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LOF Kirinyuh Leaves and Liquid Waste Tempeh with Pineapple Peel Bioactivator: Sensory and Macronutrient Content

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ABSTRACT

Liquid organic fertilizer is a liquid organic material that contains plant nutrients. Using liquid organic fertilizers can satiate the nutritional needs of plants and reduce the application of chemical fertilizers, which if used for an extended period, can damage the soil's organic structure. The purpose of this study is to determine the quality of liquid organic fertilizer made from kirinyuh leaves and tempeh liquid waste by adding a bioactivator derived from pineapple rind. The method applied is experimental, and use Completely Randomized Design with two factors. The first component is a mixture of kirinyuh leaves and tempeh effluent (K_1=168 ml: 82 ml, K_2=82 ml: 168 ml), and the second component is a bioactivator derived from ananas peel (B_1=100 ml, B_2=150 ml). Utilizing two-way ANOVA, qualitative and quantitative descriptive data research was conducted. Our field experiments showed that the N content was the highest in the treatment of K1B2 (1.02%), the P content was higher in the treatment of K_2B_1 (0.06 %), as well as the K content was highest in the treatments of K_2B_1 and K_2B_2 (0.10 %). The sensory quality of the average liquid organic fertilizer is brown, has a tapai aroma, and has a pH 4.6 – 5.

1. INTRODUCTION

The agricultural industry is constantly searching for ways to improve crop yields. Beginning with selecting superior seedlings, pesticide or insecticide application, and fertilization. Applying fertilizers to plants plays a role in meeting nutrient requirements and is crucial for soil fertility to boost plant productivity. Organic fertilizers are distinguished from inorganic fertilizers based on their origin. In general, when carrying out fertilization activities, farmers utilize chemical fertilizers because they are deemed more practical, simple to obtain, and cost-effective, and their benefits can be felt rapidly. According to the Regulation of the Minister of Agriculture of the Republic of Indonesia, Number 36/Permentan/SR/10/2017 on Registration of Inorganic Fertilizers, chemical fertilizers, also known as inorganic fertilizers, are produced through chemical, physical, or biological engineering methods and are manufactured in industrial settings or fertilizer production facilities.

Inorganic fertilizers are always accompanied by environmental issues, both for the soil and consumers. According to Maghfoer (2018), the continuous application of inorganic fertilizers without balancing the dosage can alter the soil's physical, chemical, and biological properties, even reducing soil fertility. Furthermore, using inorganic fertilizers can degrade the texture and structure of the ground, resulting in erosion and acidification caused by leaching. In addition, excess inorganic fertilizers can contaminate water and air, posing a threat to living organisms in the area surrounding the applied inorganic fertilizers.

To reduce the excessive use of inorganic fertilizers, specifically using fertilizers derived from organic materials such as animals or plants. Nuro et al. (2016)stated that the application of organic fertilizers can influence the chemical properties of the soil by creating a nutrient balance. In addition to improving the soil's physical properties, applying organic fertilizers increases soil aggregation, thereby increasing its water-holding capacity.

Both agricultural and non-agricultural materials can be utilized to produce organic fertilizers. The composition of nutrients in organic fertilizers is also contingent on the origin of organic fertilizers' fundamental constituents. Organic fertilizer is divided into two categories based on its physical state: solid organic fertilizer and liquid organic fertilizer. Each of the two options has different benefits. Liquid organic fertilizer has the use of loosening the soil's structure, enhancing water absorption, and supplying plant nutrients (Dewi et al. 2016).

Kirinyuh (*Eupatorium odoratum*) is a plant found in the wild that is not extensively utilized. This plant is a menace or an opportunity for the environment due to its abundant availability. As a competitor for nutrient and water absorption, Kirinyuh will inhibit the development of other plants if it is allowed to grow densely. However, kirinyuh also has the potential to be used as fertilizer. Leaves of kirinyuh contain 4.41 % nitrogen and 3.06 % potassium (Okalia et al. 2023). According to Jeksen (2017), liquid fertilizer derived from kirinyuh leaves contained 0.046 % nitrogen, 0.020 % phosphorus, and 0.160 % potassium.

In addition to kirinyuh, industrial waste can be incorporated into producing liquid organic fertilizer. One of the industrial residues that can be utilized is tempeh liquid waste, which can supplement the nutrient content of liquid fertilizer with nitrogen (N), phosphorus (P), and potassium (K). Prasetio (2020), reported that tempeh effluent contained 0.42 % protein, 0.13 % fat, 0.11 % carbohydrates, 98.87 % water, 13.60 ppm calcium, 1.74 ppm phosphorus, and 4.55 ppm iron. Tempeh industrial liquid waste has yet to be optimally utilized because it is considered to have no economic value, so it is disposed of in the sewer. The direct disposal of tempeh's by products can have adverse environmental effects.

In producing organic fertilizers, microorganisms in the bioactivator aid in the decomposition process. Pineapple rind waste is readily available as a bioactivator. Masengi et al. (2020) state that fermented pineapple peels will generate lactic acid bacteria that contribute to plant growth. In addition to enhancing organic decomposition and the formation of soil humus, lactic acid bacteria can also stimulate plant growth. According to Raman et al. (2022) the quality of liquid organic fertilizer is determined by the physical, biological, and chemical characteristics generated.

Based on the preceding context, the research questions are as follows: What is the quality of the liquid organic fertilizer (LOF) combination of kirinyuh leaves and tempeh liquid waste with the addition of pineapple rind as a bioactivator, as measured by sensory indicators and NPK content? The purpose of research is to determine the macronutrient content and sensorial quality of liquid organic fertilizer derived from kirinyuh leaves and tempeh liquid waste with pineapple peel bioactivator.

While the benefits of this research are that it is anticipated that the results will provide information to 1) Researchers to increase their knowledge and understanding of the use of waste that has yet to be optimally utilized to produce liquid organic fertilizer. 2) With the addition of pineapple peel bioactivator, kirinyuh leaves and tempeh liquid waste can be used as fundamental ingredients in producing liquid organic fertilizer.

2. RESEARCH METHODS

This study was conducted from February to April 2023 at the Green House Laboratory of the Teaching and Education Faculty at Muhammadiyah University of Surakarta and the Soil and Plant Nutrition Laboratory of the Agrotechnology Study Program at Muhammadiyah University of Yogyakarta. The tools needed in this study are jars, blenders, basins, scales, pans, stoves, measuring cups, blades, pH indicators, distillation, titrations, test tubes, spectrophotometer (420 nm), flame photometer, and documentation. While the materials used in this study included kirinyuh leaves, tempeh liquid waste, pineapple peel, brown sugar, molasses, coconut water, leri water, bran, pH sticks, concentrated H_2SO_4, Zn, aquades, salt, N_2OH 45%, H_3BO_3 4%, HNO_3, $HClO_4$, HCl 0.1 N, ammonium heptamolybdate vanadate, concentrated extract P.

This study employed a factorial Completely Randomized Design (CRD) with two factors and four treatments, with three repetitions. The first factor combined kirinyuh leaf extract and tempeh effluent with K_1 = 168 ml: 82 ml and K_2 = 82 ml: 168 ml proportions. The second factor was the addition of bioactivators derived from pineapple peel, specifically B_1 = 100 ml and B_2 = 150 ml.

The research implementation included the production of inventories of pineapple peel bioactivator, kirinyuh leaf extract, and tempeh liquid waste, the production of liquid organic fertilizer, as well as sensory observations and nitrogen, phosphorus, and potassium content testing. Observational data obtained were analyzed using qualitative and quantitative descriptive statistics in the form of a two-way analysis of variance (ANOVA).

3. RESULTS AND DISCUSSION

3.1. Sensory Observation

Researchers and ten panelists evaluated liquid organic fertilizer composed of kirinyuh leaves, tempeh liquid waste, and pineapple peel bioactivator based on color, aroma, and pH levels. Observation sensory employs all five senses, including a sense of vision (color) and sense of scent (aroma), whereas pH measurement employs an indicator and pH stick. The following table displays the outcomes of sensory observations.

Table 1. Nutrient observation of organic liquid mixture kirinyuh leaves and waste liquid tempeh with the addition of fermented pineapple rind for 14 days.

Combination	Parameter		
	Color	Aroma	pH
K_1B_1	Greenish brown	Tape aroma	5
K_1B_2	Brown	Tape aroma	4.8
K_2B_1	Brown	Not sting	4.9
K_2B_2	Brown	Tape aroma	4.6

Description:

K_1B_1 : Liquid organic fertilizer with a concentration of 168 ml of kirinyuh leaf extract and 82 ml of tempeh liquid waste with the addition of 100 ml of pineapple peel bioactivator

K_1B_2 : Liquid organic fertilizer with a concentration of 168 ml of kirinyuh leaf extract and 82 ml of tempeh liquid waste with the addition of 150 ml of pineapple peel bioactivator

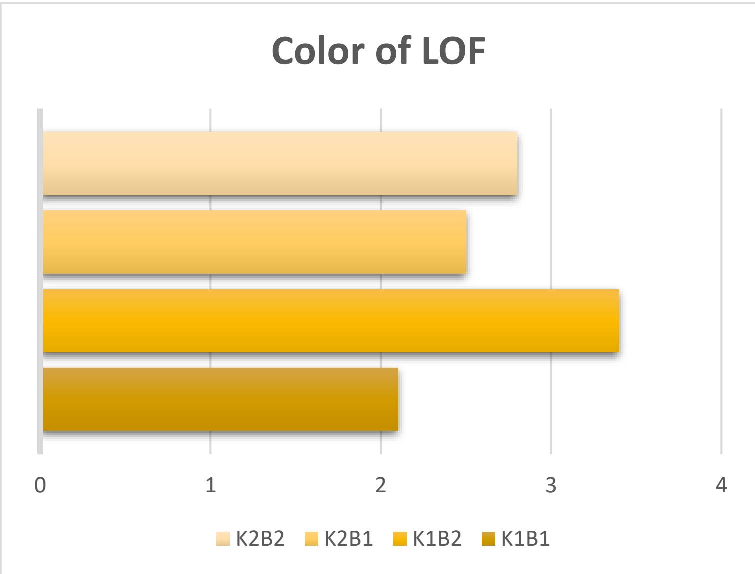
K_2B_1 : Liquid organic fertilizer with a concentration of 82 ml of kirinyuh leaf extract and 168 ml of tempeh liquid waste with the addition of 100 ml of pineapple peel bioactivator

K_2B_2 : Liquid organic fertilizer with a concentration of 82 ml of kirinyuh leaf extract and 168 ml of tempeh liquid waste with the addition of 150 ml of pineapple peel bioactivator

Based on the table data, it can be seen that the sensory observations in the treatment samples showed differences in color, aroma, or pH sensory.

3.1.1. Color parameters

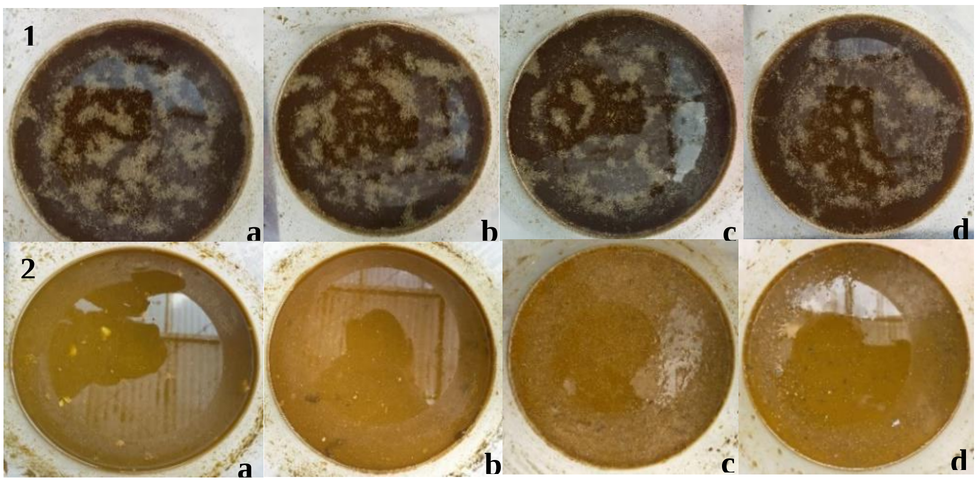
One of the criteria for determining the quality of liquid organic fertilizer is its color. The liquid organic fertilizer produced was greenish brown to brown in color, according to color observations. The colors generated by liquid organic fertilizer comprised of kirinyuh leaf extract, tempeh liquid waste, and pineapple peel bioactivator are depicted in the diagram below.



Description: 1 = brownish yellow, 2 = greenish brown, 3 = brown, 4 = blackish brown

Figure 1. Color observation diagram of kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with the addition of pineapple peel bioactivator

According to the diagram, the color of each sample of liquid organic fertilizer containing a combination of kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator is distinct. Brown was the color produced by the K_1B_2, K_2B_1, and K_2B_2 treatments. According to Tanti et al. (2020), the color of an excellent liquid fertilizer ranges from yellowish brown to brown, indicating a successful fermentation process. In contrast, the K_1B_1 treatment resulted in a greenish-brown color. This can be caused by fertilizer that has not reached its full maturity. In addition, materials with higher concentrations than other treatments, such as kirinyuh leaf extract, can cause the color of the fertilizer to be greenish brown. According to Ekawandani (2018) research, the color of vegetable refuse fertilizer remains brown. Figure 2 demonstrates the results of observing the color of liquid organic fertilizer.



Description: 1 = before fermentation; 2 = after fermentation;
a= K_1B_1 ; b= K_1B_2 ; c= K_2B_1 ; d= K_2B_2

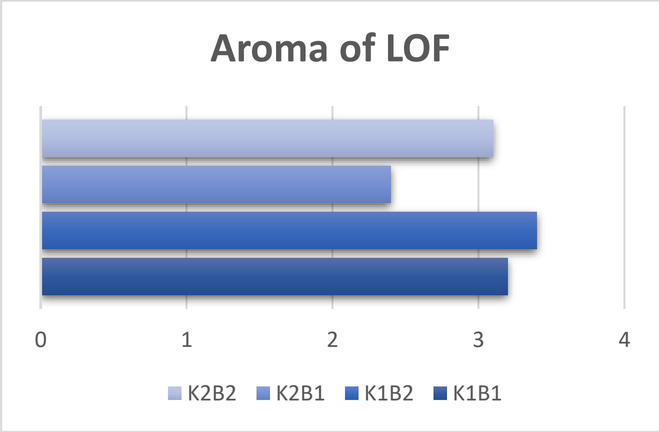
Figure 2. Color sensory observations on liquid organic fertilizer from kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator

Figure 2 demonstrates that after 14 days of fermentation, liquid organic fertilizer derived from kirinyuh leaves and tempeh liquid waste, with the addition of a bioactivator derived from pineapple rind, changes color from brown to black to brown to greenish brown. Additional ingredients, such as molasses and bran, can influence the color of liquid organic fertilizer at the outset of the manufacturing process.

The pigment change in liquid organic fertilizer may be caused by the activity of microorganisms involved in fermentation. This is in line with the findings of Andriany et al. (2018), which state that during the fermentation process, organic matter is decomposed by microbial activity, which absorbs water, oxygen, and nutrients from organic matter, which then decomposes and releases CO_2 and O_2. Arifah, (2022) also explained that the color change in liquid organic fertilizer is caused by microorganisms using sufficient oxygen to isolate heat, which causes the essential ingredients to decrease.

3.1.2. Aroma parameters

The maturation of liquid organic fertilizer can also be determined by its aroma. If the decomposition process succeeds, liquid organic fertilizer will produce a distinct fermentation odor. Figure 3 describes the aroma generated by kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with the addition of pineapple peel bioactivator.



Description: 1 = stale, 2 = not sting, 3 = tape aroma, 4 = sting

Figure 3. Aromatic observation diagram for kirinyuh leaf liquid organic fertilizer and tempeh liquid waste containing pineapple peel bioactivator

Kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with the addition of pineapple peel bioactivator prior to fermentation have a unique leaf extract fragrance derived from the aroma of kirinyuh leaves. On day 3, the aroma of the liquid organic fertilizer changed to an unpleasant odor, and on day 14, the K_1B_1, K_1B_2, and K_2B_2 treatments had a distinct fermented fragrance, known as tape aroma. The activity of microorganisms from bioactivators that carry out the fermentation process can result in alterations to the aroma generated. According to Irawan (2022), the presence of the aroma of tape in liquid organic fertilizers is also influenced by the activity of anaerobic microorganisms such as molds, yeast, and bacteria that degrade organic matter into compounds that plants readily assimilate. Therefore, the odor of tapai liquid organic fertilizer can be used to indicate the quality of liquid organic fertilizer. This is supported by Endah et al., (2015), who found that liquid organic fertilizer scents like tapai, unifying that the liquid organic fertilizer produced is of high quality. In the meantime, the K_2B_1 treatment had a faint odor, indicating that the fermentation process aided by microorganisms had concluded. Usman et al. (2022) reported that *Lactobacillus* can decompose sucrose into lactic acid so that a highly pungent odor is diminished.

3.1.3. pH parameters

The pH is measured using a pH indicator following the sensory observations of color and smells. In addition to color and aroma, potential hydrogen (pH) is an essential quality parameter for liquid organic fertilizer. Therefore, pH measurements were taken every three days for fourteen days. Before determining the pH, liquid organic fertilizer made from kirinyuh leaves and tempeh liquid waste was combined with a bioactivator made from pineapple peel. For the pH measurement to be accurate, the dissolved content in liquid organic fertilizer must be consistent and homogenous.

The pH of liquid organic fertilizer mixed with kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator at the commencement of the fermentation process is 5. A level of either too low or too high acidity will inhibit plant growth. According to Karoba et al. (2015), if liquid organic fertilizer conditions are too acidic or alkaline, plants assimilate nutrients less efficiently, resulting in stunted plant growth. Figure 4 displays the pH measurement results from this study.

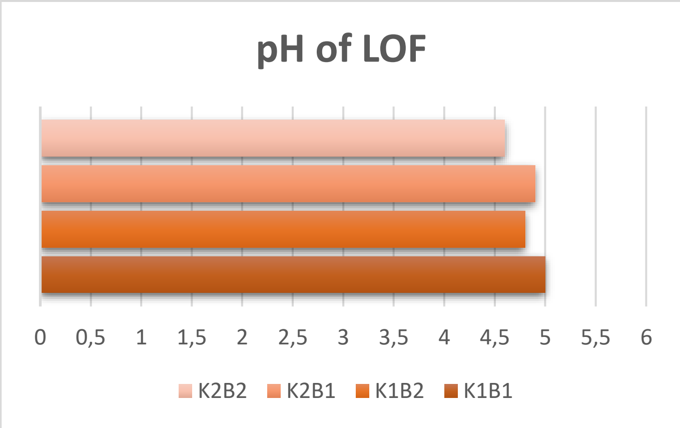


Figure 4: Chart of pH measurements of kirinyuh leaf liquid organic fertilizer and tempeh liquid effluent with pineapple peel bioactivator

Figure 4. illustrates how this is the case. According to the measurement results, the pH values of liquid organic fertilizer made from kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator were 5; 4.8; 4.9; and 4.6 for treatments K_1B_1, K_1B_2, K_2B_1, and K_2B_2, respectively. In this instance, the pH meets the quality standards for liquid organic fertilizer specified in Regulation The Minister of Agriculture RI Number 70/Permentan/SR.140/2011 regarding quality standards for liquid organic fertilizer with a standard pH range of 4-9. The proliferation of microorganisms caused the 14-day decrease in pH. According to Kurniawan et al. (2017), the increase or decrease in acidity in fertilizers caused by bacterial activity.

In addition, the K_2B_2 treatment demonstrated the lowest potential hydrogen (pH) level, which was 4.6. Due to the corrosive and high concentration of tempeh liquid waste, liquid organic fertilizer with a low pH is produced. According to Cundari et al. (2022), tempeh liquid waste has a very high concentration, is viscous, acidic, brownish yellow, and has an offensive odor. In addition, lactic acid bacteria in the bioactivators of pineapple epidermis also contribute to a low pH. Jaelani et al. (2015) confirmed that the potential hydrogen (pH) during fermentation is affected by the number of lactic acid bacteria; the greater the number of lactic acid bacteria, the lower the pH during fermentation.

3.2. Content of Macro Nutrients

Based on the results of macro-nutrient experiments involving nitrogen (N), phosphorus (P), and potassium (K) liquid organic fertilizer combination of kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator, the following average is calculated:

Table 2. The results of the nutrient content of N, P, and K organic fertilizer liquid combination leaf residue and waste liquid tempeh fermented for 14 days with the addition of bioactivator pineapple peel.

Treatment	Macro Nutrient		
	N (%)	P (%)	K (%)
K_1B_1	0.93	0.06*	0.08
K_1B_2	1.02*	0.05	0.09
K_2B_1	0.82	0.05	0.10*
K_2B_2	0.82	0.05	0.10*

Description: (*) highest result

The presence of macronutrients such as nitrogen, phosphorus, and potassium is dependent on the amount of organic matter present. According to Ramadhan et al., (2015)organic matter provides nutrients and C-organic. For example, the liquid organic fertilizer composed of kirinyuh leaves, tempeh liquid waste, and pineapple rind bioactivator contains the following nutrients:

3.2.1. Nitrogen Content

Nitrogen is one of the essential nutrients for plant growth. Plants absorb nitrogen compounds like NO_3^- (nitrate) and NH_4^+ (ammonium). As for the test results for the N content of organic fertilizers liquid combination leaf refuse And waste liquid tempeh with bioactivator: Pineapple epidermis can be seen in Figure 5:

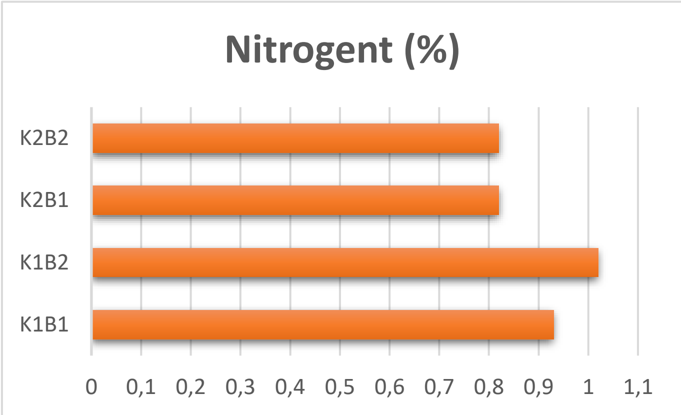


Figure 5. Diagram of nitrogen content in liquid organic fertilizer derived from kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator

The K_1B_2 treatment had the maximum nitrogen content at 1.02 %, while the K_2B_1 and K_2B_2 treatments had the lowest nitrogen content at 0.80 %. The N content of liquid organic fertilizer increases proportionally to the concentration of kirinyuh leaf extract. This is probably due to the high nitrogen content of kirinyuh leaves. Lodo et al. (2022) explained that kirinyuh is a source of organic matter due to its high nutrient content in nitrogen. This liquid fertilizer meets the nitrogen content requirements for organic liquid fertilizers. According to SNI 19-7030-2004, the minimal nitrogen content quality standard is 0.4 %. In addition, the accompanying table explains the effect of liquid organic fertilizer from kirinyuh leaves and tempeh liquid waste with the addition of pineapple peel bioactivator on nitrogen content.

Table 3. Two-way analysis of variance (ANOVA) of nitrogen content

Tests of Between-Subjects Effects					
Dependent Variable: Nitrogen					
Source	**Type III Sum of Squares**	**df**	**MeanSquare**	**F**	**P.**
Corrected Model	.084 [a]	3	.028	17,277	001
Intercepts	9,666	1	9,666	5948354	.000
combination	072	1	072	44,354	.000
Bioactivator	006	1	006	3,738	089
Combination * Bioactivator	006	1	006	3,738	089

Error	013	8	002
Total	9,763	12	
Corrected Total	.097	11	
a. R Squared = .866 (Adjusted R Squared = .816)			

To determine the effect of the combination of ingredients, addition of bioactivator, and interaction between the combination of ingredients and addition of bioactivator, a two-way ANOVA was used to analyze the mean of Table 3. The results indicated that combining kirinyuh leaves and tempeh effluent affected nitrogen content ($p < 0.05$). Sukri et al. (2019) explained that combining organic matter and fertilizers could increase the soil's nutrient availability. However, adding a bioactivator during liquid organic fertilizer production did not affect the nitrogen content ($p > 0.05$). In addition, the interaction between the combination of constituents and the addition of bioactivators did not affect the nitrogen content ($p > 0.05$).

3.2.2. Phosphorus (P) Content

Phosphorus (P) is an essential element for plant growth. Phosphorus deficiency can result in stunted plant growth, weakened and little stems, and disturbances in plant metabolism. Figure 6 illustrates the phosphorus nutrient content of liquid organic fertilizer mixtures containing waste liquid tempeh and bioactivator pineapple rind.

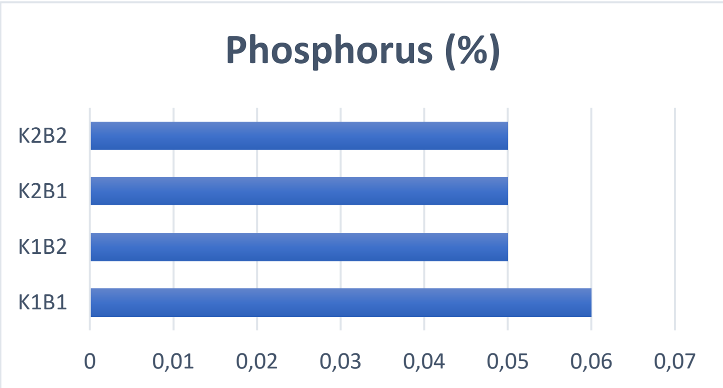


Figure 6. Phosphorus content diagram in kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with the addition of pineapple peel bioactivator

According to Figure 6, the P content of liquid organic fertilizer in this study varied between 0.05 and 0.06 %. K_1B_1 has the greatest concentration of phosphorus at 0.06%. While the K_1B_2, K_2B_1, and K_2B_2 treatments contained the same amount of phosphorus, 0.05 %, the K_1B_2 and K_2B_2 treatments contained 0.06 %. According to SNI 19-7030-2004, however, the phosphorus content of liquid organic fertilizer is more significant than 0.10 %. This indicates that the liquid organic fertilizer composed of kirinyuh leaves, tempeh liquid waste, and pineapple peel bioactivator does not meet the minimum phosphorus content requirements.

Oktiawan et al. (2015) state that phosphorus must be broken down into $H_2PO_4^-$ and HPO_4^- before plants can assimilate it. The 14-day fermentation process decomposes the organic matter's organic components into elements that plants can assimilate. However, prolonged fermentation can deplete the nutrient content of liquid organic fertilizer. This is supported by the findings of Kusumadewi et al. (2019), who found that the duration of fermentation affects the amount of phosphorus nutrients present. The longer the fermentation time, the more nutrients are consumed by the activity of microorganisms; consequently, the availability of nutrients will eventually be depleted, resulting in the demise of the microorganism. In addition, phosphorus concentrations will increase as the activity of microorganisms involved in decomposing organic compounds decreases during this phase. Therefore, the movement of microorganisms in decomposing organic compounds will reduce, producing less phosphorus. In the meantime, the following table illustrates the effect of the combination of constituents, the addition of bioactivators, and their interaction.

Table 4. Two-way analysis of variance (ANOVA) of phosphorus content

Tests of Between-Subjects Effects					
Dependent Variable: Phosphorus					
Source	**Type III Sum of Squares**	**df**	**MeanSquare**	**F**	**P.**
Corrected Model	.000 [a]	3	7.500E-005	.750	.552
Intercepts	.033	1	.033	330,750	.000
combination	7.500E-005	1	7.500E-005	.750	.412
Bioactivator	7.500E-005	1	7.500E-005	.750	.412
Combination * Bioactivator	7.500E-005	1	7.500E-005	.750	.412
Error	001	8	1.000E-004		
Total	.034	12			
Corrected Total	001	11			

a. R Squared = .220 (Adjusted R Squared = -.073)

The two-way ANOVA test in Table 4 demonstrates that the combination of kirinyuh leaves and tempeh liquid waste had no effect ($p > 0.05$) on the phosphorus content of liquid organic fertilizer. Likewise, adding a bioactivator to the phosphorus content of liquid organic fertilizer had no significant effect ($p > 0.05$) on the phosphorus content. This is because pineapple peel contains lactic acid microorganisms, which function to produce acid in fermented substances. According to Lerner et al. (2021), adding bioactivators can increase plant tolerance to water stress and plant resistance to diseases and parasites. Moreover, there was no average difference in the interaction between the combination of ingredients and the addition of the bioactivator, indicating that the interaction between the combination of ingredients and the addition of pineapple peel bioactivator had no effect ($p > 0.05$) on the phosphorus content of liquid organic fertilizer made from kirinyuh leaves and tempeh liquid waste with the addition of bioactivator peel pineapple. This can be attributed to the relatively low phosphorus content of organic matter. Anggraini et al. (2019) explained that the composition of the nutrients in organic fertilizers could be affected by the variety of materials used and the production method.

3.2.3. *Potassium (K) Content*

Potassium is another nutrient that plants need to increase their resistance. The presence of microorganisms and their activities affect potassium concentrations in compost. Figure 7 displays the results of measuring the potassium content in a mixture of kirinyuh leaves, tempeh liquid waste, and pineapple peel bioactivator used as a liquid organic fertilizer.

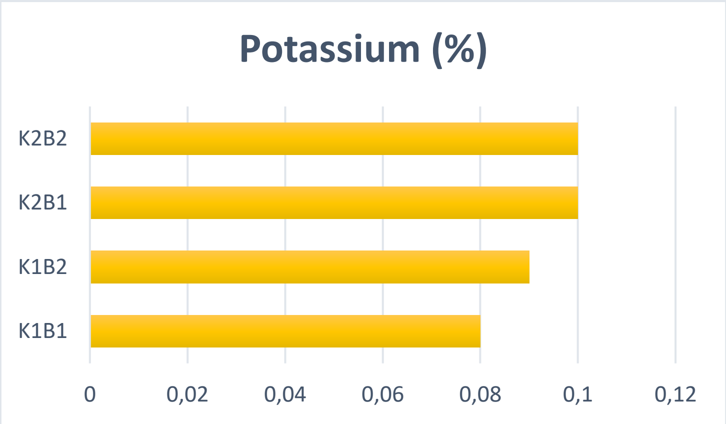


Figure 7. Diagram of potassium content in kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with pineapple peel bioactivator

The potassium content of liquid organic fertilizer was lower in the K_1B_1 and K_1B_2 regimens, as shown in Figure 7. In contrast, the K_2B_1 and K_2B_2 treatments were 0.10 % larger than the others. According to SNI 19-7030-2004, the K content of liquid organic fertilizer is more significant than 0.20 %. This indicates that the combination of kirinyuh leaves, tempeh liquid waste, and pineapple peel bioactivator does not meet the minimum potassium criteria. The low potassium content of kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with pineapple peel bioactivator can be attributed to the activity of microorganisms in decomposing organic matter. Microorganisms utilize potassium as a catalyst for their metabolic processes (Nur et al. 2016). The following table explains the effect of liquid organic fertilizer on potassium content.

Table 5. Two-way analysis of variance (ANOVA) of potassium content

Tests of Between-Subjects Effects					
Dependent Variable: Potassium					
Source	Type III Sum of Squares	df	MeanSquare	F	P.
Corrected Model	.001 [a]	3	.000	1,100	.404
Intercepts	.103	1	.103	410,700	.000
combination	001	1	001	2,700	.139
Bioactivator	7.500E-005	1	7.500E-005	.300	.599
Combination * Bioactivator	7.500E-005	1	7.500E-005	.300	.599
Error	002	8	.000		
Total	.106	12			
Corrected Total	003	11			
a. R Squared = .292 (Adjusted R Squared = .027)					

Table 5's two-way analysis of variance (ANOVA) test indicates, with a 95% confidence level, that the combination of constituents has no significant effect on the potassium content of liquid organic fertilizer ($p > 0.05$). For example, adding a bioactivator derived from pineapple rind did not affect potassium content ($p > 0.05$). Likewise, adding pineapple peel bioactivator did not affect ($p > 0.05$) on the potassium content of kirinyuh leaf and tempeh wastewater liquid organic fertilizer. A possible cause of the low potassium content is a flawed fermentation process. Conversely, a successful fermentation procedure will result in a high potassium content (Sulfianti et al. 2021).

4. CONCLUSION

The combination of kirinyuh leaves and tempeh liquid waste, with the addition of a pineapple peel bioactivator, produced a liquid organic fertilizer with acceptable levels of nitrogen, phosphorus, and potassium. K_1B_2 treatment had the highest nitrogen content, at 1.02 %, and already met the standard quality. The K_1B_2 treatment's sensory characteristics were brown in color, tapai-flavored, and had a pH of 4.8. The K_1B_1 treatment with a 0.06 % phosphorus content had greenish-brown sensory properties, a tape aroma, and a pH of 5. The maximum potassium content was found in the K_2B_1 and K_2B_2 treatments, at 0.10 % each. Sensory qualities of K_2B_1's were brown, not overpowering, and had a pH of 4.9, while K_2B_2's sensory qualities were brown, tape aroma, and had a pH of 4.6. Phosphorus and potassium concentrations produced by kirinyuh leaf liquid organic fertilizer and tempeh liquid waste with pineapple peel bioactivator did not meet quality standards. To produce liquid organic fertilizers that meet SNI standards, it is recommended to increase the materials' concentration, shorten the fermentation time to 7 days, or use materials rich in potassium and phosphorus.

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