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Growth, Total Production and Feed Efficiency of Catfish (*Clarias* sp.) Orally Administered with Shrimp Waste Hydrolyzate

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Abstract

Dimas Rizky Hariyadi, Alim Isnansetyo, Indah Istiqomah, Ign. Hardaningsih, Wahyudi and Sung Sam Kim. 2018. Growth, Total Production and Feed Efficiency of Catfish (*Clarias* sp.) Orally Administered with Shrimp Waste Hydrolyzate. *Aquacultura Indonesiana, 19 (1): 15-20*. Shrimp Waste Hydrolyzate (SWH) /Shrimp Soluble Extract (SSE) is a product produced from the enzymatic process of shrimp waste. SWH contains essential and non-essential amino acids which useful for fish. This study aimed to determine effect of SWH on the growth and total production of catfish. The parameters observed were average growth rate, specific growth rate (SGR), food conversion ratio (FCR), protein efficiency ratio (PER), total production and length weight relationship from beginning until the end of rearing period. Growth performance was observed by calculating average growth rate and SGR of catfish. The results of this study showed that oral administration of SWH significantly increased SGR of catfish length at 4th sampling period with value 1.54% body length/day. Administration of SWH did not affect on the AGR, FCR, PER and total production. The growth pattern of catfish is negative allometric.

***Keywords**:* Catfish; Food conversion ratio; Growth; Production; Protein efficiency ratio; Shrimp waste hydrolyzate

Introduction

Catfish is one of the most popular freshwater aquaculture species in Indonesia. Productions of catfish reached second ranks after tilapia production in 2015, with a total production of 719,619 tons, from the target of 1,058,400 tons (KKP, 2016). The data indicate that the target of catfish production has not been achieved. In aquaculture, feed is a key role to increasing production. Improved nutritional value in feed may provide better growth. Utilization of nutrients in an efficient diet is an important factor to improve the growth.

Protein plays a key role in maintaining optimal growth and reproduction of fish (Martínez-Palacios *et al*., 2007; Deng *et al*., 2011). Deficiency of amino acids can lead to a decrease in growth (NRC, 1983). Shrimp waste hydrolyzate (SWH)/Shrimp Soluble Extract (SSE) is a product of protein hydrolyzate produced from shrimp head waste and has been enriched with amino acid and peptide mixtures. SWH as an attracting agent has activated amino acids and active peptides that are highly digestible and can be absorbed for animals (Gildberg and Stenberg 2001; Aksnes *et al*., 2006). SWH of 2% mixed into feeds give higher growth performance in rainbow trout (Jo *et al*., 2014) and has a beneficial effect on growth performance in Malabar grouper (*Epinephelus malabaricus*) (Li *et al*., 2009) and red sea bream (*Pagrus major*) (Khosravi *et al*., 2015). However, there is a lack of information regarding to the supplementation of SWH in feed of freshwater aquaculture species. Publications on the evaluation of SWH to promote catfish growth and to improve feed efficiency are not available. This study aimed to evaluate SWH in increasing growth performance and total production of catfish (*Clarias* sp.).

Materials and Methods

Experimental setup

Nine fiber glass containers (50 cm×50 cm×60 cm) were used for rearing catfish at density of 40 fish/container. The containers were filled with clean water until 40 cm. Catfish with 9.0±0.2 g of individual weight was reared for 90 days. Feed treatments were given continuously until the observation done.

Experimental Design

This study used a completely randomized design (CRD) with three treatments in triplicates, P1 (commercial feed, as negative control), P2 (feed + 2% SWH) and P3 (feed + 2% OL4, as positive control). OL4 is a commercially available immunostimulant. The observation of catfish growth included measurement of length and weight were performed periodically. Total production was calculated at the end of the rearing period.

Feed and Feeding

Catfish used in this study was provided from a catfish hatchery in Bantul, Yogyakarta. Catfish was fed twice a day at 08.00 and 15.00. The feed was a commercial pellet from Cheil Jedang feed manufacture (Galaxy GL-2) with 20–25% of protein content. SWH (Vietnam Organic, Ca Mau Vietnam) was weighed and then dissolved in 40 mL of aquadest and sprayed to the feed. Control feed was the commercial feed without any supplement. After being sprayed, the feed was dried at room temperature (20–25°C) overnight before being applied to the fish.

Sample Collection and Analysis

Average body weight and length

Catfish was weighed using scales with a 0.01 g precision level. Total length measurement was performed by measuring the catfish using a 30 cm ruler with a 0.1 cm precision level. The length and weight data were collected every two weeks from beginning until the end of cultivation.

Specific growths of length and weight

Specific growths of length and weight were calculated every two weeks by formula (Zonneveld *et al*., 1991):

$$SGR = \frac{\ln Lt - \ln Lo}{t} \times 100\%$$

$$SGR = \frac{\ln Wt - \ln Wo}{t} \times 100\%$$

Explanation:
SGR : specific growth rate (%)
t : time (day)
Lt : length of fish at the end of rearing (g)
L0 : length of fish at the beginning of rearing (g)
Wt : weight of fish at the end of rearing (g)
W0 : weight of fish at the beginning of rearing (g)

Size distribution

Size distribution was observed at the end of cultivation period and classified in three sizes: small size (50–100 g), normal size (100–150 g) and big size (> 150 g). Size distribution of catfish showed in percentage (%).

Feed conversion ratio

Feed conversion ratio was calculated by calculating the amount of feed given during the cultivation, compared to the increase of biomass during cultivation period, FCR calculated by the formula of Stickney (1979) as follows:

$$FCR = \frac{\Sigma\ Feed}{Wt - Wo}$$

Explanation:
FCR : feed conversion ratio
Σ Feed : the consumed feed during rearing (g)
Wt : weight of fish at the end of the rearing (g)
W0 : weight of fish at the beginning of rearing (g)

Protein efficiency ratio

Calculation of protein efficiency ratio using the formula of Zonneveld *et al*. (1991):

$$SGR = \frac{Wt-Wo}{Pi} \times 100\%$$

Explanation:
PER : protein efficiency ratio (%)
Wt : weight of fish at the end of rearing (g)
W0 : weight of fish at the beginning of rearing (g)
Pi : the weight of the feed protein consumed (g)

Total production

The biomass of catfish in each container measured at the end of rearing period (90 days) by using scale with a 1 g precision level to obtain the total production data.

Length weight relationship

Analysis of 60 fish/treatments length and weight relationship using regression test with formula (Effendie, 1979):

$$W = aL^b$$

Explanation:
W : fish body weight (g)
L : fish length (cm)
a and b : constants

Data Analysis

The growth performance, FCR, PER and total production data were analyzed by using One-way analysis of variance through SPSS 20.0 program from IBM Corporation, New York USA. Normality and homogeneity tests were performed before the variance test. Duncan's test was performed on a treatment that showed significant difference (P≤0.05) to know significance between treatments with 95% confidence level.

Results

The growth of length and weight increased in each sampling period. The variance analysis of the specific growth rates of weight and length showed that there was significant difference (P>0.05) between P3 (positive control) with other treatments (P1 and P2) at 6th sampling period (70 days). The highest growth of weight and length were found in P3. Average growth rate of length and weight of catfish in this study are presented in Figure 1.

Specific growth rates of length and weight in this study decreased by increasing the rearing period. The variance analysis of the specific growth rate of weight showed that there was no significant difference (P>0.05). P2 (SWH treatment) significantly increased (P≤0.05) specific growth rates of length at 4th sampling period (42 to 56 days) with value of 1.2; 1.54 and 0.82, respectively. Specific growth rate of length and weight of catfish are presented in Figure 2.

Size distribution analysis in this study indicated that P2 (SWH treatment) provided a highest portion of small size (50–100 g) and normal size (100–150 g) groups with percentages of 29.91% and 37.19%, respectively. However, P2 showed lowest percentage in big size (>150 g) group. Highest portion of big size group was found in P3 (positive control) treatment with a percentage of 59.69%. Size distribution of catfish in this study is presented in Table 1.

The variance analysis of feed conversion ratio in this study showed no significant difference (P>0.05). P2 showed the highest level of feed conversion ratio, 1.51. The value of FCR in this study is presented in Table 2.

The variance analysis of protein efficiency ratio in this study showed significant difference (P≤0.05) between SWH treatment (P2) with positive and negative control. P2 showed the lowest level of protein efficiency ratio with value 1.89%. The PER in this study is presented in Table 3.

The variance analysis of total production, biomass improvement and length improvement showed a significant difference (P≤0.05) between P3 (positive control) with P1 (negative control) and P2 (feed with 2% HLU). P3 resulted the highest total production, biomass improvement and length improvement namely 4,478.97 g; 4132.21 g and 16.61 cm, respectively.

The result of length and weight relationship test showed that the growth pattern of catfish in each treatment was negative allometric (b<3). The value of "a" ranged from 0.009 to 0.015, and the value of "b" ranged from 2.76 to 2.91. The relationship of length and weight is presented in Table 5.

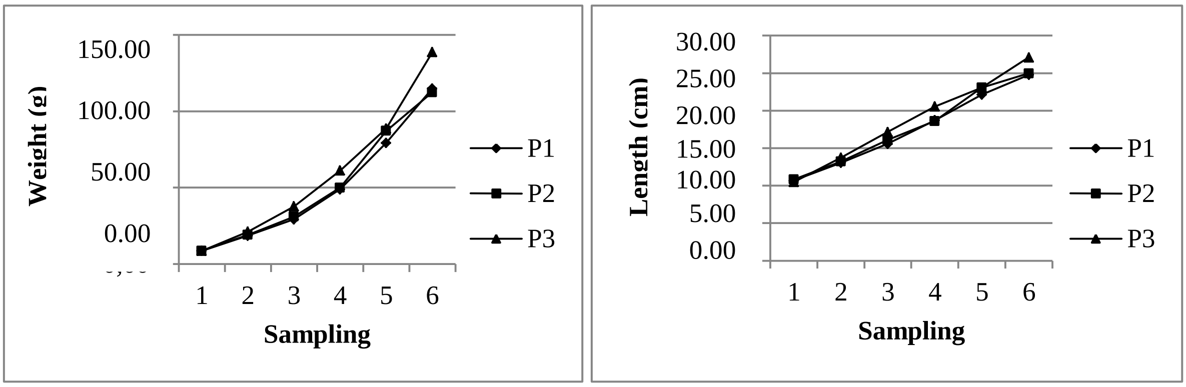

Figure 1.Weight and length increament of catfish fed with 2% SWH and OL4 in all of sampling period.

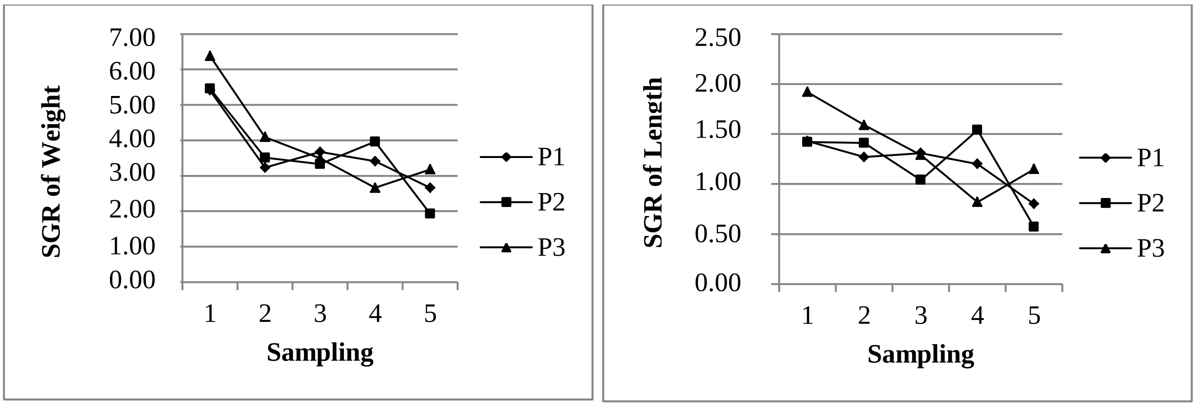

Figure 2. Specific growth rate of catfish fed with 2% SWH and OL4 in all of sampling period.

Table 1. Size distribution of catfish fed with 2% SWH and OL4

Treatment	Size Distribution (%)		
	50–100 cm	**100–150 cm**	**> 150 cm**
P1 (negative control)	25.42	36.96	37.62
P2 (SWH 2%)	29.91	37.19	32.90
P3 (positive control)	8.41	34.90	56.69

Table 2. Food convertion ratio of catfish fed with 2% SWH and OL4

Treatment	FCR
P1 (negative control)	1.20±0.13
P2 (SWH 2%)	1.51±0.27
P3 (positive control)	1.15±0.04

Table 3. Protein efficiency ratio of catfish fed with 2% SWH and OL4

Treatment	PER (%)
P1 (negative control)	2.43±0.29[b]
P2 (SWH 2%)	1.89±0.34[a]
P3 (positive control)	2.46±0.08[b]

Table 4. Biomass and length improvement, and total production of catfish fed with 2% SWH

Treatment	Biomass Improvement (g)	Length Improvement (cm)	Total Production (g)
P1 (negative control)	3050.85±258.81[a]	14.09±0.84[a]	3,399.59±257.16[a]
P2 (SWH 2%)	3165.46±242.79[a]	14.15±1.19[a]	3,517.66±248.19[a]
P3 (positive control)	4132.21±362.28[b]	16.61±0.59[b]	4,478.97±364.96[b]

*The same superscript letter in the same column indicates no significant difference (P>0.05)

Table 5. Length weight relationship of catfish orally administered with SWH

Treatment	$W = aL^b$	Growth Pattern	R^2
P1 (negative control)	$W = 0.0113\ L^{2.86}$	Negative Allometric	0.89
P2 (SWH 2%)	$W = 0.0150\ L^{2.76}$	Negative Allometric	0.87
P3 (positive control)	$W = 0.0090\ L^{2.91}$	Negative Allometric	0.70

Discussion

The results of the variance analysis showed that SWH did not provide a significant improvement (P>0.05) in average body weight and length, but the increments were still in optimum range for catfish culture for 90 days. This result is similar to the results obtained by Hung (2014), used SWH/SSE has no significant effect on growth of tilapia. Suprayudi *et al*. (2006) found that the addition of commercial yeast, β-glucan, vitamin C and chromium-yeast in the formulation of artificial feed also does not significantly affect the nutritional value and growth of grouper (*Cromileptes altivelis*). Other studies reported that feeding with different protein and protein energy levels has an effect on feed efficiency, but does not affect relative growth rates in carp (*Cyprinus carpio*) (Setiawati *et al*., 2008). Specific growth rate of catfish length in this study increased at 4th sampling period indicating it's effected on SGR of catfish length.

All of treatments in this study produced big size category of catfish (>150 g) in the range of 37.62 – 56.69%. P3 (positive control) resulted in the highest percentage of this portion. In contrast, this treatment also resulted in the lowest percentage of small size catfish indicating the good distribution of size dominated by big size and medium size group. Variation in size was found in P1 and P2 indicated that P3 is the superior treatment to promote the growth of catfish.

The feed conversion ratio (FCR) indicates the level of feed efficiency for biomass increment. The lower feed conversion indicates higher feed efficiency to support the growth of fish. The FCR in this study was not significant different (P>0.05) among treatments. Feed conversion ratio is not an absolute number, since it is not only determined by the quality of feed, but also influenced by other factors such as fish species and fish size, stocking density, water quality and genetic factors (Akbar *et al*., 2008). Feed quality is influenced by the digestibility or absorption level of feed nutrient. The lower feed conversion ratio indicates the better feed quality (Djariah, 2005).

Increase in protein levels will not certainly improve feed efficiency. The average feed efficiency increases by increasing protein feed rate, but decreases in the feed with the excessive protein level. The reduced feed efficiency may be caused by excess protein, so protein digestion rate is not optimal. If the protein is excessive in feed, the fish consumes excessive protein, so the protein is not used for growth but will be disposed as ammonia (Lan and Pan, 1993). Protein efficiency ratios are used to determine the quality of proteins in feed (Handajani and Widodo, 2010). The PER of SWH treatment in this study was significant lower than that of positive and negative control treatments. This result indicated that protein content in P1 and P3 is more appropriate for catfish requirement. Consequently the use of protein for growth is higher. According to a study conducted by Bhilave *et al*. (2012), compositions of feed formulation affect the value of protein efficiency ratios. The value of protein efficiency in feed is also influenced by several factors included fish size and fish feeding rate.

The result of variance analysis showed that there was significant difference ($P \leq 0.05$) of total production, biomass and length improvements between positive control (P3), SWH treatment (P2) and negative control (P1). P2 showed higher levels in these three parameters compared to P1, but exhibited lower levels than that of positive control (P3). These results indicated that the commercial product (P3) gives more effective impact than SWH in improving total production, biomass and length improvements of catfish. This product able to increase the growth of fish because the high concentration of available amino acids produce from tuna fish.

The catfish growth in all treatments was in an allometric negative ($b<3$) pattern, so it can be stated that the growth of catfish weight is slower compared to its length growth. Length and weight of catfish in this study is correlated because it has a value of R close to 1 (one), it shows that the relationship between the length and weight of the fish is very close. The growth pattern is determined based on the value of "b" obtained from the equation of long and weight relationship of catfish. The values of "b" in this study were different among the treatments, but the treatments still have the same growth pattern. Differences of "b" value are caused by biological and ecological factors (Manik, 2009). In wild ecosystem, ecological factors affecting the 'b" value are seasons, water quality and geographical position (Jennings *et al*., 2001). Biologically the 'b" value is influenced by growth phase, gender, gonadal development and feeding habits (Froese, 2006; Tarkan *et al*., 2006).

Conclusion

This study showed that oral administration of shrimp waste hydrolyzate (SWH) significantly increased ($P \leq 0.05$) specific growth rates of length at 4^{th} sampling period (42 to 56 days). SWH did not affect on the AGR, FCR, PER and total production of catfish.

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