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Milkfish, Apple and Pineapple Waste as Alternative Liquid Organic Fertilizer

Sri Widyastuti, Lady Softa Lovakusuma
Division of Environmental Engineering,
Universitas PGRI Adi Buana
Surabaya Indonesia
sriwidyastuti@unipasby.ac.id

Abstract **- The surge in milkfish production followed sewage pollution around the processing area. It is necessary to reduce the fish waste as alternatives. This study aims to determine the contents of C organic N P K, Salmonella and its effect on plant. Waste was fermented and added with fruit waste as well as an EM4 bioactivator. Chemical and biological quality analysis on liquid organic fertilizer was done There three compositions in the fertilizer, with apple waste, C contents 11.33%, N 3.38%, 3.39% P, 4.19% K, with pineapple waste C contents 17.26% , N 5.28%, 5.64% P, K 5.85%, and the fertilizer with a mixture of pineapple and apple waste had organic C contents 5.10%, N 2.03%, 2.13% P, 2.46% K. The number of bacteria Salmonella is on 4.23 × 10^1 colonies/ml. The highest organic C content , highest level of nitrogen and highest potassium content was liquid organic fertilizer with pineapple fruit The fertilizer in the capsicum plant (*Capsicum frutescens*) was performed the highest content of NPK highest.**

Keyword – milkfish; fish waste; liquid organic fertilizer; the capsicum plant (Capsicum frutescens)

I. INTRODUCTION

Utilization of the source of organic material from animals by utilizing the fishery waste can be an alternative. In this case, the involvement of fermentation process may produce liquid fertilizer product. However, basically, fishery waste cannot be utilized directly as liquid fertilizer because the content of organic matter, in the form of fat and protein, cannot be absorbed directly by the plant. Organic content in the wastewater should be broken down with the aim of breaking down complex compounds into simpler organic compounds so that plants more easily absorb the nutrients contained in organic liquid fertilizer. The activator added in this study was EM 4 (effective microorganism), different with Nur Hapasari, Tjatoer Welasih that use enzim as activator. Research by Sri Widyastuti , Puri Rahayu [5] found that the production of organic liquid fertilizer without additional fruits and vegetables waste will not perfectly decomposed. There are fish blood and cuttlets have been found in the final product from this fermentation process.Waste is generally collected in fish shelters as well as traditional markets. The composition of waste is generally in the form of fish that have been damaged, the contents of the stomach, fins, head, and scales. If used, fish waste has the potential to be used as a good quality fish fertilizer which is equivalent to fish fertilizer that already exist in the market.

The fertilizer can provide nutrients that match the needs of plants on the ground due to its liquid form. If there is an excess of fertilizer capacity on the soil, the plant by itself will easily regulate the absorption of the required fertilizer composition[1]. To support the utilization of waste, research related to its use as a fertilizer is required. A previous study[2]. showed that EM4 can be used as a bioactivator in the production of liquid organic fertilizer with raw materials of milkfish waste and additional vegetable waste.

This study aims to determine the contents of C organic , N P K, Salmonella and its effect on plant. This study used EM4 as a bio-activator to the quality of organic fertilizer resulted from fermentation of fish waste mix and additional fruit waste.There were three compositions in the treatment of different fertilizer, consisting of apple waste, pineapple waste, and the waste mixture of pineapple and apple.

II. METHODS

This study was conducted in the Village Kalanganyar Sedati District Sidoarjo. Fruit wastes were taken from Pasar Puspa Agro, Taman District, Sidoarjo Regency. Waste was fermented and added with fruit waste as well as an EM4 bioactivator.

A. Instruments and materials

2.5 litre fermentation reactor, analytic balance, filter paper, measuring cup, and other supporting equipment, milkfish waste (stomach contents, fins, head and scales), pineapple and apple waste, fish wash waste water, EM4, red sugar, and bread yeast.

B. Production of liquid organic fertilizer

The making of liquid organic fertilizer was done in 3 times repetition in 3 variation. Milkfish waste and fruit waste were cleaned and then destroyed until smooth. Other mixed materials were inserted and left for 72 hours. After 72 hours, an EM4 bioactivator was included, each of 100 ml. The reactor was closed tightly and left for 21 days. After 21 days, the liquid organic fertilizer was filtered with filter paper until clean organic liquid fertilizer was obtained and free from dregs. Liquid organic fertilizer was inserted into a clean, dense container, and out of reach of sunlight. Then, the liquid

organic fertilizer was tested for organic C, N, P, K, and Salmonella.

C. Analysis of liquid organic fertilizer quality

The analysis of N, P, K, C organic, *E. coli* and Salmonella organic liquid fertilizers was carried out to determine total nitrogen (N) content by Kjeldahl method, phosphorus (P_2O_5) by Colorimetry, potassium (K_2O) by Titrimetry method (SNI 2803 : 2010), C organic testing method was referred to AOAC 967.05-2000, E.coli and Salmonella SNI 01.2332.1-2006.

D. Data analysis method

Analysis of organic C content in liquid organic fertilizer was done by wet oxidation method with chromic acid and spectrometry which refers to AOAC 967.05-2000. Total nitrogen (N)% was checked by Kjeldahl method referring to SNI 4958: 2015, while phosphorus (P_2O_5)% by colorimetry and potassium (K_2O)% was done by Titrimetri method referring to SNI 2803: 2010. To find out the numbers of Salmonella MPN/gr, the Most Probable Number (MPN) method was used and the complementary test was performed on the media referring to Manual on Microbiological Technique, 1991.

III RESULT AND DISCUSSION

A. Analysis of chemical content in liquid organic fertilizer

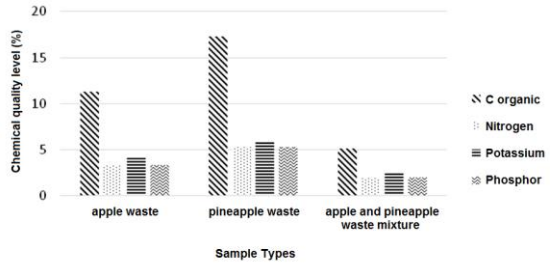

Fig 1. Variation of mixed milkfish waste with fruit waste on chemical quality in the form of organic C content, N, P, K.

Figure 1 shows that the organic C content of liquid organic fertilizer from fish waste with apple fruit, pineapple fruit, and apple and pineapple mixture on average was 5,10-17,26%. The highest organic C content was liquid organic fertilizer with pineapple fruit that was 17,26% on average. Increased levels of organic C in liquid organic fertilizer with milkfish waste was influenced by the fermentation process. The ingredients of organic liquid fertilizers production and the variation of pineapple waste mixture materials showed their effect on organic C content. In addition, the bromelin content of pineapple fruit, which is one of the sulfhydryl protease enzymes, was able to hydrolyze the peptide bonds of proteins or polypeptides into smaller molecules of amino acids. Bromelin is an amorphous powder with a clear white color to yellowish, typical smell [3]. The lowest organic C content was in liquid organic fertilizer with a mixture of apples and pineapples, which was 5.10%. The organic C content decreased because the C-organic content had been broken down into simpler compounds by microorganisms and also as a source of energy for the development and growth of microorganisms.

Nitrogen content of liquid organic fertilizer from fish waste with apple fruit, pineapple fruit, and apple and pineapple mixture had a mean of 2.03 - 5.28%. The highest level of nitrogen found in liquid organic fertilizer with pineapple fruit had a mean of 5.28%. Increased nitrogen content occurred through the breakdown of complex proteins from fish and fruit. Complex protein present in the fish body was converted into simpler compounds with the help of enzymes derived from fish bodies or microorganisms that took place under controlled conditions. Fermentation process occurring in fish was a biological or semi-biological decomposition process against complex compounds, especially proteins, into simpler compounds in a controlled state. During the fermentation process, fish protein is hydrolyzed into amino acids and peptides, then the amino acids will break down further into other components [4]. At the end of the fermentation process, nitrifying bacteria converted ammonia to nitrate which caused the nitrogen element in fermentation to increase.

The phosphorus content of liquid organic fertilizer from fish waste with apple waste, pineapple waste, and the apple and pineapple waste mixture had a mean of 2.13 - 5.64%. The highest level of phosphorus was liquid organic fertilizer with pineapple waste that was 5.64% on average. The higher the nitrogen content is conceived, the faster the microorganisms multiplication that breakdown the phosphorus, so that the phosphorus content in the fertilizer increases (Nurhapsari, 2012). Liquid organic fertilizer with pineapple and apple pineapple mixture had the lowest P content of 2.13% because the nitrogen content from the beginning was low, so the microorganisms that breakdown the phosphor was low, so that the phosphorus content in liquid organic fertilizer was also low. Fermentation determines the high level of P. But the longer the fermentation time does not mean P levels are also increasing because the fermentation process is directly related to the microorganisms that have stationary phase. In this phase, microorganisms are experiencing very significant growth, and, if fermentation is continued, microorganisms will die so that phosphorus (P) is less than before [5].

The potassium content of liquid organic fertilizer from fish waste with apple waste, pineapple waste, and apple and pineapple waste mixture had a mean of 2,46 - 5,85%. The highest potassium content was liquid organic fertilizer with pineapple fruit waste that had a mean of 5.85%. According to Hidayati et al. (2011), potassium is used by microorganisms in the substrate material as a catalyst. The presence of bacteria and its activity greatly affects the increase in potassium content. Potassium can be bound and stored in cells by bacteria and fungi. Potassium (K) is required to accelerate the process of assimilating carbohydrates, root growth and stem. Deficiency of potassium nutrients may cause patches on leaves or wrinkles and eventually leaves may dry out. In general, potassium has a function, among others, as a catalyst in the formation of proteins, regulate the activities of various mineral elements, increase the growth of meristem tissue, regulate the movement of stomata and strengthen the stem rod (because of turgor), so the plants do not easily collapse.

B. Number of Salmonella sp in liquid organic fertilizer

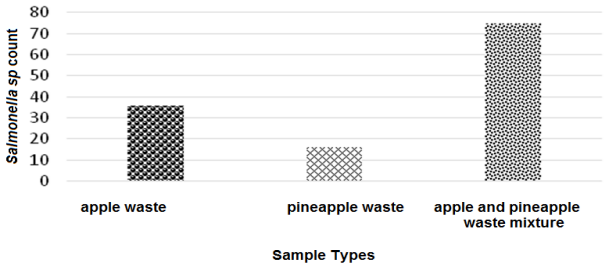

Fig 2. Salmonella count in liquid organic fertilizer.

According to Permentan No. 70 of 2011 on Minimal Technic of Liquid Organic Fertilizers, standard quality levels of Salmonella microorganisms for liquid organic fertilizer is a maximally 10^2MPN/g. Figure 2 shows that the liquid organic fertilizer of the three variations of the sample met the quality standard because it had levels of Salmonella pathogenic microorganisms below 10^2MPN/g. The sample of this liquid organic fertilizer met the quality standard because it had passed through the autoclave stage aimed at sterilizing the microbes so that the contaminant microbial *Salmonella sp*. in the liquid fertilizer died. Thus, liquid organic fertilizer was safe to apply to plants and safe when used to improve the nutrient of plants. During the fermentation process, the resulting ammonia (NH_3) was high enough and the pH became alkaline, causing the possibility of Salmonella's death. In addition, at the time of production of liquid organic fertilizer by fermentation heat was produced, causing the death of pathogenic bacteria [3]. In the process of liquid organic fertilizers production, the activator used in the decomposition was EM4 which has many beneficial microorganisms that can decompose pathogenic bacteria and other elements.

C. Observation of liquid organic fertilizer test in chili plant (Capsicum frutescens)

The result of observation was done on giving of varied doses of liquid organic fertilizer with pineapple waste mixture. Dose variations of 50 ml, 100 ml, and 150 ml on sample of organic liquid fertilizer had effects on the growth of chili plant (*Capsicum frutescens*).

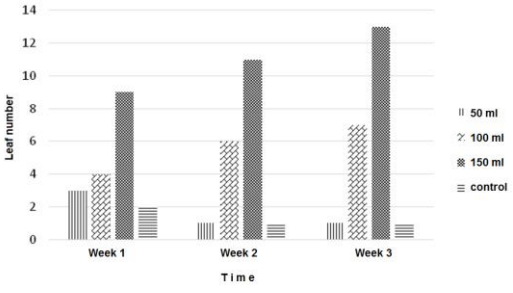

Fig 3. Data on the number of leaves of chili plants (*Capsicum frutescens*).

Figure 3 shows that administration of 150 ml dose variation is the most effective because it has more leaves than initially planted until week 2 compared to other dose variations. In a previous study, the optimal concentration of liquid organic fertilizer from fish waste in red pepper was 135 ml where there was an increase in the number of leaves growing compared to other doses of 35 ml, 50 ml and 100 ml. An increase in the growth of high leaf numbers is due to the absorption of higher nitrogen elements. Nitrogen compounds are used by plants to form amino acids that are converted into proteins. Nitrogen is also needed to form important compounds such as chlorophyll, nucleic acids, and enzymes [6].

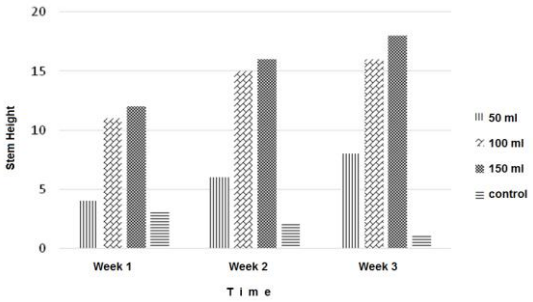

Fig 4. Stem height of *lombok* plant (*Capsicum frutescens*.)

Figure 4 shows that at dose variation of 150 ml the plants experienced high stem growth at week 1 to week 3 compared with other dose variations. Increased stem height in the growth of *lombok* plants (*Capsicum frutescens*) occurred because nitrogen spurred the growth of apical meristem so the plant grewlonger. In contrast, in the dosage of 50 ml at the beginning of planting until week 2 there was a decrease in plant stem height. This was because the plant lacked K (potassium) level needed for the growth of roots and stems. In addition to the absorption of nutrients, there was a mixture in liquid organic fertilizer given, the red sugar water. Red sugar water contains natural hormones for plant growth. Red sugar water contains two natural hormones for plant growth, the auxin and cytokinin, which are supporting plant cell division [6].

In this case, cytokinin serves to stimulate the growth of axillary buds, while auxin serves to stimulate root formation in buds. The auxin hormone is commonly used to induce callus formation, suspension culture, and roots, by spurring elongation and cell division within the cambium tissue. In addition to spurring root elongation, auxin can also stimulate leaf growth. Thus the growth of the number of leaves is supported also by the content of the hormone auxin in the fertilizer [6]

D. Physical observation (organoleptic) on liquid organic fertilizer

At the beginning of the process of liquid organic fertilizer production, the three variations of the raw material mixture emitted a very stinging fishy smell due to the smell of the fish waste. Then, the three variations of the raw material mixture underwent fermentation process in different reactors. On the 7th day, the stinging smell still existed, but some of the raw materials have been destroyed through degradation. On the 4th day, the smell had not stung, although some reactors still smelled. The raw materials of fish waste and fruit waste have been destroyed by degradation although there were still sediment or waste. On the 21st day the colors of each mixture of fruit waste were different. Liquid organic fertilizer from a mixture of apple waste had a color of orange brick, liquid

organic fertilizer from a mixture of pineapple waste had dark brown color, and liquid organic fertilizer from a mixture apple and pineapple waste had blackish dark-brown color.

IV. CONCLUSION

The organic C content, N, P, K on liquid organic fertilizer added by mixture of apple and pineapple waste have not fulfilled the quality standard. Examination of Salmonella sp. the whole variety of fertilizer meets the quality standard. Observation of leaf number and height of stem of chili plant (*Capsicum frutescens*) showed that at 150 ml dose variation the plant experienced the highest growth of leaf number and stem height at week 1 to 3 weeks.

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