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Artificial Feed Production from Fermented Aquatic Weeds and its Implementation in Climbing Perch Fish (*Anabas Testudineus*)

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Abstract: This study aims to determine the effect of artificial feed made from aquatic weeds (Pistia sp., Salvinia sp., and Lemna sp.) through fermentation of *Rhyzopus oryzae* on the growth of Climbing Perch fish. The experimental factors were aquatic weeds, namely: Pistia sp. (Kayu apu), Salvinia sp. (Kiambang), and Lemna sp. (Gulma itik) as Factor A and different percentages of *Rhyzopus oryzae* fermentation (5%, 10%, and 15%) as Factor B. Each treatment was conducted in three replications. The results showed that the combination of Salvinia sp. in 15% fermentation provided the best absolute growth of 2.31g, the best relative growth of 416.04%, the best feed conversion of 2.00, the highest feed efficiency of 50.0%, and the highest protein retention of 13.79%. The results of the ANOVA test of the feeding trials showed no significant differences among treatment combinations with regards to absolute growth, relative growth, feed conversion, feed efficiency, and protein and fat retention. The experimental Climbing Perch fish had a survival rate of 100%. Water quality data, such as temperature, DO, pH, and NH_3, showed that the living conditions are tolerable for the Climbing Perch fish.

Keywords: *Anabas testudineus, rhyzopus oryzae, aquatic weeds*

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I. INTRODUCTION

The high production cost of aquaculture is usually related to the cost of feed. The price of fish feed is increasingly high, whereas the increase in fisher price is relatively small [1, 2]. Therefore, there is a need for cheap, easy to get, and not competing with human need-unconventional alternative local feed material source, such as aquatic weeds that mostly cover swamp waters in South Borneo. In fact, components of fish feed raw materials are abundantly available in every area of agriculture-fishery development. Therefore, the production of fish feed is another alternative that can be done by fish farmers. The use of aquatic weeds, such as kiambang (giant salvinia/Salvinia sp.), kayu apu (water lettuce/Pistia sp.), and gulma itik (duckweed/Lemna sp.), is an appropriate step as an alternative for aquatic weeds control and a problem solving for fish farmers regarding the expensive price of feed. Salvinia sp., Pistia sp., and Lemna sp. are appropriate to be used as a mixture for fish feed production. The flour form of those plants can play role as a substitute of vegetable protein.

According to [3], fermentation is one of the ways of utilizing microbe in decomposition process of a complex compound into simpler compounds, thus it is easier for the fish to digest the feed and easy to be absorbed by the body. The *Rhyzopus oryzae* fungus has the ability to decompose complex fat into triglyceride and amino acid.

In addition, the fungus could produce protease [4]. Amino acid is the basic material of protein formation. Protein absorbed by fish will be used as an energy source

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for the improvement of tissue proteins and for growth [3, 5].

Based on the above phenomena, a research is needed that uses aquatic weeds (Salvinia sp., Pistia sp., and Lemna sp.) with fermentation of *Rhyzopus oryzae* as a mixture of artificial feed given to climbing perch fish. Generally, fermentation will decrease crude fiber level in feed raw material and increase protein content and in turn, it is hoped that it will increase the tested fish.

II. MATERIAL AND METHOD

A. *Tested Feed*

Tested feed used was pelleted with main materials of Salvinia sp., Pistia sp., and Lemna sp. fermented with *Rhyzopus oryzae*.

Fig. 1. Salvinia sp. (Kiambang) Pistia sp. (Kayu apu) Lemna sp. (Gulma itik)

B. *Fish Maintenance and Treatment*

The maintenance place used was 45 l plastic container. Tested fish to be used were those with standard length of 1.5 2.5 cm with 10 fish/plastic container. During the maintenance, tested fish would be fed with artificial feed of 5% of their biomass weight per day.

C. *Sampling and Analysis*

Sampling of tested fishes was conducted once in two weeks. The number of fish was calculated and fish biomass was scaled. Analyses conducted were proximate analysis on feed and fish body, relative growth rate, Feed Conversion Ratio (FCR), feed utilization efficiency, life Sustainability (SR), protein retention, and fat retention.

D. *Research Method*

A design used in the research was completely Randomized Factorial Design (RAL) with Factor A of 3 levels and Factor B of 3 levels with three repetitions (3x3x3). Factor A was types of aquatic weed (Salvinia sp., Pistia sp., and Lemna sp.) and Factor B was dose of *Rhyzopus oryzae* application (5%, 10%, and 15%).

III. RESULT AND DISCUSSION

A. *Relative Growth Rate*

Fish will grow if feed nutrition digested and absorbed by their body is higher than the amount needed to maintain their body (Lovell, as cited in [6]). The result of average relative growth from each treatment during maintenance period is displayed in Fig 2.

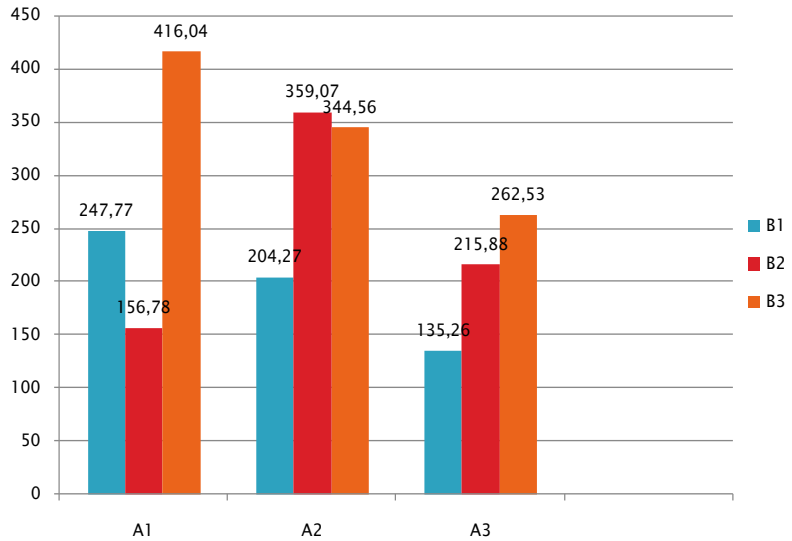

Fig. 2. Average Relative Growth (%) of Climbing Perch Fish

The differences in absolute and relative growths in every treatment were assumed to be related to the ability of fish in utilizing feed optimally and less optimum response of fish to the feed given during the maintenance. In addition, it was also due to the addition of different doses of *R. oryzae* inoculum.

In the treatment of the application of Salvinia sp., basic material with dose of *R. oryzae* (Kiambang with dose of *R. oryzae* inoculum of 15%) inoculum gave the highest relative growth of climbing perch fish weight compared to other treatments. The high rate of relative growth of climbing perch fish weight in the treatment (Kiambang with dose of *R. oryzae* inoculum of 15%) was assumed to be caused by the higher ability of fish in utilizing feed.

It is in line with the opinion of Bunasir as cited in [7]) that the high and low of fish growth is influenced by the ability of fish in responding and utilizing feed for growth as well as the amount of feed given.

B. *FCR and Feed Utilization Efficiency*

The result of average FCR in every treatment can be seen in the following Table 1. The lowest value of feed conversion during maintenance was indicated by treatment Kiambang dose 15% (2.00) and followed by Kayu apu dose 10% (2.01) and Kayu apu dose 15% (2.09), whereas the highest was in treatment Gulma itik dose 5% (3.87) and Kiambang dose 10% (3.62). According to [8], feed conversion in fish is in the range of 1.58. Therefore, artificial feed given had quite good quality since the feed given can be used by fish for maximum weight growth.

TABLE 1
AVERAGE FCR OF CLIMBING PERCH FISH (*ANABAS TESTUDINEUS*)

Types of Aquatic Weed	Dose of *R. oryzae* Inoculum		
	5%	10%	15%
Kiambang	2.64	3.62	2.00
Kayu apu	3.26	2.01	2.09
Gulma itik	3.87	2.70	2.56

The average feed efficiency value of climbing perch fish between treatments during maintenance is displayed in Table 2. In Fig 2 and Tables 1 and 2, it can be seen that feed efficiency value was inversely proportional to feed conversion, but was directly proportional to the value of the fish weight growth rate. It means that the higher the value of the fish weight growth rate, the bigger the feed efficiency value and the lower the feed conversion value. It is in line with the opinion of Djajasewaka as cited in [9] that feed efficiency value is inversely proportional to feed conversion and is directly proportional to fish body weight growth. Therefore, the higher the feed efficiency value, the lower the feed conversion value. Thus, the fish is more efficient in utilizing feed consumed for their growth.

TABLE 2
AVERAGE FEED EFFICIENCY VALUE OF CLIMBING PERCH FISH (*ANABAS TESTUDINEUS*)

Types of Aquatic Weed	Dose of *R. oryzae* Inoculum		
	5%	10%	15%
Kiambang	38.01	27.66	50.01
Kayu apu	30.84	49.65	47.90
Gulma itik	25.86	37.08	39.16

C. *Retention of Protein and Fat*

Retention of protein of climbing perch fish during maintenance is presented in Table 3. The average protein percentage retained in climbing perch fish's body indicated a relatively low result (8.72%-13.79%). The low value compared allegedly due to the protein that was mostly used by the fish as main energy source for physiological processes in warm-blooded animals that store the remaining protein in their body once the protein function is fulfilled.

TABLE 3
AVERAGE PROTEIN RETENTION VALUE (%) OF CLIMBING PERCH FISH (*ANABAS TESTUDINEUS*)

Types of Aquatic Weed	Dose of *R. oryzae* Inoculum		
	5% (B1)	10% (B2)	15% (B3)
Kiambang	11.39	8.87	13.79
Kayu apu	9.05	11.94	13.54
Gulma itik	8.72	11.03	11.49

The following Table 4 presents the average value of fat retention of climbing perch fish during 10 weeks of maintenance. The average value of fat percentage stored in climbing perch fish's body during maintenance in the combination between treatments indicated a relatively high result (42.96%-92.24%) compared to protein retention value (8.72%-13.79%). It was likely because the protein contained in fishs body was sufficient for an energy source to maintain the form and function of membrane/tissue. As a consequence, the fat percentage value stored in the body was relatively high. Thus, it could be used as an energy reserve for long-term energy needs.

TABLE 4
AVERAGE VALUE OF FAT RETENTION (%) OF CLIMBING PERCH FISH (*ANABAS TESTUDINEUS*)

Types of Aquatic Weed	Dose of *R. oryzae* Inoculum		
	5%	10%	15%
Kiambang	42.96	73.58	82.19
Kayu apu	74.17	79.93	86.59
Gulma itik	81.97	59.45	92.24

The result of ANOVA test indicated that the application of artificial feed with different types of weed, different doses of *R. oryzae* inoculum, and interaction between types of weed and dose of inoculum had no significant influence on absolute growth, relative growth, feed conversion, feed efficiency, protein retention, and fat retention in climbing perch fish.

D. SR

Based on observation result, the SR of climbing perch fish in all treatments was 100%. It means that climbing perch fish maintained for 10 weeks were all alive. It was assumed that the amount of feed given to the fish during the maintenance period was sufficient and in good quality to be consumed. It was also supported by good water quality condition.

E. Water Quality

DO content was in the range of 3.5-4.1 ppm. DO in the water is a critical factor in maintenance. Climbing perch fish could survive in dryness and low oxygen level since they have a labyrinth as an additional respiratory aid [10], [11]. Ammonia (NH_3) content not more than 3 ppm is considered as safe for fish and does not interfere with the growth [12], [13].

IV. CONCLUSION

Based on research results, a conclusion can be drawn that is Kiambang (Salvinia sp.) with dose of *Rhyzopus oryzae* inoculum of 15% gave the best result compared to other treatment combinations. The result of average absolute and relative growths of fish weight was 2.31 g and 416.04%. As well as the result of average feed efficiency gave the highest value of 50.01% and average protein retention of 13.79%. Whereas, average feed conversion had the lowest value of 2.00.

The result of ANOVA test indicated that the application of artificial feed from different types of aquatic weed and different doses of *R. oryzae* inoculum and interaction between types of aquatic weed and inoculum dose had no significant influence on absolute growth, relative growth, feed conversion, feed efficiency, protein retention, and fat retention in climbing perch fish. Life sustainability level of climbing perch fish for all treatments was 100%.

The result of water quality measurement indicated in a range of tolerable conditions for climbing perch fish life was the temperature of 25.3°-26.6°C; pH: 7.10-7.27; oxygen content (DO): 3.5-4.1 ppm; and ammonia (NH_3):

0.1-0.4 ppm.

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