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Effect of liquid organic fertilizer on water quality in shrimp ponds

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Abstract
This study aims to determine the effect of adding mangrove leaves on the nutritional quality of liquid organic fertilizer (LOF) and the effect of fermentation time on the number of microbes by adding different amounts of raw materials and the effect of its application on the quality ofshrimp pond water. The experimental design used was a randomized block design (RBD) with 3 treatment combinations and 3 replications. The first treatment is the use of 30% mangrove leaves + 30% vegetabes + 40% worm flour. The second treatment is the use of 40% mangrove leaves + 30% vegetables + 30% of worm flour. The third treatment is the use of 50% mangrove leaves + 25% fruit + 25% worm flour.. The first stage is the preparation of research materials and equipment. The second stage is the manufacture of liquid organic fertilizer. The third stage is the analysis of the effect of LOF on water quality in shrimp ponds. Then data collection, normality and homogeneity tests were carried out, and continued with analysis of variance (ANOVA) along with further testing the effect of the treatment. Parameters observed included nitrogen content (%), potassium content (%), phosphorus content (%), pH, number of bacteria, and pond water quality .

Keywords: *LOF, fermentation time, number of bacteria, number of mold/yeast, mangrove*

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I. Introduction

Pond is a general term for shrimp cultivation ponds. Even though the pond area is very large, the current fact is that there has been a decrease in pond productivity. The biggest obstacle in shrimp cultivation currently faced by fish farmers is the frequent mass and sudden death of shrimp. One of the causes of frequent mass mortality of shrimp in ponds is the high doses of inorganic fertilizers used by farmers. This can be seen by the increasingly foul-smelling condition of the pond mud, there is a grayish layer like cement on top of the pond mud. The fertilizer most often used by farmers is urea fertilizer. The use of various types of fertilizers, pesticides and feed in ponds initially only followed the use of fertilizers, pesticides and feeds that were often used in agriculture with the aim of accelerating the growth of the ponds as shrimp feed [1].

Some types of fertilizers that are often used in ponds include urea, SP36, ZA, Ponska, Raja, petroganik, Sampi. These fertilizers on average have a high nutrient content, but they are a single fertilizer which only provides 1 type of nutrient source. Excessive use of inorganic fertilizers in ponds will result in pond sludge becoming foul-smelling, damaging the physical, chemical and biological properties of the soil. In addition, the dosage of inorganic fertilizers used continues to increase, thereby increasing production costs. The use of inorganic fertilizers not only damages the soil but also has an impact on the health of the shrimp being cultivated. One solution that must be done is the use of liquid organic fertilizer(LOF). has the advantage of containing various macro and micro nutrients needed by shrimp.[2].Shumei et al[3]used cooked rice, green vegetables, cabbage, carrot, egg, fish, and meatuntuk membuat LOF dengan metode Thermal hydrolyzed.

Se et al [4]preparation LOF from animal carcasses. Generally, the materials from animal carcasses contain nutrients including protein, carbohydrate and lipid, which are considered to be a value-added fertilizer[5], The nutrients in composted materials contain chemicals can also be used as feedstock in the production of amino acids, adhesive, plastic and biofuels[6],. LOF can utilize waste vegetables, worm flour and mangrove leaves to overcome nutrient deficiencies. Based on this description, it is important to conduct research entitled "Effect of liquid organic fertilizer on water quality in shrimp ponds." different raw materials, to determine the effect of fermentation time on the number of bacteria produced, and to determine the effect of LOF on pond water quality.

II. Research Methods

2.1Material and apparatus

Apparatus : gloves, small basins, scales, knives, masks, shelter containers and stirrer, glassware autoclave, incubator, micropipette, hot plate and stirrer, biology safety cabinet (BSC), petri dish, bunsen.

Material : vegetable, fruit, worm flour, cow dung, brown sugar,

This research is an experimental study which aims to look at the nutritional content of LOF using different treatments. This study used a randomized block design (RBD) with three replications.The treatment combinations are:

P1 = 30% mangrove leaves + 30% vegetables + 40% worm flour,
P2 = 40% mangrove leaves + 30% vegetables + 30% of worm flour,
P3 = 50% mangrove leaves + 30% vegetables + 20% worm flour,

2.2 LOF preparaion

Semua vegetable, buah, mangrove leaf dipisahkandaripasir, tanah dan pengotorlainnya., kem udian di cacahdengan chopper. Buat formula LOF sesuaidenganperlakuan dan masukkankedalm container. Kedalamsetiapfermenter, ditambahkan gula merah 250 g, kotoran sapi 250 g dan air cucian beras 2 liter. Fermentorkemudianditutuprapat, didiamkanselama 0, 7, 14, 21, dan 28 hari. LOF yang dihasilkanselanjutnya diuji kandungan dan jumlah mikrobanya berdasarkan lama waktu yang digunakan.

Results and Discussion

Based on the results of observations during the study obtained the average data highest score on nutritional quality analysis and the number of microbes in the manufacture of POCthat is:

Nitrogen Levels

On testing the nitrogen contenton LOF obtained data that treatmentP1 with 21 days of fermentationproduce the highest nitrogen content viz0.154%. Results of analysis of nitrogen contenton LOF can be seen in Figure 1

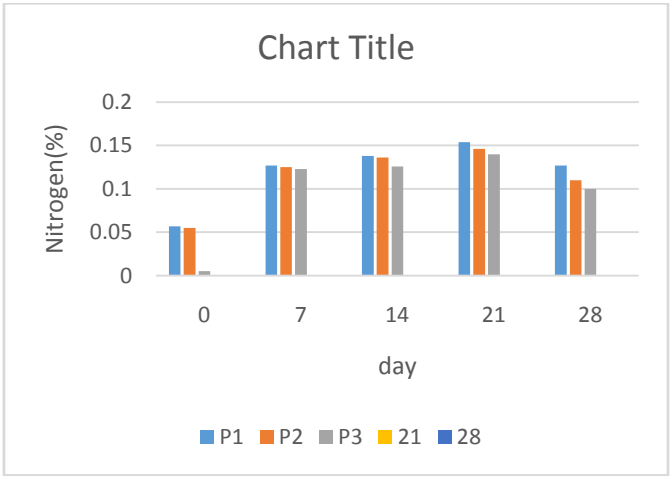

Fig 1.Nitrogen content(%)

The increase in the amount of nitrogen content is also influenced by the amount of protein content in the materials used. It is proven that the addition of the amount of material that contains a lot of protein as an energy source for microorganisms can increase the value of the nitrogen content produced. The use of mangrove leaves in the manufacture of LOF with a fermentation time of 14 days and 21 days also showed good results for nitrogen content. Mangrove leaves can increase plant metabolism, where organic compounds that act as hormones or enzymes can stimulate protein decomposition, stimulate metabolism and stimulate cell division and energy transfer properly [7], .

While the analysis of nitrogen content in LOF produced the lowest value in the P1 treatment, the fermentation time on day 0. This is because the protein content has not been decomposed into amino acids and nitrogen. The nitrogen content then increased with the longer LOF fermentation time, namely 7 days, 14 days to 21 days. The longer the fermentation time, the more the number of microbial cells is produced so that the more protease enzymes break down protein into nitrogen. The longer the fermentation time, the more microorganisms are able to produce nitrate in the nitrification process[8]. However, on the 28th day of fermentation, there was a decrease in nitrogen levels due to the growth of microorganisms and the available nutrients began to decrease

and cells began to stop defending themselves [9], . The results of this study indicate thatthe given fermentation time showed that there was a significant effect on the observed parameter with a 95% confidence level. Although the nitrogen content of LOF still has nitrogen levels below the value standardized by SNI 19-7030-2011, which is around 3% - 6%.

Potassium content

Tests for potassium content in LOF obtained the highest value in the P3 treatment with a 21-day fermentation time resulting in potassium levels of 0.145%. The results of this study indicate that the duration of fermentation and the difference in the concentrations given show that there is a significant effect on the observed parameter with a 95% confidence level. Potassium content testing data can be seen in Figure 2 below:

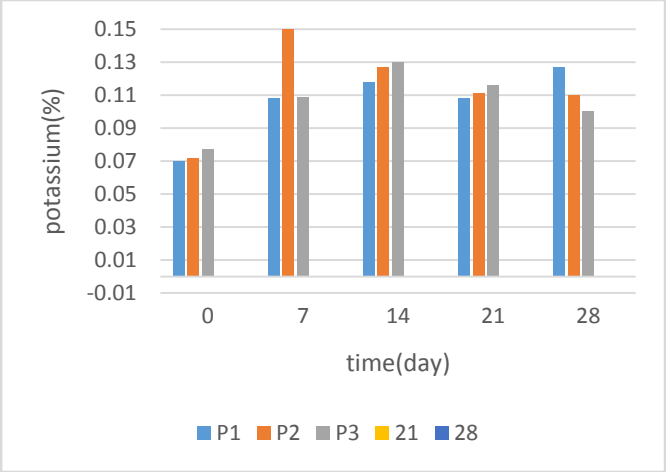

Fig 2.Potassium content(%)

There was an increase in potassium content from the fermentation time of 0, 7, 14 to 21 days. The longer the fermentation time the higher the potassium content produced in LOF. During the 7 days of fermentation, the highest cell division occurs where more and more nutrients are broken down by microbes. The longer the fermentation time it will produce enzymes that can break down complex components into simple components in LOF. The high content of potassium in LOFtreated with P3 for 21 days of fermentation was due to the high content of nutrients in the materials used. The P3 treatment used Rhizophora apiculata mangrove leaves. Rhizophora apiculate leaves contain various secondary metabolites, namely the terpenoid group, containing Na, K, Ca and Mg. Other ingredients in Rhizophora apiculata mangrove leaves are phenols, steroids/triterpenoids, saponins and tannins [10], .

The high potassium content is due to the element Potassium (K) being a catalyst for microbes or microorganisms to speed up the fermentation process. In addition, the addition of bioactivator in the manufacture of liquid fertilizer also affects the high potassium in the fertilizer. That is, if the fermentation process runs quickly and is accompanied by the right supporting raw materials, the potassium content will also increase. This is in accordance with the opinion of Jamilah et al[11], who stated that the element potassium in the compound potassium dioxide (K_2O) used by microorganisms in the substrate material as a catalyst, will affect the presence of bacteria and their activity in the fermentation process. Potassium is bound and stored in cells by bacteria and fungi, if it is degraded again, potassium will be available again
[12],

Phosphorus Levels

Based on the results of fingerprint analysisvariety indicates that the duration of fermentationas well as the concentration of LOF givenindicating that there is a real influenceresulting from the phosphorus content generated. The phosphorus content will be higher the longer the fermentation time is done. The highest phosphorus content was obtained in the P3 treatment with afermentation time of 28 days with a value of 0.160%. Data from the analysis of phosphorus content can be seen in the image below:

The higher the phosphorus content produced, the longer the fermentation time is due to the fact that microorganisms in the form of bacteria are more actively dividing cells. Cell division that is fast enough by phosphate solubilizing bacteria will produce a phosphatase enzyme which functions to dissolve phosphate in the substrate and is able to break the bound phosphate resulting in an increase in its content. In addition, the P3 treatment using mangrove leaves as one of the raw materials for making LOFcontains high phosphorus and is

capable of triggering rapid protein overhaul which will increase rapidly (Hidayati et al., 2011). The phosphorus content of Rhizophora apiculata leaves is quite high, which is around 0.025%. Phosphorus is one of the most important nutrient compounds because it is absorbed by phytoplankton and enters the food chain. Phosphorus in the form of phosphate ismicronutrients needed in small amounts but very essential for aquatic organisms. Phosphate deficiency can also inhibit the growth of phytoplankton which is food for shrimp and milkfish [13]. pH Measurement Based on the results of the analysis of variance, it was shown that the fermentation time and the given LOF concentration had a significant effect on the pH content. pH measurement data can be seen in the image below:

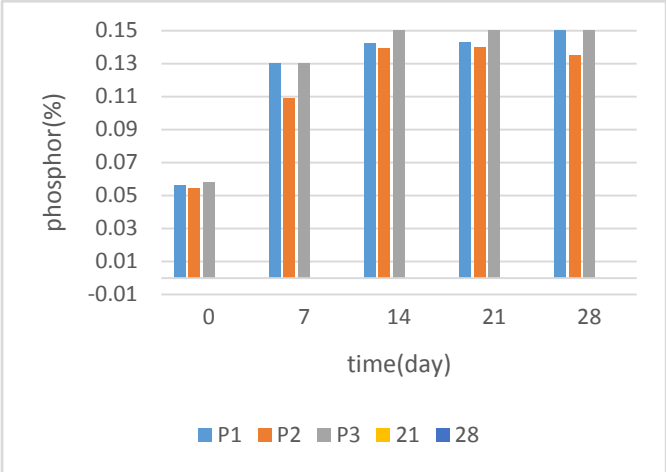

Fig 3.Phosphor content(%)

The higher the phosphorus contentproduced over timeFermentation is caused by microorganisms in the form of bacteria that are more activedividing cells. Sufficient cell divisionquickly by phosphate solubilizing bacteria willproduce the enzyme phosphatas serves to
dissolve phosphate insubstrate and able to break down the phosphatebound to result in an increasecontent. In addition, the P3 treatmentusing mangrove leaves as onea raw material for making LOF contains high phosphorus and capabletriggers rapid protein breakdownwhich will increase substantiallyquickly.

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pH Measurement

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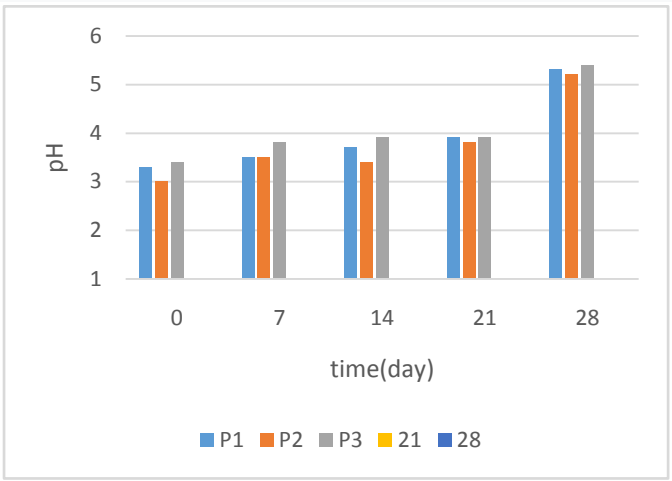

Fig 4 pH LOF

During fermentation there was an increase in the pH of the LOF, the longer the fermentation time, the higher the pH. Where the initial pH of the fermentation averaged 3.2 then became pH 5.3 at 28 days of fermentation. The increase in pH from the duration of the fermentation on day 0 to day 28 indicated that the fermentation process was going well, where the pH would encourage the optimum activity of bacterial microorganisms. The degree of acidity at the beginning of the fermentation process converts organic matter into organic acids, besides that the reforms that occur during the fermentation process will produce nitrogen and ammonia which will cause the pH value to increase. The increase in pH is also caused by other types of microorganismsconvert organic acids that have been formed so that the degree of acidity is getting closer to neutral. An acidic pH with a value of 3.4 indicates the growth of lactic acid bacteria, including Lactobacillus and Lactococcus, which experience very fast growth during the 7th day of fermentation, this is due to nutrition, temperature and acidity which are sufficient to support their growth [14] . The pH value at 21 days and 28 days of fermentation is in accordance with the LOF pH standard according to SNI 19-7030-2011, namely pH 4-8.

Number of Bacteria

The liquid organic fertilizer that has been made is then counted for the number of bacteria. Analysis of calculating the number of bacteria resulted in data that there was an increase in the number of bacteria from the start of the fermentation until the 10th day of fermentation. At the beginning of the POC fermentation there were already bacteria with an average of 5.967 CFU/ml. The number of bacteria continued to increase during the fermentation time of 0 days, 7 days to 10 days with a total of 8.17 CFU/ml bacteria. After the 14th day of fermentation, the number of bacteria began to decrease until the 28th day of fermentation. Bacterial calculation data can be seen in the image below:

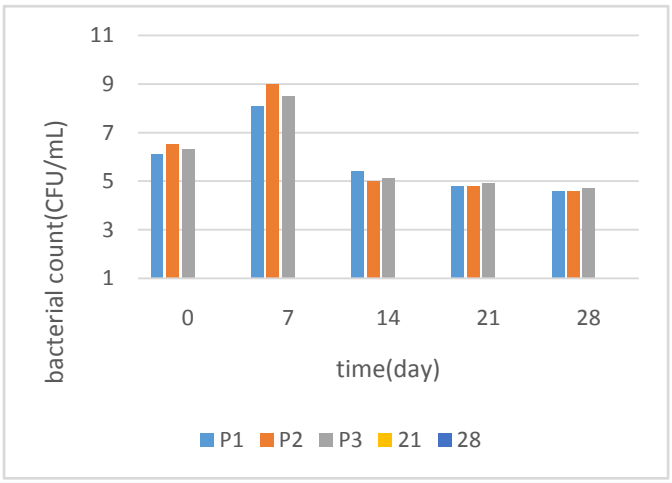

Fig 5Bacteria count

The increase in the number of bacteria starting to ferment 0 days to 10 days is due to cell division by bacteria by utilizing the nutrients available in LOF. Nutrients in the form of leaves, fruit, fish are a source of energy for bacteria. LOF fermentation from day 0 to day 10 is an exponential phase for bacteria to carry out cell division, this is indicated by an increase in the number of bacterial colonies up to 9.0 CFU/ml. According to Wibowa et al.[16] the more nutrients available, the faster the growth rate of bacteria. Several factors affect the development of bacterial cells including: amount of nutrients, pH, temperature, oxygen availability, humidity and light. The increase in the number of bacteria during the fermentation time of 0 days to 10 days was due to the availability of sufficient nutrients.

Meanwhile, during the fermentation time of 14 days to 28 days, the bacteria have entered a static phase where the number of living bacteria is almost the same as the number of dead bacteria. This was indicated by the decrease in the number of bacterial colonies observed during this fermentation time. If the fermentation time continues, the available nutrients will be exhausted so that the number of bacteria will experience a death phase with the number of dead cells being greater than the number of living cells. Bacterial fermentation will produce organic acids which will inhibit the growth of the bacteria itself .

Application of LOF to Ponds

Liquid Organic Fertilizer (LOF) that has been made is then applied to shrimp ponds approximately 1 time per week for 2 months. Then do a pond water analysis to see the effect of the LOF on shrimp and water. There are

several parameters observed in the observed pond water including: temperature, pH, dissolved oxygen as the data below:

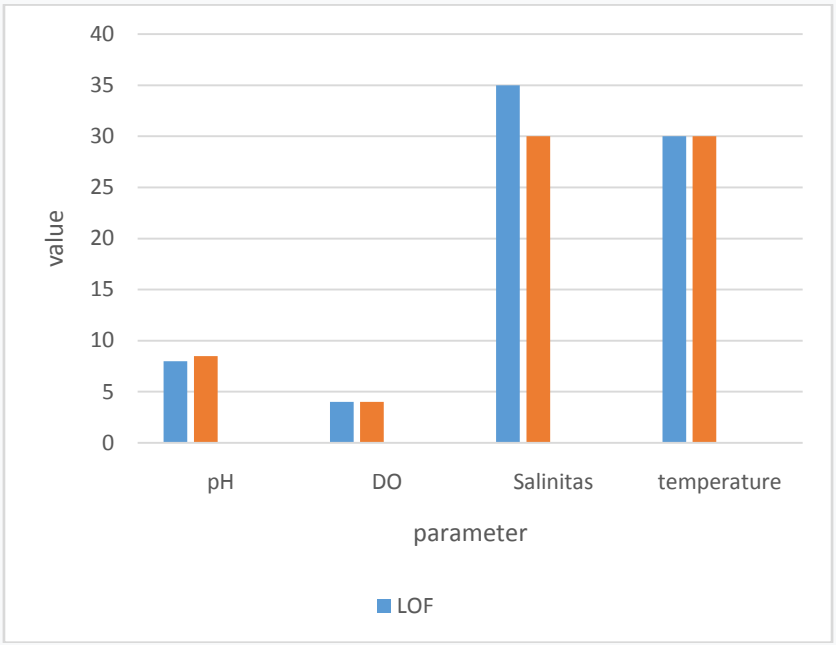

Fig 4 Pond water quality

Water quality observation data atponds is the average dataobtained during 2 months of observation. Fromthe results of the observations made were obtaineddata that the water quality is good in the pondswith POC and ponds without POCshows quite normal values andnot that different. Pond water pHshows an average value of 8-8.5 onesmeans that the pH is quite normal for pH conditionspond water. Likewise with parametersothers such as salinity. Salinityis a water quality parameter that has an important role in the survival and growth of shrimp. Salinity plays a role in osmoregulation and molting processes in shrimp. Disturbances in osmolarity cause the energy used for growth activities to decrease so that it can reduce the growth rate (Salsabiela, 2020). The brightness of the water is related to the organic activity that occurs in it. In observing the brightness of the pond without LOF is quite low because sunlight reaches the bottom of the pond. This indicates low organic matter contained in pond water and will affect the increase in water temperature which can be harmful to shrimp growth.

III. Conclusion

The results showed that Liquid Organic Fertilizer made from mangrove leaves, fruit and worm flour showed the best N, P, K content. LOC contains bacteria which can function as biocatalysts in the decomposition of LOF. Application of LOF in ponds can improve the quality of shrimp pond water and inhibit pathogenic microbes in shrimp.

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