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Nutrient analysis of liquid organic fertilizer from agricultural waste and rumen liquid

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Abstract Organic fertilizers are able to bind the ability of soil to absorb water, increase resistance to erosion, improve biodiversity, and increase soil fertility, but will not increase residuals on crop yields so it is safe for the environment and human health. Agricultural waste is a by-product of agriculture that is not utilized or thrown away so that it has no sale value like vegetable waste, rotten fruit, coconut fiber, agricultural waste, fisheries and household waste, which can directly cause environmental pollution, sources disease, and interfering with environmental cleanliness. Rumen cow is a slaughterhouse waste that is not utilized properly, even though the rumen still contains nutrients, microbes and undigested food that can be recycled. The objective of this study was to find out the ratio of the composition of rumen fluid and agricultural waste to the liquid organic fertilizer nutrient content. The analysis method used was 3x3 technique of rumen fluid for each control, namely PI 15% rumen fluid, PII 30% rumen fluid and PIII 45% rumen fluid. The results of the nutrient analysis of organic liquid fertilizer towards agricultural waste and rumen liquid showed that the highest nitrogen in PII is 1.85%, PIII was 1.29% and PI was 0.68%. The highest phosphorus (P) content in PII was 2.52%, PIII was 2.47% and PI was 1.87% and the highest potassium (K) content was in PII (2.90), PIII was 2.72 and PI was 2.14. According to the results obtained, nutrient analysis of liquid organic fertilizer is in accordance with the quality standards of liquid organic fertilizer regulated in the Agriculture Regulation No. 28 / Regulation of the Minister of Agriculture / OT.140 / 2/200 which stated that liquid organic fertilizer for its N-total content, Phosphorus and Potassium is greater of 2%.

1. Introduction

Nowadays, agriculture in the community tends to take the importance and capacity of the land, where land is forced to produce abundant harvests by giving pesticides with excessive doses and longer periods of time, this will cause land dependence on pesticides and the land will be difficult to cultivate. Besides, excessive use of pesticides on plants will also affect the environment and public health.

The concept of modern agriculture has begun being developed in Indonesia, the use of chemical fertilizers has been reduced and replaced by using organic fertilizers to produce organic plants that are free



of chemicals. This will lead to the better quality of the soil if it is used continuously in a certain vulnerable time. Organic fertilizer capable to bind the ability of soil to absorb water, increase resistance to erosion, improve biodiversity, and increase soil fertility, but will not bind residues to crop yields so it is safe for the environment and human health [1].

Agricultural waste is a by-product of agriculture that is not utilized or disposed of so that it has no selling value like vegetable waste, rotten fruit, coconut fiber, agricultural waste, fisheries and household waste, which can directly result in environmental pollution, sources disease, and can interfere with environmental cleanliness. To reduce the waste of agricultural products, the waste as organic fertilizer can be utilized to fertilize the soil. Based on research [2] stated that the highest macro-nitrogen content (N) is in liquid waste from vegetables, phosphate (P) in vegetable and fruit waste and Potassium (K) is in fruit waste, while the microelement Calcium (Ca) is in fruit and vegetable waste, Magnesium (Mg) found in fruit waste, iron (Fe) in vegetable and fruit waste, zinc (Zn) in cow urine and Ammonia (NH₄) in the liquid fertilizer mixture of vegetable and fruit waste.

Rumen cattle are slaughterhouse waste that is not utilized properly, whereas in the rumen it still contains nutrients, microbes, and undigested food that can be recycled [3]. One cow will produce 10-12% rumen contents of the total weight of live cattle. However, cow rumen waste has not been utilized properly. Utilization of rumen waste into liquid organic fertilizer is a solution that can be done as an effort to utilize slaughterhouse waste. This utilization will reduce the risk of environmental pollution and water from slaughterhouse waste due to the accumulation of rumen contents. The content of the rumen is one of the industrial wastes that are currently not fully utilized in Merauke slaughterhouse, whereas the waste contains many elements that can be utilized by plants. The purpose of this study is to know the comparison of the composition of rumen fluid and agricultural waste as liquid organic fertilizer that can accelerate and help the agricultural process and the ratio of the composition of rumen fluid and agricultural waste to the liquid organic fertilizer nutrient content.

2. Methodology

The research was conducted in laboratories from September to December 2018 at the Laboratory of Animal Husbandry University of Merauke. Liquid Organic Fertilizer nutrient analysis was carried out at the Hasanuddin Laboratory in Makassar. This research was experimental, using a factorial completely randomized design (RAL) with 3, namely the I Treatment 15%, Treatment II 30% and Treatment II 45% which will be carried out by fermentation. The treatment duration was 2 weeks. The research sample was analyzed by sending samples to the UNHAS laboratory. The production of Liquid Organic Fertilizer was from agricultural waste and rumen liquid, while agricultural waste was obtained from the market, household waste, and others ingredients such as vegetables, rotten fruits, coconut fiber, bran, rumen, coconut water, and aqua. The coconut fiber was cut into pieces and then torn into small pieces. After that, weighed 40% of agricultural waste, 40% of coconut fiber, 5% gram of brown sugar and 15% of bran, a liter of coconut water and mixed with aqua. Then, mixed the rumen liquid as much as 15%, 30% and 45% in each treatment and left for 2 weeks, every 3 days the gas was released, fermentation was done by an anaerobic method. The research data will be analyzed using Factorial RAL. If the results are significantly different then the Duncan test is performed.

3. Results and discussions

In the initial stage of this study, fermentation of agricultural waste and rumen liquid, where agricultural waste was obtained from the Wamanggu market in Merauke Regency and Rumen Liquid was taken from the slaughterhouse. In the rumen liquid, there are several types of microorganisms that can be used as bio activator in the overhaul or breakdown of organic substances fermenting liquid organic fertilizer needed by plants.

3.1 Analysis of content of N-Total liquid organic fertilizer content of the agricultural waste and rumen liquid

From the results of the analysis of N-Total Liquid Organic Fertilizer content of Agricultural Waste and Rumen Liquid can be seen in table 1.

Table 1. Analysis result of N-total content

Treatment	Frequency			Total	Average
	1	2	3		
PI	0.69	0.66	0.70	2.05	0.68 ^a
PII	1.85	1.88	1.83	5.56	1.85 ^c
PIII	1.28	1.32	1.27	3.87	1.29 ^b

PI 15% rumen fluid, PII 30% Rumen fluid and PIII 45% rumen fluid

Note: Different superscripts in the same column show significantly different treatments ($P < 0.05$).

According to the results of the analysis, the fermentation of agricultural wastes towards nitrogen content of liquid organic fertilizer was found the highest in PII (30% rumen liquid), which was 1.85%, then PIII (45% rumen fluid) was 1, 29% and the lowest was 0.68% in PI (rumen fluid by 15%).

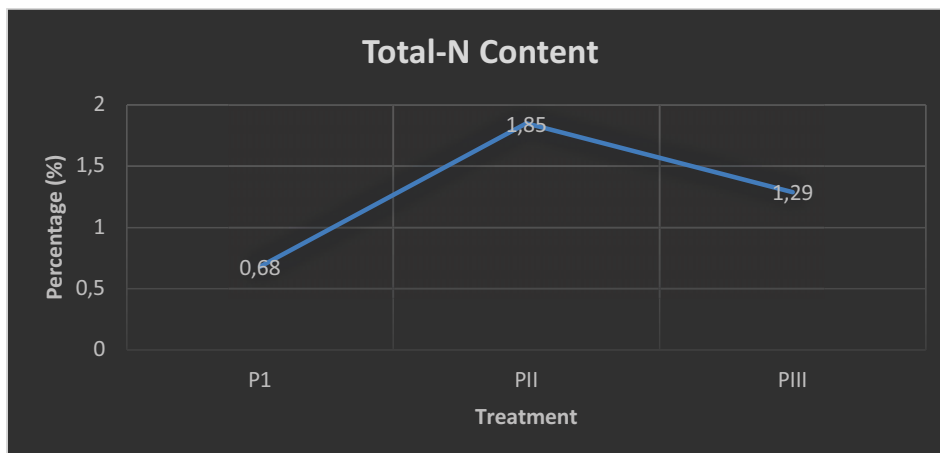


Figure 1. Composition of Total-Nitrogen POC content Agricultural waste and Rumen liquid

The increase of Nitrogen content in PII treatment that was 1.85% came from rumen liquid waste with rumen fluid composition by 30% and fermentation for 14 days had increased and decreased in PIII 1.29% with rumen liquid composition by 45%. The increase in nitrogen content occurred because there was the intervention of rumen microbes in the Liquid Organic Fertilizer fermentation process, nitrifying bacteria converted ammonia into nitrate which caused the nitrogen element to increase. According to [4] stated that microorganisms can increase the absorption of nutrients, besides microorganisms can also increase the absorption of carbohydrates and several other elements. In addition, according to [5] expressed that the fermentation process is faster in an airtight environment (anaerobic) or does not require oxygen. Fermentation can produce a number of organic compounds such as lactic acid, nucleic acids, bio hormones and other elements that can be absorbed by plants. The decrease in nitrogen content at PIII 1.29% occurred because the availability of microbes in rumen fluid was difficult to remodel nitrogen because of the lack of nutrient availability. Also, [6] claimed that the activity of microbes added, the value of C material content,

and the addition of other organic materials and fermentation temperature can slow decomposition, while high temperature can increase nitrogen loss through ammonia volatilization. Furthermore, [7] stated that a factor that can cause a decrease in nitrogen content is due to nitrogen in oxygen in the form of ammonia as a result of the decomposition of organic material which is released into the air, then does not enter evenly on the pile so that oxygen is limited in number which causes ammonia cannot be converted into nitrate and further downstream nitrogen in the form of NH₃ gas.

The results of the N-Total PII (1.85) nutrient analysis research are still below the standard, according to the quality standard of liquid organic fertilizer according to Agriculture Regulation No. 28 / Regulation of the Minister of Agriculture / OT.140 / 2/200 which stated that liquid organic fertilizer for its N-total content should be greater than 2% [8,9]. Nitrogen has an important role for plants in the process of formation and growth of plants such as the formation of chlorophyll or green matter leaves, leaves, roots, and stems of plants. If the plant lacks the nitrogen element, it will cause disturbance to plant development and the occurrence of plant metabolism imperfections. Then, it leads to symptoms of nutrient deficiency which causes yellow leaves [10]. Besides, it can cause a deviation of leaf growth and the plant becomes stunted [11].

2. Analysis of phosphorus content (P₂O₅) agricultural waste and rumen liquid

From the analysis of Liquid Organic Fertilizer Phosphorus content in Agriculture Waste and Rumen Fluids can be seen in table 2.

Table 2. Analysis of phosphorus content (P₂O₅)

Treatment	Frequency			Total	Average
	1	2	3		
PI	1.89	1.85	1.88	5.62	1.87 ^a
PII	2.51	2.55	2.5	7.56	2.52 ^c
PIII	2.47	2.5	2.45	7.42	2.47 ^b

PI 15% rumen fluid, PII 30% Rumen fluid and PIII 45% rumen fluid

Note: Different superscripts in the same column showed significantly different treatments (P < 0.05).

The results of the analysis of tables and graphs 2 showed that the fermentation of agricultural waste to the highest content of liquid organic fertilizer (POC) was found in PII (30% rumen liquid), which was 2.52%. Then, PIII (45% rumen liquid) was 2.47%, while the lowest in the PI (15% rumen fluid) was 1.87%.

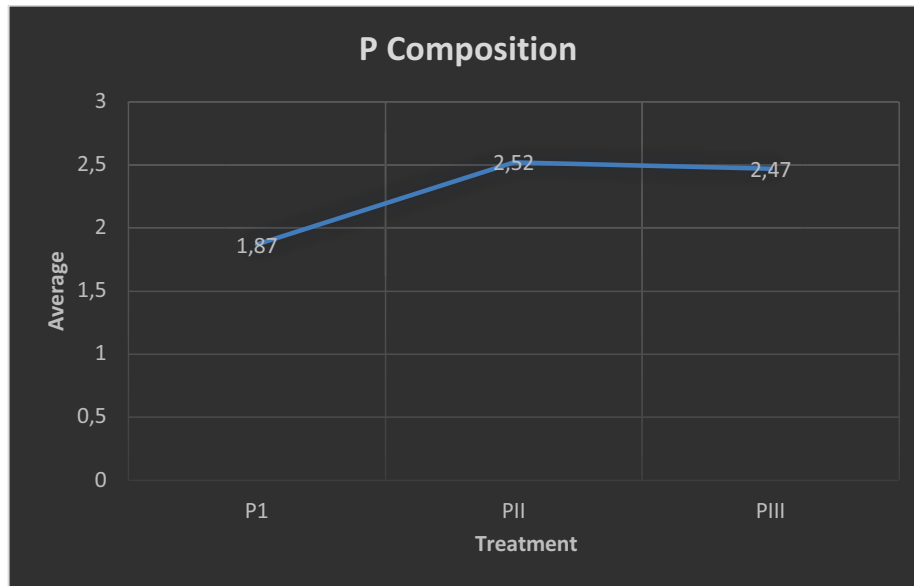


Figure 2. Composite content of POC phosphorus agricultural waste and rumen liquid

The results of nutrient analysis of Phosphorus (P) experienced an increase in PII treatment that was 2.52%, and decreased in the treatment of PIII 2.47% and the lowest was in the PI treatment (1.87%). The increase in phosphorus content in the PII treatment was due to microbial activity contained in the rumen fluid which helped in the process of phosphorus breakdown so that it affected the increase in P-total. This is consistent with the opinion [12] which stated that the activity of microbial division of *Lactobacillus* sp., *Streptomyces*, sp, cellulose and yeast decomposing fungi can remodel phosphorus, so it affects the increase in P content. And the fermentation process also has a role in increasing the acceleration of reshuffle and destruction of organic matter. In addition, the high content of phosphorus is related to the availability of nitrogen where the higher the nitrogen content, the higher the phosphorus content. According to [13] expressed that the phosphorus content is related to the N content in the substrate, the higher the nitrogen contained, the more increased multiplication of microorganisms change the phosphorus. Therefore, the phosphorus content in the POC increases because the phosphorus contained in the substrate will be used by microorganisms to build cells.

The decrease in phosphorus content in the PIII treatment was due to the lack of Nitrogen availability which resulted in the formation of phosphorus for the formation of inhibited microbial cells. In addition, the decrease in phosphorus levels is caused by the availability of nutrients used by decomposing bacteria in the fermentation process. And it has completely reacted and the bacteria has reached maximum growth conditions, called static phases. The longer the fermentation, the more phosphorus content produced. The low content of nutrients produced is not only caused by the organic matter which is not completely transformed into nutrients but also used for the process of metabolism of life [14].

The results of the Liquid Organic Fertilizer nutrient research in PII treatment and PIII treatment that has met the quality standards of liquid organic fertilizer according to Agriculture Regulation No.28 / Permentan / OT.140 / 2/2009 which was 2 % [8,9]. Phosphorus plays an important role in the process of removing flowers, fruit, seeds and plant safety. Lack of phosphorus (P) in plants will result in various metabolic obstacles such as the process of protein synthesis, which will cause carbohydrate accumulation and nitrogen bonding, visually the older leaves are yellowish or reddish due to the formation of anthocyanin pigment [10].

3. *Analysis of Potassium (K₂O) Liquid Organic Fertilizer Levels of Agricultural Waste and Rumen Liquid*
From the analysis of the content of Potassium (K₂O) POC of Agricultural Waste and Rumen Liquid can be seen in table 3.

Table 3. Analysis of potassium (K₂O) content

Treatment	Frequency			Total	Average
	1	2	3		
PI	2.14	2.1	2.17	6.41	2.14 ^a
PII	2.96	2.85	2.9	8.71	2.90 ^c
PIII	2.74	2.77	2.65	8.16	2.72 ^b

PI 15% rumen fluid, PII 30% Rumen fluid and PIII 45% rumen fluid

Note: Different superscripts in the same column show significantly different treatments (P <0.05).

The results of the analysis of tables and graphs 3 represented that the fermentation of agricultural waste to the content of Potassium liquid organic fertilizer was the highest in PII (30% rumen fluid), which was 2.90%, Meanwhile, lowest was 2.14%, in PI (15% rumen fluid) then PIII (45% rumen fluid) was 2, 72% .

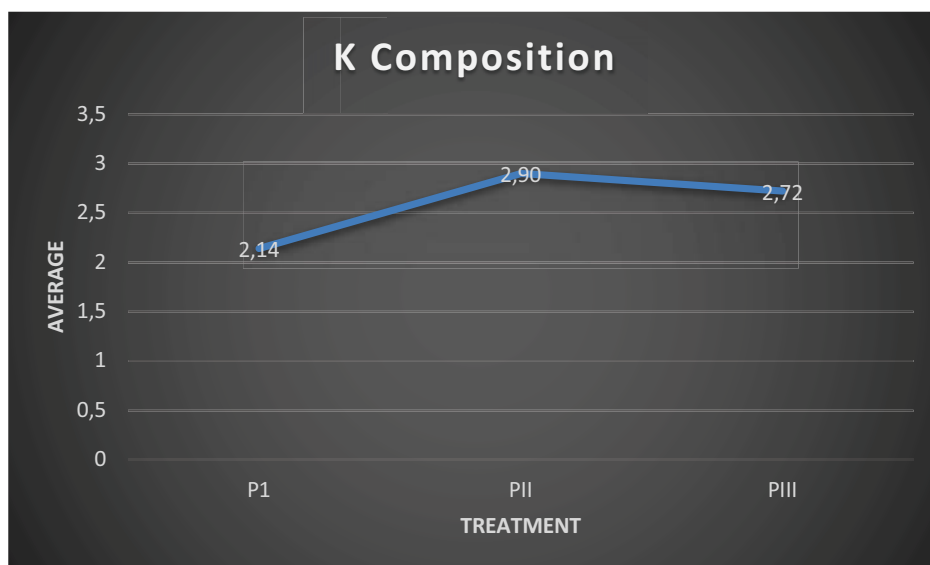


Figure 3. Composite content of POC phosphorus agricultural waste and rumen liquid

Potassium (K) nutrient analysis occurred an increase in PII treatment, which was 2.52%, and decreased in PIII treatment 2.47%, while the lowest was in PI treatment, 1.87%. The increase in potassium was influenced by POC supporting materials, namely coconut coir. This is consistent with the opinion [15] which claimed that the greater the content of crude fiber with a mixture of rumen fluid, the more potassium can be produced. This is also in accordance with to a study result [16], the highest effect of differences in the construction of coconut coir ash on potassium (K) levels of organic fertilizer towards fermented tempeh production of liquid waste with an addition of 10% coconut coir ash 10: 1 ratio is 0.56%. While the results of agricultural waste and rumen liquid research on nutrient nutrients of liquid organic fertilizer from analysis results obtained were higher in PII treatment, which was 2.52%, this shows that rumen microbial fermentation of the potassium reshuffle process contained in coconut fiber worked

very efficiently. The results of the study [17] showed the analysis of the characteristics of C-Organic coconut coir ash was low, while the total K in coconut coir ash was quite high at 21.87%. Potassium has an important role as a biocatalyst making and dismantling carbohydrates, especially in the conversion of proteins and amino acids. Microorganisms use potassium as a biocatalyst, in the presence of bacteria and activity is very influential in the increase in potassium [12].

The results of the Liquid Organic fertilizer nutrient research in PII treatment and PIII treatment that has met the quality standards of liquid organic fertilizer based on the Agriculture Regulation No.28 / Permentan / OT.140 / 2/2009. [8,9] Potassium has the function of regulating the assimilation for plants, so that can grow well. Potassium deficiency can inhibit plant growth, leaves appear dry, shiny, weak leaf stalks and wrinkled seed shells [16].

4. Conclusion

The results of the nutrient analysis on organic liquid fertilizer, agricultural waste, and rumen liquid found the highest nitrogen found in PII is 1.85%, PIII is 1.29% and Pi is 0.68%. The highest phosphorus (P) content in PII is 2.52%, PIII is 2.47 and PI is 1.87% and the highest potassium (K) content is in PII is 2.90, PIII is 2.72 and PI is 2, 14. From the research results of the nutrient analysis of liquid organic fertilizer that is in accordance with the quality standards of liquid organic fertilizer based on Agriculture Regulation No. 28 / Regulation of the Minister of Agriculture / OT.140 / 2/200, stated that liquid organic fertilizer for its N-total content, Phosphorus and Potassium is greater of 2%. Further research needs to get conducted to increase the content of Nitrogen Liquid Organic Fertilizer.

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