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THE NPK NUTRIENT CONTENT OF LIQUID ORGANIC FERTILIZER FROM VARIOUS TYPES OF RICE WASHING WATER

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ABSTRACT

This research aims to assess the NPK nutrient content of liquid organic fertilizers from various types of rice washing water. This study was designed using a completely randomized design (CRD) with 5 treatments, i.e. P0 (water), P1 (white rice washing water), P2 (white glutinous rice washing water), P3 (black glutinous rice washing water), and P4 (black glutinous rice washing water) red glutinous rice wash), the treatment was repeated 4 times so that there were 20 experimental units. The observation parameters in this research were the observation of temperature, pH, color, and aroma of liquid organic fertilizer during the fermentation process and the resulting N, P, and K content. The results showed that the treatment of rice washing water did not have a significant effect on temperature, pH, color, and flavor of the liquid fertilizer produced, but had a very significant effect on the content of N, P, and K. For parameters the highest N content was obtained in treatment with the addition of rice washing water. white glutinous rice (P2) which produced an N content value of 0.15%, for the observation of P and K content, the addition of red glutinous rice (P4) washing water gave the highest results with a P content of 0.09% and K of 0.14 % but not different from the addition of washing water for white glutinous rice (P2).

Keywords*:* Waste, Rice Water, Organic Fertilizer, NPK.

INTRODUCTION

Rice washing water is one of the household wastes which is always available every day. Rice washing water is waste that comes from the cleaning process for the rice to be cooked. This liquid waste is usually thrown away just like that, even though the content of organic and mineral compounds that is owned is very diverse so it has the potential to be processed into environmentally friendly liquid organic fertilizer.

Liquid organic fertilizer is a solution that contains one or more carrier elements needed by plants that are easily dissolved. Liquid organic fertilizers are more easily

absorbed by plants because the complex compounds contained in them have broken down and are in liquid form so that they are easily absorbed by plants both through roots and leaves (Hidayati et al., 2011). Organic fertilizers are very beneficial for increasing agricultural production both in quality and quantity, reducing environmental pollution, and sustainably improving land quality. Liquid organic fertilizers can be produced by a fermentation process that produces nutrients needed by plants (Santi, 2010).

Plants can carry out their metabolic activities by utilizing nutrients. Metabolic activities will run well if the nutrient elements in the soil are sufficient. Plants that are deficient in a nutrient will show symptoms in certain organs. The nutrient element most needed by plants is the NPK element.

The amount of micronutrients needed by plants is around 0.5-3% of the plant's body weight, while the amount of micronutrients needed by plants is a few ppm of the plant's dry weight. Of all the nutrients that must be available to plants, the elements N, P, and K are the elements that plants need in greater amounts than other elements (Rina, 2015).

According to Suprehin, (2011) plant growth requires three important nutrients, namely Nitrogen (N), Phosphorus (P), and Potassium (K). Nitrogen is used by plants for the growth of shoots, stems, and leaves. Phosphorus functions to circulate energy to all parts of the plant, stimulate root growth and development, accelerate flowering and fertilization, and accelerate fruit ripening. Potassium serves to help the formation of protein, carbohydrates, and sugar strengthens the plant body so that leaves, flowers, and fruit do not fall easily, helps transport sugar from leaves to fruit or tubers, and provides strength to plants in the face of drought and pest attacks.

Research on rice washing water as fertilizer has been widely carried out and has proven it can increase plant growth and yield. Research by Wardiah et al. (2014) applied rice washing water fertilizer to pakchoi plants, Ratnadi et al. (2014) stated that giving rice washing wastewater increased the growth and dry weight of water henna plants. According to Bahar, et al (2016), giving rice washing water can increase the growth of kale plants. From several studies on rice washing water, there are no studies that examine the effectiveness of rice washing water as liquid organic fertilizer for various types of rice. So that in this study studied the NPK content in liquid organic fertilizers from various types of rice washing water produced from household waste. This study will provide information on NPK nutrient content in liquid organic fertilizers from various types of rice washing water.

MATERIALS AND METHODS

Materials.

This research was conducted in September 2020 at Sidondo III Village, Sigi Biromaru District, Sigi Regency and the Soil Laboratory of the Faculty of Agriculture, Tadulako University. The materials used in this study were mustard greens, tomatoes, brown sugar, Em4, white rice washing water, white glutinous rice washing water, black glutinous rice washing water, brown rice washing water, and water. The tools used are 10 L fermentation bucket, blender, knife, analytical scale, stirring wood, thermometer, pH meter, and plastic bottle

Design of research.

This research was designed using a completely randomized design with 5 treatments, namely P0 (water), P1 (white rice washing water), P2 (white glutinous rice washing water), P3 (black glutinous rice washing water), and P4 (rice washing water). red glutinous rice), the treatment was repeated 4 times so that there were 20 experimental units.

Preparation of Liquid organic fertilizer.

Liquid organic fertilizer is made by blending tomatoes and mustard greens to reduce its size, then put it in a fermentation

bucket, then add brown sugar and EM4 as well as rice washing water according to treatment, rice washing water is obtained by washing 1 kg of rice with 1 L of water. for the first wash, then this is repeated until the third wash, then the bucket is closed tightly and allowed to ferment for 8 days, stirring every day and measuring the temperature and pH. After fermentation for 8 days, the resulting liquid organic fertilizer is then filtered and analyzed for the content of N, P, and K elements. The determination of the 8-day fermentation time is anaerobic because in previous studies that examined the NPK content of market waste liquid organic fertilizer at different fermentation times and conditions The highest NPK content was obtained at 8 days fermentation using anaerobically. The treatment composition in this research is shown in Table 1.

Table 1. Treatment Composition

Materials	Composition
Mustard greens	1 kg
Tomato	1 kg
Brown sugar	100 g
Em4	300 ml
Rice washing water	3 L
Water	3 L

Parameters measured

Parameters measured include:

1. Measured temperature during the fermentation process is carried out by taking 100 ml of liquid organic fertilizer then measuring the temperature using a thermometer (Marjenah, 2017).
2. Measured pH during the fermentation process is carried out using a pH meter. Before being used, the pH meter is calibrated by immersing the electrode in a buffer solution whose pH value is known, then measuring the pH of the liquid organic fertilizer solution by dipping the electrode in the sample to be observed. (Kurniawan, et al 2015).
3. Measured of color was carried out through organoleptic tests using the sense of sight (Holifah, 2019). where number 1 is the basic color of liquid organic fertilizer (green), number 2 is brownish-green; and number 3 is brownish yellow
4. Measured flavor was carried out through organoleptic tests using the sense of smell (Holifah, 2019), where number 1 is the aroma of the basic ingredients, number 2 is a sour aroma and number 3 is a sour aroma like tape.
5. Analysis of nitrogen nutrient content was carried out using the kjedahl method (Syafri, et al. 2017).
6. Analysis of phosphorus nutrient content was carried out using a spectrophotometer method (Syafri, et al. 2017)
7. Potassium nutrient content analysis was carried out using the atomic absorption spectrophotometer (AAS) method, (Syafri, et al. 2017).

RESULTS AND DISCUSSION

The temperature of the liquid organic fertilizer during fermentation

The results of temperature observations during the fermentation process of liquid organic fertilizer are described in Table 2.

The results of observations of the temperature of the liquid organic fertilizer solution during the fermentation process were in the range of 29.1-30.9 ˚C. The temperature observation data in table 2 shown that the possibility of fermentation can still be continued, seeing from the temperature range that has not reached optimal so that if the fermentation is continued for 14 days, the decomposition process of raw materials will be more perfect. This is because the microorganisms used in the fermentation process originate from the EM4 material used, where the optimum temperature range of bacteria contained in EM4 is 40˚C.

EM4 microorganisms before carrying out the fermentation process go

through an adaptation phase, where this adaptation phase depends on the number of nutrients and the environmental conditions in which it is fermented. The length of the adaptation process will directly affect the process of decomposing the ingredients in the manufacture of liquid organic fertilizers (Kurniawan, et al. 2015).

Table 2. Observation of the Average Temperature of Liquid Organic Fertilizer During the Fermentation Process.

Treatment	Temperature Observation day-^{0}C							
	1	2	3	4	5	6	7	8
P0	29.7	29.3	30.5	29.8	30.4	29.4	29.8	30.7
P1	29.6	29.3	30.6	29.8	30.7	29.5	29.8	30.8
P2	29.5	29.6	30.6	29.8	30.3	29.3	29.8	30.8
P3	29.5	29.4	30.5	29.8	30.8	29.7	29.7	30.7
P4	29.5	29.5	30.5	29.8	30.4	29.8	29.8	30.8

Table 3. Observation of the Average pH of Liquid Organic Fertilizers During the Fermentation Process.

Treatment	Observation day-							
	I	II	III	IV	V	VI	VII	VIII
P0	4.0	3.6	3.3	3.1	3.0	2.9	3.0	3.2
P1	4.0	3.6	3.3	3.2	3.1	2.9	3.0	3.2
P2	3.9	3.7	3.3	3.1	3.1	3.0	3.1	3.2
P3	4.0	3.6	3.3	3.2	3.1	2.9	3.1	3.2
P4	4.0	3.5	3.2	3.2	3.1	3.0	3.2	3.3

In the adaptation phase, the temperature in the fermentation solution is still low, this is because the activity of microorganisms is still very slow. The increase in temperature in the fermentation solution indicates that the activity of microorganisms in the solution is going well. This is in line with the research of Marjenah, et al. 2017 which stated that the temperature increase in the process of making fruit peel liquid fertilizer indicates that the fermentation process is going well, this indicates that the microorganisms contained in EM4 work optimally during the composting process, the higher temperature (up to 40 C) the more effective the bacteria will work. Furthermore, Marjenah stated that in the process of changing the organic matter, a certain amount of energy is released in the form of heat, which causes the temperature to rise and fall. The increase in temperature indicates the activity of bacteria in decomposing organic matter.

The pH value of liquid organic fertilizer during fermentation.

The results of pH observations during the fermentation process of liquid organic fertilizer can be seen in Table 3.

Based on the results of pH observations, it was known that the resulting pH value is low, which indicates that the liquid organic fertilizer was acidic, this was because in making liquid organic fertilizer an EM4 solution is added which has a pH value of 3.2 so that the pH at the beginning of fermentation was already low (acidic). From this observation, it is also known that there was a decrease in the pH value starting from the beginning of fermentation to the 6th day and increasing again on the 7th and 8th day. This indicates that there was an overhaul or decomposition of the material which results in an increasingly acidic atmosphere until the 6th day, however, on days 7 and 8 it started to increase again but the increase was not that big. From the

available data, it was estimated that pH will continue to increase with increasing fermentation time. This is in line with the research of Riansyah and Wesen (2011), which states that organic material is broken down by certain types of microorganisms to produce simple organic acids to form an acidic atmosphere. In the next process, other types of microorganisms will eat organic acids, causing the pH value to rise again.

According to Sutanto (2002) in Lussy et al. (2015) at the beginning of the fermentation process, the pH of the liquid organic fertilizer will decrease due to the activity of microorganisms in converting organic matter into acidic organic acids which are acidic so that it can lower the pH, over time the pH will rise again due to the emergence of microorganisms. which will convert the organic acids that have formed and the pH will approach neutral after the liquid organic fertilizer is cooked. According to Budiaman et al (2010), very acidic conditions at the beginning of the process, as a result of the activity of acid-producing microbes, indicate that composting runs without an increase in temperature. Along with the growth of other microbes from the decomposed material, the pH of the material will increase.

Holifah (2019) reported a decrease in pH at the beginning of liquid organic fertilizer fermentation of anchovy cooking water waste, and gradually increased in the second week to the fourth week of the fermentation process. So it is estimated that if the fermentation is continued until the second week, the pH value will tend to increase. This is in line with the research of Syafri, et al. (2017) who reported that the optimum fermentation time for the manufacture of liquid organic fertilizer from a mixture of liquid waste from pineapple peel and jackfruit and cow urine was 14 days because the optimum macro and micronutrient levels were obtained at that time.

Observation of liquid organic fertilizer color during fermentation

Liquid organic fertilizer color observation data during the fermentation process can be seen in table 4.

Based on the observations of liquid organic fertilizer color, it was known that at the beginning of fermentation, the color of the solution was green, this is because the basic material used is dominated by the color of mustard, which is green. At 4 days after fermentation, a color change began to occur, namely greenish-brown, this indicated that there was an overhaul/decomposition of the material for making liquid organic fertilizer, at the end of fermentation before filtering, the liquid organic fertilizer contained a white layer on the surface of the liquid organic fertilizer which indicated the presence of microorganisms, after stirring and filtering, the final color of the liquid organic fertilizer is brownish yellow. These characteristics indicate the general characteristics of liquid organic fertilizers. This is in line with the research of Endah et al. (2015) which states that the physical characteristics of good quality liquid organic fertilizer are characterized by the aroma produced like tape and brownish-yellow. Initially, the basic material is green with a texture that is still coarse and then decomposed by microorganisms so that the size gets smaller and dissolves so that it is brownish yellow. This was also stated by Nurlaila et al. (2017) that the characteristics of a ripe liquid organic fertilizer are marked by the presence of a white layer on the surface, no foul odor, stable temperature, and the color changes from green to brown.

Observation of the flavor of liquid organic fertilizers during fermentation

Observation data on the flavor of liquid organic fertilizer during the fermentation process can be seen in table 5.

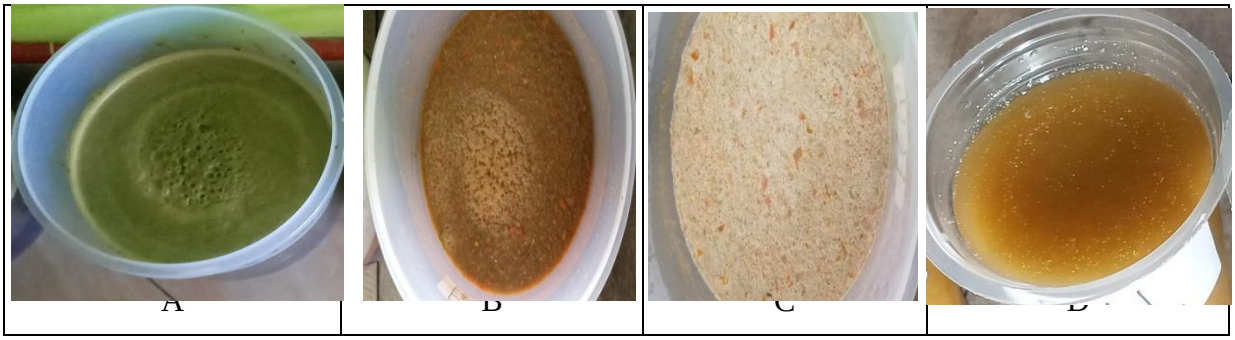
Based on the observations of the flavor of liquid organic fertilizer, it was known that from the beginning of fermentation until the third day, the flavor of the solution is still like the basic ingredients, this was because the basic

ingredients used have not been decomposed properly, on the fourth to the sixth day, the flavor of liquid organic fertilizer has started to smell sour. approaching the flavor of tape, and on the seventh and eighth day, the aroma of liquid organic fertilizer was getting stronger. This is in line with Holifah's research (2019) which states that at the beginning of the liquid organic fertilizer fermentation of anchovy stew waste in the first week there has not been a change in flavor, but at the end of fermentation the characteristic aroma of liquid organic fertilizer produced is a sour flavor like tape. This was also stated by Budiaman, et al. (2010) in their research which explained that signs of solids (waste) and liquids that could be used as fertilizer began to appear on the 12th day, namely the color became brown, the waste became more weathered and had an odor. which is typically sweet and sour. Kasmawan et al (2018) also argue the same thing that when composting has been carried out perfectly, which is characterized as the smell of ripe tape, harvesting liquid fertilizer can be done, generally around 12 days.

Table 4. Liquid Organic Fertilizer Color Observation Data During the Fermentation Process.

Treatment	Observation day-							
	1	2	3	4	5	6	7	8
P0	1	1	1	2	2	2	3	3
P1	1	1	1	2	2	2	3	3
P2	1	1	1	2	2	2	3	3
P3	1	1	1	2	2	2	3	3
P4	1	1	1	2	2	2	3	3

Note: 1= green; 2= brownish green; 3= brownish yellow



Note: Figure A= the initial color of fermentation (green)
Figure B = color 4 days of fermentation (brownish-green)
Figure C = color 8 days of fermentation (before filtered)
Figure D = color 8 days of fermentation (after filtered)

Table 5. Observation Data of Flavor Liquid Organic Fertilizer During the Fermentation Process.

Treatment	Observation day-							
	1	2	3	4	5	6	7	8
P0	1	1	1	2	2	2	3	3
P1	1	1	1	2	2	2	3	3
P2	1	1	1	2	2	2	3	3
P3	1	1	1	2	2	2	3	3
P4	1	1	1	2	2	2	3	3

Note: 1= ingredients flavor; 2= flavor approaching the sour tape; 3= the distinctive flavor of the tape.

Table 6. Nitrogen Liquid Organic Fertilizer Content of Rice Washing Water.

Treatment	Content of Nitrogen (%)
P0	0,14 c
P1	0,09 a
P2	0,15 d
P3	0,11 b
P4	0,09 a

Table 7. Phosphorus Content of Liquid Organic Fertilizer of Rice Washing Water.

Treatment	Content of Phosphorus (%)
P0	0,004 a
P1	0,005 b
P2	0,008 c
P3	0,008 c
P4	0,009 d

Table 8. Potassium Content of Liquid Organic Fertilizers Of Rice Washing Water.

Treatment	Content of Potassium (%)
P0	0,118 a
P1	0,120 a
P2	0,140 b
P3	0,118 a
P4	0,145 b

Content of Nitrogen

The results of the analysis of the average N content in the liquid organic fertilizer of rice washing water can be seen in Table 6.

Based on the ANOVA test and the BNJ further, test $p<0.05$ and $p<0.01$ showed that the type of washing water treatment had a very significant effect on the N content of liquid organic fertilizer. From the data table 6, it shows that the highest nitrogen content was obtained in treatment P2 and was significantly different from treatments other. This was thought to be due to the initial nitrogen content in white rice washing water that is higher than brown and black rice.

This is in line with the research of Wulandari, et al. (2011) which studied the nutrient content in the liquid organic fertilizer of white rice and brown rice washing water, which resulted in higher nitrogen content in white rice than in brown rice. In his research, the N content obtained was 0.015% in white rice POC and 0.014% in brown rice liquid organic fertilizer.

The data table 6, also provides information on Nitrogen content in liquid organic fertilizer without giving rice washing water (P0) does not provide a significant difference with the treatment of giving white glutinous rice washing water (P2), so it was known that giving rice washing water does not make a big contribution in increasing the content. The value of the nitrogen content in the liquid organic fertilizer produced in this study is still low, this is because the nitrogen content in rice washing water before fermentation is low, namely 0.015% (Wardiah, 2014). Another thing, it is suspected that the cause of the low N content is due to the not optimal fermentation time, which is only 8 days, this is in line with the research of Syafri

(2017) which states that there is an increase in the N content in the liquid organic fertilizer of pineapple chips waste as the fermentation time increases to 14 days. Purnawati et al. (2016) who studied the use of water washing rice and chicken manure as liquid organic fertilizer also reported that the resulting nitrogen content was still low, namely 0.065% in the 8-day fermentation time. Purnawati further reported that the organic material in the manufacture of liquid organic fertilizer had not been completely degraded or fermented in the 8 days fermentation time. This is also in line with Santi's research (2008) which explains that a good fermentation time is 14 days.

Content of Phosphorus

The results of the analysis of the average phosphorus content in the liquid organic fertilizer of rice washing water can be seen in Table 7.

From data table 7. It shows that the highest Phosphorus content was obtained in the P4 treatment and it was significantly different from other treatments while the lowest Phosphorus content was obtained in the P0 treatment, is because in the P0 treatment the washing water was not added to rice so that the accumulated phosphorus obtained only came from vegetable waste used (mustard greens and afkiran tomatoes).

Wulandari et al (2011) stated that the nutrient content that dominates in the washing water solution of red and white rice is phosphorus, magnesium, and calcium, while the nitrogen and potassium content is low. However, in this study, the resulting phosphorus content did not dominate as in Wulandari's research, this is probably due to the different rice varieties used.

The low phosphorus content produced in this study is thought to be due to the not optimal fermentation time so that the degradation of the basic ingredients for making liquid organic fertilizers is not yet perfect, this is closely related to the resulting pH value, where it is possible that if the fermentation process is continued, the pH value will increase to the limit. certain and will decrease until the degradation of the organic matter in the solution has been exhausted. This is in line with the research of Rahman and Setyawati (2010), who stated that the increase in phosphorus content depends on the pH of the solution and the length of time of fermentation, the more acidic the solution is, the more phosphorus content will increase, where the longer the fermentation time is at a certain limit, the more acidic the solution will be the increase followed by an increase in Phosphorus content.

Content of Potassium

The results of the analysis of the average potassium content in the liquid organic fertilizers of rice washing water can be seen in Table 8.

Based on the ANOVA test and further test of BNJ $p<0.05$ and $p<0.01$, it shows that the type of washing rice water treatment has a very significant effect on the P content of liquid organic fertilizer. Data table 8 shows that the highest potassium content was obtained in treatment P4 but not different from treatment P2. This was because the amount of potassium in glutinous white and red glutinous rice was not significantly different. This is in line with the research of Wulandari et al. (2011), which examined the NPK content in the liquid organic fertilizers of washing water for red rice and white rice which resulted in the same amount of potassium content in both types of rice, namely 0.02%.

This shows that the liquid organic fertilizers produced in this study can be used if the aim is to increase and support plant growth and yields not for commercialization purposes. This is in line with the research of Lussy, et al. (2015) which examines the chemical characteristics of liquid organic fertilizers from three types of animal manure and their combination, which results in N, P, and K content below the minimum standards of liquid organic fertilizers,

Minister of Agriculture Regulation number 70 / Permentan / SR.140 / 10/2011 so that the commercial needs of fertilizers produced do not meet the feasibility standards, however, Lussy et al. (2015) further explained that to improve the quality of POC produced, it is necessary to enrich nutrients so that the nutrient content of fertilizers can increase.

CONCLUSIONS AND SUGGESTIONS

Conclusions

1. Different types of rice washing water have different effects on the nutrient content of NPK Liquid Organic Fertilizer produced
2. The treatment with the addition of washing water for white glutinous rice (P2) produced the highest N content (0.15%) compared to other treatments, but on the observation of P and K content, the addition of washing water for red glutinous rice (P4) gave the highest results with content values P of 0.09% and K of 0.14% but not different from the addition of washing water for glutinous white rice (P2).

Suggestions

1. It is necessary to increase the length of fermentation time so that the decomposition of the material is more complete,
2. It is necessary to add organic materials containing higher NPK to increase the resulting POC nutrient content.

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