



Growth, Survival Rate and Feed Efficiency of Baronang Fish (*Siganus* sp.) Fed with the Addition of *Alstonia acuminata* Plants

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Abstract

One of the main challenges in cultivation is the availability of feed made from local raw materials. Artificial feed with good nutritional value is known to increase fish growth and feed digestibility. Therefore, we must look for cheaper raw materials so that we can reduce feed prices. One approach that can be used is to use natural ingredients, both vegetable and animal, based on local raw materials, as energy providers for fish growth. The use of the *Alstonia acuminata* plant as a local raw material component for feed is aimed at increasing growth, feed digestibility, and resistance to disease. This research aims to determine the addition of *A. acuminata* plants at different doses in feed to increase the growth, survival, and feed efficiency of rabbitfish fry. This research used a completely randomized design consisting of four treatments and three replications. *A. acuminata* plants at doses of 0, 1, 2, and 3% were mixed into isoprotein feed. The test fish used were rabbitfish fry with an initial weight of around 10–20 g, kept in an aquarium measuring 50 cm x 40 cm x 40 cm with a stocking density of 10 fish per aquarium. Fish were given test feed twice a day at 07.00 and 17.00 at satiation. Maintenance was carried out for 42 days. Growth measurements were carried out at the beginning and end of the experiment. The results showed that treatment C provided absolute growth, the highest specific growth rate, a 100% survival rate, as well as high feed efficiency.

Keywords: *A. acuminata*, Baronang, Efficiency, Survival, Growth.

1. Introduction

Currently, FAO estimates that global demand for fish and fish processing products in 2015 will increase to 183 million tonnes. This means that there is a significant increase compared to the amount of demand in 1999/2000 which reached 133 million tons. This figure shows that the level of dependence of the global community on fishery products is very high so that along with the increase in population, every year demand for fishery products increases by 3.1% [1]. Fisheries cultivation is an effort to increase the production and value of fisheries production, especially for types of fish with important economic value.

Rabbitfish (*Siganus* sp.) is one of the marine fisheries commodities with economic value and has quite bright prospects because the technology for rearing it has been mastered. This fish has the opportunity to become a species that can be developed in cultivation. According to Salampessy and Irawati (2021), in Indonesia the rabbitfish rearing business has only been carried out in several places, for example in the Seribu Islands, Banten Bay and the Riau Islands. Meanwhile in Maluku, research related to raising

rabbitfish in floating net cages (KJA) was only carried out at the Ambon Marine Cultivation Center (BBL), but this research used trash fish feed as the main feed, obtained results with a total length of 23 cm, SR 80.7% (Umar et al. 2014).

One of the main challenges in developing cultivation systems in Indonesia is the availability of feed with local raw materials. Feed availability is important because almost 60%–70% of production costs come from feed (Zakaria et al. 2018), so feed is an inseparable part. Good, quality, and cheap feed is certainly a hope for cultivation business actors. Feed with sufficient nutritional intake helps improve the growth performance of farmed fish and also improves the fish's immune system in dealing with pathogen infections and degradation of the quality of the rearing environment. Feed is also expected to be free from contaminants because mycotoxin contamination caused by feed will disrupt physiological and histological growth, which results in reduced fish immunity to disease (Novriadi, 2015).

Feed is a very important factor in determining the success of a cultivation business, including rabbitfish cultivation. Feed functions as the main energy source for the survival and growth of fish (Santoso and

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Agusmansyah, 2011). Artificial feed with good nutritional value is known to be able to increase fish needs to support intensive cultivation systems. Therefore, we must look for cheaper raw materials so that we can reduce feed prices. Fish growth is very dependent on the supply and nutritional content of the feed. One approach that can be used is to use natural ingredients, both vegetable and animal, based on local raw materials, as energy providers for fish growth. The use of *Alstonia acuminata* as a component is aimed at increasing growth, feed digestibility, feed efficiency, and increasing resistance to disease. The application of superior feed formulations originating from local ingredients is expected to reduce feed costs for farmers, accelerate fish growth, and increase rabbitfish production.

Research related to the use of natural ingredients has been carried out by several researchers on various types of fish. The research results of Dangeubun et al. (2013) reported that the *A. acuminata* plant can be used as an antibacterial and immunostimulant using the soaking method. Meanwhile, a study on adding *A. acuminata* plants to fish feed was carried out by Syahailatua et al. (2017) and Serang et al. (2018) for the mouse grouper *Cromileptes altivelis*. Both studies found that the addition of *A. acuminata* plants to as much as 0.2 g/100 g of feed could increase the absolute growth, daily growth rate, feed consumption, feed efficiency, and survival of *C. altivelis*. It is thought that the results of this research can be used to increase the growth of rabbitfish (*Siganus* sp.). This research aims to determine the addition of *A. acuminata* plants at different doses in feed to increase the growth, survival, and feed efficiency of rabbitfish juvenile.

2. Material and Methods

2.1. Time and Place

This research was carried out from September to October 2023 at the Tual State Fisheries Polytechnic Cultivation Laboratory.

2.2. Experimental Containers and Media

The experimental container used was 12 aquariums measuring 50 cm x 40 cm x 40 cm. Before using the aquarium, wash it with chlorine and leave it for one day. The media water used is sea water with a salinity of 32–33 ppt. Before use, the sea water is filtered first, then collected in a holding tank and sterilized with chlorine at a dose of 15–20 ppm. The water is neutralized first before use, and then the water from the holding tank is distributed to experimental containers. Each container was filled with 70 liters of sea water. To maintain the oxygen solubility of the

experimental medium, each aquarium was given moderate aeration using a hose and air stone. The aeration source comes from the 'root blower'. To maintain the quality of the media in the experimental container, the remains of food and droppings from the tested pompano fish were removed every day by siphoning them using a plastic hose. Before siphoning is carried out, aeration is stopped first.

2.3. Animals Test

The test animals used in this research were rabbitfish (*Siganus* sp.) seeds with an initial weight ranging from 20 to 50 g, kept in an aquarium measuring 50 x 40 x 40 cm with a stocking density of 5 fish per aquarium. The seeds were obtained from fishing in the natural waters around Sathean village, Southeast Maluku.

2.4. Feed Test

The test feed used consisted of 4 types with different doses of *A. acuminata* plant addition, including Feed A (0%), Feed B (1%), Feed C (2%) and Feed D (3%). Fish were given test feed twice a day at 07.00 and 17.00 at satiation.

Table 1. Composition of feed with the addition of *A. acuminata* plants

	Treatment Material	Dosage of <i>A. acuminata</i> (%)			
		0 %	1%	2%	3%
1	<i>A. acuminata</i> Meal	0.0	1.0	2.0	3.0
2	Fish Meal	28.0	28.0	28.0	28.0
3	Shrimp Head Meal	15.0	15.0	15.0	15.0
4	Corn Meal	10.0	10.0	10.0	10.0
5	Polar Meal	12.0	11.0	10.0	9.0
6	Merus Meal	10.0	10.0	10.0	10.0
7	Bran Meal	8.0	8.0	8.0	8.0
8	Fish Oil	5.0	5.0	5.0	5.0
9	Mineral Mix	5.4	5.4	5.4	5.4
10	Vitamin Mix	5.4	5.4	5.4	5.4
11	Attractant	0.6	0.6	0.6	0.6
12	Cr ₂ O ₃	0.6	0.6	0.6	0.6
Total		100	100	100	100

Table 2. Proximate composition of experimental feed

Proximate composition (%) dry matter)	Dosage of <i>A. acuminata</i> (%)			
	0%	1%	2%	3%
Water Content	4.05	5.14	4.61	4.05
Protein	45.32	45.35	45.16	45.22
Lipid	12.27	13.35	13.41	14.22
Ash Content	24.76	26.75	24.37	25.57

Crude Fiber	3.65	4.36	3.45	4.56
BETN	10.47	12.67	11.54	11.38

2.5. Experimental Design

The experimental design used was a completely randomized design with 4 treatments and 3 replications. These treatments are different doses of *A. acuminata*.

2.6. Research Parameters

The parameters measured include the individual's average absolute growth rate, daily growth rate, survival rate and feed efficiency.

2.6.1. Absolute Growth

Absolute growth in weight is calculated using the formula (Effendie 1997):

$$W_m = W_t - W_0$$

Note:

- W_m = Absolute growth in average weight (g)
- W_t = Average weight at the end of the study (g)
- W_0 = Average weight at the beginning of the study (g)

Absolute growth in length is calculated by referring to the formula (Effendie 1997):

$$L_m = L_t - L_0$$

Note:

- L_m = Absolute growth in average length (cm)
- L_t = Average weight at the end of the study (cm)
- L_0 = Average weight at the beginning of the study (cm)

2.6.2. Daily Growth Rate

The daily growth rate of fish is calculated based on the equation referring to the formula (Bambang *et al* 2011):

$$G = \frac{\ln w_t - \ln w_0}{t} \times 100\%$$

Note:

- G = Daily Growth Rate (%)
- L_t = Growth of test biota at the end of the study (g)
- L_0 = Growth of test biota at the beginning of the study (g)
- t = Length of maintenance (days)

2.6.3. Survival Rate

Survival Rate (SR) is calculated based on the equation referring to the formula (Tarigan, 2014.)

$$SR\% = \frac{\text{number of initial fish} - \text{number of dead fish}}{\text{number of initial fish}} \times 100\%$$

2.6.4. Feed Utilization Efficiency

Feed Utilization Efficiency (FUE) is calculated based on the formula (Effendie 1997) as follows:

$$EPP\% = \frac{w_t - w_0}{F} \times 100\%$$

Note:

- FUE = Feed Utilization Efficiency(%)
- W_t = Average weight at the end of the study (g)
- W_0 = Average weight at the beginning of the study (g)
- F = Total amount of fish feed given (g)
- D = Weight of fish that died during the study (g)

To determine the growth of rabbitfish seeds, then the increase in body weight and body length of the rabbitfish was measured. Measurements were taken at the beginning and end of the experiment. Body weight was measured using a sitting scale with an accuracy of 0.1 gr. Body measurements using a sliding anchor.

2.5. Data Analysis

These parameters will be tested statistically, to determine the effect of the test feed on the measured parameters, an analysis of variance (F test) was used. If there is a difference between treatments, continue with the BNJ Test (Steel and Torie, 1993).

3. Results and Discussion

3.1. Results

3.1.1 Average Absolute Growth of Individuals

The results of measuring the average weight of individual fish show that during the 42-day observation period, there was an increase in the average absolute growth in weight of rabbitfish (Figure 1). The highest average absolute weight growth was in the 2% treatment, with a value of 28.40 g. Followed by the 1% and 3% treatments, and the lowest value is the 0% treatment with a value of 16.00 g. Based on the results of statistical tests, it showed that feeding with the addition of different *A. acuminata* provided a significant difference in the absolute growth of the average weight of fish fry during 42 days of rearing ($P < 0.05$).

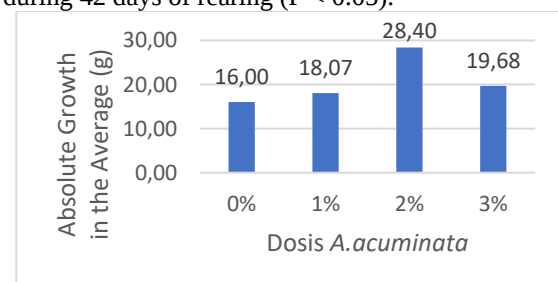


Figure 1. Absolute growth in the average weight of individual fish during the rearing period.

Meanwhile, the results of measuring the average length of individual fish show that during the 42-day observation period, there was an increase in the average absolute growth in length of rabbitfish (Figure 2). The highest average absolute length growth was in the 2% treatment, with a value of 3.00 cm. Followed by the 3% and 1% treatments, and the lowest value is the 0% treatment with a value of 1.13 cm. Based on the results of statistical tests, it shows that feeding with the addition of different *A. acuminata* provides a significant difference in the absolute growth in the average length of fish fry during 42 days of rearing ($P < 0.05$).

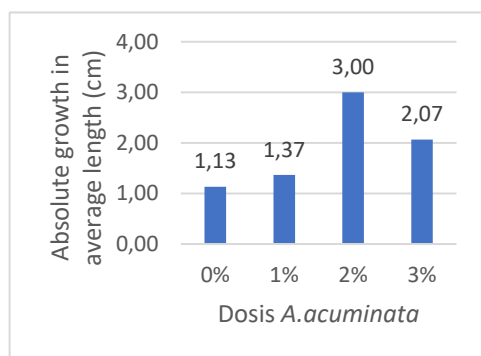


Figure 2. Absolute growth in average length of fish during the rearing period

3.1.2. Daily Growth Rate

The measurement results showed that during the observation period, there was an increase in the specific growth rate of rabbitfish weight (Figure 3). The highest average daily weight growth rate was in the 2% treatment, with a value of 1.45%/day. Followed by 3% treatment, and 1%, and the lowest value is the 0% treatment with a value of 0.88%/day. Based on the results of statistical tests, it showed that feeding with the addition of different *A. acuminata* did not provide a significant difference to the daily growth rate of the average weight of fish fry during 42 days of rearing ($P < 0.05$).

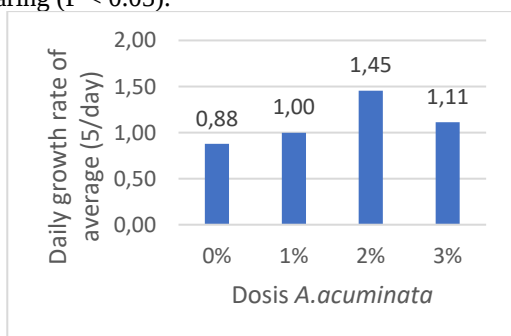


Figure 3. Daily growth rate of average fish weight during the rearing period

Meanwhile, the results of measuring the length of the fish showed that during the observation period

there was an increase in the average specific growth rate for the length of the rabbitfish (Figure 4). The highest average daily growth rate in length was in the 2% treatment, with a value of 0.52%/day. Followed by the 3% and 1% treatments, and the lowest value is the 0% treatment with a value of 0.21%/day. Based on the results of statistical tests, it showed that feeding with the addition of different *A. acuminata* provided a significant difference in the daily growth rate of the average length of fish fry during 42 days of rearing ($P < 0.05$).

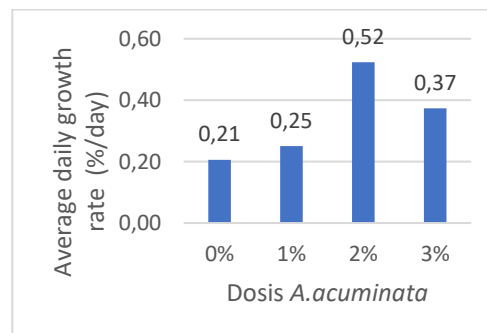


Figure 4. Average daily growth rate of fish during the rearing period

3.1.3. Survival Rate

The fish survival rate obtained was 100% for all treatments. During the maintenance period, it showed that no fish had died (Table 3).

Table 3. Fish survival rate during the observation period

days	Dosage of <i>A. acuminata</i> (%)			
	0%	1%	2%	3%
0	100	100	100	100
42	100	100	100	100

3.1.4. Feed Utilization Efficiency

The feed efficiency values obtained from each treatment can be seen in the table below. Based on the results of statistical tests, it showed that feeding with the addition of different *A. acuminata* provided a significant difference in the feed efficiency of rabbitfish fry during 42 days of rearing ($P < 0.05$).

Table 4. Feed Utilization Efficiency values for each feed treatment

Parameters	Dosage of <i>A. acuminata</i> (%)			
	0%	1%	2%	3%
Feed Utilization Efficiency (%)	63.65±12	68.68±3	81.38±5	75.16±5
	.18 ^b	.97 ^{ab}	.12 ^a	.41 ^{ab}

3.2. Discussion

Growth is the process of increasing the length and weight of an organism, which can be seen from changes in length and weight over a period of time. Fish growth is influenced by the quality and quantity of feed, age, and water quality. The increase in the average absolute growth in weight and body length of tiger grouper fish proves that the external factor that is very influential, apart from the aquatic environment, on growth is food.

The increase in the average absolute growth in weight and body length of tiger grouper fish proves that external factors are very influential. Apart from the aquatic environment, food is also affected by growth. In this study, the use or addition of *A. acuminata* plants at 2 g/100 g of feed provided good absolute growth performance. As said by Laheng et al. (2016). The use of plant materials in fish feed is starting to get more attention to improve the health status of organisms and the efficiency of feed utilization, which can ultimately increase fish growth.

Studies on the addition of *A. acuminata* plants in feed were reported by Syahailatua et al. (2017) and Serang et al. (2018) for grouper *Cromileptes altivelis*. The results showed that the addition of *A. acuminata* plants at 0.2 g/100 g of feed resulted in absolute growth, feed consumption, and high feed efficiency. Meanwhile, Dangeubun et al. (2019) reported that the addition of *A. acuminata* plants to as much as 0.2 g/100g of feed was able to increase the average absolute growth of *Lates calcarifer* snapper.

The increase in growth performance may be due to the addition of 2 g/100 g of *A. acuminata* feed, which is the optimum level of *A. acuminata* for rabbitfish fry, so that the feed is used more efficiently and produces better growth. Based on research results (Dangeubun et al., 2013), it is known that pure isolates from the ethyl acetate extract of *A. acuminata* skin are known to contain the structure of the compound methyl-hydroxy-2-methoxy-3(2-oxohexyl) benzoate, while based on LC-MS results, the crude extract of *A. acuminata* skin methanol is known to contain the dominant compound coumaric acid, as indicated by a spectrum with a molecular mass of 339.0468. This compound is thought to be p-coumaroyl quinic acid (C₁₆H₁₈O₈), which is included in the group of phenolic compounds (Dangeubun, 2012). The results of this research strongly suggest that the *A. acuminata* plant has the potential to be an immunostimulant.

Serang et al. (2018) reported that the addition of *A. acuminata* plants at 0.2 g/100 g of feed resulted in the highest daily weight growth rate of *Cromileptes altivelis* duck grouper fry, namely 4.00%/day. Meanwhile, the brood grouper fish is *Cromileptes altivelis*. The highest average daily weight growth rate was when *A. acuminata* was added at 0.4 g/100 g of feed, namely 0.74%/day (Serang et al. 2018). The same research was carried out by Dangeubun et al. (2019) on several types of fish, where the addition of

A. acuminata to as much as 0.2 g/100 g of feed provided the highest daily growth rate in weight and length in snapper *L. calcalifer*.

The high survival rate of fish shows that the addition of *A. acuminata* can produce a high survival rate of rabbitfish (*S. guttatus*), but it must be remembered that accurate feed formulation must be used. The addition of *A. acuminata* does not necessarily affect the growth and survival of fish. Suprayudi et al. (2011) found that the high survival rate of fish indicates that the quality and quantity of feed provided are sufficient to meet basic needs and can even increase growth.

The survival results obtained during the research are in line with what was reported (Hermawan et al., 2015); the average survival rate for tiger groupers fed egg yolk and tembang fish was 100% and given pelleted feed was 98.89%. The same results were also obtained by Hamzah et al. (2012) With the addition of selen methionine as an amino acid mixture in pellet feed up to 16 mg/kg feed, the survival rate for duck grouper seeds was 100%.

Meanwhile, Dangeubun et al. (2013) stated that administering a crude extract of *A. acuminata* skin with 200 ppm treatment resulted in the highest average response in increasing total leukocytes. monocytes. lymphocytes and neutrophils were able to increase the survival rate of tiger grouper fish, namely 94.44%. This research found that the number of lymphocytes before infection at a dose of 200 ppm was 75.5% and increased to 82.35%. This shows that the fish's humoral immune response is in good condition, resulting in resistance to foreign objects and the formation of antibodies.

Feed efficiency is the percentage of the amount of feed that can be utilized by fish during the rearing period. The efficiency of feed use increases in fish that experience rapid growth, namely rapid increase in body weight when the fish are fed again after fasting. Based on the results of observations. It was found that the highest feed efficiency for rabbitfish was 81.38%, followed by treatment D. B and the lowest was treatment A, namely 63.65%. According to Satpahty et al. (2003), the daily weight gain rate of fish is closely related to the feed efficiency value. If the daily weight gain rate increases, the feed provided can be used as efficiently as possible for fish growth. so that the efficiency value also increases. This will be followed by the feed conversion value. Feed that is of good quality and can be digested well by fish has a high efficiency value and a low conversion value.

4. Conclusion and Recommendation

From this research, it can be concluded that feeding with the addition of *A. acuminata* at 2 g/100 g of feed can increase the best growth of rabbitfish (*Siganus sp.*) fry. High survival rate and feed efficiency, in cultivating rabbitfish (*Siganus sp.*), the feed provided is expected to add 2 g/100 g of *A.*

acuminata plant feed with a feed protein content of 45% to accelerate the growth of rabbitfish.

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