

Effects of *Sacharomyces cereviceae* Incorporated Diet on Growth Performance, Apparent Digestibility Coefficient of Protein and Survival Rate of Catfish (*Pangasius hypothalamus*)

Diana Rachmawati*, Istiyanto Samidjan, Ristiawan Agung Nugroho, Titik Susilowati

Aquaculture Study Program, Diponegoro University, Semarang, Indonesia

*Corresponding Email : dianarachmawati1964@gmail.com

Abstract

Diana Rachmawati, Istiyanto Samidjan, Ristiawan Agung Nugroho, Titik Susilowati. 2019. Effects of Sacharomyces cereviceae Incorporated Diet on Growth Performance, Apparent Digestibility Coefficient of Protein and Survival Rate of Catfish (*Pangasius hypothalamus*). Aquacultura Indonesiana, 20 (1): 8-14. A new culture system is introduced to maximize diet usage for growth of Catfish (*Pangasius hypothalamus*). The new culture system is by incorporating *Saccharomyces cerevisiae* into the feed. It aims to increase feed efficiency; in turn it increases the growth of fish. The objective of the research is to know the effects of *S. cereviceae* incorporated diet on growth performance, apparent digestibility coefficient of protein and survival rate of catfish (*P. hypothalamus*). The average weight of fish used in the study were 4.02 ± 0.22 g. The study used experimental method with completely random design, with 4 (four) treatments and each treatment had 4 (four) replications. The treatments were 4 different dosages of *S. cerevisiae* addition in the diet, i.e; 0 g per kg feed (A), 0.5 g per kg feed (B), 1 g per kg feed (C) and 2 g per kg feed (D). The results show that the incorporated of *S. cerevisiae* in feed has significant effect ($P < 0.05$) on the specific growth rate (SGR), apparent digestibility coefficient of protein (ADC_p) and survival rate (SR) of the catfish (*P. hypothalamus*) fingerlings. The optimum dosages of *S. cerevisiae* for SGR, ADC_p and SR of the Catfish (*P. hypothalamus*) fingerlings ranged from 1 to 1.08 g/kg feed.

Keywords : Catfish ; *Saccharomyces cerevisiae* ; Protein digestibility ; Growth performance;

Introduction

Feeding is the main factor in the success of Catfish (*Pangasius hypothalamus*) aquaculture. As reported by Muhammad-Lawal and Omotesho (2010) that feed is one of the important factors in aquaculture and 50% of the cost is for feed (Rana *et al.*, 2009). Costly of feed is often due to an inefficiency of feed. The fish cannot efficiently utilize the feed to grow. Incorporation of feed additive such as enzyme, probiotic, prebiotic or immunostimulant into the feed for fish could be considered as an alternative to solve that problem. Yeast (*Saccharomyces cerevisiae*) has been used as an immunostimulant to increase fish immune system (Tewary and Patra, 2011). Sakai *et al.* (2001) reported that the supplementation of immunostimulant in the diet significantly boost growth and immunity in fish and crustacean. Yeast contains high nutrients such as protein, fat, vitamin, and

minerals (Abu-Elala *et al.*, 2013). The supplementation of the *Saccharomyces cerevisiae* in the feed could increase digestibility of feed and protein, therefore it raised feed efficiency, growth, and immunity of the fish (Wache *et al.*, 2006; Abdel-Tawwab *et al.*, 2008; Abu-Elala *et al.*, 2013). The digestibility increase was due to the ability of *Saccharomyces cerevisiae* to increase digestive enzyme in the fish digesting system. The findings of the study had similar findings with the some studies conducted by Tewary *et al.* (2011) in *Labeo rohita*, He *et al.* (2009) and Abu-Elala *et al.* (2013) in *Oreochromis niloticus*, Semih *et al.* (2009) in gilthead sea bream, and Pooramini *et al.* (2009) in rainbow trout fry.

The use of *S. cerevisiae* has some advantages, such as fast, easy, and cheap to produce. It can also be recycled from other industry waste and a natural substance without negative effect whether for the animal or the

environment (Tewary and Patra, 2011). Olvera *et al.* (2001) also reported that yeast (*S. cerevisiae*) has a positive effect on the growth and the feed efficiency, as also reported by Pangrahi *et al.* (2005), Barnes *et al.* (2006) and Abo-State *et al.* (2009). Moreover, Korkmaz and Cakirogullari (2011) and He *et al.* (2009) suggested that the addition of *S. cerevisiae* in the feed could increase the growth of tilapia and carper.

Information on the study of addition of *S. cerevisiae* in the feed in catfish (*P. hypophthalmus*) is very limited; therefore, the study is very important especially to find out the effects of addition of *S. cerevisiae* in the feed on the efficiency of feed and growth of catfish. The objective of the research is to find out the effects of *S. cereviceae* incorporated diet on growth performance, apparent digestibility coefficient of protein and survival rate of catfish (*P. hypophthalmus*).

Materials and Methods

Experimental System

The experiments were conducted in 16 aquariums in the Center for Hatchery and Freshwater Aquaculture, Muntilan, Central Java, Indonesia. The study took place from August to December 2017. Each aquarium was filled with 25 l of water and stocked with 50 catfish fingerlings. The average weight of the fingerling was 4.02 ± 0.22 g. The total stock was 800 fingerlings that were obtained from the center. Before the fingerlings were stocked in the aquarium, the fingerlings were first acclimated in the special container for 2 (two) weeks with the temperature of 31-33 °C and water pH of 7,42 - 7,53. To maintain dissolved oxygen at 6 mg/l, aerators were installed in each aquarium during the study. After acclimation, healthy and similar size of fingerlings were selected (Rachmawati *et al.*, 2017), then they were weighed and stocked into the aquariums according to the experimental setting.

Experimental Design

The study used Completely Random Design ex

periment. The experiment has 4 (four) treatments and each treatment has 4 (four) repetition. The treatment in the study was implementing various dosages of *Saccharomyces cerevisiae* incorporated diets.

Container Preparation

Containers used in the study were aquariums. Each aquarium has the dimension of $50 \times 30 \times 30 \text{ cm}^3$. Each aquarium was installed with aerator. Containers, tools, and media were sterilized with disinfectant. The disinfectant was 5 mg/L chlorine (Cl_2) and kept in one day. After that, they were neutralized with 3 mg/L natrium triosulphat (Na_2SO_3) and rinsed with water (APHA, 1992). Then the aquariums were filled with fresh water as needed.

Preparing Diet and Treatment Procedure

The study used diet containing 32% protein which was obtained from commercial market. The treatments were by adding *Saccharomyces cerevisiae* into the feed with dosages of 0 g per kg feed (A), 0.5 g per kg feed (B), 1 g per kg feed (C) and 2 g per kg feed (D). To produce the experimental feed, first the feed was crushed, sieved and then mixed with yeast *Saccharomyces cerevisiae* and oil. Then the mixture was added water and blended to get firm dough. The firm dough was formed into pellets. The pellets were stored at the temperature of -20°C until it was used for the experiment.

Fish fed experimental feed in satiation level twice everyday, in the morning and in the afternoon for 49 days. Uneaten feed was taken out using pipet 30 minutes after feeding. The collecting feed waste was dried at 75°C . Then the dried uneaten feed was weighed.

To get the weight data of the fish, each fish was weighed everyweek. To maintain good water quality in aquarium, 25% of water was replaced everyday.

Chemical Analysis of Diet

Diet for every treatment was analyzed for protein, fat and ash content based on AOAC (2006) method. Ash was obtained by

baking the feed in the furnace for 6 hours at 550 ° C (Thermolyne Corporation, Dubuque, IO, USA).

Water Quality Analysis

Water quality (pH, DO, Alkalinity, Ammonia) from the aquarium was measured every week using APHA method (1992) and maintained at the normal level.

Fish Performance

Parameters observed for fish performance were Specific Growth Rate (SGR) and Survival Rate (SR) based on Tacon (1992), while Apperent Digestibility of Protein (ADC_p) was based on Fennuci (1981). Efficiency of Feed Utilization (EFU), Food Conversion Ratio (FCR), and Protein Efficiency Ratio (PER) were based on Takeuchi (1988). The calculation of the parameters values were as follows:

-) ADC_p = 100(% Cr₂O₃ in the feed/% Cr₂O₃ in the feces)x(%protein in the feces/% protein in the feed);
-)EFU (%) = 100 (final weight-initial weight)/the amount of feed consumed;
-) SGR (%) = 100 (ln W2–ln W1)/T; where

W1 and W2 are the initial and final weight of fish, respectively, and T is the number of days in the feeding period

-) FCR = (feed intake (g) /weight gain (g);
-) PER = (weight gain (g) /protein intake (g));
-) SR (%) =100 (final number of fish/initial number of fish)

Statistical Analyses

Statistical analysis of parameter data was observed using Anova test, Duncan test and othogonal polynomial (Steel *et al.*, 1996). While water quality data was analyzed descriptively.

Results

The results of SGR, ADC_p, EFU, FCR, PER and SR of Catfish (*P. hypothalamus*) fingerlings were shown in Table 1.

The relationships of biological response variables and the regression equation of Catfish (*P. hypopthalmus*) to the experimental feed containing various dietary *S. cerevisiae* based on the polynomial orthogonal test were depicted in Table 2.

The water quality parameters during the study were presented in Table 3

Table 1. The Values ofADCP, SGR, EFU, FCR PER, and SR of fish fed experimental feed for 49 days

Parameters	Treatments			
	A	B	C	D
ADC _p (%)	50.43±0.03 ^d	65.24±0.05 ^c	75.56±0.04 ^a	70.34±0.04 ^b
SGR (%/day)	1.78±0.02 ^c	2.45±0.03 ^b	3.56±0.02 ^a	2.21±0.02 ^b
EFU (%)	60.68±0.06 ^d	75.85±0.06 ^c	83.73±0.09 ^a	70.42±0.07 ^b
FCR	2.50±0.03 ^c	2.03±0.05 ^b	1.54±0.05 ^a	2.02±0.04 ^b
PER	1.72±0.02 ^c	2.06±0.03 ^b	2.64±0.01 ^a	2.00±0.03 ^b
SR (%)	75.33±0.09 ^c	85.33±0.35 ^b	90.33±0.89 ^a	80.33±0.14 ^b

Table 2. The Regression Equation of Catfish (*P. hypopthalmus*) on the Experimental Feed Containing Various Dosages of Dietary *S. Cerevisiae*

Response variable (Y)	Regression equation	Optimum level Dose of <i>S. Cerevisiae</i> (g/kg diet)	Maximum value of Y
SGR (%/day)	Y= -0.79x ² +1.665x+1.605, R ² =0.88	1	3.56
EFU (%)	Y= -22.944x ² +50.852x+55.538, R ² =0.99	1.11	85.03
FCR	Y= 0.5355x ² -1.1697x+2.1757, R ² =0.99	1	1.54
ADC _p (%)	Y= -15.523x ² +35.743x+55.741, R ² =0.99	1	75.56
PER	Y= -0.5745x ² +1.2833x+1.5987, R ² =0.98	1.12	2.71
SR (%)	Y= -0.5633x ² +1.2633x+1.4987, R ² =0.98	1.08	92.31

Table 3. Values of water quality parameters during the study

Treatment	Water Quality Parameters			
	Temperature (⁰ C)	pH	DO (mg/l)	NH ₃ (%)
A	26 – 31	7.23 – 7.65	4.08– 5.13	0.004 – 0.005
B	26 – 31	7.10 – 7.72	3.84– 5.12	0.004 – 0.005
C	26 – 31	7.42 – 7.61	4.23– 5.21	0.004 – 0.005
D	26 – 31	7.33 – 7.62	4.12– 5.23	0.004 – 0.005
Feasibility	14-38*	6.50 – 8.5*	>2*	<0.1*

Note : * Boyd (2003)

Discussion

The results of anova show that the *S. cerevisiae* supplementation into the feed has a significant effect on the catfish SGR. The catfish fingerlings fed with *S. cerevisiae* addition of 0.5-2.0g/kg feed has the value of SGR as much as 2.21-3.56%/day. It was higher than that of the value of SGR without the addition of *S. cerevisiae* in the feed, i.e., 1.78%/day. The highest value of SGR (3.56%/day) was obtained when the fingerlings were fed with the dosage of 1.0 g *S. cerevisiae*/kg feed (treatment C). It was followed by treatment B, D, and A with the values of 2.45%/day, 2.21%/day and 1.78%/day. The value of SGR in the treatment C was thought that the dosage of *S. cerevisiae* (1.0 g/kg feed) was an appropriate dosage to increase protein digestibility and efficiency of feed utilization; therefore it boosts growth of catfish fingerlings. The digestibility increase was due to the ability of *Saccharomyces cerevisiae* to increase digestive enzyme in the fish digesting system fish digesting system. Gawlicka et al. (2000) and German et al. (2004) suggested that *S. cerevisiae* incorporated diet could increase growth due to increasing of alkali phosphate activities. The result were also in line with the findings in *Labeo rohita* (Tewary et al., 2011), *Cyprinus carpio* (Manopo and Kolopita, 2016), *Oreochromis niloticus* (He et al, 2009; Abu-Elala et al., 2013), gilthead sea bream (Semih et al., 2009), rainbow trout fry's (Pooramini et al, 2009). The result of polynomial orthogonal test about the relationship between *S. cerevisiae* supplementation and SGR value was shown in the Table 2. The optimum dosage of *S. cerevisiae* supplementation can be drawn from

the equation. The optimum dosage of *S. cerevisiae* was 1 g/kg feed and resulted in the SGR of 3.56%/day.

The results of ANOVA also show that *S. cerevisiae* incorporated diet has significant effect on EFU and FCR of catfish fingerlings, as shown in the Table 1. The feeding of the *S. cerevisiae* addition of 0.5-2.0g/kg feed resulted higher value of EFU (70.42-83.73%) compared to the feeding without the addition of *S. cerevisiae* in the feed (60.68 %). Moreover, the addition of *S. cerevisiae* in the feed (0.5-2.0g/kg feed) brought about FCR to decrease become 1.54 – 2.03 compared to without the addition of *S. cerevisiae* in the feed which has FCR as mch as 2.50. The study showed that *S. cerevisiae* supplementation in the feed could increase EFU and resulted lower FCR.

The highest value of EFU was obtained when the fingerlings were fed with the dosage of 1.0 g *S. cerevisiae* per kg feed (83.73%), followed by treatments B (74.85%), D (65.42 %) and A (55.68 %). The result of polynomial orthogonal test about the relationship between *S. cerevisiae* supplementation and EFU value was shown in the Table 2. The optimum dosage of *S. cerevisiae* supplement was calculated using the equation of EFU on *S. cerevisiae* supplementation. The optimum dosage was 1.11 g/kg feed and resulted in the EFU of 85.03%. While the lowest values of FCR was obtained from the treatment C (1.0 g/kg feed) with the lowest value of 1.54. That value was followed by the treatment B (2.03), D (2.02) and A (2.50). The relationship between *S. cerevisiae* supplementation and FCR was drawn as shown in the Table 2. From the equation, the optimum dosage of *S. cerevisiae* supplementation was obtained with

the optimum value of 1.54. The addition of *S. cerevisiae* in the feed increased efficiency of feed utilization and decreased FCR of fish due to the Tawwab *et al.* (2008) also found the similar result for tilapia.

The improvement of growth and efficiency of feed utilization in the present study was because of the increase of protein digestibility. Table 1 show that ADC_P increased due to the availability of *S. cerevisiae* incorporated diet. The fingerlings fed with the addition of 0.5 – 2.0 g *S. cerevisiae* per kg feed has higher value of ADC_P compared to the value of ADC_P without the addition of *S. cerevisiae* in the feed. In this case, *S. cerevisiae* as an imunostimulant can increase enzyme production in the digestive system, in turn it improved protein digestibility (Welker and Lim, 2011). Meanwhile, Merrifield *et al.* (2010), Nayak (2010) and Welker and Lim (2011) suggested that imunostimulant improved digestibility and the absorption of nutrients, amino acid, vitamins and enzymes. The result of polynomial orthogonal test about the relationship between *S. cerevisiae* supplementation and ADC_P value was shown in the Table 2. The optimum dosage of *S. crevisiae* was 1 g/kg feed and resulted in ADC_P of 75.56%.

The addition of *S. cerevisiae* in the feed can significantly increased efficiency of feed utilizationas, PER and SR. The catfish fingerlings fed with the addition of 1.0 g *S. cerevisiae* per kg feed (treatment C) had highest values of EFU, PER , SR, and the lowest value of FCR, as shown in the Table 1. The highest values of PER and SR of the catfish were obtained from the treatment C (1 g.kg feed) with the values of 2.64 and 90.33% respectively. Those values were followed by the treatment B (2.06; 85.33%), D (2.00;80.33%) and A (1.72;75.33%). Tovar *et al.* (2002) and Wache *et al.* (2006) also suggested that the *S. cerevisiae* supplementation in the feed was significantly able to increase protein digestibility; therefore, it can maximize the efficiency of feed utilization, increased protein efficiency ratio and survival rate, while it decreased feed conversion ratio. Abdel-Tawwab *et al.* (2008) also found the similar result in the case of tilapia, while Tovar *et al.* (2002) and Wache *et al.* (2006) found in sea bass and rainbow trout,

increase of protein digestibility (Tovar *et al.* (2002); Wache *et al.* (2006). Abdel-

respectively. The result of polynomial orthogonal test about the relationship between *S. cerevisiae* supplementation and PER value was shown in the Table 2. The optimum dosage of *S. cerevisiae* supplementation in the feed for PER derived from the equation was 1.12 g/kg feed with the PER value of 2.71. The relationship between *S. cerevisiae* supplementation and SR value was also shown in the Table 2. The optimum dosage of *S. cerevisiae* supplementation in the feed for SR derived from the equation was 1.08 g/kg feed with the SR value of 92.31%.

Table 3 indicating that water quality during the study was still in a reasonable range for catfish *P. hypophthalmus* cultivation.

Conclusion

The supplementation of *S. cerevisiae* in the feed could increase SGR, ADC_P, and SR of catfish (*P. hypophthalmus*) fingerlings. The optimum dosage of *S. cerevisiae* for good SGR, ADC_P, and SR of catfish fingerlings were 1, 1 and 1.08 g /kg of feed, respectivel

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