made of wood. The designated table wood are made to drip off water from food waste. The leeching water collected from the food waste has high protein. The unwanted waste such as drinking plastic, plastic bottle, straw, food container, spoon and fork were separate off from the food waste. Food waste was

mixed with coconut pulp to let the grinding process smooth. After the food waste has mixed well with coconut pulp, the food waste was grind by using designated grinder that compressed off water from food waste and break it off into smaller size and kill worms. Fast decomposition of food waste results in the release of significant quantities of energy heat, while increasing the acidification rate and bulking properties of food waste may create anaerobic zones in composting reactors (X. Wang et al. 2018). Food waste that have been grind is blended in with the activated effective microbes to kill bacteria such as salmonella and E. coli and prevent maggots from laying eggs in it. Effective microbes function as a pesticide. (Chan et al, 2012)

2.2 Drying Method

Conventional Fan

Conventional fan uses to dry the food compose is at room temperature which is 27 Celcius. High speed used to enhance in lowering percentage of moisture content. It also decreases time to dry the food waste as it has high energy in reducing excess water. The percentage of moisture content also decreasing per time. Although it can be reducing the moisture it also can admitting the problems on taking too long to dry the food waste. The humidity of surrounding area also effects the moisture content of the food compose while dry using conventional fan. The degradation process needs an active microbes present in food waste to start. (Mutala Mohammed et al, 2017) Sometimes the duration may take 2 days. While it consuming time to dry, it also delaying process of reducing the moisture content and spoil by flies and dust. Thus, breeding of maggots in the food compose will occur. Growth of bacteria also will give affects in reducing the properties content in food waste.

Oven Dryin

Oven drying method is used by setting the temperature at 50 Celcius. The duration for drying takes 1 day. The food compose is mostly dried as the method of reducing excess water is efficient. The heat from oven was absorb by the food compose during the drying process.

2.3 Fourier Transform Infrared (FTIR) Spectroscopy Method

This technique is to obtain qualitative and quantitative features of IR-active molecules in organic or organic solid, liquid or gas samples. (Linker Raphael, 2011). Three samples which treated with effective microbes, untreated food compost and food composed with addition of wheat pollard was sent to the laboratory to undergo FTIR Spectroscopy analysis to measure how well each sample absorbs light at each wavelength based on C and N functional group. In the process, carbohydrates levels are decreased while levels of alkyl C, aromatic C, and carboxyl groups increased (Y. Inbar, et al 1988)

3. Result and Discussion

3.1 Moisture Content

Moisture content is needed to measure the moisture of food compose after dry. Lower percentage of moisture content obtained is effective in reducing excess water contain in the food waste. Lower moisture content is the best in avoiding growth of bacteria.

$$\% MC = (WW-DW)/WW \times 100\%$$

Where: WW =Wet weight of sample and beaker, g.

DW =Dry weight of sample and beaker, g.

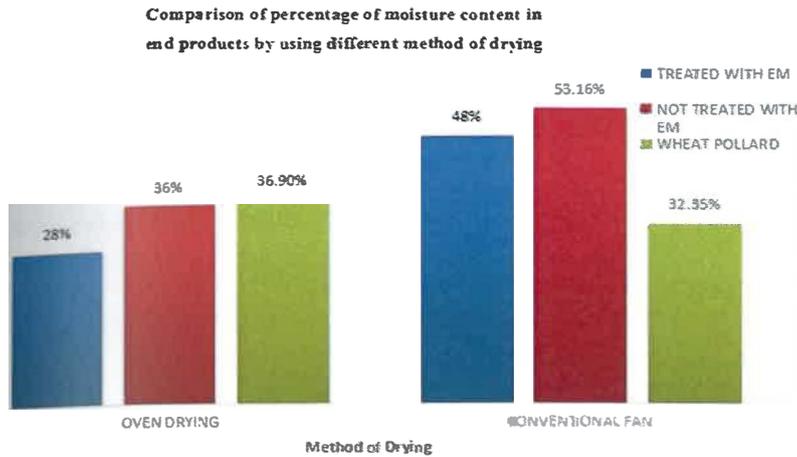


Figure 1: Comparison of percentage of moisture content in end products by using different method of drying

It is recommended for the dried food waste to undergo fermentation process by mix it with wheat pollard as it will help to increase the nutrient content loss during drying. In addition, wheat pollard will act as protein in the end products and help to increase the growth of animals and makes it become healthy and increase the anti-body which will prevent animals from any infections. After undergoing some treatment, protein content in the food waste will reduced as well as reducing the nutrients in the animal feeds. Hence, fermentation method is applied to increase the protein and other nutrients content in the animal feeds. In addition, protein is important for the animal growth. Fermentation process helps in reducing moisture content in the food waste and it will makes the dried food waste to be completely dried. (Agoreyo.B.O, 2011). Then, 15g of the sample was placed in the aluminium dish and weighed using analytical balance. After that, total of 3 samples from each batch were placed in the oven and fan as quickly as possible and the sample is dried. After identified, the food waste treated with effective microbes by using oven drying has lower moisture content compare the other batch. By using oven, the percentage is 28% between other between another batch. Effective microbes play a vital role in succession and evolution of microbiological communities in the entire biological processes (M. waqas et al, 2014). Besides that, by using conventional fan the percentage is 32.35% after the food waste has been mixed with wheat pollard. Hence the safety of animal feeds will be increase by decreasing the moisture content as the factor of E. coli growth is depends on the especially E. coli. it can be seen that some of the E. coli results are less than 10 CFU/g which considered as not detected. This is likely due to the targeted organism is not found in the sample on that moment. According to American Chemical Society (2010), sometimes it is difficult to find samples bacteria that contain E. coli in large samples.

3 Fourier Transform Infrared (FTIR) Spectroscopy analysis

The transmitter unit of three sample of food compose was obtained by using FTIR spectroscopy analysis It is an ible instrument in detecting functional group and covalent bond component in the compound structure. Each sample contain different unit of absorbance. The composition of the sample shows by each peak of the results obtained, FTIR spectra obtained by those three sample are mostly intervals at band 500-4000 cm^{-1} .

3.1 Food compost that treated with effective microbes

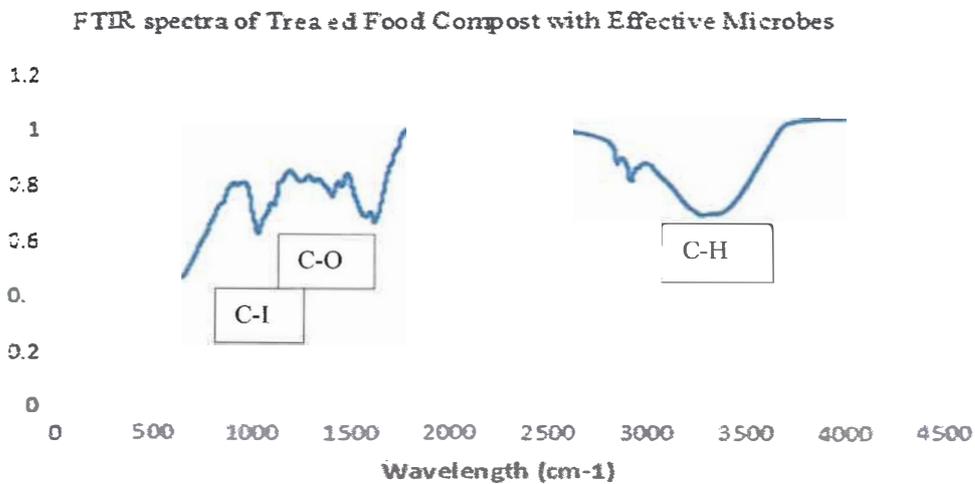


Figure 2: FTIR spectra of Treated Food Compost with Effective Microbes

Based on figure 2, absorption spectra for the sample is shown that at range 3500-3200 cm^{-1} , strong and broad band (O-H stretching vibrations) is higher relative shown compared with the untreated composition. (Siwatt Pongpiachan, 2014) Two peaks is shown as C-H that is medium and broad band that stretch at 3000-2500 cm^{-1} . Halo compound which C-I groups was pronounced strong and broad band at range of 500-1000 cm^{-1} . Aromatic ester compound also shown at range 1500-1000 cm^{-1} in variable of strong and broad band stretching vibrations.

3.2.2 Untreated Food Compost