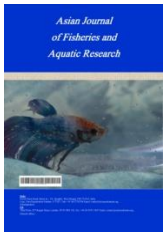

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Comparative Effect of Ratio of Fermented *Azolla pinnata* on Growth and Survival of Carp *(Cyprinus carpio)* Seeds

Mia Nurhidayati [a*], Roffi Grandiosa [a], Izza Mahdiana Apriliani [a] and Ibnu Bangkit [a]

[a] Department of Fisheries, Faculty of Fisheries and Marine Sciences, Padjadjaran University, Jln, Raya Bandung Sumedang KM 21, Jatinangor 40600, Indonesia.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The production in Indonesia of cultured fish in 2019 has increased from the previous year, the high demand for freshwater fish, especially carp will affect the feed needed in the cultivation process, while for now the price of commercial fish feed with good protein content the price of commercial feed are too expensive to come by and not readily available. The research evaluated the effect of different levels of formulated feed with fermented *Azolla pinnata* on the growth and survival of carp juveniles. The different levels of feeding fermented *A. pinnata* on the growth and survival of carp juvenile. The research was conducted from March 3, 2021 to November 2021 at the Fisheries Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. This study used methods and Completely Randomized Design (CRD), which consisted of five treatments with triplicate of each , namely commercial feed control and feed containing 25%, 50%, 75%, and 100% of fermented *A. pinnata* . The test 300 carp juveniles were used for this study and they were divided into five group containing 20 carp juveniles with triplicate of each group of 5-7 cm are kept in aquariums filled with water as much as 10 liter with the density of carp juvenile during the study was 20 fish per aquarium with a maintenance period of 40 days. The feed given was 5% of the body weight of the test fish. Parameters observed were growth rate, feed conversion ratio, absolute growth, survival rate, and water quality which were observed weekly. Data obtained from

**Corresponding author: Email: mia17004@mail.unpad.ac.id;*

this study were analyzed using ANOVA by Duncan's multiple post hoc analysis with a 95% confidence level. Based on research that fermented *A. pinnata* can be used as an additional feed for carp, feeding with a mixture of 25% pellets combined with *A. pinnata* 75% for the best treatment with a growth rate of 2.35%, absolute growth of 3,2 grams, feed conversion ratio of 2. 81 and a survival rate of 68%. Compare with control treatment, the results obtained were a growth rate of 2.60%, absolute growth of 4.1 grams, a feed conversion ratio of 1.62 and a survival rate of 68%, but the control treatment cost more due to using commercial feed without using feed addition.

Keywords: Carp; Azolla pinnata; growth rate; fermentation; feed conversion ratio; survival rate; absolute growth.

1. INTRODUCTION

Belongs the class of fish called Carp (*Cyprinus carpio*) is one of the freshwater fish that has economic value and is favored by the community, and contains omega 3 which can reduce cholesterol in the blood of human when consumed fish, is resistant to disease and tolerant of temperature fluctuations (Patriono *et al.* 2009). Carp are classified as omnivores, namely fish that prey on various types of food, and the nutritional content of goldfish is 16% protein, 2% fat, 1% carbohydrates [1]. Fish production in 2019 has increased from the previous year, currently in the aquaculture sector it has been recorded to reach 8.2 tons. Production in the aquaculture sector is currently increasing due to independent feed activities. Meanwhile, the development of freshwater fish production in 2020 is targeted to reach 18.44 million tons [2]. The high demand for freshwater fish, especially carp, which is the most desirable commodity, will affect the feed needed in the cultivation process. Thus, additional feed that has high protein is needed to form new tissues and repair existing tissues, including fat, carbohydrates, crude fiber, vitamins, and minerals. The addition of the feed is expected to have a low price as an additive to the main fish feed. One of them is using Azolla which is an aquatic plant. *A. pinnata* is a water fern that lives in rice fields, swamps, lakes and small rivers in tropical and sub-tropical areas, *A. pinnata* can be easily found and is usually not utilized by farmers and only considers it a weed, but actually *A. pinnata* has a very high protein content of 25-30% [3]. *A. pinnata* has the potential to be used as feed because it is widely found in calm waters. The protein content contained in *A. pinnata* is 21.58%, crude fat 2.23%, crude fiber 17.86%, ash 23.94% (Askar 2001). Azolla contains 24-30% crude protein, 0.4-1% calcium, 2-4.5% phosphorus, 3-3.3% fat, 9.1-12.7% crude fiber, 6.5% starch, and does not contain toxic compounds [4]. This study emphasizes the use of *A. pinnta* as a solution to reduce costs at the time of production which is used as a feed additive at a low price and to determine the effect of the ratio of *A. pinnata* and commercial feed on the growth and survival of carp (*Cyprinus carpio*).

2. MATERIALS AND METHODS

The research process lasted for 40 days from March to April 2021, at the Fisheries Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University. The tools used in the research are aquarium, analytical scales, ruler, pH meter, DO meter, thermometer, heater, millimeter block, stationery and documentation tools, while the materials used in the research are goldfish seeds measuring 5-8 cm, *Azolla pinnata* and EM4.

The method used in this research is the experimental method. This experimental design used a completely randomized design (CRD) with 5 treatments and with triplicate of each group. Furthermore, the analysis using the method of analysis of variance (ANOVA) F-test at the 95% confidence level. If there is a significant difference, it is continued with *Duncan's Multiple Range Test* (DMRT) with a significance level of 5%.

Experimental A: 100% *Azolla pinnata*
Experimental B: 25% *Azolla pinnata* and 75% commercial feed
Experimental C: 50% *Azolla pinnata* and 50% commercial feed
Experimental D: 75 % *Azolla pinnata* and 25% commercial feed
Experimental E: 100% commercial feed

Preparation begins with the adaptation of the test fish for 3 days and continues with the preparation of the test feed and aquarium. Preparation of test feed to be used is commercial feed with a minimum protein content of 30% and dried

A. pinnata which has been fermented and mashed mixed together. Feeding was carried out 3 times a day, namely in the morning, afternoon and evening at 07.00, 12.00 and 17.00 WIB.

The parameters observed are as follows:

Relative Growth Rate: According to (Taeuchi 1988 *in* Rachmawati and Samidjan 2006, Perdana *et al.* 2016 in Arsyadana *et al.* 2017) The relative *growth rate* or abbreviated as RGR is calculated by the following formula:

$$\mathrm{RGR} = \frac{W_t - W_o}{W0 \times t} \mathrm{X}\ 100\ \%$$

Information:

RGR : Relative growth rate (%/day)
W_t : Biomass of fish at the end of rearing (g)
W_o : Biomass of fish at the beginning of rearing (g)
t : Maintenance time (days)

Absolute growth: Absolute growth using the following formula (Weatherley *in* Putri *et al* . 2017) .

$$W = W_t - W0$$

Information:

W : Growth absolute weight (g)
W_t : Final weight of maintenance (g)
Wo : Initial weight of maintenance (g)

Life sustainability: Survival is a percentage of the number of organisms that live at the end of a certain time (Perdana *et al* . 2016 in Arsyadana *et al.* 2017) .

$$\mathrm{SR}\ (\%) = \frac{\mathrm{Nt}}{\mathrm{No}}\ \mathrm{X}\ 100\ \%$$

Information:

SR : Survival rate (%)
Nt : Number of fish fry at the end of the t research
No : Initial number of fish seeds

Feed Conversion Ratio: Feeding ratio is one of the efficiency parameters of FCR *(Feed Conversion Rate) feeding* (Arsyadana *et al.* 2017) .

$$\mathrm{FCR} = \frac{\text{Feed given (g)}}{\text{Fish weight gain (g)}}$$

Water quality: Water quality measurements were carried out to determine the condition of the water as the environment where live fish fry were measured, namely temperature, dissolved oxygen (DO) and pH, measurements were carried out every 7 days.

3. RESULTS AND DISCUSSION

3.1 Relative Growth Rate

Growth rate is the result of metabolism that can cause weight and volume gain in a certain period of time. Based on the results of observations made on goldfish which were treated for 40 days with five different treatments, namely as follows.

The effect of the treatment results on the relative growth rate of carp was analyzed using variance at the 95% confidence level, showing significantly different results between commercial feed and feed added with azolla.

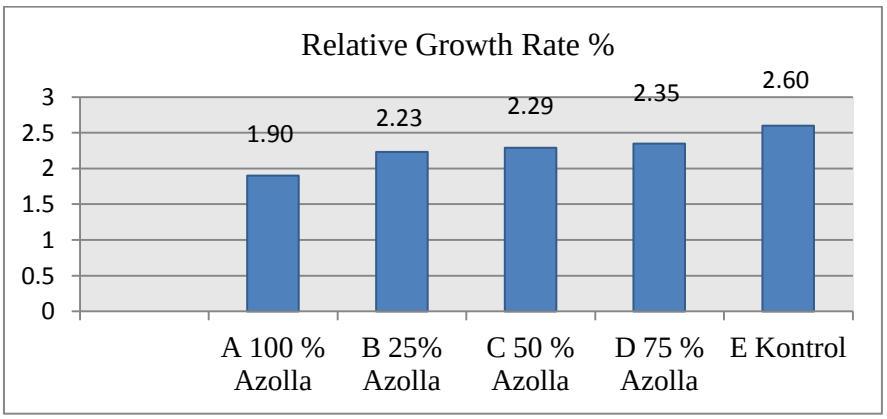

Fig. 1. Relative Growth Rate of Carp

In this study, with a maintenance period of 40 days, it was found that carp with treatment E (control) had the best value, this was because the fish had previously been used to the feed given during the study so they no longer had to adapt to the feed given. The treatment with a large growth value after control was treatment D (75% *A. pinnata*), with this, *Azolla* could be used to increase growth in fish.

Growth in fish will occur because of the energy left behind after the needs for metabolism and for the fish's body are met. Growth in fish will continue to occur if the feed consumed has protein levels, protein levels and the right protein-energy balance so that protein is used as a building block for the body for growth, while non-protein energy from fat and carbohydrates is used as an energy source [5]. The amount of feed that can be consumed by fish every day and the level of daily food consumption are factors that influence fish to grow optimally [6].

3.2 Absolute Growth

The next parameter, namely absolute growth, shows that there is growth in fish during maintenance, this can happen because the fish are able to absorb feed well and the feed given is according to their needs. A very important factor in determining the level of feed consumption is feed that has physical and chemical conditions possessed by feed ingredients which are reflected by their appearance, smell, texture and temperature so that they will help accelerate the fish growth process (Marbun *et al.* 2018).

According to Dani *et al.* (2005) fish growth is influenced by the size and age of the fish, the quality and quantity of feed given during the rearing period, differences in the composition of materials, the amount of feed and the frequency of feeding the fish. The quality of feed which includes (palatability, deliciousness of feed and nutritional content of feed) can affect the level of higher feed consumption, therefore the more feed consumed and utilized by fish, the better for fish growth. In addition, growth is also influenced by the digestibility of fish. Digestibility of fish is influenced by several factors, including composition and feed rations, feeding and the amount of feed consumed by fish (Marzuqi and Anjusary, 2013).

3.3 Survival Rate

The results of observations on the survival of carp during the maintenance period showed good results, where the average fish was able to survive above 65%. Below is a graph showing the treatment that produces the best survival value.

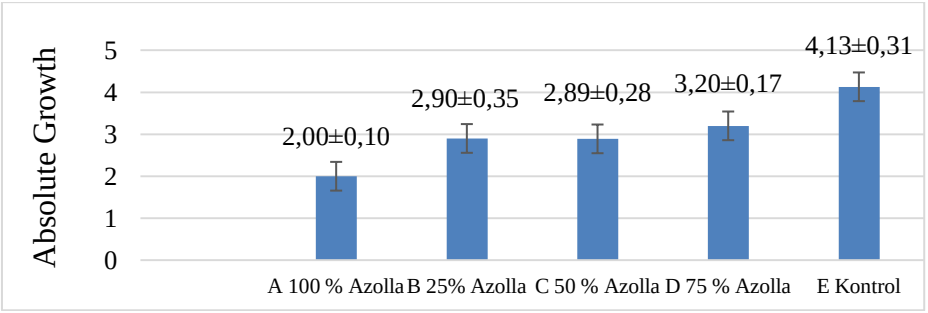

Fig. 2. Absolute growth of Carp

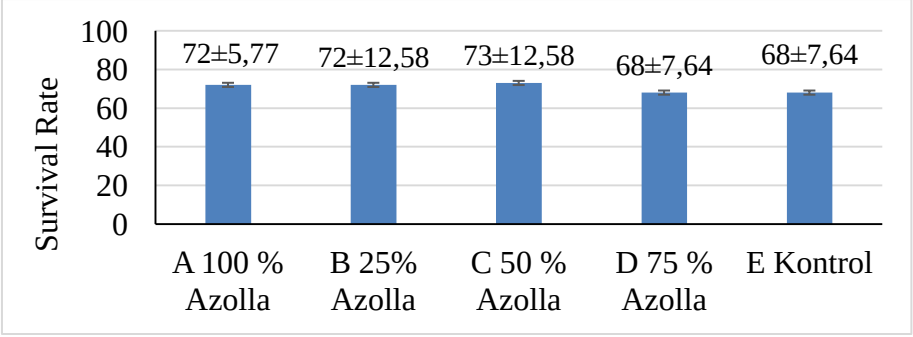

Fig. 3. Survival Rate of Carp

The survival of fish is also very dependent on the type of feed provided and the water conditions in the environment. Provision of feed with good quality and sufficient quantity to fish as well as good aquatic environmental conditions will greatly support the survival of carp. Based on (Ministry of Agriculture 1999 in Fahrizal and Nasir [7] states that the value of good survival for fish is on average 63.5% -86%. Meanwhile, according to Murjani [8] stated that the survival of fish ranged from 68.89%-75.56%. Research that has been carried out by researchers on goldfish on the survival of carp has results with an average value of 68%-73% which can be said to be good for the survival rate or survival of fish during cultivation and research.

3.4 Feed Conversion Ratio

Feed Conversion Ratio (FCR) is an indicator that determines feed effectiveness. It can be seen that if the feed conversion value is high, the efficiency level value is bad or not good, conversely if the value is lower, the feed conversion efficiency value will be better. The following is a graph of commercial feeding to which *A. pinnata has been added* with different presentation levels for 40 days.

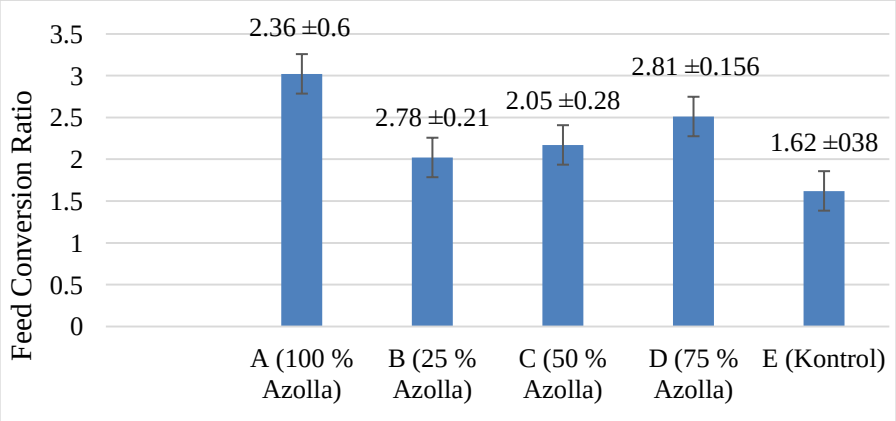

Fig. 4. Feed Conversion Ratio of Carp

Feed efficiency for fish is closely related to the level of fish's preference for the feed given, in addition to this the ability of fish to digest feed is also an indicator or parameter of feed being able to be efficient. Good quality feed is feed that has complete nutritional value so that it can meet the needs of fish. According to (Hariati 1989 in Arief et al. [9]) states that the best level of feed use efficiency will be achieved at the lowest feed conversion calculation value, where the condition of feed quality is better than other treatments. The results of analysis of variance showed that the addition of commercial feed with azolla showed good results to improve the feed conversion ratio. This is reinforced by Hariyanti et al. [10] the higher the conversion rate feed , the more feed will be given. Undigested feed or types of feed that are less preferred by fish are the causes of high feed conversion ratios [11,12].

3.5 Water Quality

Water quality is one of the important role holders in aquaculture activities for the sustainability of fish. The following table of water quality during the maintenance of goldfish.

Table 1. Carp rearing water quality

Treatment	Parameter		
	Temperature (°C)	Do (mg/l)	pH
A 100% Azolla	28	5.5	7.1
B 25% Azolla	28	5.3	7.6
C 50 % Azolla	28	5.3	7.5
D 75% Azolla	28	5.6	7.6
E Control	28	5.6	7.6
Standard	28-30*	>5*	6.5-8.5*

*Note: * SNI (1999)*

Based on the data above, the range values obtained are still in normal conditions for the growth and survival of carp.

4. CLOSING

4.1 Conclusion

Based on the results of the research that has been done, it can be concluded that *A. pinnata* can be used as additional feed for carp, feeding with a mixture of 25% pellets with *A. pinnata* 75% is the best treatment with a growth rate of 2.35%, absolute growth of 3.2 grams, feed conversion ratio of 2.81 and survival rate of 68%.

4.2 Suggestions

It is better you retitled this has recommendation and recommend other things that needs to be done in order to achieve a better. Like feed toxicity testing.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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