Research Article

Potential of *Saccharomyces cerevisiae* UNJCC y-87 and Amino Acid on The Quality of Casgot and The Growth of Water Spinach (*Ipomoea reptans*)

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ABSTRACT

Water spinach (*Ipomoea reptans*) is a plant with quite high productivity every year. so that the growing media planted should be safe for the environment and plants. One planting medium that has many benefits for plants is casgot fertilizer which comes from the residue of *black soldier fly* (BSF) larvae that consume fermented feed with microorganisms, namely the yeast *Saccharomyces cerevisiae* UNJCC Y-87 and Amino Acids. This research aimed to determine the effect of the yeast *S. cerevisiae* UNJCC Y-87 and amino acids on the wet weight of BSF larvae and the effect of casgot fertilizer produced from BSF larvae residue on water spinach plants The method used was an experiment with an experimental design, namely a Completely Randomized Design consisting of 3 treatments with 5 repetitions of BSF fermented feed. Meanwhile, to apply casgot fertilizer to water spinach plants, 4 treatments were carried out with 4 repetitions. The results of the research showed that for fermented feed treatment with the addition of the yeast microorganism *S. cerevisiae* UNJCC Y-87 and amino acids of the wet weight of BSF larvae were superior in terms of morphology. Meanwhile, the results of the growth of water spinach plants showed that the treatment of casgot fertilizer containing the yeast *S. cerevisiae* UNJCC Y-87 was better in terms of plant morphology.

Keywords: amino acids, BSF, casgot, *Ipomoea reptans*, *Saccharomyces cerevisiae*

Introduction

Water spinach plant is an organic plant that is beneficial for body health. Water spinach has many important benefits, one of which is that it contains high levels of nutrition. The nutritional content of water spinach is quite high, including phosphorus, iron, potassium, vitamin A, calcium, and vitamin C (Iskandar, 2018). The productivity of water spinach plants continues to be increased by improving the quality of soil fertility and growing media Hartati et al., 2021). One growing media that is very good at improving soil quality and fertilizing plants is organic material.

One of the growing media that comes from organic materials is organic fertilizer. In general, organic fertilizer contains 2 elements, namely Nitrogen (N) 21% and Sulfur (S) 24%. Nitrogen and sulfur are macro elements that are needed by plants. Nitrogen plays a role in cell development and division, especially in leaves. Meanwhile, sulfur has a role as an enzyme and vitamin which is useful in the photosynthesis process (Suroso & Antoni, 2016).

Currently, there is a fertilizer derived from *black soldier fly* (BSF) larvae known as Casgot, where this fertilizer can function as a planting medium and organic fertilizer for cultivated plants because it has high nutrients and can improve soil quality (Kusumawati et al., 2020; Ah et al., 2022). The potential of Casgot is that it contains nutrients such as nitrogen, sulfur, and potassium (K) (Kare et al., 2023). Casgot is the remainder of the bioconversion carried out by BSF larvae by fermenting organic waste as feed using the help of living organisms.

Feed fermentation is a way to break down organic compounds which will turn into simpler compounds using microorganisms. One of the microorganisms that can have a positive impact on the health of other organisms is probiotics. Probiotics are composed of several microorganisms, one of which is yeast (Feliatra, 2018).

Probiotic yeast has several benefits, including being beneficial for human health, inhibiting pathogens, treating various diseases, and others (James & Wang, 2019). The yeast *Saccharomyces cerevisae* is known to have the ability to increase plant growth and is an alternative mixture of organic fertilizers that replaces chemical fertilizers, so it is very safe for humans, animals, and the environment. This is because the yeast *S. cerevisae* is thought to contain cytokinin and tryptophan and has a role in cell enlargement and division, as well as playing a role in plant vegetative growth (Karajeh, 2013).

Based on the background above, this research aims to determine the effect of giving the yeast *Saccharomyces cerevisiae* UNJCC Y-87 and amino acids on the wet weight of BSF larvae and the effect of Casgot fertilizer produced from BSF larvae residue on water spinach plants.

Materials and Methods

This research was carried out at the Innovation Centre of Tropical Science (ICTS), Bogor. This research took place over a period of approximately 4 months from July to November 2023. Materials used are *S. cerevisiae* yeast isolate UNJCC Y-87, BSF larvae, and water spinach.

Table 1. Research design to test the effect of adding the yeast *S. cerevisiae* UNJCC Y-87 to fermented feed on the wet weight of BSF larvae

Treatment	Test	Treatment Code
PA (Control)	1	PA. 1
	2	PA. 2
	3	PA. 3
	4	PA. 4
	5	PA. 5
PB	1	PB. 1
	2	PB. 2
	3	PB. 3
	4	PB. 4
	5	PB. 5
PC	1	PC. 1
	2	PC. 2
	3	PC. 3
	4	PC. 4
	5	PC. 5

Description: PA (control) = YMB media + Pineapple Extract; PB= *S. cerevisiae* UNJCC Y-87 + Amino Acid; PC= *S. cerevisiae* UNJCC Y-87.

This research uses a Completely Randomized experimental design. In this research, 3 treatments were carried out with 5 repetitions on BSF-fermented feed (Table 1). Meanwhile, to apply Casgot fertilizer to water spinach plants, 4 treatments were carried out with 4 repetitions. The variables in this research are independent variables and dependent variables. The independent variable is probiotic yeast (*S. cerevisiae)* while the dependent variable is organic plants. The composition for each treatment can be seen in Table 2.

The implementation of this research began with subculturing the yeast isolate *S. cerevisiae* UNJCC Y-87, hatching maggot eggs, making a cell suspension of the yeast *S. cerevisiae* UNJCC Y-87, fermenting feed, harvesting maggots and frass, planting water spinach seeds with the addition of Casgot fertilizer, and collecting data. Data analysis was performed using Oneway Analysis of Variance (ANOVA) to determine the effect of the application of the yeast *S. cerevisiae* UNJCC Y-87 and amino acids on the wet weight of BSF larvae, BSF larvae frass (Casgot fertilizer), and the growth of water spinach plants. Duncan's further test is carried out at a significance level of 5% to determine the real differences between treatments.

Table 2. Research design for testing casgot fertilizer with the addition of the yeast *S. cerevisiae* UNJCC Y-87 in BSF larvae fermented feed on the growth of water spinach plants

Treatment	Test	Treatment Code
Control	1	K.1
	2	K.2
	3	K.3
	4	K.4
PA	1	PA.1
	2	PA.2
	3	PA.3
	4	PA.4
PB	1	PB.1
	2	PB.2
	3	PB.3
	4	PB.4
PC	1	PC.1
	2	PC.2
	3	PC.3
	4	PC.4

Description: Control= Soil + Husk + Manure; PA= Control Casgot fertilizer; PB= *S. cerevisiae* UNJCC Y-87 Casgot fertilizer + Amino Acid; PC= *S. cerevisiae* Casgot fertilizer UNJCC Y-87.

Subculturing of the yeast isolates S. cerevisiae UNJCC Y-87

Isolate subculturing is carried out using a YMEA medium to reactivate isolates that have been stored for a long time. A dose of yeast isolate was inoculated into a YMEA medium and then incubated for 24-48 hours at room temperature (Maya & Alami, 2019).

Eggs Maggot Hatching

Hatching of maggot eggs is carried out using bran-based on (Mokolensang et al., 2018). A 400-gram bran was added with 400 ml of amino acids in a container. Maggot eggs were hatched in the container then weighed with a size of 0.5 grams, placed on the net, and fed when they were 10 days old.

Preparation of Yeast Cell Suspension S. cerevisiae UNJCC Y-87

Yeast cell suspension was prepared using YMB (Yeast Malt Broth) media containing 3 g/L yeast extract, 3 g/L malt extract, 5 g/L peptone, and 10 g/L glucose (Widiastutik & Alami, 2014). 10 ml of distilled water was poured into a test tube containing *S. cerevisiae* UNJCC Y-87 then scraped it slowly with a loop needle to ensure that all of the isolates were mixed evenly. The suspension was then transferred into an Erlenmeyer containing YMB medium and 10% pineapple extract in sizes of 112.5 ml (Treatment A) and 102.375 ml (Treatment B) then incubated for 48 hours and homogenized with a shaker at 35 rpm. In the control, 125 ml of YMB media was prepared with 10% pineapple extract and no yeast cells were present. The yeast cell suspension was prepared up to 1250 ml for 48 hours of shaking containing 10% pineapple extract, distilled water, and granulated sugar, then shaken for 48 hours (Rahayu et al., 2020).

Feed Fermentation

Fermentation is carried out utilizing organic waste such as chicory, cabbage, papaya, and tofu dregs (Bay et al., 2022). Each of these items weighed 3.125 kg, resulting in 12.5 kg of feed for each treatment. The feed fermentation was then subjected to several treatments, with treatment A serving as a control, consisting solely of YMB media and 10% pineapple extract. Meanwhile, t treatment B consists of yeast and amino acids, and treatment C consists of yeast cultured in YMB (Yeast Malt Broth) media and 10% pineapple extract. After that, they were closed and allowed to ferment for about three days. After 3 days, the fermented feed is filtered till dry and weighed 2 kg to be fed to BSF maggots.

Harvest Maggot and Frass

After three feedings, when the maggots were 19 days old, the maggot and frass were harvested. Then maggots were harvested by separating them from frass, the leftover residue that the maggots produced (Rodli & Hanim, 2022). Next, dry the resulting frass was dried in the sun for long-term use.

Planting Water Spinach Seeds with the Addition of Casgot Fertilizer

Water spinach seeds are sown first for approximately 30 minutes. Then prepare land measuring 50 cm x 20 cm for each treatment. 9 grams of casgot fertilizer is added to the loosened soil. The addition of Casgot fertilizer is expected to produce good water spinach plants. After that, 30 kale seeds were planted in the land for each treatment with 4 repetitions for each treatment. Then, the seeds that have been planted are covered with a little bit of casgot fertilizer and soil, and watered. Watering is done every day in the morning and evening. Water spinach data collection is carried out once a week and water spinach harvesting can be carried out in the 4th week after planting (Setyaningrum & Saparinto, 2012).

Results and Discussion

Based on statistical results, it showed that treatment with the addition of the yeast microorganism *S. cerevisiae* UNJCC Y-87 and amino acids had a real effect with a significance level of 5% on the wet weight of BSF larvae (Table 3). Meanwhile, treatment with only the addition of the yeast *S. cerevisiae* UNJCC Y-87 showed the highest results on the weight of frass (casgot fertilizer) and the growth of water spinach plants including plant height, number of leaves, leaf length, leaf width, and post-harvest plant wet weight. Table 3 shows the results for various parameters:

Table 3. Wet weight of *black soldier fly* (BSF) larvae (maggot)

Treatment Group	Maggot Wet Weight (g)
PA	818 ^{a}
PB	993 ^{b}
PC	971 ^{b}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column. **Description:** PA (control) = YMB media + Pineapple Extract; PB= *S. cerevisiae* UNJCC Y-87 + Amino Acid; PC= *S. cerevisiae* UNJCC Y-87.

Table 4. Weight values of frass maggot (casgot fertilizer)

Treatment	Average Weight of Frass Maggot	
	Wet Weight (kg)	Dry Weight (grams)
PA	2.52 ^{b}	688.00 ^{b}
PB	1.98 ^{a}	511.00 ^{a}
PC	2.22 ^{a}	562.00 ^{a}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column.

Table 5. Average value of water spinach height

Treatment	Average Plant Height (cm)			
	1 WAP	2 WAP	3 WAP	4 WAP
Control	4.30 ^{a}	9.07 ^{a}	18.57 ^{a}	28.67 ^{a}
PA	5.04 ^{b}	10.67 ^{b}	22.15 ^{b}	33.12 ^{ab}
PB	5.18 ^{b}	11.72 ^{c}	22.97 ^{b}	37.15 ^{b}
PC	5.43 ^{b}	12.03 ^{c}	23.50 ^{b}	38.47 ^{b}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column. **Description:** 1 WAP = 1 week after planting; 2 WAP = 2 weeks after planting; 3 WAP = 3 weeks after planting; 4 WAP = 4 weeks after planting.

Table 6. Average value of the number of leaves of water spinach plants

Treatment	Average Number of Leaves		
	2 WAP	3 WAP	4 WAP
Control	2.72 ^{a}	5.97 ^{a}	7.40 ^{a}
PA	3.00 ^{ab}	6.42 ^{b}	8.45 ^{b}
PB	3.42 ^{bc}	6.47 ^{b}	8.87 ^{b}
PC	3.50 ^{c}	6.60 ^{b}	8.92 ^{b}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column. Description: 1 WAP = 1 week after planting; 2 WAP = 2 weeks after planting; 3 WAP = 3 weeks after planting; 4 WAP = 4 weeks after planting.

Table 7. Average value of leaf length water spinach plants

Treatment	Average Leaf Length (cm)		
	2 WAP	3 WAP	4 WAP
Control	3.22 ^{a}	6.17 ^{a}	6.22 ^{a}
PA	4.12 ^{b}	6.67 ^{ab}	8.17 ^{b}
PB	4.80 ^{c}	7.05 ^{BC}	9.70 ^{b}
PC	5.02 ^{c}	7.42 ^{c}	9.77 ^{b}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column. Description: 1 WAP = 1 week after planting; 2 WAP = 2 weeks after planting; 3 WAP = 3 weeks after planting; 4 WAP = 4 weeks after planting.

Table 8. Average Value of Leaf Width of Water Spinach Plants

Treatment	Average Leaf Width (cm)		
	2 WAP	3 WAP	2 WAP
Control	0.57 ^{a}	0.92 ^{a}	0.87 ^{a}
PA	0.62 ^{a}	1.20 ^{b}	1.10 ^{a}
PB	0.80 ^{b}	1.17 ^{b}	1.72 ^{b}
PC	0.82 ^{b}	1.30 ^{b}	1.75 ^{b}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column. Description: 1 WAP = 1 week after planting; 2 WAP = 2 weeks after planting; 3 WAP = 3 weeks after planting; 4 WAP = 4 weeks after planting.

Table 9. Harvested Wet Weight of Water Spinach Plants

Treatment Group	Harvest Wet Weight (grams)
Control	350 ^{a}
PA	425 ^{ab}
PB	575 ^{bc}
PC	687 ^{c}

Note: Duncan's advanced test results at a significance level of 5% are expressed in superscript letters in one column

The wet weight of BSF larvae showed the highest results in treatment B due to the addition of amino acids in the form of agriminovit which contains amino acids and vitamins. Agriminovit can increase the weight of livestock (Jamko, 2013). Amino acids are also added so that the essential amino acid in maggots is increased, so the quality of maggots is better. Generally, maggots contain amino acids in the form of isoleucine, leucine, threonine, valine, phenylalanine and arginine (Izzatusholekha et al., 2022). Meanwhile, treatment C showed results that were not much different from treatment B, this was because the yeast microorganism *S. cerevisiae* UNJCC Y-87 was used at the same concentration, only in treatment B amino acids were added. *S. cerevisiae* has good nutrition because it is one of the choices used as additional feed for livestock that is safe for the environment (Suryani et al., 2015).

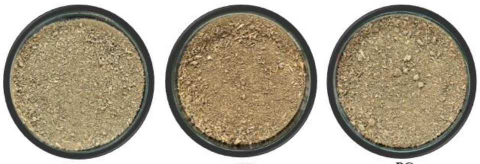

Fig. 1 Casgot fertilizer in 3 different treatments. PA= Control; PB= *S. Cerevisiae* UNJCC Y-87 + amino acid; PC= *S. cerevisiae* UNJCC Y-87

As the wet weight of the BSF larvae produced increases, the frass produced decreases (Tables 4 and 5). This is because in treatments B and C there are microorganisms that can ferment the feed faster and better so that the maggots can consume the feed quickly. This is different from treatment A, which does not contain any microorganisms, causing the maggots to take longer to consume their food.

Casgot fertilizer produced from the residue of BSF larvae that consume fermented feed with the yeast microorganism *S. cerevisiae* UNJCC Y-87 shows quite good plant growth results including plant height, number of leaves, leaf length, leaf area, and post-harvest plant wet weight. This is because the addition of microorganisms in the form of the yeast *S. cerevisiae* can protect water spinach plants from pest attacks that the resulting plants are very good in terms of morphology. Apart from that, casgot fertilizer can play a role in increasing plant growth because it contains many nutrients needed by plants (Agustin et al., 2023). Casgot fertilizer contains quite high levels of nutrients such as N, P, K and contains 42% organic matter (Muhadat, 2017; Kare et al., 2023). The casgot fertilizer contains 2.16% nitrogen, 2.68% potassium, and 2.73% phosphorus (Sinuraya & Melati, 2019).

In treatments B and C it is also revealed that the number of leaves shows the highest yield compared to treatment A, where the increased number of leaves enables more photosynthesis than increased photosynthesis so that the final weight produced by the plant will enhanced (Tables 5-9). The photosynthate can produce energy to develop and maintain the quality of leaves. (Kare et al., 2023).

Conclusion

Based on research results, adding the yeast *S. cerevisiae* UNJCC Y-87 and amino acids affected the wet weight of the BSF larvae produced. However, when applying casgot fertilizer, the treatment only containing *S. cerevisiae* UNJCC Y-87 yeast showed significantly different results on the wet weight of water spinach plants compared to the control that did not contain microorganisms. In addition, water spinach plants that used casgot fertilizer containing the yeast *S. cerevisiae* UNJCC Y-87 are morphologically healthier, such as leaves and stems that were not attacked by pest.

Conflict of Interest

All authors have no conflicts of interest to declare.

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Sukmawati, entitled Alternatif Ketahanan Pangan Kaya Gizi Berbasis Black Soldier Fly (Hermetia Illucens) Dan Khamir Oleaginous Probiotik Melalui Pendekatan Metabolomik.

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