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Analysis of Nitrogen and Potassium in Liquid Organic Fertilizer from Rice Washing and Mature Coconut Water

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Abstract

Mature coconut and rice washing water contain nitrogen and potassium, which are helpful for plants. This study aims to determine the levels of nitrogen and potassium in liquid organic fertilizer from a mixture of mature coconut water and rice washing water. Nitrogen content was analyzed using the Kjeldahl method. Potassium levels were analyzed using a flame photometer. The results indicated that the best nitrogen and potassium levels were obtained in liquid organic fertilizer with a mixture ratio 50:50, namely N 1.26% and K 1.27%. The highest nitrogen content was obtained in liquid organic fertilizer (LOF) with a mixture ratio of 25:75, 1.40%, and the highest potassium content was obtained in liquid organic fertilizer with a mixture ratio of 50:50, 1.27%. When mixed, the increase in nitrogen and potassium levels was caused by the bacteria in the liquid organic fertilizer, which breaks down protein during digestion.

Keywords: LOF, nitrogen, mature coconut water, potassium, rice washing water

Introduction

Indonesia is known as an agricultural country because it has abundant natural resources and strategic geographical conditions. Most of Indonesia's population works in agriculture (Anwar & Firmansyah, 2020). Meanwhile, in the coming 40 years, farming emissions will increase by almost 60% so that people can be provided with the correct quantity and quality of food. Farm productivity and soil fertility are necessary with this increasing population and food shortage. There are many strategies to increase soil fertility and productivity, including using beneficial microbes and fertilizers (Ilahi et al., 2021).

Fertilizer, though one of the most essential inputs for increasing agricultural production, is a leading cause of nitrous oxide emissions from agriculture, contributing significantly to global warming. Therefore, understanding factors affecting farmers' use of fertilizers is crucial to developing strategies to improve efficiency and minimize adverse impacts (Aryal et al., 2021).

It is known that besides the macronutrient phosphorus (P), nitrogen (N), and potassium (K) are the most important nutrients for plant growth and development (Ye et al., 2019). Therefore, farmers can ensure plants get the nutrients they need by adjusting the dosage and type of fertilizer applied more effectively and efficiently to achieve optimal yields. Innovative and targeted organic matter and fertilizer applications will avoid waste and environmental pollution due to excessive fertilizer use (Moe et al., 2019; Ridwansyah et al., 2020).

According to where they come from, fertilizers can be classified as either organic or inorganic. Farmers frequently apply artificial fertilizers to their soil because they believe they can speed up the planting season and boost crop yields without considering the long-term effects. Examples of waste or agricultural products used to make organic fertilizers include manure, green manure, crop residues, and agricultural waste. There are two types of organic fertilizers: liquid and solid. The benefits of LOF include their ability to supply nutrients swiftly, ease of application, and efficient remediation of nutritional deficits. Even when applied frequently, LOF typically does not harm plants or soil. LOF is natural and synthetic (Andriyani et al., 2022). Providing all the nutrients required for plant growth, enhancing soil structure, and promoting the health of soil microorganisms are just a few benefits of using LOF.

LOF is derived from animals and plants as the basic material that has been fermented. The advantages of using liquid organic fertilizer in the agricultural sector are that it contains nutrients that plants easily absorb and contains many microorganisms. Making organic fertilizers requires

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a short time, and their application in agriculture is essential. An easy farmer only needs to spray organic fertilizer in agricultural areas (Tanti et al., 2019). Rice washing water is a household waste that can be used as liquid organic fertilizer because rice washing water contains nutrients needed for plant growth, including N, P, K, phosphorus, iron, protein fiber, amino acids, and zinc (Pitaloka et al., 2022).

Manganese (Mn), which is essential for protein synthesis and aids in plant N use, and phosphorus (P), which is involved in cell division, albumin creation, and the formation of flowers, fruits, and seeds, are among the minerals found in rice washing water that are generally beneficial. Furthermore, phosphorus increases plant resistance to disease, improves plant quality, strengthens stems and roots, speeds fruit ripening, and improves glucose metabolism. Iron (Fe) contributes to the respiratory process of plants and the production of green substances called chlorophyll; nitrogen (N) content contributes to the stimulation of plants' overall vegetative growth, particularly the growth of roots, stems, and leaves, as well as the production of chlorophyll, which is crucial for the process of photosynthesis and the synthesis of proteins and fats. In addition to helping plants transport phosphate, magnesium (Mg) synthesizes the green molecules called chlorophyll and the carbohydrates, lipids, and oil components that plants require. In addition to strengthening plants so that leaves, flowers, and fruits do not fall off easily, potassium (K) content aids in forming proteins and carbohydrates. Finally, calcium (Ca) content helps stimulate root hair formation, harden plant stems, and stimulate seed formation in stems and leaves (Adlian et al., 2023).

Based on research conducted by Dewi et al. (2021), it was found that the application of rice washing water waste increased the number of leaf blades, stem height, and wet weight of mustard plants. The higher the rice washing water waste concentration, the more these three parameters increase. This is due to the higher content of nutrients absorbed. In conclusion, rice washing water waste can increase the vegetative growth of mustard plants, so it has the potential as an LOF.

Besides rice washing water, coconut water can also be used as LOF. This is because coconut water contains auxin and cytokinin hormones and has complex nutrients needed by plants, such as vitamin C, sodium, thiamine, phosphorus, calcium, and riboflavin. Researchers have extensively researched the application of coconut water LOF (Sari et al., 2021).

We divide coconut water into two categories: young coconut water and mature coconut water. Compared to young coconut water, mature coconut water is the leftover coconut milk that is often discarded or unused and ends up as waste. In fact, mature coconut water contains natural growth regulators that promote growth (Banna et al., 2023). One of the many advantages of mature coconut water, according to Mergiana et al. (2021), is that it includes hormones that, when administered in the right amounts, can promote plant development, making it a natural plant growth regulator (PGR). Gibberellins, auxin, and cytokinin are hormones found in aged coconut water. These three hormones trigger cell division, bud development, and stem elongation (Setyawati et al., 2020).

Based on experimental results, applying coconut water as a liquid organic fertilizer significantly affects the growth of tomato plants, especially plant height (Sari et al., 2021). In addition, the application of coconut water liquid organic fertilizer and gold snail gives a positive response to the growth of mung bean plants (Vigna radiata) Hidayanti et al. (2022), and had a significant impact on the growth of cocoa seedlings, affecting the number of leaves, plant height, number of roots, and length of roots (Baid et al., 2022).

Based on the explanation, the researcher is interested in analyzing nitrogen (N) and potassium (K) levels in liquid organic fertilizer derived from rice washing water and mature coconut water.

Methods

Tools and materials

The tools used in this study were plastic jars, jerry cans, bottles, clear hoses, digital scales, a spectrophotometric Flame Photometer, a UV-Vis spectrophotometer, a Kjedahl destruction apparatus, a dropper pipette, a beaker, and a measuring flask. This research used mature coconut water, rice washing water, EM4 (Effective Microorganism 4), brown sugar, clean water, concentrated sulfuric acid, Kjedahl tablets, aquades, and iron glue.

Sample collection and preparation

The samples used in this study were aged coconut water taken from coconuts in Bancea Village, Poso Regency, and rice washing water from Super type rice, which also came from Bancea Village, Poso Regency.

Making liquid organic fertilizer

Making LOF by washing 1 liter of Super type rice 2 times with 750 mL of clean water. Then the sample was filtered, cleaned, and put into a jar. Each sample was added 50 mL of EM4 and 50 mL of liquefied brown sugar, then stirred until homogeneous. Next, mix the mature coconut and rice washing water with a mixture ratio of 50:50, 75:25, and 25:75, respectively. Then, I added 100 mL of EM4 and 100 mL of brown sugar solution. Next, mix mature coconut water and rice washing water with a ratio of 50:50 and add 100 mL of brown sugar solution. EM4 is not added to this mixture because it will be used as a comparison. Furthermore, fermentation is carried out for 14 days until the fertilizer smells of tapeh. The addition of EM4 functions as a bioactivator to accelerate the

fermentation process, and the addition of brown sugar solution serves as a source of nutrition for microorganisms (Tanti et al., 2019).

Nitrogen analysis

The sample of LOF fermented was weighed as much as 1 gram and put into a Kjedahl flask, then 10 mL of 1 M H_2SO_4 from a Kjedahl tablet was added. Then it is destroyed or heated until it boils, and the solution changes color to clear. After completion of destruction, the sample extract solution was allowed to stand for a while until the solution cooled. Furthermore, the sample extract solution was diluted to 100 mL. Then the diluted sample will be distilled. The sample extract solution was taken as much as 10 mL and put into a distillation flask. 10 mL of 40% NaOH was added to the distillation flask containing the sample extract solution and immediately closed tightly. Next, a solution of 10 mL H_3BO_3 1% was prepared in an Erlenmeyer flask as a reservoir for NH3, and two indicators of BCG + MR (bromocresol Green + Methyl Red) were added. Distillation is carried out until all nitrogen is distilled (blue). Then the distillate is titrated with 0.1 N HCL until the endpoint of the titration is reached, which is a color change from blue to pink.

$$N\% = \frac{(Vs-Vb) \times N\ HCL \times 14.008 \times FP}{w} \times 100$$

Description: Vs = Sample titration volume (mL)
Vb = Blank titration volume (mL)
FP = Dilution factor
W = Sample weight
(Amalia & Fajri, 2020).

Analysis of potassium

The fermented sample was weighed as much as 5 grams and put into an Erlenmeyer flask. 4 mL of HNO_3 and 2 mL of $HCLO_4$ were added and stirred until homogeneous. Then it was heated until the sample extract solution was clear. Then the solution was cooled and diluted by adding distilled water to 25 mL, shaken until homogeneous, and filtered with W-41 filter paper to obtain a clear extract. Then 1 mL of the sample was taken and put into a test tube, 9 mL of distilled water was added, and the mixture was shaken with a vortex until homogeneous. Analysis of K levels in samples of LOF from mature coconut water and rice washing using a Flamephotometer at the Laboratory of the Faculty of Agriculture, Tadulako University, with a wavelength of 766.5 nm, with K standard series concentrations of 0, 2, 4, 8, 12, 16, and 20 ppm (Zakiyah et al., 2019).

$$K\% = \text{ppm kurva} \times \frac{mL\ sample}{1000\ ml} \times \frac{100}{mg\ sample} \times fp \times fk$$

Description:

ppm curve = Sample content obtained from the curve of the relationship between standard series content and readings after correction
100 = Conversion to %
fk = Moisture content correction factor
fp = Dilution factor

Results and Discussion

A LOF made from a combination of mature coconut water and rice washing water is the end product of examining these two sources' nitrogen and potassium content. We use fermentation in our production of LOF.

Fermentation, specifically ammoniation fermentation, aims to improve the quality of animal feed ingredients. Biochemically, fermentation is the formation of energy through organic compounds. At the same time, application to the industrial field is defined as the process of converting basic ingredients into products by microbial cell mass, so that the fermentation process can occur if there is contact between the microorganisms that cause fermentation and the appropriate organic substrate (Rasyid et al., 2022).

In this study, coconut and rice washing water were divided into several mixing ratios, and fertilizer from each sample was added as a comparison. The samples were fermented for 14 days at room temperature. The nitrogen content in liquid organic fertilizer was analyzed using the Kjeldahl method, starting with digestion, distillation, and titration. Potassium levels were analyzed using a Flame Photometer.

The following table contains nitrogen and potassium obtained from this study. Based on **Table 1**, the nitrogen content of mature coconut water is 0.56% and the nitrogen content of rice washing water is 0.91%. It can be seen that the rice washing water contains more nitrogen than mature coconut water. This is due to the protein content in the rice washing water, which decomposes into nitrogen during digestion. This study obtained the highest nitrogen content in a mixture of aged coconut and rice washing water (Ratio 25:75), 1.40%. The increase in nitrogen levels when the two samples were mixed with a ratio of 75% rice washing water and 25% aged coconut water was caused by bacteria that decomposed during digestion.

However, the nitrogen content obtained in this study did not meet the standards for trading. In the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70 of 2011 concerning "Organic Fertilizers, Biological Fertilizers, and Soil Improvements", the quality standard for nitrogen content is 3 - 6%. However, liquid organic fertilizer from a mixture of mature coconut water and rice

washing water in this study can be used in everyday life.

Table 1. Nitrogen content in POC samples of mature coconut water and rice washing water

No.	Sample	Content Test (%	Sample Repeat		Average
			I	II	
1.	Mature coconut Water	N	0.56	0.56	0.56
2.	Rice Washing Water	N	0.84	0.98	0.91
3.	Mixed mature coconut water and Rice washing water (Ratio 50:50)	N	1.40	1.12	1.26
4	Mix of aged coconut water and rice washing water (Ratio 75:25)	N	0.70	0.84	0.77
5	POC of Mixed coconut water, aged coconut water, and rice washing water (Ratio 25:75)	N	1.54	1.26	1.40
6	Mixture of aged coconut water and rice washing water without the addition of EM4(50:50 ratio)	N	1.12	0.84	0.98

Based on **Table 2**, the potassium content obtained in mature coconut water is 1.26% and the potassium content of rice washing water is 0.271%. Potassium levels in mature coconut water are higher than in rice washing water. This is because mature coconut water contains many minerals. Previous research also showed that potassium levels in aged coconut water were higher than in rice washing water. Gultom & Prabatiwi (2017) showed that potassium levels in aged coconut water were 2.18% and in Jannah et al. (2018), the potassium level in rice washing water was 2.02%.

Table 2. Potassium content in POC samples of mature coconut water and rice wash water

No.	Sample	Content Test (%)	Sample Repeat		Average
			I	II	
1.	Mature coconut Water	K	1.225	1.3	1.26
2.	Rice Wash Water	K	0.259	0.283	0.271
3.	Mix of mature coconut water and rice washing water (Ratio 50:50)	K	1.20	1.34	1.27
4.	Mix of aged coconut water and rice washing water (Ratio 75:25)	K	0.925	0.912	0.918
5.	Mixture of mature coconut water and rice washing water (Ratio 25:75)	K	0.63	0.645	0.637
6.	Mix of aged coconut water and rice washing water without the addition of EM4(50:50 ratio)	K	0.325	0.35	0.337

This study obtained the highest potassium levels in a mixture of aged coconut water and rice washing water (50:50), 1.27%. However, the potassium levels obtained in this study can be used in daily life even though they do not meet the standards for trading because the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 70 of 2011, which states that the standard level of potassium in organic fertilizers is 3 – 6%. The results of measuring potassium levels in this study are relatively low compared to previous studies. The fermentation process may not be perfect, so the material's decomposition is slow (Sulfianti et al., 2021). The decrease in potassium levels in this study may also be caused by the type and location of growth of the two samples used, because each type of coconut and rice has different potassium levels.

Conclusions

The results indicated that the best nitrogen and potassium levels were obtained in liquid organic fertilizer with a mixture ratio 50:50, namely N 1.26% and K 1.27%. The highest nitrogen content was obtained in LOF with a mixture ratio of 25:75, namely 1.40%, and the highest potassium content was obtained in LOF with a mixture ratio of 50:50, namely 1.27%. When mixed, the increase in

nitrogen and potassium levels was caused by the bacteria in the liquid organic fertilizer, which breaks down protein during digestion.

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Conflict of Interest

The authors state that there is no conflict of interest related to the publication of this paper.

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