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Research Article

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Growth and Survival Rate of Tilapia (*Oreochromis niloticus*) Receiving *Acanthaster planci* Based Feed

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ABSTRACT

Crown of thorns star (*Acanthaster planci*) is one of the aquatic organisms that contains protein and amino acids similar to fish meal, and has not been used properly for feed ingredients. This research was conducted to examine *A. planci* flour as a feed ingredient on the growth of tilapia. The research method was a completely randomized design, consisting of 4 treatments with doses of *A. planci* flour, 7 %, 14 %, 21 % and 0 % (control), given three replications. The results showed growth (daily growth rate and biomass increase) of 3.84 %, 3.81 %, 4.00 %, and 4.21 % per day, and 61.00 g, 49.33 g, 54.33 g, and 52.67 g. This growth did not show any difference between treatments (P>0.05). Feed consumption ranged from 129.20 g – 132.24 g (P>0.05). Feed conversion ratio and survival rates ranged from 2.13 – 2.75 and 94.44 % - 100.00 % (P>0.05). *A. planci* flour can be used up to 21 % as a source of protein to reduce the use of fish meal in feed of the fish.

Keywords: *Acanthaster planci*, *Amino acid, Fish meal, Growth rate, Protein*

ABSTRAK

Bintang mahkota duri (*Acanthaster planci*) merupakan salah satu organisme perairan yang mengandung protein dan asam amino yang mirip dengan tepung ikan dan belum dimanfaatkan dengan baik untuk bahan pakan. Penelitian ini dilakukan untuk mengkaji tepung *A. planci* sebagai bahan pakan pada pertumbuhan ikan nila. Metode penelitian adalah Rancangan Acak Lengkap, terdiri dari 4 perlakuan dengan dosis tepung *A. planci*, 7%, 14%, 21% dan 0% (kontrol), diberikan tiga kali ulangan. Hasil penelitian menunjukkan pertumbuhan (laju pertumbuhan harian dan peningkatan biomassa) sebesar 3,84 %, 3,81 %, 4,00 %, dan 4,21% per hari, dan 61,00 g, 49,33 g, 54,33 g, dan 52,67 g. Pertumbuhan ini tidak menunjukkan adanya perbedaan antar perlakuan (P>0,05). Konsumsi pakan berkisar antara 129,20 g – 132,24 g (P>0,05). Rasio konversi pakan dan tingkat kelangsungan hidup berkisar antara 2,13 – 2,75 dan 94,44 % - 100,00 % (P>0,05). A. Tepung planci dapat dimanfaatkan hingga 21% sebagai sumber protein untuk mengurangi penggunaan tepung ikan dalam pakan ikan.

Kata kunci: *Acanthaster planci*, asam amino, tepung ikan, tingkat pertumbuhan, protein

1. Introduction

Tilapia (*Oreochromis niloticus*) is a type of freshwater fish consumption. Tilapia has several advantages such as relatively fast growth, tolerance to wide environmental changes, more resistance, and widely consumed (Belton et al., 2009). Because of these advantages, development of Tilapias production in aquaculture became one of an effort to provide animal protein needs for the community.

The best food which plays as a main source of nutrients for fish is very important to push production. Poor management of fish feed can causes low profits because fish feed is the highest cost in aquaculture (Baki and Yücel, 2017). The cause of high feed prices is the availability of raw materials, especially fish meal as the main protein source which is rare and

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expensive (Hernandez et al., 2008; Monentcham et al., 2010). An effort to reduce feed price can be done by optimizing the use of vegetable raw materials as a source of protein in fish feed (Jiang et al., 2018; Ariman-Karabulut et al., 2019; 2021). Vegetable raw materials are not able to replace fish meal as a source of protein because of their high content of anti-nutritional substances such as phytic acid (Schlemmer et al., 2009; Wang et al., 2009; Chakraborty et al., 2019) and an unbalanced amino acid profile such as methionine, cysteine and tryptophan which are low (Hertrampf and Felicita, 2000; Kaushik et al., 2008). Crown of thorns star flour (*Acanthaster planci*) alternatively has a high protein and amino acid which might be able to apply as substitute for fish meal (Luo et al., 2011).

Crown of thorns star (*A. planci*) is an aquatic organism that lives in coral reef ecosystems (Stella et al., 2011: Kayal et al., 2012). In abundant conditions these organisms are caught, dried and stockpiled because they become pests for coral reef ecosystems (Suharsono, 1991; Rotjan and Lewis 2008; Stella et al., 2011; Kayal et al., 2012). These organisms in the form of flour have the potential to used as feed raw materials (Lou et al., 2011). Azlou, (2016) has reported that the use of *A. planci* flour, as a feed ingredient, has been shown to increase the color of carp. Therefore, this study aims to examine the effect of using *A. planci* flour as a feed raw material on the growth and survival of tilapia (*O. niloticus*).

2. Materials and Methods

2.1. Location

This research is located at the Tadulako University Fisheries Laboratory, Palu City, Central Sulawesi.

2.2. Test Organism

Tilapia (*O. niloticus*) sized 12.4±1.7g, obtained from the Central Fish Seed Center of Kalawara, Sigi Regency, Central Sulawesi were used in this research. The test fish were adapted to the media for 12 hours before implementation of the treatment.

2.3. Research Design

The study was designed using a completely randomized design (CRD). Three dosages of *A. planci* flour in the feed compared with one control deigned with: A); 7 %, B); 14 %, C); 21 %, and D; 0 % (control). Each treatment consisted of three replications.

2.4. Feed Formulation and Manufacturing

The research feed was formulated with a protein target of 28 %, and the same energy (Safir et al., 2017b). The composition of the use of feed raw materials is presented in Table 1. The manufacture of feed begins with weighing and mixing the ingredients, molding and drying the feed. The methods and procedures used refer to the research of Jiang et al. (2018). The prepared feed was confirmed for its nutrient content through proximate analysis using the

Table 1. Raw Material Composition and Feed Nutrient Content

Raw Material	Composition (%)			
	7	**14**	**21**	**0 (control)**
Sardine flour	28.00	21.00	14.00	35.00
A. planci flour	**7.00**	**14.00**	**21.00**	**0.00**
Soy flour	28.00	37.00	44.50	20.50
Bran flour	14.50	10.50	6.50	17.00
Corn strach	15.00	10.00	6.50	20.00
Corn Oil	2.25	2.25	2.25	2.25
Fish oil	1.75	1.75	1.75	1.75
Tapioca	2.00	2.00	2.00	2.00
Vitamin & Mineral mix	1.50	1.50	1.50	1.50
Total	100.00	100.00	100.00	100.00
Target Gross energy (kcal/kg)	3909.99	3951.99	3979,00	3902,83
C/P	13.61	13.73	13.94	13.48
Results				
Protein (%)	28.58	28.18	29.16	28.82
Carbohidrat* (%)	34.42	33.14	34.17	33.36
Fat (%)	12.55	13.84	11.38	13.32
Ash (%)	14.68	14.67	15.68	14.29
Water content (%)	9.78	10.18	9.62	10.22

Carbohidrat: Extract ingredients without Nitrogen + Coarse Fiber

AOAC method (2007). Total fat content was measured by the Soxhlet method and protein by the Kjedhal method. The water content was measured to calculate the difference in the weight of the feed before and after drying by heating method using an oven at 105 to 110 ºC for six hours (Takeuchi, 1988).

2.5. Maintenance of The Fish

A sample of twelve tilapia was put in an aquarium (50 x 25 x 30 cm^3) with a volume of 40 liters of water that had been prepared, Fish stocking at afternoon. Maintenance of test fish for 40 days with a frequency of feeding three times a day (morning, afternoon and evening) ad-libitum (Safir et al., 2017a). Before feeding, a shift pond was carried out in the aquarium and water was added to the amount of water that came out. To maintain water quality in the normal range, periodic monitoring is carried out. Water changes 2-3 times a week until the end of maintenance. Water quality measurements include temperature, pH and dissolved oxygen in the morning and evening before and after water changes.

2.6. Test Parameters and Data Analysis

Measurement of body weight of the test fish was carried out every 20 days by weighing all the test fish for each replication. The response of the treatments tested fish was observed through several observation parameters including daily growth rate (DGR), biomass increase (BI), feed consumption (FC) and feed conversion ratio (FCR) as well as the survival rate (SR) of each treatment. The data for the DGR, FCR and SR of the test fish were calculated by referring to the formula used by Jiang et al. (2018). BI is calculated by subtracting the final fish weight from the initial fish weight, the same thing for the value of feed consumption. The data obtained were tabulated using the Microsoft excel program and analyzed using the one-way ANOVA test at the level of 95%, and Duncan's test.

3. Results

3.1. Growth Rate and Biomass Increase

The daily growth rate (DGR) and biomass increase (BI) of tilapia fed with different dosages of feed made from *A. planci* are presented in Table 2. Test fish fed treatment with the percentage of *A. planci* flour was 7 %; 14 %; 21 % and control (0 %) resulted in a mean LPH respectively of 3.94±0.24; 3.81±0.67; 4.00±0.51; 4.21±0.23 %/day, and BI is 61.00±6.08; 49.33±14.43; 54.33±15.95; 52.67±3.06. Based on the results of the analysis, all treatments did not show an effect on the body's DGR and BI of the test fish.

3.2. Feed Consumption (FC) and Feed Conversion Ratio (FCR)

The number of FC in tilapia (*O. niloticus*) for 40 days and given treatment feed made from *A. planci* flour with different doses from the lowest to the highest value, namely 129.20±6.49 g (7 %), 129.85±8.20 g (21 % dose), 129.96±4.67 g (dose 14 %), and 132.24±9.34 g (0 %/control). The lowest to highest FCR were 2.13±0.13 (7 % dose), 2.51±0.63 (21 %), 2.52±0.26 (0 % dose/control), and 2.75±0.61 (14 % dose) (Table 2). Analysis of all treatments did not show any effect on the level of feed consumption and feed conversion ratio.

3.3. Survival Rate dan Water Quality

The percentage of survival rate of tilapia (*O. niloticus*) fed treated feed for 40 days ranged from 94.44 % - 100 % (Figure 1). The analysis showed that there was no difference in the survival rate of the test fish for all treatments. The value of water quality during maintenance ranged from 25.1-28.3 °C temperature, 4.0-7.9 ppm dissolved oxygen and 7.4-8.3 pH.

Table 2. Daily Growth Rate (DGR), Biomass Increase (BI), Feed Consumption (FC) and Feed Conversion Ratio (FCR) as well as the Survival Rate (SR), tilapia as a result of feed treatment made from *A. planci* with different percentages.

Observation parameters	Treatment (dose of *A. planci* raw material)			
	7%	14%	21%	0% (control)
DGR (%/day)	3.94±0.24[a]	3.81±0.67[a]	4.00±0.51[a]	4.21±0.23[a]
BI (g)	61.00±6.08[a]	49.33±14.43[a]	54.33±15.95[a]	52.67±3.06[a]
FC (g)	129.20±6.49[a]	129.96±4.67[a]	129.85±8.20[a]	132.24±9.34[a]
FCR	2.13±0.13[a]	2.75±0.61[a]	2.51±0.63[a]	2.52±0.26[a]

Note: the same superscript on the same line shows no significant difference (P>0.05).

4. Discussions

Tilapia fed a diet containing *A. planci* flour at 7 %, 14 % and 21 % did not show differences in growth between treatments including controls (P>0.05). The same results were found by Azlou, (2016) who tested feed made from *A. planci* on carp (*Carassius auratus*). The decrease in protein sourced from fish meal along with the decreasing use of this material, can be replaced by protein sourced from *A. planci* flour which is increasingly being used (Table 1). Content of *A. planci* flour such as high protein is 29.69% (proximate analysis results) and can be absorbed by fish. Lou et al., (2011) reported that *A. planci* flour also contains 18 amino acids whose profile resembles that of fish meal. Of the 18 amino acids, there are 4 essential amino acids (leucine, valine, isoleucine, methionine) and 1 non-essential amino acid (cysteine) which have high values.

Leucine and isoleucine have functions as insulin protein simulators and regeneration of damaged cells. Valine plays a role in increasing endurance, lowering blood sugar levels and increasing growth (Bae et al., 2012; Han et al., 2014). Methionine plays an important role in metabolic processes in the body as well as a precursor of non-essential amino acids such as cysteine. Methionine and cysteine containing sulfur function as precursors of carnitine and glutathione to protect cells from oxidative stress (Fang et al., 2002; Li et al., 2007; Andri et al., 2020). *A. planci* also contains astaxanthin and saponins as antioxidants and anti-inflammatory (Mayer and Gustafson, 2008; Lou et al., 2011). This strengthens the suspicion that the cause of growth performance including the consumption level and feed conversion ratio of the treated fish remained the same as the control fish even though the fish meal used was reduced. The use of fish meal in food composition therefore can be replaced by *A. planci* flour with no diffenences in fish growth between treated fish and control fish.

Furthermore, the consumption rate and feed conversion ratio were the same in all treatments with controls, indicating that the feed could be consumed and absorbed well by the fish. These conditions directly support the high survival rate of this study (Figure 1). One of the survival factors that remains high is the ability of organisms to absorb and utilize nutrients in feed for metabolic needs (Hamza, 2013).

5. Conclusions

The use of *A. planci* flour as a raw material did not have a negative effect on growth, consumption levels and feed conversion ratios and the survival of tilapia (*O. niloticus*). *A. planci* flour can be used up to 21 % as a raw material for protein sources in minimizing the use of fish meal.

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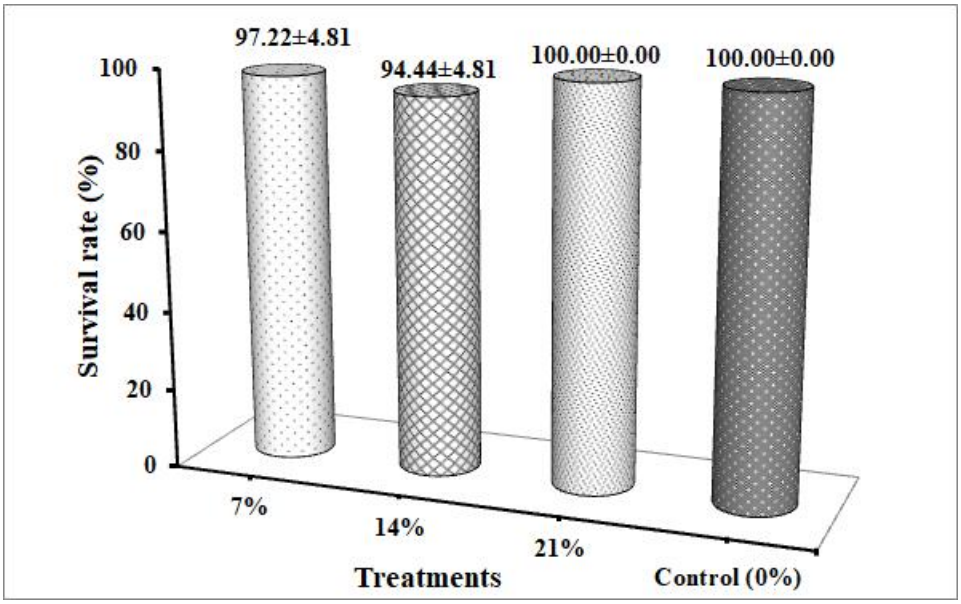

Figure 1. Survival rate of tilapia (*O. niloticus*) fed a feed containing *A. planci* flour at different doses for 40 days

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