The Effectiveness of Feeding *Azolla Microphylla* on Catfish (*Clarias Batrachus*) Growth

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Abstract

The usage of Azolla Microphylla as fish feed provides several advantages for fish farmers such as; the low-cost, the easy-to-obtain, and the taste that is favoured by some freshwater fish especially catfish (Clarias Batrachus). Azolla Microphylla is known as one of Pterideophyte aquatic plants that can be utilized as fish feed for catfish because of its high nutritional values, including N, P, Si, Ca, Fe, Mg, and some others. This study aims to analyze the effectiveness of feeding Azolla Microphylla on catfish length and weight growth by an experimental method. A completely randomized design was conducted with 5 treatments and 4 repeatabilities using 20 fish farms containing a cluster of catfish with an average size of 5 cm, that regularly fed with Azolla Microphylla. The observation was conducted every 10 days during the treatment, with a total number of observations held 4 times in the 40-days treatment. The result indicated that the treatment in P2, with a 60-gram dosage of Azolla Microphylla feeding, gives the optimal growth on catfish length and weight compared to other treatments. Best scores in P2 treatment is found in the fourth observation, where the catfish length reaches around 28 cm, and the weight reached 100 gram. Based on the single factor ANOVA test, the real difference values for each group and treatment which analysed at a significance level of 0,05, namely Fvalues>Ftable, indicates a significant effect of Azolla Microphylla on the catfish growth. The Tukey's Honest Significant Difference test also shows a significant effect of the Azolla Microphylla feeding on the catfish length and weight growth. Therefore, feeding catfish with 60-gram of Azolla Microphylla creates an effective treatment to gain catfish length and weight.

Keywords: *Azolla Microphylla, Feeding, Fish Feed, Catfish Growth*

1. Introduction

Many fish farmers have been complaining about the expensive fish feed (pellets) which believed is the cause of the rocketing price of fish in the market. Meanwhile, there are many sources of local raw materials that can be utilized as a fish feed to solve this problem. Four out of seven the main non-rice food commodities

such as wheat, soybean, meat, and fish are known in critical categories, whereas the stability of food is necessary to maintain the food commodity availability. Animals and plants are ones of the food available for consumption. Catfish constitutes one of the animals with high protein and are mostly consumed by people in Indonesia because of its high nutritional values (Muttaqin & Murwono, 2012).

The demand for catfish is highly increasing in many areas in Indonesia. Therefore, the amount of catfish quality and quantity depends on the fish feed availability which provides the main nutritional needs to those animals and then influences their growth speed. Availability of natural fish feed has an important role in catfish cultivation, particularly in the livestock aspect. With an affordable price, the utilization of natural feed can be the first choice hoped to help the government in overcoming the food crisis problem. Therefore, the production of the alternative fish feed, particularly those that are cheaper and more practical, is urgent. One of the alternatives of food feed production is through utilizing local raw materials in such as *Azolla Microphylla*.

Azolla Microphylla constitutes Pterideophyte aquatic plant and one of natural fish feed with an abundance availability in nature. Its characteristics are (1) speedy growth and development, (2) floatable on the water and (3) symbiosis related with *Cyanobacteria* (the blue-green algae), means, it gets a fixation with Nitrogen (N2) in the air. *Azolla Microphylla* can be used as an alternative fish feed that brings a lot of benefits. It is cheap and the taste is favoured by some freshwater fish. According Indarmawan et al (2012); and Surdina & Hasri (2016), the nutrient content in Azolla sp. includes N (1,96-5,30%), P (0,16-1,59%), Si (0,16-3,35%), Ca (0,31- 5,97%), Fe (0,04-0,59%), Mg (0,22-0,66%), Zn (26-989 ppm), Mn (66–2944 ppm).

Similarly, Lumpkin & Plucknett, 1982; Van Hove & Lopez (1983); cited in Datta (2011) reported that the utilization of aquatic plants with high food value for fish food supplement has offered a new way in the highly-required animal protein production with a low cost. Azolla, which forms a cyanobacterium *Anabaena Azollae*, from a permanent, hereditary symbiosis with a nitrogen-fixing heterocyst, is perhaps the most promising fish food alternative from the point of view of cultivation, productivity and nutritional value. Azolla as a fish feed ingredient substitutes fish meal and soybean has been reported in many studies. This aquatic plant is most liked by catfish and can convert its raw protein into the best edible protein. Thus, the cost of production of aqua feed can be reduced using eco-friendly and sustainable resources (Datta, 2011).

Furthermore, Surdina et al., (2016) added that *Azolla Microphylla* can be produced easily through cultivation. Based on the cultivation techniques which developed from many theories; by providing a fish farm with mud in the ground and putting the combination of manures, *Azolla Microphylla* can grow easily. Therefore, the utilization of *Azolla Microphylla* as fish feed is recommended to catfish farmers considering the benefits they will obtain.

Research related to *Azolla sp* and its utilization has been previously conducted. Hundare et al., (2018), for instance, studied the *Use of Azolla in Fish Feed as Fishmeal Substitute.* The researchers of the mentioned study reported several species of aquatic plants that could potentially be the sources of fish meal substitutes in aquaculture. Whilst in the present study, Azolla is hypothesized an effective substitute for fishmeal. Supartoto, Shodiq, Wahid, and Suyanto (2018) conducted *The Cultivation Development of Azolla Microphylla as Fowls Feed* that aimed to socialize the *Azolla Microphylla* as a potential natural resource, along with its cultivation technology, and the practicality of utilization of *Azolla Microphylla* as fowls feed. Another related research found the mechanism of The Grow-Out of *Azolla Microphylla* using a combination of Manurses (Surdina et al., 2016). While Radhakrishnan, Bhavan, Seenivasan, Shanthi, and Muralisankar (2014) developed research about *Replacement of Fishmeal with some Aquatic Plants on Non-Enzymatic and Enzymatic Antioxidant Activities* of *Macrobrachium rosenbergii* to show that the formulated food through non-enzymatic antioxidants (vitamin C and E) is non-toxic and does not cause any stress to post-larvae. These ingredients can be used as an alternative protein source for sustainable *Macrobrachium* culture.

Based on the explanation above, this research aimed to find an effective method of feeding *Azolla Microphylla* on catfish (*Clarias Batrachus*). Through this study, the authors aimed to share information for people who are involved in catfish cultivation about the most effective dosage of feeding *Azolla Microphylla* for the catfish optimal growth.

1.1 Research Problem

A research problem was formulated to guide this study: How is the effectiveness of feeding *Azolla Microphylla* on catfish (*Clarias Batrachus*) length and weight growth?

1.2 Aim of Research

This study aims to analyze the effectiveness of feeding Azolla Microphylla on catfish length and weight growth.

2. Method

2.1 Location

The research was conducted from 10 July to 22 August 2020, and took place at one of the authors' back yards at Lambaro Kafe, in Aceh Besar District.

2.2 Materials

The materials used in this research are 20 catfish livestock with a size of 5 cm which was obtained from a traditional market in Lambaro Kafe. While the *Azolla Microphylla* was bought from a fish farmer, from which then cultured by the

Researchers in an artificial farm with a size of 1m x 0,5m x 0,5m. Meanwhile, the Artificial fish farm made for the experiment included 20 boxes with a size of 1m x1m x 0,5 m. The research procedure for 5 treatments and 4 repeatabilities are as follow:

1) Po = without Azolla (Control), 2) P1 = with azolla 40 gram, 3) P2 = with azolla 60 gram, 4) P3 = with azolla 80 gram, 5) P4 = with azolla 100 gram.

2.3 Research Design

Rancangan Acak Lengkap (RAL) means A Completely Randomized Experimental Design was used in the 5 treatments and 4 repeatabilities related to the utilization of *Azolla Microphylla* on catfish growth. The design of RAL is as follow:

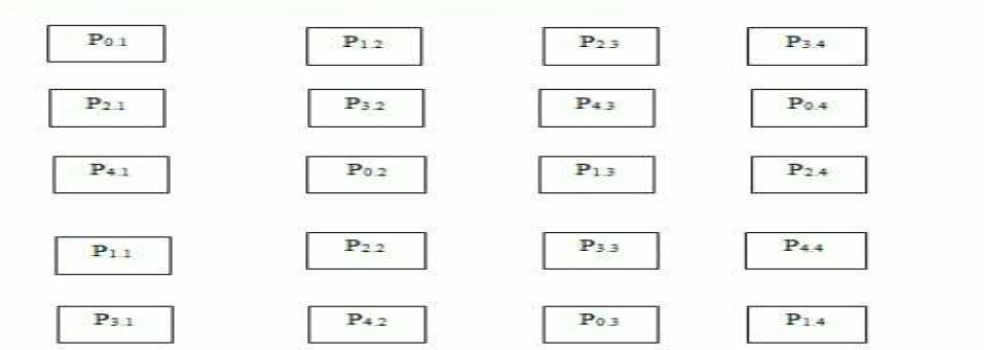

Figure 1. RAL Design

2.4 Catfish treatment and Feeding *Azolla Microphylla* Process

The process of catfish treatment is as follow:

Firstly, the researchers prepared an artificial fish farm and the cultivation of *Azolla Microphylla.* Secondly, 20 catfish livestock were put into the fish farm based on the RAL design, as showed in the research procedure. The method of feeding *Azolla Microphylla* is as follow: starting on the first day when the catfish had been put into the fish farm, the researchers put *Azolla Microphylla* in the fish farm twice per day. According to Fish Farm Talk (2019), there are many things to be considered so the catfish can grow well and thriving. Catfish feeding should be based on how old or how big the catfishes are. There are many sizes of catfish feed available, so it should not be too hard to find one that is suitable with the catfish size. When the catfish gets bigger, it can be fed with a bigger food size. For example, when a catfish reaches 1 kg in weight or more, the 8- or 10-mm feed sizes can be considered. It will be more practical and easier to feed. Apart from that, it is important to pay attention to how often they are fed. Different stages of growth require a different frequency of feeding too. Fingerlings of 3–4 grams weight should be fed twice per day. When they reach the post-fingerlings and juvenile stage, they can keep on being fed twice a day

or to once a day. Next, after they reach the post-juvenile or above, the feeding frequency can be reduced to once a day.

To grow catfish well, the researchers feed the catfish twice per day starting on the first day when their size was 5 cm. The catfish was fed at 9.00 am and at 5.00 pm. *Azolla Microphylla* was a floating feed type, thus in fingerlings period (5cm), catfish liked this feed type most. The treatment was conducted for 40 days, whereas the observation was made every 10 days to measure the length and weight of the catfish.

2.5 Data Analysis

Data were collected through observation using a sheet developed by the researchers. The result of the observation on catfish length and weight growth was analyzed using an ANOVA test which can be formulated as below:

$$Yij = \mu + i + \sum ij \ldots\ldots\ldots \text{(Sudjana 2012)}$$

Where:

Yij = Variable which observed at the level of concentration to i (I = 0, 1, 2, 3)

i = The effect of concentration level to – i

j = The effect of treatment at the level to – j

μ = Old median value

$\sum ij$ = The effect of error at block to –i and treatment to- j

To see if the hypothesis is accepted or rejected, the significant level of (α) 0,05 and 0,01 is used. If F-values > F-table, the hypothesis is received, conversely, if F-values < F-table, thus the hypothesis is rejected.

3. Result and Discussion

3.1 Length Growth of Catfish on the First and Fourth Observation

Data is collected through a series of observation which was conducted as long as 40 days of catfish feeding treatment with *Azolla Microphylia.* The measurement was conducted every ten days and was done using a ruler while the fish lays one by one on a basin. The following table shows the average of catfish length from the first to the fourth observation.

Table 1. Presenting Catfish Length on 10 Days in cm (First Observation)

Treatments	Groups				Sum	Average
	I	II	III	IV		
P0	15	15	15	15	60	15
P1	16	16	18	18	68	17
P2	18	18	18	26	80	20
P3	19	19	20	20	78	19,5
P4	14	14	14	14	56	14
Total	**82**	**82**	**85**	**93**	**342**	

Table 2. Presenting Catfish Length on 40 Days in cm (Fourth Observation)

Treatments	Groups				Sum	Average
	I	II	III	IV		
P0	25	25	25	25	100	25
P1	26	26	26	26	104	26
P2	28	28	28	28	112	28
P3	27	27	27	27	108	27
P4	24	24	24	24	96	24
Total	**130**	**130**	**130**	**130**	**520**	

Tabel 3. Test of ANOVA on Catfish Length for the Fourth Observation

Variety of Source	DB	JK	KT	Test F	
				F Values	F Table (0,05)
Group	4	3380	1126,6	3,99*	2,87
Treatment	4	40	10,00	4*	2,71
Galat	16	3390	282,5		
Total	**24**	**6.810**			

DB: Derajat Bebas/Degrees of Freedom
JK : Jumlah Kuadrat/ Sum of Square
KT : Kuadrat Tengah/ Median Square
* : Signifikan / Significant

Based on the ANOVA test on values of catfish length, it is known that there is a significant difference among groups. The score of $F_{values} > F_{table}$ showed F_{values} around 3,99 and F_{table} around 2,97. The treatment is also indicated $F_{values} > F_{table,}$ while F_{values} reach of 4 dan F_{table} reach of 2,71. The result revealed a significant difference, so it needed to continue for the test of *Beda Nyata Jujur* (BNJ), or the Honest Significant Difference. The result is as follow:

$$BNJ = q\alpha\,(P,n_2)\sqrt{\frac{KT\ galat}{r}}$$

$$= 4{,}45 \times \sqrt{\frac{11{,}78}{5}}$$

$$= 6{,}83$$

Table 4. Test of BNJ for Catfish Length on the Fourth Observation

Treatment	P0	P1	P2	P3	P4
P0	-	-	-	-	-
P1	$7{,}4^{*}$	-	-	-	-
P2	$4{,}6^{Ns}$	$2{,}8^{Ns}$	-	-	-
P3	$10{,}46^{*}$	$3{,}06^{Ns}$	$5{,}86^{Ns}$	-	-
P4	$9{,}56^{*}$	$2{,}16^{Ns}$	$4{,}96^{Ns}$	$0{,}96^{Ns}$	-

Ns : No Significance/*: Significance

For more details, the following chart presents the figures of the recapitulation scores of catfish length on the fourth group for all observations. All groups and treatments showed that feeding *Azolla Microphylla* brings a significant effect on the catfish length.

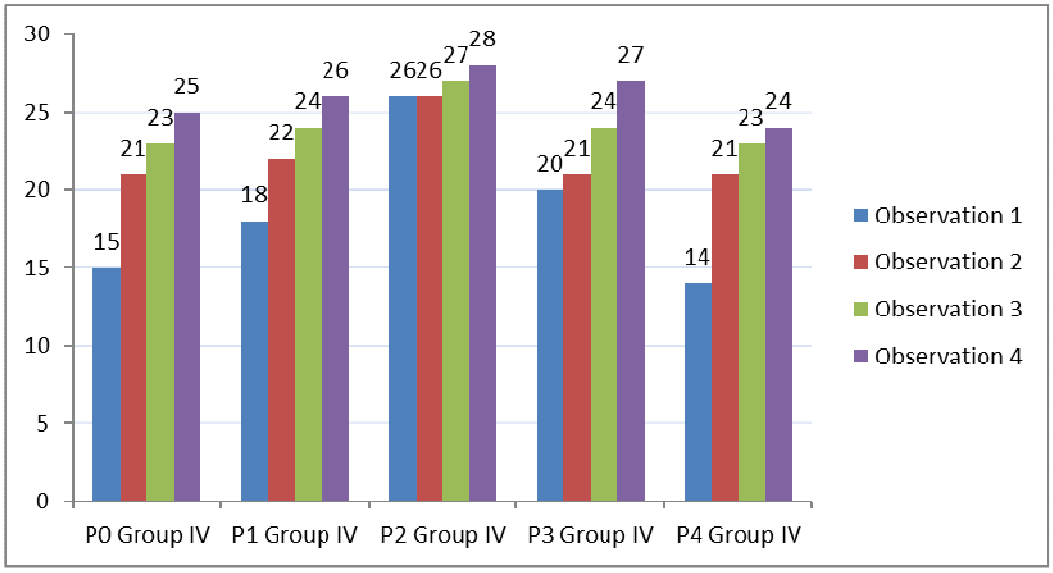

Figure 2. Describes Scores of Catfish Length on the Fourth Group for All Observations

3.2 Weight Growth of Catfish on the First and Fourth Observation

Table 5. Presenting Catfish Weight in 10 Days in Gram (First Observation)

Treatments	Groups				Sum	Average
	I	II	III	IV		
P0	45	45	40	45	175	43,75
P1	51	50	51	51	203	50,75
P2	55	54	55	55	219	54,75
P3	53	53	53	53	212	53
P4	40	41	40	41	162	40,5
Total	**244**	**243**	**239**	**245**	**971**	

Table 6. Presenting Catfish Weight in 40 Days in Gram (Fourth Observation)

Treatment	Groups				Sum	Average
	I	II	III	IV		
P0	90	90	90	90	360	90
P1	95	95	95	95	380	95

P2	100	100	100	100	400	100
P3	82	82	82	82	328	82
P4	80	80	80	80	320	80
Total	**447**	**447**	**447**	**447**	**1788**	

Tabel 7. Test of ANOVA on Catfish Weight for Fourth Observation

Variety of Source	**DB**	**JK**	**KT**	**Test F**	
				F Values	**F Table (0,05)**
Group	4	39961,8	13320	3,97*	2,87
Treatment	4	1148,8	287,2	4*	2,71
Galat	16	40249	3354		
Total	**24**	**81.359,6**			

Based on the ANOVA test on the values of the catfish growth, it is known that there is a significant difference among the groups. The score of $F_{values} > F_{table}$ with the F_{values} of 3,97 and F_{table} of 2,87. The treatment is also indicated by the $F_{values} > F_{table,}$ with F_{values} reaches of 4 dan F_{table} reaches of 2,71. The result reveals a significant difference and is required to continue to be tested with the test of *Beda Nyata Jujur* (BNJ) or the test of Honest Significant Difference, which the result is described as follow:

$$BNJ = q\alpha\,(P,n_2)\sqrt{\frac{KT\ galat}{r}}$$

$$= 4{,}45 \times \sqrt{\frac{11{,}78}{5}}$$

$$= 6{,}83$$

Table 8. Test of BNJ for Catfish Weight on fourth Observation

Treatment	**P0**	**P1**	**P2**	**P3**	**P4**
P0	-	-	-	-	-
P1	7,4*	-	-	-	-
P2	$4{,}6^{Ns}$	$2{,}8^{Ns}$	-	-	-
P3	10,46*	$3{,}06^{Ns}$	$5{,}86^{Ns}$	-	-
P4	9,56*	$2{,}16^{Ns}$	$4{,}96^{Ns}$	$0{,}96^{Ns}$	-

The following figure presents the details of catfish weight scores for the fourth groups on all observations. All groups and treatments show that being fed with *Azolla Microphylla* brings a significant effect on the catfish weight.

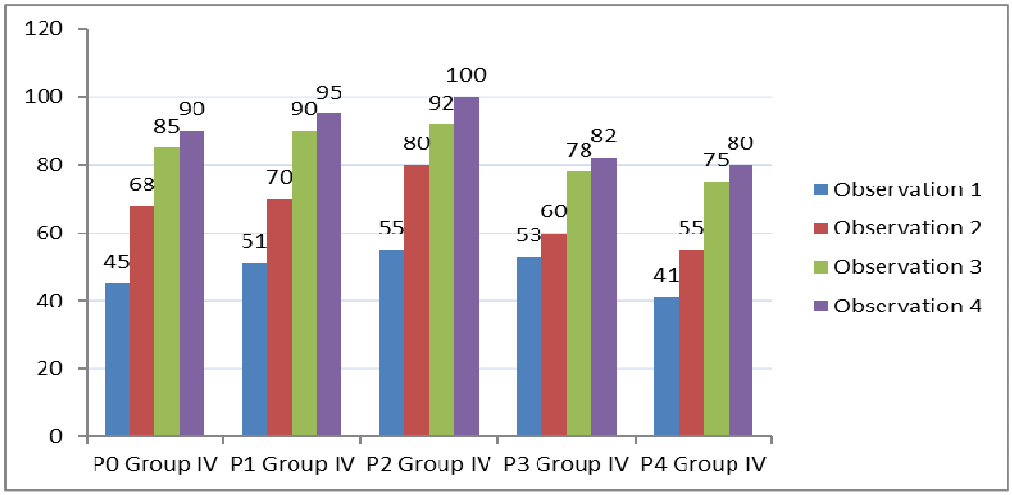

Figure 3. Describes Scores of Catfish Weight on the Fourth Group for All Observations

3.3 Discussion

3.3.1 Length and Weight of Catfish

Azolla Microphylla has been known to increase catfish growth especially the length and weight. The gain of the length of catfish was proved from the result of the present study that was conducted through a treatment. There are some scores indicated that *Azolla Microphylla* brought good nutrition for the growth of catfish. For instance, the length of the catfish for first observation is gradually increased in P1 and P3. Meanwhile, P2 shows a significant increase, whereas P0 and P4 are steady. Furthermore, the result also shows a gain of catfish length on the fourth observation. Compared to P0, P4 shows a higher number of lengths. For $P0_1$ to $P0_4$ the length of catfish reached 25 cm, while $P4_1$ to $P4_4$ the length of catfish reached 28 cm. This result indicates that feeding of 60-gram of *Azolla Microphylla* contributes well to the length of catfish growth which is shown in observations.

The increase in catfish growth also occurred in terms of weight. Groups P2 reached 100 gram which means feeding of 60-gram of *Azolla Microphylla* is proven to gain catfish weight. The scores of catfish length and weight for all observations in figures 2 and 3 confirmed that feeding catfish with *Azolla Microphylla* in 60 gram brings good growth, in length and weight for catfish.

From the result of this study, it is concluded that the nutrition contained in *Azolla Microphylla* needs to be informed to the catfish farmers so that an adequate amount of protein to keep catfish growing well is well learnt. As mentioned above, *Azolla* contains some potential protein such as N, P, Si, Ca, Fe, Mg, Zn, Mn. In recent research, it is stated that Azolla has higher protein content (19-30%) than most green forage crops, aquatic macrophytes and essential amino acids favourable for animal nutritional needs. The protein of Azolla plant is 23% - 3% which includes 55% of the amino acid (Gokcinar & Bekcan, 2015; Hundare et al., 2018).

Furthermore, Basak et al., (2002); Pillai et al., (2002); Maity & Patra (2008); Prabina et al., (2010); Cherryl et al., (2014); Anitha et al., (2016); Das et al., (2018) stated the family of *Azollaceae,* grows together with the blue-green algae (*Anabaena Azollae*) and is considered to be a promising feed because of its high productivity. *Azollaceae* appears as a good source of protein and contains almost all essential amino acids that are superior to wheat bran, maize and offal. Generally, the crude protein content of that plant's species is found in the range from 25% to 30% in dry matter basis at an optimum growth condition. However, under natural conditions, protein values near 20% to 22% are frequently found. Therefore, the protein content of *Azollaceae* is comparable to or higher than that of most other aquatic macrophytes. This plant is naturally rich in minerals such as iron, calcium magnesium, potassium, phosphorus, manganese and others, apart from its substantial quantities of vitamin A, precursor beta-carotene and vitamin B_{12}. It is also found that *Azolla* plants contain some probiotics and biopolymers.

4. Conclusion

Azolla Microphylla was found suitable for catfish growth that is proven by the gain of the length and weight which observed in around 40 days. It is suggested for catfish farmers to also cultivate *Azolla Microphylla* as natural and alternative fish feed, because of the plant's provided nutrition that scientifically proven to increase the catfish growth. Feeding each fish with 60-gram Azolla Microphylla is proven better than giving other treatments, but this dosage needs to be developed in the future research on the sustainable food, especially those that focus on animal food sources.

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