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Effect of adding β-glucan in feed on the growth rate of White Snapper (*Lates calcarifer*) fingerling

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ABSTRACT

White snapper *Lates calcarifer* is an economically important marine fish commodity. The addition of immunostimulant ingredients in fish feed is believed to increase immunity and increase fish growth. This study aims to determine the effect of adding β-glucan into the feed of white snapper (*L. calcarifer*). This study used a completely randomized design (CRD) consisting of 5 treatments with 3 repetitions. The white snappers used has a weight of ± 6 grams and a length of ± 7. The frequency of feeding was done 3 times a day. The results of the ANOVA test showed that the addition of β-glucan in the feed significantly affected the growth rate of the white snapper (*L. calcarifer*) fry (P>0.05). The best treatment in this study was treatment E (commercial feed + β-glucan 8g/kg feed) which gave the best growth in white snapper, increasing their absolute weight (4.51 ± 0.29), absolute length (4 .84 ± 0.284), specific growth rate (2.09 ± 0.15), FCR (1.00 ± 1.00), feed utilization efficiency (97.42 ± 0.50), and survival (100.00 ± 0.00).

Introduction

White snapper *(Lates calcarifer)* is an economically important marine fish commodity. White snapper has become a commercial cultivation business for aquaculture entrepreneurs in the fisheries sector. The high market demand makes white snapper production expected to be stable, but white snapper production has not yet reached its production target. Indonesia's white snapper production in 2017 was 22,545 tons, while the national production target was 30,000 tons (KKP, 2018). Constraints faced by white snapper fish farming include the limitation due to white snapper fish seeds which is caused by the low growth rate of white snapper fish. This is due to several factors such as feed nutrition and the use of additional supplements.

Problems that occur in the field include the difficulty of using artificial feed in the growth rate of white snapper seeds (Mudjiman, 2001). Another factor that hinders the development of white snapper aquaculture in Indonesia is that at the size of 3-7 cm, white snappers are susceptible to stress and has an immune system that is susceptible to disease (Affandi et al., 2002). Efforts can be made to optimize the utilization of feed nutrients by white snapper, one of which is by improving the quality of the feed. This can be achieved by adding feed additives into the feed. Feed additive is an ingredient that is added to the feed in relatively small amounts for a specific purpose.

The addition of β-glucan into the feed is an effort that can be done to increase the growth rate of white snapper seeds. β-glucan is a glucose homopolymer that is bound by β -(1.3) and β -(1.6)

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glucoside bonds and is found in many cell walls. β-glucan is a major component of polysaccharides. Some microorganisms such as yeast and mold/fungus, and cereals such as wheat and barley, have high economic value because they contain large amounts of β-glucan. Several studies on β-glucan show advantages in its use.

β-glucan supplementation in vannamei shrimp feed increased the effect of immune response and growth, while in giant prawns β-glucan affected their growth rate (Ekasari et al., 2016). According to Hai et al. (2009) giving β-glucan to shrimp causes the surface structure of their intestine to become wider, so that nutrient absorption is better, an improvement in nutrient digestion will lead to better feed efficiency and protein absorption which in turn will result in increased growth performance (Dawood et al., 2015).

According Suprayudi et al. (2006) found that the addition of immunostimulant ingredients (commercial yeast, vitamin C, β-glucan and chromium-yeast) in feed could increase the immune response and growth of duck grouper *(Cromileptes altivelis*) and their resistance to Vibrio parahaemolyticus bacterial infection. Until now, reports on the use of β-glucan on the growth rate of white snapper fish are not yet available, therefore it is expected that β-glucan can support the growth performance of white snapper fish.

Materials and Methods

Location and time of research

This research was carried out from October to December 2020. This research took place at the Brackish Water Cultivation Fisheries Center (BPBAP) Ujong Batee, Aceh Besar.

Experimental design

The research method used is an experimental method using a completely randomized design (CRD) with five treatment levels and three repetitions.

Treatment level:

Treatment A : commercial feed (control)
Treatment B : commercial feed + β-glucan 2g/kg feed
Treatment C : commercial feed + β-glucan 4g/kg feed
Treatment D: commercial feed + β-glucan 6g/kg feed
Treatment E : commercial feed + β-glucan 8g/kg feed

Addition of β-glucan to commercial feed

The β-glucan used is commercial β-glucan. The β-glucan is then mixed into the white snapper seed feed. The working method applied is ß-glucan with a predetermined dose dissolved using 5 ml of distilled water and then sprayed into the feed. The β-glucan solution that has been mixed with the feed is aired for a few minutes before being given to the white snapper fry.

Maintenance container preparation

The containers used during the study were 15 units of 25-liter buckets. Before the containers were used, they must be sterilized first. The containers were then filled with 10 liters of sterile water and is equipped with hose and aeration stone. Before spreading the seeds, acclimatization was carried out, so that the water temperature of the transport medium is the same as the container water. 10 seeds were stocked in each container.

Fish seed maintenance

The sample fish used were white snapper seeds measuring 5 cm - 7 cm. The fish were kept for 30 days, with sampling done every 7 days starting from the beginning of the study. During maintenance, water changes of as much as 50% of the amount of water in the container were carried out 2 times a day.

Observation parameters

Absolute weight growth

The absolute growth of fish is calculated by the formula from Effendie (1979), which is as follows:

$$W = W_t - W_0$$

Where: W is Absolute average growth (g), W_1 is Average weight at the end of the study (g), W_0 is Initial average weight of the study (g)

Absolute Length Growth

The calculation for absolute length growth can be calculated by the Effendi formula (1979), as follows:

$$PPM = Lt - L0$$

Where: PPM is Average growth of absolute length (cm), Lt is the average length at the end of the study (cm), and L0 is the average length at the start of the study (cm)

Specific Growth Rate

Specific growth rate can be calculated using the Effendie (1979) formula, as follows:

$$LPS = \frac{LnWt - LnW0}{t} \text{ X } 100\%$$

Where: LPS is Specific growth rate (%)/day, W0 is Average initial weight (gr), Wt is Average final weight (gr), t is Time (day).

Table 1. Growth, efficiency of feed utilization, ratio of feed utilization and survival of white snapper seeds.

Treatment	Parameter					
	Absolute Weight (Grams)	Absolute Length (Cm)	Specific Growth Rate (%)	FCR	Feed utilization efficiency (%)	Survival Rate (%)
A	2.313 ± 0.590^{a}	2.873 ± 0.029^{a}	1.300 ± 0.249^{a}	1.147 ± 0.040^{c}	87.297 ± 3.285^{a}	86.67 ± 5.77^{a}
B	3.160± 0. 123^{b}	3.920 ± 0.558^{b}	1.6133± 0. 1069^{b}	1.043± 0.045^{b}	87.457 ± 1.980^{b}	100.00 ± 0.00^{b}
C	3.707± 0. 327^{b}	4.420 ± 0.585^{bc}	1.9033± 0. 1644^{bc}	1.037± 0.035^{b}	89.017 ± 3.648^{b}	100.00 ± 0.00^{b}
D	3.627± 0. 346^{b}	4.207 ± 0.539^{bc}	1.8033± 0. 1222^{bc}	1.033± 0.015^{b}	90.577 ± 0.575^{b}	100.00 ± 0.00^{b}
E	4.510± 0. 288^{c}	4.837 ± 0.284^{c}	2.0867± 0. 1457^{c}	1.000± 1.000^{a}	97.423 ± 0.500^{c}	100.00 ± 0.00^{b}

Note: The average value in the same column with different superscripts shows a significant difference (P<0.05) and the value with the same superscript in the column shows no significant difference (P>0.05).

Feed conversion ratio (FCR)

Feed Conversion Ratio (FCR) is the ratio between the amount of feed given to the fish meat produced. According to Muchlisin et al. (2016) Solid FCR is calculated based on the following formula:

$$FCR = \frac{F}{Wg} \times 100$$

Where: FCR is feed conversion ratio, F is Amount of feed given during the study (g), Wg is Weight gain during the study (g)

Survival rate

Survival rate can be calculated according to Effendie (1979), namely:

$$KH = \frac{Nt}{N0} \times 100\%$$

Where: KH is survival rate (%), Nt is number of live fish at the end of rearing (quantity), N0 is number of fish at the beginning of rearing (quantity)

Water quality

Observation of water quality parameters, namely temperature, pH, salinity and DO. Measurements were made at the time of fish sampling, i.e. once every 7 days during the maintenance period.

Results

The results showed that the weight gain of white snapper during the study ranged from 2.31±0.60 to 4.51±0.29 grams, the absolute length increase was between 2.88±0.03 to 4.84±0.28 cm, the growth rate was between 2.88±0.03 to 4.84±0.28 cm. Specificity ranged from 1.3±0.25 to 2.09±0.15%/day, feed conversion ratio ranged from 1±1.00 to 1.15±0.04, feed efficiency ranged from 87.30±3.29 to 97.42±0.50%/day, and survival ranged from 86.67±5.77 to 100±0.00%. Based on the results of the ANOVA test, it was shown that the addition of β-glucan in the feed had a significant effect on absolute weight gain, absolute length gain, specific growth rate, feed conversion ratio, feed utilization efficiency, and snapper survival. The best treatment in this study was treatment E (commercial feed + β-glucan 8g/kg feed) (Table 1).

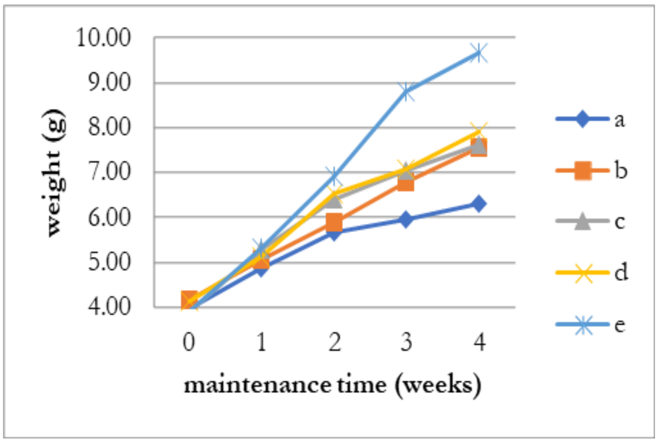

Figure 1. Absolute weight gain graph of snapper.

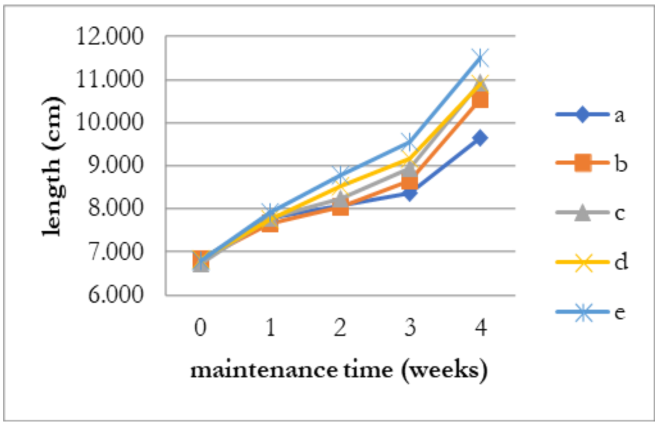

Figure 2. Absolute length gain graph of snapper.

Based on Duncan's test, the absolute weight of treatment E was significantly different from other treatments. For the absolute length parameters and specific growth rates, treatment E was significantly different from treatments A and B, but not significantly different from treatments C and D. The BNJ follow-up test also showed that FCR and FUE in treatment E were different from the other treatments. Treatment with the addition of β-glucan resulted in a high live game value (100%) and was significantly different from the control.

During the five weeks of rearing, the white snapper experienced normal weight and length gain. In the second week there was a faster increase in growth until the 4th week. The best growth was found in treatment E compared to other treatments (Figure 1), the growth rate during the study did not have any obstacles so that the graph value did not decrease. The absolute length growth rate at week 4 was significantly different compared to other weeks (Figure 2). Measurement of water quality during 35 days of maintenance shows good conditions for the growth of white snapper fry. The quality of water data during the study can be seen in Table 2.

Table 2. Water quality parameters during maintenance.

No	Water Quality Parameters	Value During Maintenance	unit
1	Salinity	24-27	Ppt
2	DO	4.55-6	mg/l
3	PH	7.1-8.7	-
4	Temperature	22-31.9	°C

Discussion

Based on the results of the study, it can be seen that the results of the application of ß-glucan in the feed was significantly different, and it had a significant effect on absolute weight gain, feed conversion ratio, feed utilization efficiency, and survival of *L. calcarifer*. Absolute weight gain, absolute length gain, specific growth value, feed conversion value and feeding efficiency were best in treatment E that given 8g ß-glucan and followed by treatment groups of 2 grams, 4 grams, and 6 grams, while feeding without ß-glucan did not affect the growth of white snapper (*L. calcarifer*) seeds. For survival rates, all treatments using ß-glucan have a fairly good value from the control treatment (without ß-glucan).

Results from the research showed that the use of ß-glucan in feed was able to increase the growth rate of white snapper seeds. This is indicated because ß-glucan is a prebiotic that can improve digestion. This is in line with the statement of Ye *et al.* (2011) who said that in general, the positive effect of the use of probiotics and feed efficiency was related to the process of nutrient digestion. The results of the research by Ekasari *et al.* (2016) also explained that the addition of 0.15% ß-glucan which gave the best immunity performance and could also increase the specific growth rate of giant prawns by 18.52%. Ringo *et al.* (2010) also added that the increase in digestive enzyme activity occurred possibly due to changes in microbes in the digestive tract caused by the administration of prebiotics and probiotics.

It is also suspected that the addition of ß-glucan in the feed can increase the activity of good bacteria which has a positive impact on the digestion system of white snapper fry. Rufuchaie and Hoseinifar, (2014) explained that ß-glucan administration has been known to increase the growth of good bacteria such as lactic acid bacteria in the digestive system which can produce enzymes such as proteases and amylase in the digestive tract (Irianto and Austin, 2002; Farzanfar, 2006; Waché et al., 2006; Hoseinifar et al., 2011). This would accelerate the process of food degradation in the digestive tract, a good digestive system will certainly accelerate the growth of white snapper seeds. Irianto (2003) stated that probiotics can regulate the microbial environment in the intestines and restrain pathogenic microorganisms in the intestines by releasing enzymes that help the process of digestion of food.

Utilization of feed during the study can be seen from the FCR value obtained (1), which was recorded in treatment E. According to Effendie (1997) a relatively good Food Conversion Ratio (FCR) value ranges from 0.8 to 1.6. The lower the value of the feed, the better the quality of the feed given. This FCR value also indicates that during maintenance the feed provided is efficient. This is supported by Sulawesty *et al.* (2014) which states that the feed conversion ratio indicates efficiency in feeding. Indirectly, a good FCR value also indicates that the value of feed utilization efficiency is optimal. Treatment E has an FUE value of 97%. Suprayudi (2006) explained that the addition of 2.5 g/kg of ß-glucan feed was able to increase the feed efficiency of duck grouper by 62.49%. Maulidin *et al.* (2016) explained that a good FUE value indicates that the food consumed has good quality, so it can be easily used and utilized efficiently.

The survival rates of white snapper seeds at the end of the study using ß-glucan had a survival value of 100%, in contrast to the treatment which has a value of 86.67%. According to Suprayudi (2006), the addition of ß-glucan of as much as 2.5 g/kg of feed was able to maintain the life of grouper duck by 90%. This is indicated by the application of ß-glucan as an immunostimulant that can increase the immunity of white snapper. The results from Bridle *et al.* (2005) also showed that administration of ß-glucan in salmon (*Salmo salar*) can stimulate an increase in respiratory burst activity (RBA) in macrophages in vitro. Other results are also confirmed by the study of Spain-Hartono et al. (2002) who stated that administration of yeast cells (S. cerevisiae) containing -glucans could increase several parameters of the natural immune system in gilthead seabream (*Sparus aurata*).

The survival of fish fry in general is not only influenced by the factor of ß-glucan administration in the feed but also by external factors such as the environment. Mulyani *et al.* (2014) stated that the survival rate is influenced by internal and external factors. The external factor in question is the environment where the fish lives and the internal factor is the fish itself. However, based on the results obtained, it was found that giving ß-glucan had a good impact on the life of barramundi fry when compared to giving ß-glucan in the feed.

Water quality during the study was not much different from levels detailed under SNI (2014) and was suitable for the survival of white snapper fry. Siphoning is carried out every day, in the morning and evening to maintain clean water quality from feces and leftover feed. The water quality obtained during the study was temperatures ranging from 24-31.9°C, Chua and Teng (1978) in Langkosono (2007), stated that the optimal water quality for snapper growth, such as temperatures ranging from 24-31°C and Kordi and Tancung statement (2005) which states that the optimum temperature range for fish life is 24-32 °C. The value of the degree of acidity (pH) ranges from 7.1 to 8.7.

According to Hardianti *et al.* (2016), a good pH or degree for production is the pH of seawater that ranges between 7–9. DO measurement values ranged from 4.55-6 ppm, DO for marine aquaculture should be above 5 mg/L. This is confirmed by Shubhi *et al.* (2017), which states that the oxygen consumption of each species is different, where pelagic fish such as red snapper and white snapper require higher DO than demersal fish. The value of salt content (salinity) ranges from 20-27 ppt, the temperature range is in accordance with SNI (2000), which ranges from 15-35 ppt.

Conclusion

Based on the results of the study, it was found that the addition of ß-glucan had a significant effect on absolute weight gain, absolute length, specific growth rate, feed utilization efficiency, feed utilization ratio, and seed life of white snapper. The best treatment in this study was treatment E, which was 8 g/kg of feed.

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