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## Liquid Organic Fertilizer Production From Kersen Leaves (*Muntingia Calabura L.*) And Eggshells With Addition Of Spoiled Rice Local Microorganism (Mol) Bioactivator

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### Keywords

Kersen leaves; egg shells; spoiled rice local microorganism; liquid organic fertilizer; fermentation

### Abstract

Organic fertilizer are fertilizer that work in increasing the biological, chemical and physical activities of the soil so that the soil becomes fertile and good for plant growth. Kersen leaves and eggshells are materials that can be used as liquid organic fertilizer because they contain various types of ions such as nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg) and calcium (Ca) ions. The production of liquid organic fertilizer is carried out using an anaerobic fermentation process. This study aims to obtain the optimum conditions for the volume of spoiled rice MOL bioactivator (30, 50, and 70 ml) and fermentation time (7, 12, and 18 days) to produce liquid organic fertilizer with the best quality. Parameters observed in the production of liquid organic fertilizer are nitrogen content, phosphorus content, potassium content (NPK), pH and color and scent. The results of the best quality liquid organic fertilizer were obtained in the 50 ml addition of spoiled rice MOL. The optimum fermentation time for nitrogen and potassium content was obtained on the 18th day, 0.01296% N and 0.2947% K<sub>2</sub>O, phosphorus content obtained on the 12th day is 0.8928% P<sub>2</sub>O<sub>5</sub>, with the pH value of 6, dark brown and odorless.

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## ABSTRACT

Organic fertilizer are fertilizer that work in increasing the biological, chemical and physical activities of the soil so that the soil becomes fertile and good for plant growth. Kersen leaves and eggshells are materials that can be used as liquid organic fertilizer because they contain various types of ions such as nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg) and calcium (Ca) ions. The production of liquid organic fertilizer is carried out using an anaerobic fermentation process. This study aims to obtain the optimum conditions for the volume of spoiled rice MOL bioactivator (30, 50, and 70 ml) and fermentation time (7, 12, and 18 days) to produce liquid organic fertilizer with the best quality. Parameters observed in the production of liquid organic fertilizer are nitrogen content, phosphorus content, potassium content (NPK), pH and color and scent. The results of the best quality liquid organic fertilizer were obtained in the 50 ml addition of spoiled rice MOL. The optimum fermentation time for nitrogen and potassium content was obtained on the 18th day, 0.01296% N and 0.2947% K<sub>2</sub>O, phosphorus content obtained on the 12th day is 0.8928% P<sub>2</sub>O<sub>5</sub>, with the pH value of 6, dark brown and odorless.

**Keywords:** *Kersen leaves, egg shells, spoiled rice local microorganism, liquid organic fertilizer, fermentation..*

## 1. INTRODUCTION

Indonesia is an agrarian country in which the agricultural zone performs an important position in the national economy, and lots of people live inside the agricultural sector. Fertilizers play an important role in increasing agricultural manufacturing and most farmers nonetheless rely upon inorganic fertilizers due to the fact inorganic fertilizers include several nutrients in big portions. Inorganic fertilizers used continuously can damage soil conditions, which could purpose the soil to harden quick, be less able to keep water, and quick grow to be acidic which in the end reduces plant productivity [1]. Liquid organic fertilizer is a solution due to the decomposition of organic substances derived from plant residues, animal, and human wastes which incorporate more than one nutrient detail. In preferred, liquid

organic fertilizers do not harm the soil and vegetation even though used as frequently as feasible. further, liquid fertilizer can also be used as an activator to make compost [2].

Indonesia has numerous varieties of vegetation that can be used as alternative raw substances for the production of liquid natural fertilizers. one of the plants that may be used as an alternative raw material for fertilizer production is the Kersen plant (*Muntingia Calabura L.*), the leaves/twigs of the plant include numerous styles of ions such as nitrogen ions (N), phosphorus (P), potassium (K), Magnesium (Mg) and calcium (Ca) so that this plant can be used as fertilizer [3]. in line with Iskak (2014) [4], cherry leaves and fruit can be processed or produced into liquid fertilizer by using extraction and fermentation methods, the quality of liquid fertilizer produced at the time of extraction and

fermentation of 6 weeks with a weight/solvent ratio (three hundred gr/500 ml) indicates the best concentration of ions is 2,04% N, 0,38% P, 23,93% K, and 12,08% Mg.

Besides kersen plants, the manufacture of liquid fertilizer can be combined with eggshell waste. Eggs are one of the foodstuffs that are widely consumed by the community because of how easy it is to process. The use of abundant materials, causes an abundance of eggshell waste to accumulate [5]. Eggshells can be used as fertilizer as a source of nutrients for plants because they have a large enough calcium content. The content of the eggshell consists of 97% calcium carbonate, the rest is phosphorus, magnesium, sodium, potassium, zinc, manganese, iron, and copper [6].

To get good quality fertilizer and faster fermentation time, the addition of organisms, namely micro-degrading organic matter using bioactivators [7]. MOL (Local Microorganisms) spoiled rice is one of the bioactivators with ingredients that are very easy to have. Because in general, spoiled rice is no longer used and will be thrown away. The microorganism contained in MOL rice is *Azotobacter* with benefits as a decomposer [8]. The minimum technical standart for liquid organic fertilizer regulated in PERMENTAN No. 261/KPTS/SR.310/M/4/2019 can be seen in the following table :

**Table 1.** Liquid Organic Fertilizer Quality Standard

Parameter	Unit	Standar
C-organik	%	Min 10
N-organik	%	Min 0,5
pH	-	4-9
Hara Makro		
- N	%	2-6
- P	%	2-6
P <sub>2</sub> O <sub>5</sub>		
- K	%	2-6
K <sub>2</sub> O		
Hara Mikro		
- Fe total	ppm	90-900
- Mn total	ppm	25-500
- Cu total	ppm	25-500
- Zn total	ppm	25-500
- B total	ppm	12-250
- Mo total	ppm	2-10

This study aims to achieve the effect of variations in the volume of the MOL bio activator of stale rice and fermentation time on the NPK content material of liquid organic fertilizer, the optimum conditions for producing liquid organic fertilizer with parameters which include NPK content, pH, colour, and aroma, and to obtain the quality of liquid organic fertilizer that is predicted to be suitable. with quality standards primarily based on PERMENTAN No. 261/KPTS/SR.310/M/4/2019.

## 2. METHOD

### 2.1. Material

The materials used in this study were spoiled rice, kersen leaves, egg shells, water, sugar and molasses.

### 2.2. Procedure

Research procedure this research is consist of two stages, namely 1) Making Local Microorganisms (MOL) Spoiled Rice, 2) Making Liquid Organic Fertilizer Local. Microorganisms (MOL) Spoiled Rice is made by mushrooming 100 g of spoiled rice for 5 days. Spoiled rice that has been moldy is mixed with 50 grams of sugar and 1 litre of water until evenly distributed. The mixture is put into a bottle with a hole in the lid and then a clear tube is inserted for the process of removing gas from the fermenter. Then the mixture is fermented for 7 days The next stage is the manufacture of liquid organic fertilizer. The raw materials used are kersen leaves and egg shells each 300 grams for each fermenter. The raw materials are cleaned and mashed using a blender to a small size. Then prepared MOL solution of spoiled rice with volume variations of 30, 50, and 70 ml. refined material is mixed with a MOL solution of spoiled rice, 50 ml of molasses and 1500 ml of water until evenly distributed. After that, the mixture is put into a conductor which is used as a fermenter. The lid of the fermenter is perforated with scissors and a clear hose is inserted for the gas removal process. The fermentation process takes place with variations in time for 7, 12, and 18 days. After the fermentation process is complete, the liquid organic fertilizer is filtered through a sieve to separate the liquid from the dregs. The samples obtained were analyzed for pH, color, and aroma, and content of N, P, and K. The methods used were UV-Vis spectrophotometer (for N and P) and AAS spectrophotometer (for K).

## 3. RESULT AND DISCUSSION

### 3.1. Characteristics of Liquid Organic Fertilizer

Based on the observations that have been made on the liquid organic fertilizer of kersen leaves and egg shells, the liquid fertilizer produced after the fermentation process causes white spots on the surface of the liquid, and the color and aroma of the liquid organic fertilizer can be seen in Table 2. acid is close to neutral, which is at a pH of 5-6. According to Prahesti and Dwipayanti (2011)[9], the acidic pH close to neutral is formed by the activity of bacteria that convert organic acids into simpler compounds such as methane, ammonia, and carbon dioxide (CO<sub>2</sub>). The pH value will affect microbial activity during the composting

process, the optimum pH for the decomposition of organic matter ranges from 6.5 to 7.5 [10]. Damayanti, et al. (2018) [11] reported that microbes from liquid organic fertilizers with the highest and best growth were at pH 6.5. In this study, the pH value of the liquid organic fertilizer

obtained has met the requirements Minimum Technical PERMENTAN No. 261/KPTS/SR.310/M/4/2019, namely 4-9.

**Table 2.** Characteristic Liquid Organic Fertilizer

Volume MOL (ml)	Fermentation Time (Day)	pH	Colour	Aroma
30	7	5	Dark Chocolate	Smell not pungent
	12	5	Dark Chocolate	Smell not pungent
	18	5	Dark Chocolate	Strong Smells
50	7	6	Dark Brown	Strong smell
	12	6	Dark Brown	Smell not pungent
	18	6	Dark Brown	Smell not pungent
70	7	6	Yellowish brown	Strong Smells
	12	6	Yellowish brown	Smell not pungent
	18	6	Yellowish brown	Smell not pungent
PERMENTAN No 261/KPTS/SR.310/M/4/2019		4-9	-	-

**3.2. Nitrogen, Phosphorus and Potassium Content of Liquid Organic Fertilizer**

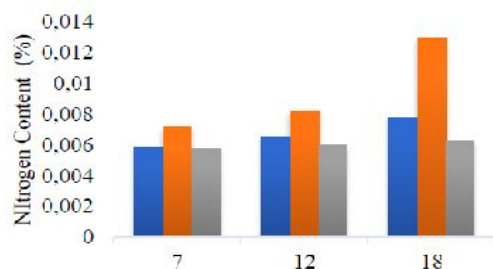
Before the fermentation process is completed inside the production of liquid fertilizers, first an evaluation of the nutrient content material of nitrogen, phosphorus, and potassium contained in raw materials. the following are the results of the evaluation of the nutrient content material of kersen leaves and eggshells.

**Table 3.** Results of Analysis of Nutrient Content in Raw Materials

Materials	N (%)	P <sub>2</sub> O <sub>5</sub> (%)	K <sub>2</sub> O (%)
Kersen Leaves	0,00560	0,1676	0,0414
Egg shells	0,00325	0,0537	0,0213

**3.2.1. Nitrogen Content**

Nitrogen is the primary nutrient for plant growth because nitrogen is needed for the formation or growth of vegetative elements of plants including plant peak and quantity of leaves



**Figure 1.** Effect of fermentation Time to Nitrogen Content

The graph in figure 1 indicates that the effect of fermentation time at the nitrogen content in liquid organic fertilizer in each variant of the addition of MOL increased with the longer fermentation time. in line with Sundari et al. (2012) [12], the growth in nitrogen content is thought to be due to the breakdown of natural count number by means of nitrifying microorganism which converts ammonia to nitrate at the cease of the fermentation process. similarly, microorganisms additionally contribute several single-cell proteins obtained throughout the fermentation process, after of entirety of the decomposition process, nitrogen will be released once more as one of the components contained in fertilizers.

The effect of adding MOL of spoiled rice showed an increase in nitrogen content with the maximum condition of adding 50 ml of MOL. Meanwhile, with the addition of 70 ml MOL, the nitrogen content produced was lower than the others. This is due to the fact that the number of microorganisms is not proportional to the amount of available nutrients (the volume of molasses is

50 ml), so that the microorganisms experience nutritional deficiencies in the fermentation process or the decomposition process takes place less than perfect. The highest nitrogen content was obtained in the 50 ml MOL addition treatment with a fermentation time of 18 days, which was 0.01296%. While the lowest nitrogen content was obtained by adding 70 ml MOL with a fermentation time of 7 days, which was 0.00578%.

### 3.2.2. Potassium Content

Potassium in plants is to improve the quality of plant seeds to become fuller and denser, besides that potassium element also improves fruit quality.

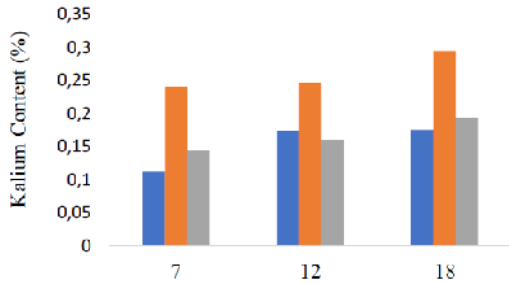


Figure 2. Effect of fermentation Time to Potassium Content

Based on the results of the analysis of the potassium content (as K<sub>2</sub>O) shown in Figure 2, the K<sub>2</sub>O content in the resulting liquid organic fertilizer tends to remain the same or experience a slight increase in the length of fermentation time. According to Amanillah (2011)[13], microbes produce potassium compounds and use K<sup>+</sup> ions contained in fertilizer raw materials for the benefit of their metabolism so that potassium levels will increase along with the growing number of microbes.

The effect of adding MOL of stale rice to the K<sub>2</sub>O content shows the same thing as the nitrogen and phosphorus content, where the more MOL is added, the K<sub>2</sub>O content increases to a maximum MOL condition of 50 ml. Then at the addition of 70 ml MOL, the resulting K<sub>2</sub>O content was lower than the others due to the unbalanced composition of the number of nutrients and microorganisms. The highest K<sub>2</sub>O content was found in the 50 ml MOL addition treatment with a fermentation time of 18 days, which was 0.2947%. The lowest K<sub>2</sub>O content produced in the addition of 30 ml MOL treatment with a fermentation time of 7 days was 0.1102%.

### 3.2.3. Phosphorus Content

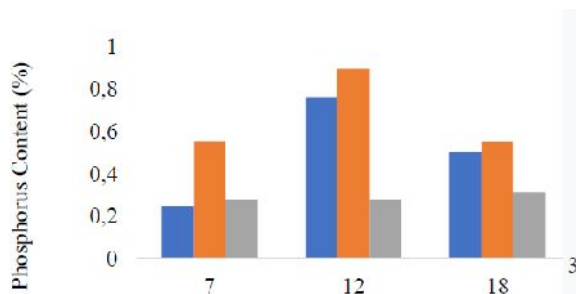


Figure 3. Effect of fermentation Time to Phosphorus Content

The phosphorus content (as P<sub>2</sub>O<sub>5</sub>) of liquid organic fertilizer can be seen in figure 3 which indicates

that the addition of 30 ml and 50 ml MOL treatment increased P<sub>2</sub>O<sub>5</sub> content from day 7 to 12. This is due to the growth factors of microorganisms which initially entered the adaptation phase in the fermentation process, where microorganisms will undergo adjustments and the cell mass can change without changing the number of cells. Then the growth of microorganisms will move to an exponential phase where the microorganisms develop optimally on the number of cells so that the maximum phosphorus content is produced, namely at the time of fermentation for 12 days. However, on the 18th day the P<sub>2</sub>O<sub>5</sub> content in liquid fertilizer decreased, this was due to microorganisms entering a stationary phase, in this phase the number of cell populations remained because the number of cells that grew was equal to the number of cells that died because the available nutrients had decreased [14].

In the treatment with the addition of 70 ml of MOL, the P<sub>2</sub>O<sub>5</sub> content increased slightly with the length of fermentation time. However, the P<sub>2</sub>O<sub>5</sub> content obtained was lower than the addition of other MOL, this was due to the fact that the amount of nutrients (the volume of molasses) was less than the volume of MOL added, so that microorganisms would absorb phosphorus in the substrate for metabolic needs during the fermentation process [14]. The highest P<sub>2</sub>O<sub>5</sub> content was found in the treatment with the addition of 50 ml MOL with a fermentation time of 12 days, which was 0.8928% and the lowest was in the treatment with the addition of 30 ml MOL with a fermentation time of 7 days, namely 0.2489%.

## 4. CONCLUSION

Based on the results of the studies that has been executed, it could be concluded that:

1. Production of liquid organic fertilizer of kersen leaves and egg shells with variations in the volume of MOL bioactivator of spoiled rice and fermentation time has an effect on increasing the NPK content.
2. The optimum conditions for the manufacture of liquid organic fertilizer of cherry leaves and egg shells to obtain the best nitrogen, phosphorus and potassium (NPK) content were obtained from the addition of 50 ml MOL of stale rice. The optimum fermentation time to obtain the best nitrogen and potassium content is 18 days, to obtain the best phosphorus content is 12 days. The NPK content obtained was 0.01296% N and 0.2947% K<sub>2</sub>O and 0.8928% P<sub>2</sub>O<sub>5</sub>. Liquid organic fertilizer obtained at optimum conditions has a pH value of 6, is dark brown in color and has no pungent odor.
3. Based on the Minimum Technical Requirements of PERMENTAN No. 261/KPTS/SR.310/M/4/2019,

the pH value of the liquid organic fertilizer of cherry leaves and egg shells produced has met the standard of 4-9. However, the resulting NPK content does not meet the minimum standard of liquid organic fertilizer, which is 2-6%. Liquid Organic Fertilizer Quality Standard.

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