EVALUATION OF QUALITY OF LIQUID ORGANIC FERTILIZER FROM RABBIT'S URINE WASTE FERMENTED USING LOCAL MICROORGANISMS AS DECOMPOSERS

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ABSTRACT

Rabbit's urine waste (RUW) is one of the by-products of rabbit metabolism that not utilized. The complex nutrient content of rabbit's urine is an enormous potential as a basic ingredient of liquid organic fertilizer (LOF). In the production process of LOF, the fermentation process becomes very important. In the fermentation process, the role of decomposer is very important. The use of commercial decomposers (CD) containing selected microorganisms is difficult to implement in rural areas, as they are expensive and difficult to obtain. Therefore, it is very important to find alternative sources of decomposers derived from nature. This study aims to evaluate the quality of LOF made from RUW using local microorganism (LM) as a decomposer. A total of 3 types of decomposers are applied, namely: 1) feces extract (FE); 2) banana root extract (RBE) and 3) commercial decomposer (CD) as a control. The fermentation process was done for 4 weeks. As many as 3 types of aeration process time (APT) were applied, namely: 1) 0 h; 2) 48 h and 96 h. The results showed that the differences of APT resulted in pH values; C-Organic levels and C/N ratio of LOF from LUK were different, whereas N-organic and P_20_5 levels were relatively constant. Different types of decomposers applied in the fermentation process yield different levels of K_2O, but the pH value, C-Organic content, C/N ratio and P_20_5 were relatively constant. Performance of CD in LOF fermentation process was no different from FE and RBE performance. Application of both types of decomposers (FE and RBE)was equally potential to replace CD as a decomposer in the production process of LOF. Implementation of APT for 48 h was the best time process than others.

Key words: fermentation, local microorganism, organic fertilizer, rabbit's urine

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تقييم جودة الأسمدة العضوية السائلة من نفايات الأرانب المخمرة باستخدام ميكروبات محلية كالمحللات

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قسم علوم المحاصيل، كلية الزراعة، جامعة بوترا ماليزيا، سيلانجور، ماليزيا

المستخلص

نفايات الأرانب في البول هي واحدة من المنتجات الثانوية لعملية استقلاب الأرانب التي لم يتم استخدامها. المحتوى المغذي المعقد في بول الأرانب هو إمكانات هائلة كمكون أساسي للأسمدة العضوية السائلة. في عملية الإنتاج من الاسمدة العضوية السائلة، تصبح عملية التخمير مهمة جدا. في عملية التخمير، فإن دور المُحلل مهم جداً. يصعب تنفيذ استخدام المحللات التجارية التي تحتوي على كائنات دقيقة مختارة في المناطق الريفية، لأنها مكلفة ويصعب الحصول عليها. لذلك، من المهم جداً إيجاد مصادر بديلة للمحللات المشتقة من الطبيعة. تهدف هذه الدراسة إلى تقييم جودة الاسمدة العضوية السائلة المصنوع من نفايات الأرانب في البول باستخدام الكائنات الحية الدقيقة المحلية كمحلل. يتم تطبيق ما مجموعه 3 أنواع من المحللات، وهي: 1) مستخلص البراز؛ 2) مستخلص جذور الموز و 3) محلل تجاري كعنصر تحكم. تم إجراء عملية التخمير لمدة 4 أسابيع. تم تطبيق ما يصل إلى 3 أنواع من وقت معالجة التهوية، وهي: 1) 0 ساعة؛ 2) 48 ساعة و96 ساعة. أظهرت النتائج أن فروق الـ وقت معالجة التهوية نتج عنها قيم درجة الحموضة ، مستويات الكربون العضوي ونسبة الكربون للنيتروجين من عملية التخمر من LUK كانت مختلفة، في حين كانت مستويات النيتروجين العضوي و P205 ثابتة نسبياً. تنتج أنواع مختلفة من المُحلِّلات المستخدمة في عملية التخمير مستويات مختلفة من K2O، لكن قيمة درجة الحموضة، ومحتوى الكربون العضوي، ونسبة النيتروجين للكربون و P205 كانت ثابتة نسبيًا. أداء المحلل التجاري في عملية التخمير للأسمدة العضوية السائلة لا يختلف عن أداء مستخلص البراز ومستخلص جذور الموز. كان تطبيق كلا النوعين من المحللات (مستخلص البراز ومستخلص جذور الموز) على نفس القدر من القدرة على استبدال القرص المضغوط كحلل في عملية إنتاج الأسمدة العضوية السائلة. كان تنفيذ وقت معالجة التهوية لمدة 48 ساعة أفضل عملية زمنية من غيرها.

الكلمات المفتاحية: المتحلّل، التخمير، الكائنات الحية الدقيقة المحلية، السماد العضوي، بول الأرانب

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INTRODUCTION

The use of chemical fertilizers has become increasingly uncontrolled. This is certainly very dangerous to human health and the environment. Chemical fertilizers has been widely applied to increase agricultural production globally since the beginning of the green revolution (52)(30)(37). One characteristic of the high intensity of an agricultural ecosystem is the excessive use of chemical fertilizers, pesticides, and herbicides (18). In addition, some of them also have been using hormones (10**)** and microorganism (bacteria) (38) and fungi (54). The use of chemical fertilizers can directly improve yield (47). This is because the plants directly or indirectly will assimilate the nutrients provided by the inorganic fertilizer (3). However, on the other hand, the use of these chemicals has provided many negative effects on agricultural ecosystems (27). In general, the application of organic farming system will produce root system and improve the productivity of plant stems compared to agricultural systems that use chemical compounds (8)(14). The presence of mineral elements in fertilizers has played an important role in the success of agricultural production systems. Exponential growth in the human population continues to increase demand for biofuels and leads to ever-increasing demand for fertilizer. Despite the success of the current agricultural production system, excessive use of fertilizer has caused severe environmental problems and an increasing number of health problems (36)(1)(41). These effects are in the form of soil degradation, loss of plant genetic diversity, reduction of soil microbial diversity, groundwater source contamination and increased pollution (26)(11). Along with the development of livestock business, the livestock waste also become one of the pollutant factors. There are many organic ingredients contained in untreated livestock waste. The use of livestock waste as a raw material for fertilizer seems to be an alternative to increase the added value of the waste. Soil microorganisms play an important role in ecological functions such as nutrient cycles and the formation of soil aggregates through the decomposition of organic matter (49). Conditions of microbial ecosystems have an important role in soil stability. Microbes will affect the levels of de-nitrification, nitrification and nitrogen fixation processes (21)(39). Organic concept change with an-organic has a significant effect on soil microorganisms ecosystem condition (22). Changes in microbial activity and composition may affect plant growth. This occurs because of increased nutrient turnover and suppresses disease (58). Soil microbial biomass, activity and community structure are useful indicators of soil quality and health. This parameter is important in the change of agricultural land management practices (9). Therefore, adaptation processes, soil microbial structures are important for sustainable agricultural production processes (55). The soil in the organic farming regime has a more functional microbial diversity higher than conventional farming systems (33). The level of diversity of bacterial microorganisms is always higher in fertilizers than in processed farmlands regardless of land use patterns or seasons (19). Fertilizer can increase soil microbial activity and improve plant growth and prevent the development of pests and diseases. Compared with chemical fertilizers, livestock manure has been tested comprehensively and is determined as effectively in increasing the availability of nutrients in food crops, thereby increasing the yield of agriculture more efficiently and environmentally friendly (5)(31)(56)(53). The addition of livestock waste can increase the levels of organic matter and improve soil porosity, structural stability, moisture, and nutrient availability as well as biological activity. In the production process of liquid organic fertilizer (LOF), the role of decomposer is a . Decomposers involve the activity of microorganisms. The use of commercial decomposers should be considered, as they are expensive and difficult to obtain, especially farmers in rural areas. Therefore, it is necessary to develop a natural decomposer by utilizing local microorganism (LM). The LM is a number of microorganisms that develop on a particular substrate. The LM is a natural microorganism that grows and develops naturally in the environment and grown on a particular substrate. Source of LM can be derived from extracts of animal origin or a extracts from vegetable origin. The LM will then be applied in the fermentation process of LOF from Rabbit's urine waste (RUW) as a decomposer. The objective of this study was to evaluate the quality of LOF based on RUW utilizing LM as a decomposer.

MATERIALS AND METHODS

Materials

This study used the main ingredients of RUW local type. The RUW obtained from the rabbit local farm, in Sub-District Lalabata, Soppeng District, South Sulawesi Province, Indonesia. Decomposer type using feces extract (FE) from Bali cattle, and banana root extract (RBE) obtained from Makassar city, South Sulawesi Province. Commercial decomposer (CD) obtained from Songgo Langit Persada Ltd.Co. FE decomposer is a type of decomposer that uses local microorganisms from animal origin, while RBE uses a local vegetable substrate of vegetable origin. Other additional ingredients needed to produce liquid fertilizers are dolomite (lime farming) and brown sugar as the energy source of microorganism. The research equipment uses aerator (capacity 3L/min), fermentation container, hose, bottle, measuring cup (Pyrex), thermometer and pH meter (Hanna).

Methods

Production process of FE decomposer

A total of 1 kg of wet feces from Bali cattle mixed with 1 kg of brown sugar (ratio 1: 1). The mixture was supplemented with 500 mL of aquadest and then homogenized by using the mixer at 100 rpm for 10 min. The FE was subsequently fed into an anaerobic and natural fermented in the plastic container for 14 days

Production process of RBE decomposer

As much as 1 kg of root from local bananas, aged 2-3 years milled using a grinder to form a slurry. Furthermore, it is added to 100 g of brown sugar and 2 L of waste from rice washing process. The mixture was homogenized and subsequently inserted into a sealed plastic container. The fermentation process carried out on the an-anaerobic basis for 14 days

Production process of LOF from RUW

The production process of LOF from RUW by applying different decomposer was done based on the formula design in Table 1

Table 1. Design of materials composition of LOF from RUW that using different types of decomposers and APT (43)

Material Composition	Decomposer Type								
	FE-T_0	FE-T_{48}	FE-T_{96}	RBE-T_0	RBE-T_{48}	RBE-T_{96}	CD-T_0	CD-T_{48}	CD-T_{96}
Urine from Bali Cattle (L))**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Dolomite/Lime Farming (%) (w/v) *)	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**
Brown Sugar (%) (w/v) *)	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**	**0.45**
FE (%) *)	**4.5**	**4.5**	**4.5**	-	-	-	-	-	-
RBE (%) *)	-	-	-	**4.5**	**4.5**	**4.5**	-	-	-
CD (%) *)	-	-	-	-	-	-	**4.5**	**4.5**	**4.5**

Note: FE=feces extract; RBE= root banana extract; CD=commercial decomposer ; aeration process time (APT) (T_0=0 h; T_{48}=48 h; T_{96}=96 h); *) percentage of ingredients calculated based on the amount of fermented urine(**)). The mixing of materials for the production process of LOF was made based on the design of the formula in Table 1. Each of the decomposer/material mixtures was stirred to homogeneous and fed into the fermentation tube. The fermentation process was carried out on all tubes for 4 weeks at an-anaerobic room temperature. The APT was carried out according to each treatment

Measurement and determination

Analysis of pH (4). A total of 100 mL of LOF sample was put into a 100 mL shake bottle and 50 mL of ionized water was added. Bottle in shake using a shaker machine for 30 min. pH meter calibrated using buffer pH 7.0 and pH 4.0. The LOF suspension was then measured with pH meters

C-organic content (4). A total of 50 mL of LOF sample was put into a 100 mL measuring flask and then added with 5 mL of 2N-$K_2Cr_2O_7$. To the flask was added 7 mL of 98% H_2SO_4 (p.a), shaken, then let stand for 30 min. The standard solution of 250 ppm C was then prepared. A total of 5 mL of 5000 ppm standard solution was introduced into a flask

100 mL, furthermore, 5 mL of H_2SO_4 + 7 mL of 2N-$K_2Cr_2O_7$ solution as in a preceding manner was added. Blank was used as standard 0 ppm C. Each was diluted with aqua dest. After a cold, 100 mL was shaken back and forth until homogeneous and then stored for 1 night. Further, measured by a spectrophotometer at a wavelength of 651 ηm. The formula used is C-organic (%) = ppm curve x 100/mg sample x Cf, where ppm curve = standard regression curve; Cf = correction factor of water content = 100/(100-% of water content).

N-organic (4). A total of 5 mL of LOF was put into Kjeldahl's flask. Samples were added 0.25-0.50 g selenium mixture + 3 mL H_2SO_4 (p.a) into the flask. The solution was shaken until homogeneous and left for 2-3 h. The solution was washed for 3-3.5 h on a hot plate with 150-350 ^oC gradually until a clear solution was obtained. The solution was then cooled and diluted to prevent crystallization. The solution was transferred quantitatively into a 250 mL of boiler distillation. Then, aquadest was added to half the volume of the boiling flask and a little boiling stone. The prepared distillate container was 10 mL of 1%-boric acid in a 100 ml volume Erlenmeyer spiked with, drops of Conway indicator. Distilled by adding 20 ml of 40% NaOH. The distillation was complete when the volume of fluid in the Erlenmeyer has reached about 75 ml. Distillate was titrated with 0.05N-H_2SO_4, until the end point (the color of the solution changes from green to pink) (A) (mL), the determination of the blank was done (B) (mL). Formula used, N-organic = B (mL) – A (mL) x N x NEW/sample weight (mg) x 100, where, NEW = nitrogen equivalent weight

C/N Ratios (4). The C/N ratio value was calculated by comparing the value of C-organic with N-organic. Formula used, Ratio C/N = C-organic value/N-organic value

P_2O_5 content (4). A total of 100 mL of LOF sample was inserted into a beker glass then heated. The precipitate was then filtered and washed with 3 x 10 mL of hot aquadest. The filtrate was accommodated and supplemented with 10 mL of 2M-NH_4Cl and 10 mL of magnesia mixture. The cloudy solution was added 1:1 of HCl until dissolved. Further, added with the PP indicator and precipitated with NH_4OH (1:10) was excessive. The precipitate was cooled in ice and then filtered and washed with NH_4OH (1:20) to chloride free. The precipitate was then dried, incandescent and weighed until the weight was fixed. The result was then determined by the formula, P_2O_5 (%) = Cf x Aw/Sw x 100%, where Cf = Correction factor = Mr of P_2O_5/ Mr of MgP_2O_5; Aw = ash weight; Sw = sample weight; Mr = molecular relative

K_2O content (4). Determination of K_2O content using a flame photometer (Jenwey) tool with the P05-020A protocol (Bibby Scientific). A total of 2.5 mL of the LOF was inserted into 400 mL glass and added 125 mL of aquades and added with 50 mL of ammonium oxalate solution. The solution was heated for 30 minutes. The solution was then cooled and add a small amount of ammonium hydroxide solution. The solution was put into a 250 mL flask and diluted to a line mark. The solution was filtered by Whatman filter No. 30 into a 250 mL drying glass. A total of 25 mL of the solution was piped and put into a 500 mL pitcher and diluted with aquadest until the line marks. The solution was shaken until homogeneous. The solution was transferred to a 100 mL powder flask until it contains approximately K_2O content of 16 ppm. The solution was diluted with aquades up to 100 mL and then stirred until homogeneous. Standard solutions were prepared with series containing 10, 12, 14, 15, 16, 17, 18 and 20 ppm K_2O. K_2O content was determined by using flame photometer. The formula used, K_2O (%) = A x 20/B, where A = ppm K_2O in the sample solution; B = volume of titration (mL)

Data analysis

The data obtained were analyzed by means of a Completely Randomized Design (CRD) of factorial pattern with the aid of SPSS (one-way ANOVA) statistical program. The treatment showed a significant effect, then tested the real difference with Duncan'S Multiple Range Test (DMRT) at 5% level (50).

RESULTS AND DISCUSSION

pH value

The results of pH testing of LOF from RUW that produced by different APT and decomposer type were presented (Fig.1). The treatment differences were tested using Duncan's test. The results showed that the difference of APT significantly affects the pH value of LOF. The use of FE, RBE and CD (control) as decomposers was not significantly different (P>0.05) in APT. The performance of FE and RBE as decomposers was relatively similar to CD performance so that decomposers which were the source of local microorganisms can be applied in the liquid fertilizer production process. Based on the standard of regulation of the minister of agriculture, the Republic of Indonesia, that pH standard for liquid fertilizer was 4-9, so the quality associated with the pH value can be said to have fulfilled. The pH value of liquid fertilizer made from rabbit urine produced close to the pH value of dairy cow urine used by (48) in the research was 7.8. The value of pH of LOF from RUW produced was also higher than liquid fertilizer by (42), was 5.45-5.64 that using 3 types of bio-activator (EM_4, boisca and shrimp paste). Microbes will work on neutral pH to acidic conditions (pH 5.5-8). In the early stages of the decomposition process will form organic compounds. This condition will encourage the growth of bacteria and fungi. During the fermentation process, the organic acids will become neutral with a pH of 6-8. After the hydrolysis process, urine will have an optimal pH (8.5-10) (57).

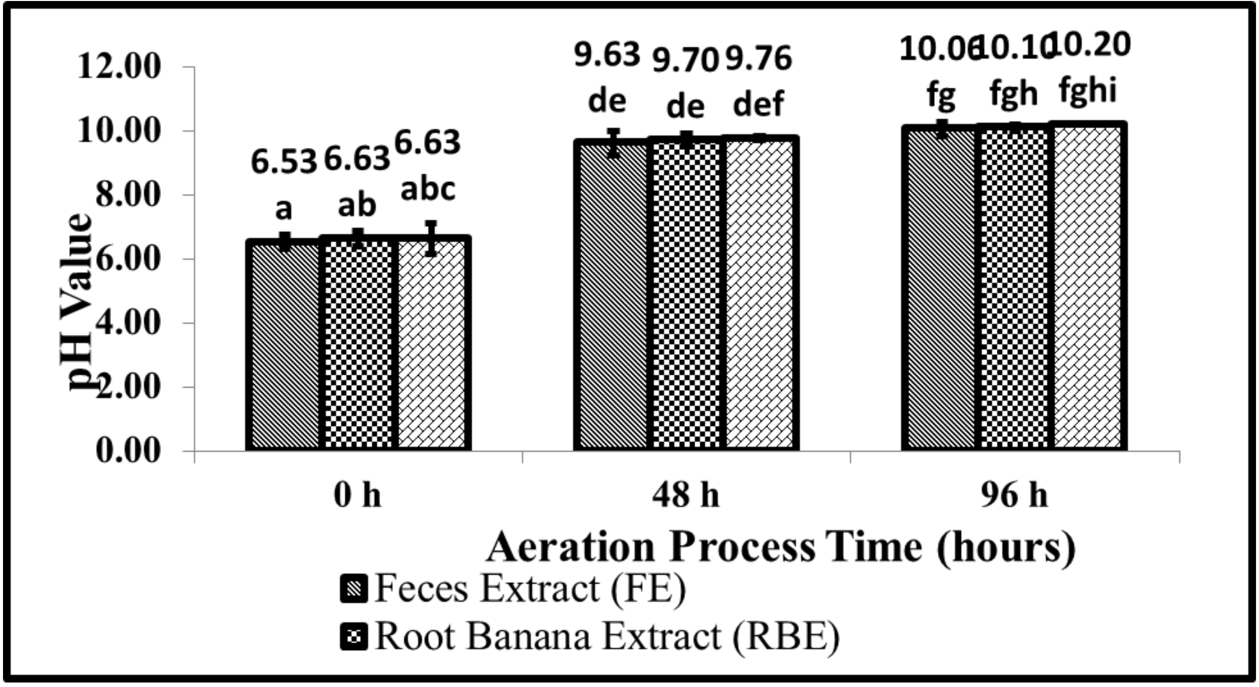

Fig 1. pH value of LOF from RUW produced using different APT and types of decomposer; $^{a-i}$Different superscripts showed significant differences (P<0.05); FE-T_0 (6.53±0.21) ; FE-T_{48} (9.63±0.38) ; FE-T_{96} (10.06±0.23) ; RBE-T_0 (6.63±0.25) ; RBE-T_{48} (9.70±0.20) ; RBE-T_{96} (10.10±0.10) ; CD-T_0 (6.63±0.49) ; CD-T_{48} (9.76±0.06) ; CD-T_{96} (10.20±0.00) ; Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h;; Comparative test using Duncan's multiple range test (DMRT).

C-organic content

Comparison of the C-organic content of LOF from RUW was presented (Fig.2). The result of the statistical analysis showed that the difference of APT significantly (P<0.05) differs on the level of C-organic of LOF from RUW. The different use of decomposer had no significant effect (P>0.05) at the level of C-organic (Fig. 2). The use of LM sources from FE and RBE performance didn't different from CD performance. This shows that FE and RBE had the same ability in fermenting LOF. The FE and RBE were potentially used as decomposers to replace CD. The content of C-organic of LOF produced was higher than the result of LOF research by (35), i.e 0.67-0.86. This fertilizer used 3 types of bio-activators (EM_4, boisca and shrimp paste) in the fermentation process. C-organic is one indicator to determine the quality of a fertilizer (44). The results of (15) showed that the application of fertilizer from livestock can increase the level of C-organic to the soil by up to 18%, especially on the surface layer. However, implementation errors, timing, and methods can lead to nutrient losses (nitrate leaching, and ammonia volatilization), increased soil salinity and pathogen migration and weeds. Level C-Organic urine produced higher than the results of research by (45) that was 0.62 in rabbit urine and 0.74 in cow urine. C-organic content is a very important factor in organic fertilizer. C-organic content is what distinguishes with an-organic fertilizer. Organic fertilizer was aimed more at the content of C-organic or organic matter than its content. The value of C-organic that is the differentiator with inorganic fertilizer. If the value of C-organic is low and not included in the provision of organic fertilizer then classified as an organic soil enhancer. Soil or soil enhancer ameliorant according to the provisions of the Indonesian Minister of Agriculture Regulation is synthetic or natural, organic or mineral materials. Organic matter acts as a "binder" of primary granules into secondary soil grains in the formation of a solid aggregate. This situation has great influence on porosity, storage and water supply, soil aeration, and soil temperature. Organic materials with high C/N such as straw or husk have a greater effect on improving soil physical properties than with decomposed organic materials such as compost. Organic fertilizers/organic materials have important chemical functions such as (1) provision of macro-nutrients (N, P, K, Ca, Mg, and S) and such as Zn, Cu, Mo, Co, B, Mn, and Fe, although the amount is relative. The use of organic materials can prevent the loss of micro-elements on marginal soil or land that has fewer with less balanced fertilization; (2) increase of land cation exchange (LCE); and (3) form anion capacity complex compounds with metal ions poisoning plants like Al, Fe, and Mn. Increased C-organic by the application of inorganic nutrients leads to increased production of roots and higher air biomass to improve better plant productivity (24)(2).

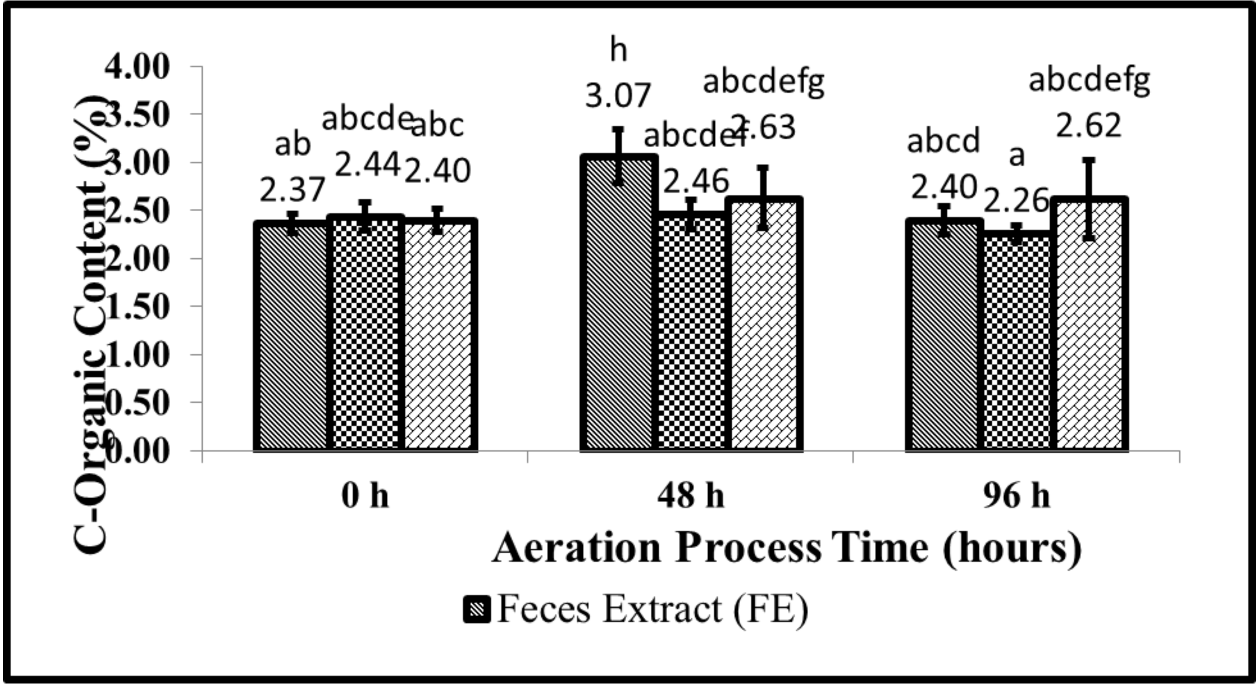

Fig 2. C-organik content of LOF from RUW produced using different APT and types of decomposer; $^{a-h}$ Different superscripts showed significant differences ($P<0.05$); FE-T_0 (2.37%±0.10) ; FE- T_{48} (3.07%±0.28) ; FE-T_{96} (2.40%±0.15) ; RBE-T_0 (2.44%±0.15) ; RBE-T_{48} (2.46%±0.15) ; RBE-T_{96} (2.26%±0.09) ; CD-T_0 (2.40%±0.12) ; CD-T_{48} (2.63%±0.31) ; CD-T_{96} (0.62%±0.41); Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h; Comparative test using Duncan's multiple range test (DMRT).

N-organic content: The result of the test of the N-organic content of LOF from RUW was presented (Fig.3). The result of the statistical analysis showed that the difference of LM source as decomposer and APT had a significant effect (P<0.05) on N-organic content (Fig.3). At the RBE, increase in fermentation time significantly increased the N-organic content of LOF. This is because with increasing APT, the activity of decomposer microorganism will increase to do fermentation activity. This results increased levels of N-organic in the liquid fertilizer.

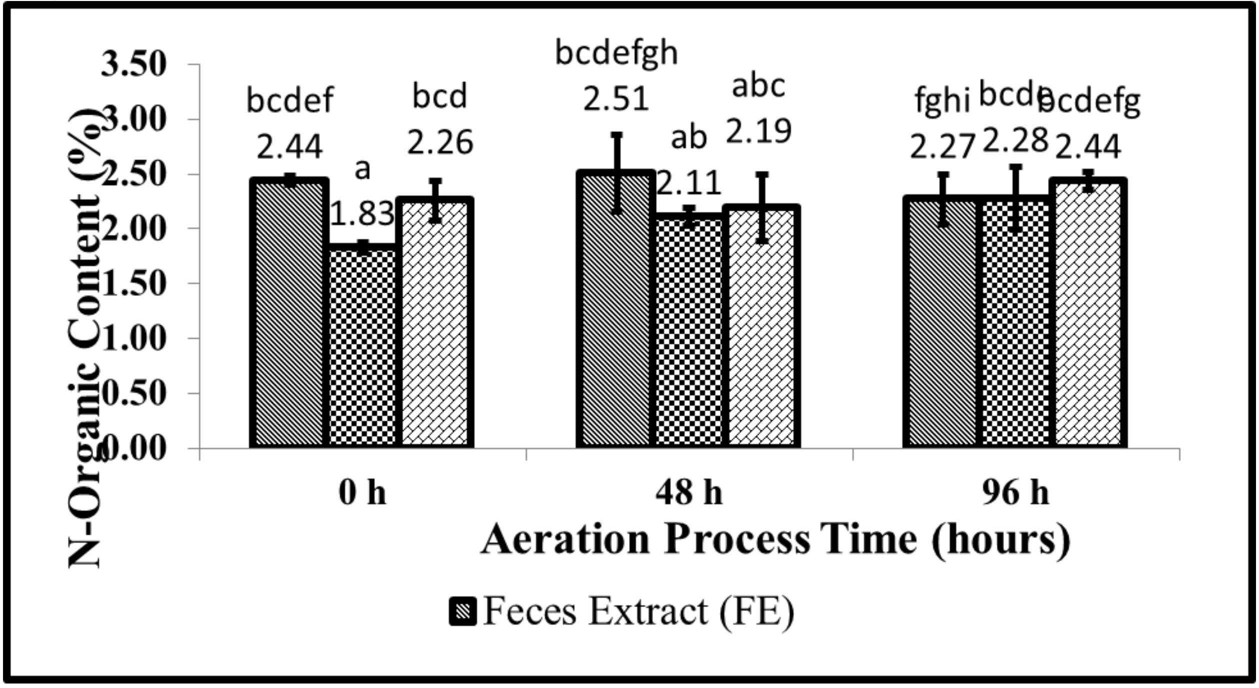

Fig 3. N-organik content of LOF from RUW produced using different APT and types of decomposer; $^{a\text{-}i}$Different superscripts showed significant differences (P<0.05); FE-T_0 (2.44%±0.04) ; FE-T_{48} (2.51%±0.35) ; FE-T_{96} (2.27%±0.23) ; RBE-T_0 (1.83%±0.05) ; RBE-T_{48} (2.11%±0.08) ; RBE-T_{96} (2.28%±0.29) ; CD-T_0 (2.26%±0.18) ; CD-T_{48} (2.19%±0.30) ; CD-T_{96} (2.44%±0.08); Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h; Comparative test using Duncan's multiple range test (DMRT).

Based on these data it was show that the role of aerobic bacteria in the fermentation process is very large. Based on the data in Fig.3 it can be seen that the N-organic content of the LOF using FE as decomposer was caused because, FE was derived from the feces of Bali cattle. Bali cattle's feces had high N levels as a result of the bacterial fermentation process that takes place in cattle rumen. In pastureland areas, cattle urine is one of the nitrogen sources in both NO_3^- and N_2O emissions (46). Nitrogen element was required for plant growth in a pasture. Excess N levels can affect plant growth. Thus, N element is a limiting factor in an intensely managed grazing field (28). During the grazing process, livestock will contribute N derived from urine waste (13). This urine waste will certainly contribute NO_3^- which greatly affects the diarrheal N composition (29). N requirements in a cattle grazing area need to be controlled to avoid damaging the ecosystem. One strategy to reduce the use of N on a pasture is to reduce the use of fertilizer applied to high N already derived soil from urine liquid fertilizer (16) (35). The deposition of urine to the soil can produce nitrous oxide emissions through the process of nitrification and microbial denitrification (7).

C/N ratio

The value of C/N ratio in LOF from RUW produced by decomposer type and different APT was presented (Fig.4). The result of the statistical analysis showed that the APT differs significantly (P<0.05) in C/N value ratio, whereas the difference of decomposer type was not significantly different (P>0.05) (Fig.4). C/N ratio is the ratio of the mass of carbon to the mass of nitrogen on a substance.

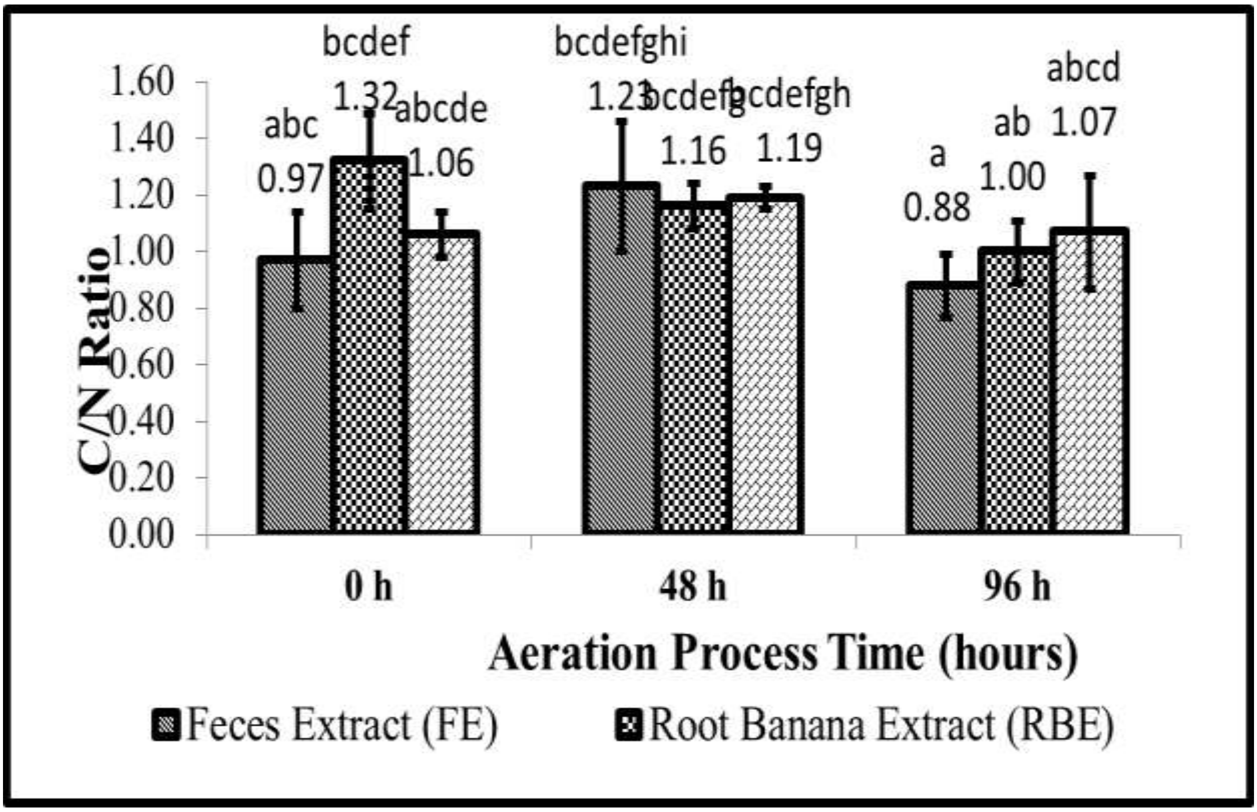

Fig 4. C/N ratio value of LOF from RUW produced using different APT and types of decomposer; $^{a-i}$ Different superscripts showed significant differences ($P<0.05$); FE-T_0 (0.97±0.17) ; FE-T_{48} (1.23±0.23) ; FE-T_{96} (0.88±0.11) ; RBE- T_0 (1.32±0.17) ; RBE-T_{48} (1.16±0.08) ; RBE-T_{96} (1.00±0.11) ; CD-T_0 (1.06±0.08) ; CD-T_{48} (1.19±0.04) ; CD-T_{96} (1.07±0.20); Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h; Comparative test using Duncan's multiple range test (DMRT).

The C/N ratio was used to study the presence of plants somewhere because nitrogen was absorbed by plants and microorganisms. Dead plants and microorganisms will leave behind carbon sediments. The magnitude of the difference between nitrogen and carbon will also distinguish the type of ecosystem that once was above (23). A higher C/N ratio will cause the rate of fermentation in liquid fertilizers to decrease (40). Liquid fertilizer that has a higher C/N ratio can cause the concentration of nitrogen in the soil is reduced because the activity of soil organisms tend to spend nitrogen for its growth. Organic compounds can directly affect groundwater conditions as well as the availability of N (32). The ability of soil in high root penetration causes the water binding capacity of the soil to be not optimal (51).

P_2O_5 content

Comparison of the P_2O_5 content of LOF from RUW at different APT and decomposer type was presented. The result of the statistical analysis showed that the difference between APT and type of decomposer did not affect the P_2O_5 level of LOF from RUW ($P>0.05$) (Fig. 5).

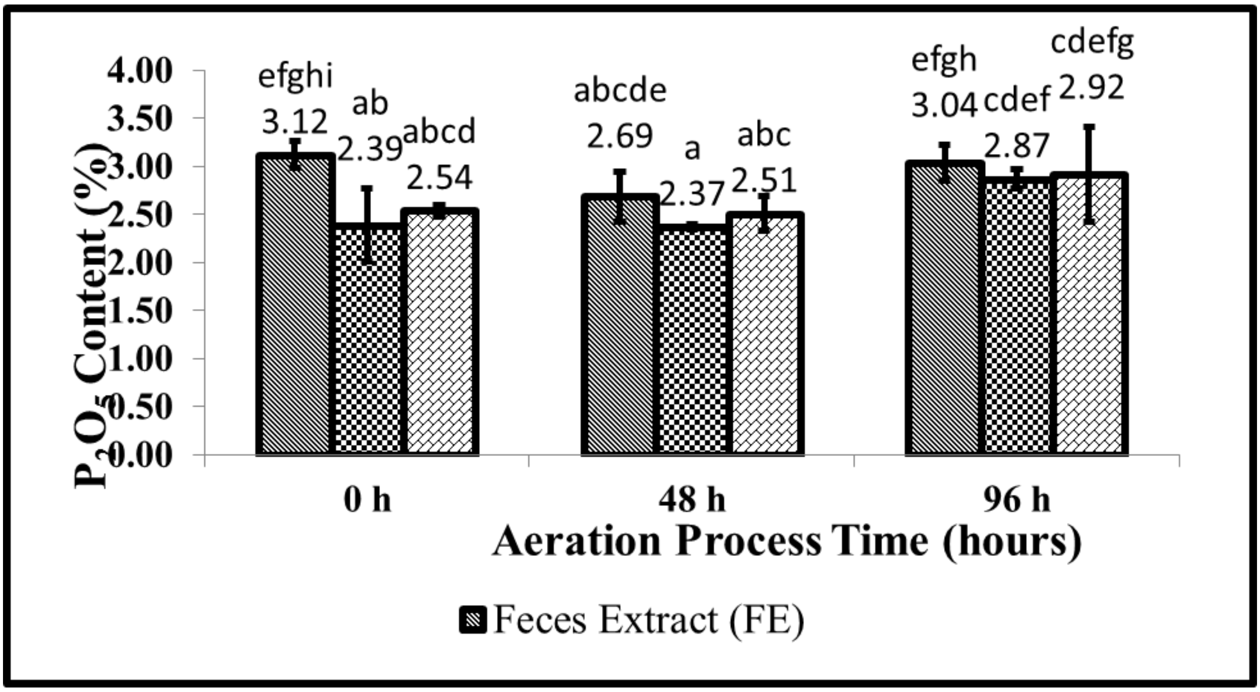

Fig 5. P_2O_5 content of LOF from RUW produced using different APT and types of decomposer; $^{a\text{-}i}$ Different superscripts showed significant differences ($P<0.05$); FE-T_0 (3.12%±0.14) ; FE-T_{48} (2.69%±0.26) ; FE-T_{96} (3.04%±0.19) ; RBE-T_0 (2.39%±0.38) ; RBE-T_{48} (2.37%±0.03) ; RBE- T_{96} (2.87%±0.10) ; CD-T_0 (2.54%±0.06) ; CD-T_{48} (2.51%±0.18) ; CD-T_{96} (2,92%±0,49); Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h; Comparative test using Duncan's multiple range test (DMRT).

Phosphates are a major source of potassium and nitrogen elements that are insoluble in water but can be treated to obtain phosphate products by adding acids. Commercially the phosphate compounds are marketed with various P_2O_5 content, i.e. 4-42%. Meanwhile, the phosphate fertilizer test rate was determined by the amount of N (nitrogen), P (phosphate or P_2O_5), and K (liquid potassium or K_2O). Phosphate as a natural fertilizer is not suitable for food crops, because it is not soluble in water so it is difficult to be absorbed by the roots of food crops. Phosphate for food crop fertilizer needs to be processed into artificial fertilizer. Phosphorus elements can not be substituted from other resources so that the search for new resource resources is needed (6). Phosphorus elements should be sought to be moved from excess resources to less resources (17). Phosphorus is one of the most important element for living things. Phosphorus elements in addition to having benefits, also have a weakness when the amount is excessive. Excess phosphorus element in water will cause eutrophication so that phosphorus element is considered as a pollutant (12). Phosphorus is present in nature in two forms: organic phosphate compounds and inorganic phosphate compounds. Organic phosphate compounds are present in plants and animals, whereas inorganic phosphate compounds are present in water and soil where this phosphate dissolves the groundwater and seawater that are eroded and settled in the sediments. Phosphorus is also a limiting factor. Comparison of phosphorus with other elements in the aquatic ecosystem is smaller than in the body of living organisms. Phosphates are present in natural or waste water as orthophosphoric compounds, polyphosphates, and organic phosphates. Each phosphate compound is present in the form of dissolved, suspended or bonded within the cells of aquatic organisms. The presence of phosphate compounds in water greatly affects the balance of aquatic ecosystems. When the water phosphate levels are low (<0.01 mg P/L), alga growth will be blocked, this is called the oligotrophic. Conversely, when the water phosphate levels are high, plant growth and algae are not limited (eutrophic poverty). It can reduce the amount of oxygen dissolved in water. This is certainly very dangerous for the preservation of aquatic ecosystems

K_2O content

The result of analysis related to K_2O content in LOF from RUW produced using different APT and decomposer type was presented. The result of the statistical analysis showed that the difference of type of decomposer had a significant effect ($P<0.05$) on K_2O content of LOF from RUW, but no significant effect on APT ($P>0.05$) (Fig. 6).

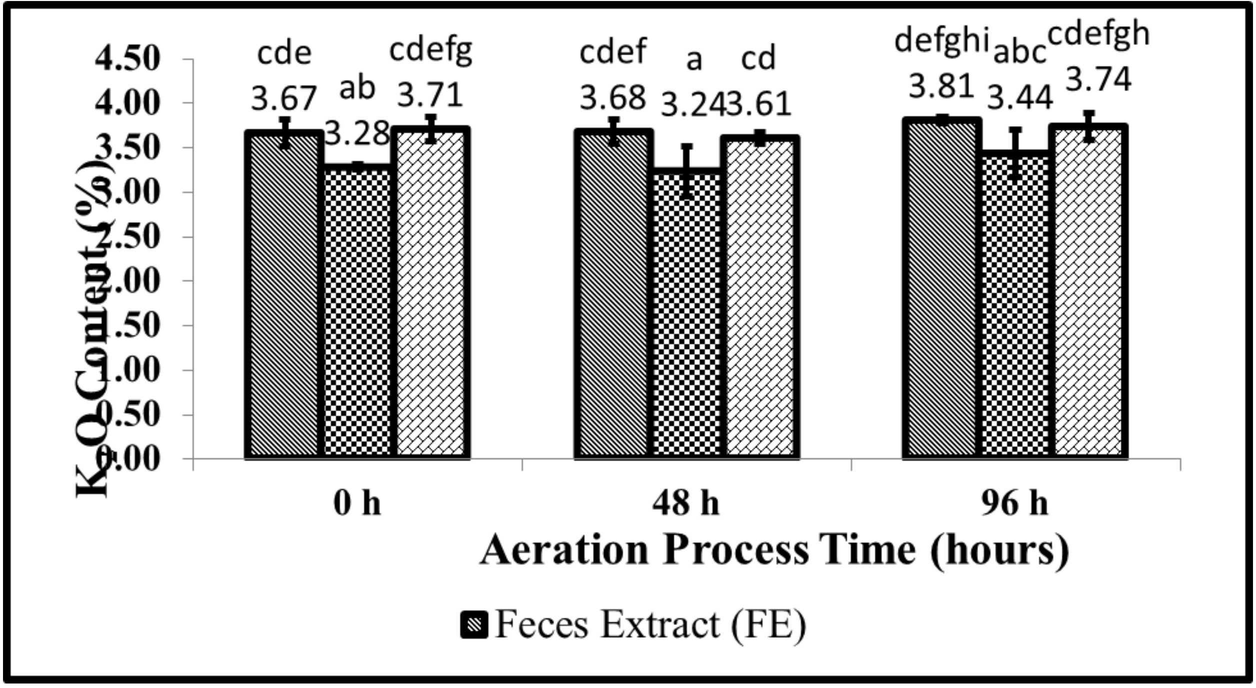

Fig 6. K_2O content (%) of LOF from RUW produced using different APT and types of decomposer; $^{a-i}$ Different superscripts showed significant differences ($P<0.05$); FE-T_0 (3.67%±0.15) ; FE-T_{48} (3.68%±0.14) ; FE-T_{96} (3.81%±0.04) ; RBE-T_0 (3.28%±0.03) ; RBE-T_{48} (3.24%±0.28) ; RBE-T_{96} (3.44%±0.27) ; CD-T_0 (3.71%±0.13) ; CD-T_{48} (3.61%±0.06) ; CD-T_{96} (3.74%±0.15); Feces Extract (FE) ; Root Banana Extract (RBE) ; Commercial Decomposer (CD); Liquid organic fertilizer (LOF); Rabbit's urine waste (RUW); Aeration process time (APT) ; T_0=APT 0 h ; T_{48}=APT 48 h ; T_{96}=APT 96 h; Comparative test using Duncan's multiple range test (DMRT)

Currently, approximately 95% of potassium (K) was used in fertilizers. Crop production has increased dramatically above. The last few decades, largely due to the introduction of fertilizers that began in the mid-1900s. Test results of the K_2O content of LOF from RUW were in the range of 3.24-3-81%. This value is higher than the K_2O content of LOF by (35), i.e. 0.47-0.59%. The produced fertilizer uses 3 types of bio-activators (EM4, boisca and shrimp paste) in the fermentation process. Applications of P_2O_5 and K_2O may not be required every year, depending on the specific amount available on the soil and the amount of P_2O_5 and K_2O required to meet production targets for certain crops to be grown (34). The element of potassium is one of the main elements that make up K_2O compounds. The K_2O compounds play a role in the growth and strengthening of plants. The potassium element in the plant tissue is present in cationic form and varies from about 1.7 to 2.7% of the dry weight of the leaf that grows normally. The K^+ ion in the plant serves as an activator of many enzymes that participate in several major metabolic processes of plants. Potassium is used in the form of K_2O. In western Europe, potassium applications peaked in 1979. Since then experienced a decrease of 40% to 3.8 million tonnes per year (25). Potassium is vital in the process of photosynthesis. If K^+ ion deficiency then the process of photosynthesis will decrease, but the respiration of plants will increase. This incident will cause many of the carbohydrates present in the plant tissue to be used to obtain energy for its activities. This causes the process of formation of parts of the plant will be reduced which in the end the formation and production of plants will also be reduced.

There are many studies that examine the effect of fertilizer doses on plant growth. However, do not consider the comparison of the type of fertilizer used. This is very important as a recommendation in the fertilization process, especially in new cultivars (20). Increased APT leads to an increase in pH value, C-organic and C/N ratio, whereas N-organic and P_20_5 levels were relatively constant. Different types of decomposers affect the K_2O content of LOF products from RUW, but didn't affect pH values, C-organic, C/N ratio and P_20_5. The FE and RBE decomposer types had the same performance as CD. FE and RBE decomposer can be applied as a replacement CD in the production process of LOF from RUW. APT for 48 h was the best process time than others

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