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HALAL BIOTECHNOLOGY ON FERMENTATION AND LIQUID FERTILIZER PREPARATION FROM KOMBUCHA WASTE OF TECABLOWE WASTE IN INCREASING EGGPLANT (*Solanum molengena*) GROWTH

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Abstract: The fermented waste of butterfly pea flower kombucha can be used in the formulation and preparation of organic liquid fertilizer to support the growth of this eggplant plant. The purpose of this study was to determine the effectiveness of liquid fertilizer made from the waste of butterfly pea flower kombucha fermentation in supporting the growth of eggplant plants. The design of this study was a completely randomized design (CRD) with a single factor, namely the difference in the concentration of organic liquid fertilizer that had been treated five times. The data from this study were analyzed through ANOVA and DMRT. The results of this study have shown that the T5 treatment in the form of formulations and preparations of organic liquid fertilizer from a 5 mL/L concentration of Tela kombucha fermentation waste is the best treatment for the growth parameters of eggplant plant height, eggplant leaf number, and eggplant wet and dry weight, so that it can It was concluded that the butterfly pea flower kombucha can be used as a halal probiotic drink, and its waste can also be used as a halal organic liquid fertilizer to support the growth of eggplant plants.

Keyword: Halal, Organic Liquid Fertilizer, Kombucha, Butterfly Pea Flower, Eggplant

INTRODUCTION

The use of microbes in various industries, one of which is agriculture, is part of a global trend. Kombucha is a biotechnology product that has been extensively studied regarding its ingredients. Research conducted by Riswanto and Priyono in 2021 concerning a study of alcohol content in fermented kombucha drinks The test's findings were in compliance with the Indonesian Ulema Council's (MUI) requirements for halal fermented beverages, which are limited to 0.5 percent. The amount of time spent fermenting throughout the kombucha-making process will alter its physicochemical qualities and is connected to the halal critical point (Sulistiyawati and Solihat, 2022). Hence, the fermented kombucha beverage tested has been deemed a halal beverage and is suitable for consumption by Muslims.

Kombucha is a biotechnology product made from microorganisms as a form of fermentation. The use of organic fertilizers is one alternative for maximizing agricultural production. Effective microbes are one of the best organic fertilizers for plant growth. The microbes found in kombucha waste are expected to be the best organic fertilizer in agriculture.

The butterfly pea flower kombucha waste affects the growth parameters of tomatoes (Saddam et al., 2022) and cayenne pepper (Rezaldi and Hidayanto, 2022). Microorganisms in kombucha waste are expected to be able to maintain the balance of carbon (C) and nitrogen (N), which is one of the determining factors for success in the process of making liquid fertilizer. The volume of Effective Microbial Bioactivator (EM 4) greatly influences the N, P, and K

content (Meritna et al., 2018).

Utilization of kombucha waste is expected to increase the growth of eggplant plants. The high growth will be synergized with an increase in eggplant production. It is mostly grown in subtropical Asia, where it accounts for 94% of global production, and is known as the "king of vegetables" due to its widespread popularity (Caruso et al., 2017). The top producers of eggplant globally, according to the Food and Agricultural Organization of the United Nations (FAO 2015), are China and India (28 and 13 Mt per year, respectively). Turkey (827,000 t), Italy (220,000 t), Spain (206,000 t), and Romania (123,000 t) are the primary European countries where eggplant is grown. It's interesting to note that eggplant growing has recently spread to northerner regions of Europe.

METHOD

Media Selection

The planting medium used was 1 kg of lembang soil, which is about 34 of the volume of a polybag; 15 grams of compost were put in one polybag with a size of 30 x 30 cm; 500 mL of butterfly pea flower kombucha fermented waste; and 1 kg of Scoby kombucha. There were 6 treatments, and the overall treatment was repeated 5 times.

Making Liquid Organic Fertilizer

The raw material for making this liquid organic fertilizer is 1 kg of Scoby kombucha, which is old and no longer productive, washed and blended until smooth to put in a bucket, as well as a solution of fermented butterfly pea flower kombucha to be added to a bucket of 500 mL. The next step is to add 100 grams of shrimp paste solution and 200 grams of palm sugar. The next step is to add 200 mL of bacterial solution (EM4) to the bucket. The next stage is to fill the water into the bucket until it is full, which is about 4L. The next stage is to stir the mixture of these ingredients for 5 to 10 minutes every day for 12 days to prevent oxygen exchange in the fertilizer. The next step is to analyze the C/N ratio of the fertilizer. Ideally, after 12 days, you will get organic liquid fertilizer in fresh condition. The liquid in the bucket can be used as organic fertilizer, while the dregs that remain from the filtering process and still contain bacteria have the potential to be reprocessed into liquid fertilizer (Rahmah et al., 2014).

Seed Selection

The seeds selected in this study were tomato seeds which are genetically superior. Has a uniform size, free from pests and diseases. The category of healthy seeds is that they will sink if soaked in water, while unhealthy seeds will ideally float when soaked in water.

Seed Planting

Eggplant seeds are soaked for 1 day; take the seeds that sink. Seeds that have been selected according to the criteria are planted in 3 polybags with a size of 30x30 cm each. Planting the seeds involves immersing them in the planting medium in a sinking position about 2-3 cm below the soil surface. A week after planting, the seeds that grow into seeds are selected according to a homogeneous size so that each polybag contains only one plant seed.

Provision of Telang Flower Kombucha Liquid Fertilizer

The treatment in giving organic liquid fertilizer is carried out as a treatment by spraying it on the leaves. Spraying on the leaves was carried out from 8:00 to 9:00 in the morning. Foliar spraying is carried out once a week for two months.

Each concentration was 0 mL/L (control), 1 mL/L (T1), 2 mL/L (T2), 3 mL/L (T3), 4 mL/L (T4), and 5 mL/L (T5). The volume of spraying for each treatment was 100 mL/plant.

Maintenance

Watering and weeding eggplant plants as necessary for maintenance all treatments, 100 mL of water were applied once daily between 8:00 and 9:00 in the morning, and weeding was done once per week for two months if there was weed growth.

RESULT AND DISCUSSION

The parameters of this study included the observation of eggplant plant height, number of eggplant leaves, fresh weight of eggplant plants, and dry weight of eggplant plants.

Parameters of Eggplant Plant Height (cm)

The highest growth in eggplant in this study was found at a concentration of 5 mL/L, namely in the treatment given the symbol T5. Kombucha has an element of N in its growth medium. According to Lakitan (2011), that the nutrient that most influences the growth and development of leaves is element N. High levels of element N generally produce more and larger leaves. In this study, the higher the concentration of the treatment, the higher the plant height when compared to other treatments. The results of this study can be seen in the DMRT test after the ANOVA test is performed (Table 1).

Table 1. Average Eggplant Plant Height Post Application of Telang Flower Kombucha Liquid Fertilizer

No.	Treatment	Treatment Average (cm)	DMRT
1.	T0	1,2	$1.2^{a,b,c}$
2.	T1	4,5	$4.5^{a,b}$
3.	T2	6,7	$6.7^{a,c}$
4.	T3	8,7	$8.7^{b,c}$
5.	T4	9,5	$9.5^{c,d}$
6.	T5	12,08	$12.08^{e,f}$

Note: Different notations indicate significantly different treatments among other treatments.

The results of the research listed in table 1 above show that T0 was not significantly different from T1, T2, T3, and T4 in producing eggplant plant height, but significantly different from T5 treatment in producing eggplant plant height after applying liquid fertilizer made from kombucha flower fermentation waste EM4 added telang. Plant height after application of liquid fertilizer made from telang flower kombucha fermentation waste in this study is in line with the statement expressed by Zubachtirodin and Subandi (2008), namely that plant height is ideally influenced by nitrogen application, which is capable of increasing plant height by up to 35 cm or even more when compared to control plants or those not treated with nitrogen.

Figure 1 below shows the average height of eggplant plants after the application of organic liquid fertilizer made from the waste of butterfly pea flower kombucha fermentation, added with EM4 at a concentration of 0 mL/L to 5 mL/L.

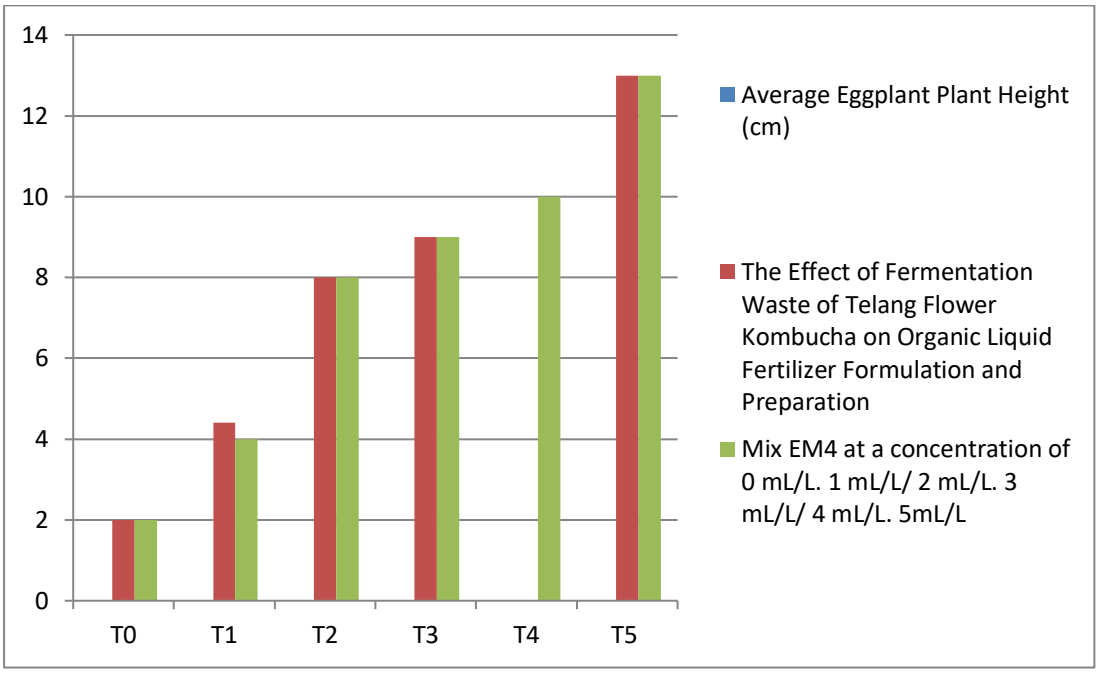

Figure 1. Average Height of Eggplant Plants After Application of Organic Liquid Fertilizer Waste of Fermented Telang Flower Kombucha mixed with EM4.

Figure 2 above explains that the application of organic liquid fertilizer made from telang flower kombucha fermentation waste and combined with EM4 at a concentration of 0 mL/L to 5 mL/L is proven to affect eggplant plant height. The results of this study also reflect that each treatment will have a different effect on plant height. The difference in plant height is caused by its potential to absorb nutrients. This is in line with Lakitan (2011), where there are differences in the rate of growth and activity of different meristematic tissues, causing differences in the rates of formation of different organs, including the formation of organs in leaves, stems, and other organs.

The results of this study were specifically related to the measurement of eggplant plant height parameters after the application of liquid fertilizer made from telang flower kombucha fermentation waste added with EM4, it was proven that a concentration of 5 mL/L in the treatment called T5 was the best treatment in producing plant height. The results of this study are in line with the results of research conducted by Rezaldi and Hidayanto (2022) which stated that a concentration of 5 mL/L in the treatment added EM4 with a mixture of telang flower kombucha fermented waste is a formulation and preparation of liquid fertilizer in producing high cayenne pepper plants. Likewise, the results of a study conducted by Saddam et al., (2022) stated that the formulation and preparation of liquid fertilizer derived from the waste of butterfly pea flower kombucha fermentation at a concentration of 5 mL/L was the best treatment in producing tomato plant height.

Number of Eggplant Leaves

The second parameter carried out in this study was the observation of the number of eggplant leaves. The number of eggplant leaves produced in this study had a significant and significant effect after the application of organic liquid fertilizer formulated from the waste of butterfly pea flower kombucha fermentation mixed with EM4. The results of the study proved that the higher the concentration in the application of organic liquid fertilizer made from telang flower kombucha fermentation waste mixed with EM4, the more the number of eggplant leaves

increased. The results of this study can be seen in the DMRT test after the ANOVA test is performed (Table 2).

Table 2. Average Number of Leaves of Eggplant Plants After Application of Liquid Fertilizer Made from Telang Flower Kombucha Fermentation Waste

No.	Treatment	Treatment Average (fruit)	DMRT
1.	T0	2.5	$2.5^{a,b,c}$
2.	T1	5.5	$5.5^{a,b}$
3.	T2	7.3	$7.3^{a,c}$
4.	T3	9.2	$9.2^{b,c}$
5.	T4	10.2	$10.2^{c,d}$
6.	T5	12.7	$12.7^{e,f}$

Note: different notations indicate significantly different treatments among other treatments.

The results of the research listed in Table 2 above show that T0 was not significantly different from T1, T2, T3, and T4 in producing eggplant plant height but significantly different from T5 treatment in producing eggplant fruit numbers after administration of liquid fertilizer made from kombucha fermentation waste with butterfly pea flowers. The results of this study have proven that a concentration of 5 mL/L of the formulation and preparation of organic liquid fertilizer made from telang flower kombucha fermentation waste to which EM4 has been added is the best treatment for producing eggplant leaves. Application of liquid organic fertilizer through the leaves provides better plant growth and yields than application through the soil. The higher the concentration of fertilizer given, the higher the nutrient content received by the plants, as well as the more frequent the application of foliar fertilizers to plants, the higher the nutrient content (Rizqiani et al., 2006).

The average number of eggplant leaves after the application of organic liquid fertilizer made from the waste of butterfly pea flower kombucha fermentation and added with EM4 is shown in Figure 2 below.

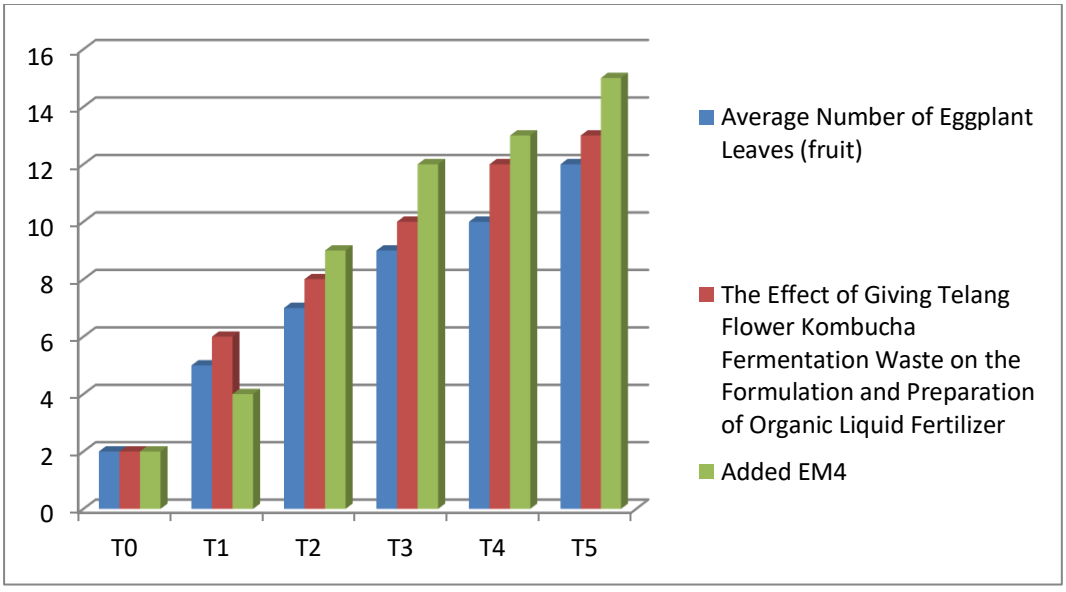

Figure 2. Figure 2. The average number of leaves produced in eggplant plants after administration of kombucha fermented liquid fertilizer

Figure 2 above explains that the number of leaves is strongly influenced by the growth of eggplant plants. The results of this study produced 2 leaves at a concentration of 0 mL/L. 5 pieces at a concentration of 1 mL/L. 7 pieces at a concentration of 2 mL/L. 9 pieces at a concentration of 3 mL/L. 10 fruits at a concentration of 4 mL/L and 12 fruits at a concentration of 5 mL/L The results of this study have proven that a concentration of 5 mL/L is the best treatment for eggplant production. This was based on Foth (1994), who said that the abundance of nitrogen was able to encourage rapid growth in supporting vegetative growth that occurred in the soil, including the growth in the number of leaves, which tended to increase.

The results of this study specifically regarding the observation of the parameters of the number of leaves are in line with the results of research conducted by Rezaldi & Hidayanto (2022) which stated that the formulation and preparation of liquid fertilizer made from the waste of butterfly pea kombucha fermentation added EM4 at a concentration of 5 mL/L is a very effective treatment. the best at producing the number of leaves on cayenne pepper plants. This is also in line with the results of a study conducted by Saddam et al. (2022), namely the best number of leaves on tomato plants from the formulation and preparation of organic liquid fertilizer from kombucha fermentation waste with butterfly pea flowers added (EM4) at a concentration of 5 mL/L.

Wet and Dry Weight of Eggplant Plants

The weight of the plant when it is still alive is then weighed directly post-harvest before wilting of the plant due to water loss is known as wet weight (Lakitan, 2011). The accumulation of carbohydrates, proteins, vitamins, and other organic matter that tends to increase is referred to as "dry weight." The results of the study regarding the average wet weight and dry weight of eggplant after the application of organic liquid fertilizer derived from the waste of butterfly pea flower kombucha fermentation were also added with EM4 at concentrations of 0 mL/L to 5 mL/L and tested by ANOVA and DMRT, as listed in Table 3 below.

Table 3. Average Wet and Dry Weight of Eggplant Plants After Giving Kombucha Fermentation Waste Fertilizer

No	Treatment	Average Treatment Wet Weight (grams)	DMRT
1.	T0	1.08	$1.08^{a,b,c}$
2.	T1	2.09	$2.09^{a,b}$
3.	T2	3.07	$3.07^{a,c}$
4.	T3	3.15	$3.15^{b,c}$
5.	T4	3.45	$3.45^{c,d}$
6.	T5	4.78	$4.78^{e,f}$

Note: different notation indicates significantly different treatment among other treatments.

The results of the research listed in Table 3 above show that T0 was not significantly different from T1, T2, T3, and T4 in producing the wet and dry weight of eggplant plants. However, it was significantly different from the T5 treatment in producing the wet and dry weight of eggplant plants after fertilizer application liquid made from eggplant kombucha fermentation waste added with EM4. The average wet and dry weight of eggplant after the application of organic liquid fertilizer made from the waste of butterfly pea flower kombucha fermentation with the addition of EM4 is shown in Figure 3 below.

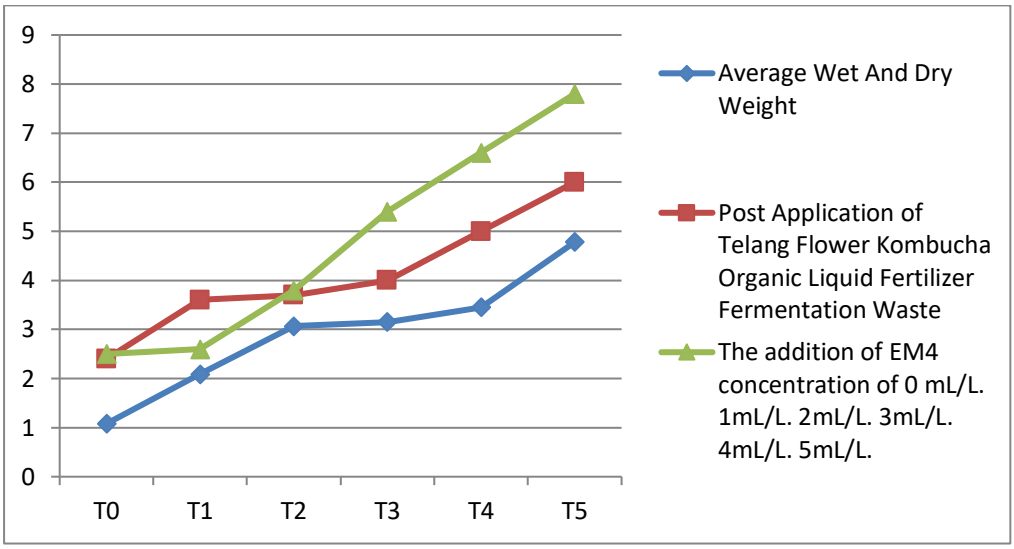

Figure 3. Average Wet and Dry Weight After Application of Organic Liquid Fertilizer Waste of Telang Flower Kombucha and Addition of EM4.

The results of this study have proven that the highest wet weight and dry weight that have been produced are in the T5 treatment, namely, a concentration of 5 mL/L. This is due to an increase in biomass at this concentration being able to absorb water and nutrients more efficiently, so that the dominance of nutrients has the potential to increase the development of plant organs, especially roots. This causes nutrients and water to be more dominantly absorbed in subsequent photosynthetic activities. This can also affect the increase in the wet and dry weight of a plant.

The presence of nutrients plays an important role, especially as a source of energy, so that nutrient levels that are sufficiently fulfilled can affect a plant's biomass. Low biomass can interfere with the growth of a plant. Increased additional nutrients will cause the biomass to be high. Additional nutrients in the form of liquid organic fertilizers, which tend to decrease, can ideally lead to lower biomass. The smallest growth in the parameters of this study, which include plant height, number of leaves, wet weight, and dry weight, has been proven in the T0 treatment, namely a concentration of 0 mL/L. This is due to growth due to less concentrated fertilizer concentrations that inhibit the process of absorption of nutrients and water associated with the process of photosynthesis and cause plant growth to be disrupted.

Plant growth is greatly affected by water content, where if the water supply contained in the network is sufficient, then plant growth will run better, whereas if the water supply is deficient, then plant growth and development will be disrupted, which can cause plants to wither or die easily.

Plants also have a certain time limit to absorb the nutrients they get. where the level of concentration is able to affect the permeability of leaf cells and determine the dominant nutrient to be absorbed in the fertilization process. Fertilizer concentrations that are too high can have the opposite potential, namely inhibiting the absorption of other nutrients, which causes nutrients to be low. For example, plants that contain excessive amounts of potassium have the potential to absorb magnesium (Mg).

Organic fertilizer treatment at a concentration of 1 mL/L is the smallest treatment compared to other concentrations. This is because the nitrogen contained in the fertilizer is diverted to the growth of other plant organs such as plant height.

This is in accordance with the results of research conducted by Rezaldi & Hidayanto (2022) and Saddam et al., (2022).

CONCLUSION

Based on the results of the study, liquid organic fertilizer based on telang flower kombucha fermentation solution with various concentrations of 5 mL/L had a significant effect on eggplant plant growth, especially on overall growth parameters.

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