

The Application of Probiotic to Increase Growth, Body Composition, and Feed Efficiency on Catfish (*Clarias* sp.)

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Abstract—For 45 days, research was conducted to evaluate the administration of probiotic *Bacillus* NP5 to increase growth, body composition, and feed efficiency on catfish (*Clarias* sp.). This research was carried out with 3 different treatment of *Bacillus* NP5 probiotic doses (0, 0.5 and 1% probiotic) and 3 replications. The result showed that the value of the daily growth rate significantly showed the highest value ($P < 0.05$) in 1% probiotic (11.32%), followed by 0.5% probiotic (9.20%) and control (8.20%). The value of protein and lipid composition was significantly in 1% probiotic (14.24%, 5.49%, respectively) than the other treatment. The administration of probiotic *Bacillus* NP5 not affect to water quality of catfish.

Keywords: Body composition, feed efficiency, growth, probiotic

I. INTRODUCTION

Catfish is a popular freshwater fish commodity in Indonesia. The ministry of marine and fisheries of Indonesia [1] reported that catfish was the second largest commodity with 19.604.260 tons' production in 2017. However, the low of feed efficiency is one of the problems in the intensive cultivation of catfish system. In addition, feed is one of the biggest cost component in aquaculture, which is about 40-60% of total production costs [2]. [3] noted that only 20-30% of feed are assimilated in fish biomass, and the remaining for about 70-80% of the feed will be accumulated in the water body as uneaten feed and excretion products (ammonia). Ammonia is toxic to fish and at high levels can cause death [4].

One effort that can be applied to improve feed efficiency is the application of probiotic in fish feed. According to [5], probiotic is live micro-organisms which have positive effect on

their host by improving feed efficiency or increasing feed digestive enzyme [6], by ensuring increase response immune [7], by improving water quality [8]. The administration of *Bacillus* NP5 as probiotic has been reported could enhance growth performance of tilapia [9,10] and Dumbo catfish [11]. The supplementation of *Bacillus* NP5 also reported improve response immune of white shrimp [12] and catfish [13]. [14] noted that *Bacillus* NP5 is probiotic bacteria from digestive of tilapia. There are 7 steps of selection to obtain *Bacillus* NP5, namely: amylolytic test, bacterial growth test, resistant on acid and alkali test, activity of antagonistic, adhesion test, pathogenic test, and feeding trial test. The purpose of this study is to evaluate the administration of probiotic *Bacillus* NP 5 to increase growth, body composition, and feed efficiency on catfish (*Clarias* sp.).

II. MATERIALS AND METHODS

A. Preparation of Probiotic and Feed

At temperature of 29°C for 18 hours (exponential phase of *Bacillus* NP5), *Bacillus* NP5 were cultured on agar medium (trypticase soy broth). Then, culture of *Bacillus* NP5 was centrifuged at speed of 1000 rpm for 10 minutes to harvest probiotic bacteria. The commercial feed (protein of 33.95%, lipid of 7.73%, ash of 9.9%, fibre of 4.16%, nitrogen-free extract of 44.25% and moisture of 6.49%) was used in the present study. Probiotics (mixed with 2% yolk egg according to [9]) were added at different doses into the feed, i.e. 0% probiotic (control), 0.5% probiotic, and 1% probiotic (g/100g) and 3 replications.

B. Experimental Design

This research was conducted at Laboratory of Aquaculture, University of Sultan Ageng Tirtayasa for 45 days. The initial weight of juvenile of catfish is 9.02 ± 0.29 g. Catfish obtained from Ary Farm, Serang, Indonesia. Catfish was reared in 12 tanks with volume of 60 L (20 fish/tank) and they were acclimatized for 7 days. Feed were given to catfish three times (08.00, 12.00, and 16.00) with satiations. The maintain water quality was conducted every 3 days by water replacement of tank (50% of total volume).

C. Measurement of Growth, Body Composition and Water Quality.

Dissolved oxygen and pH were measured weakly, while water temperature was measured every day. At the end trial, catfish were weighed and 5 fish from each tank were used for proximate analyses. Fish were analyzed (protein, lipid, moisture, nitrogen-free extract, ash, fibre and moisture) referring to [15]. Feed intake, specific growth rate, feed efficiency and survival rate were measured in accordance [16], by equations:

$$FI (\%) = \frac{F_t - F_o}{F_o} \times 100 \quad (1)$$

Where FI is feed intake, F_o is total feed at the beginning, and F_t is total feed at the end.

$$DGR (\% \text{ day}^{-1}) = 100 \times \left(\frac{W_t - W_o}{t} \right) \quad (2)$$

Where DGR is daily growth rate, W_t is final body weight, W_o is initial body weight, and t is days.

$$FE (\%) = 100 \times \left(\frac{W}{F} \right) \quad (3)$$

Where FE, W , F were feed efficiency, weight gain and feed consumption, respectively.

$$SR (\%) = 100 \times \left(\frac{N_t}{N_o} \right) \quad (4)$$

Where SR is survival rate, N_t is total individual at the end and N_o is total individual at the initial.

D. Statistical Analyses

The value of feed intake, specific growth rate, feed efficiency, survival rate, and body composition were analyzed using the Statistical Package for the Social Sciences (SPSS) program for Windows (v. 16.0). the significant data were compared by Duncan of multiple comparisons. All data of water quality were analyzed descriptively.

III. RESULT AND DISCUSSION

A. Growth and Survival Rate

Growth parameter and survival rate in this study was presented in Table 1. No significant effect ($P > 0.05$) was obtained in feed intake for all treatments (control: 479.10 ± 48.3 g, 0.5% probiotic: 472.24 ± 42.3 g, and 1% probiotic: 544.78 ± 21.3 g). Feed intake shows the amount of feed consumed by fish [17]. Its value related to feed palatability [18]. [19] noted that nutrient and toxin content in the feed are factor affecting feed palatability. In the present study, feed intake was found no different among all treatments. This result showed that the addition *Bacillus* NP 5 in the feed not influenced on feed palatability. The similar result has been reported by [20], the administration of *Lactococcus lactis* and *Enterococcus faecium* not effect on feed intake of grouper *Epinephelus coioides*.

TABEL I. GROWTH PARAMETERS AND SURVIVAL RATE OF CATFISH WITH DIFFERENT PROBIOTIC DOSES IN THE FEED.

Treatments	Control	0.5% probiotic	1% probiotic
Parameters*			
Feed intake (g)	479.10 ± 48.3	472.24 ± 42.3	544.78 ± 21.3
Daily growth rate (% day ⁻¹)	8.20 ± 0.55^a	9.20 ± 1.61^a	11.32 ± 0.8^b
Feed Efficiency (%)	77.20 ± 3.23^a	87.35 ± 8.78^{ab}	93.44 ± 4.27^b
Survival Rate (%)	96.67 ± 5.77	96.67 ± 2.89	100 ± 0.00

* The value in the same row with different superscript are significantly different ($p < 0.05$).

Daily growth rate was significant highest ($P < 0.05$) in 1% probiotic (11.32 ± 0.8 % day⁻¹), but no significant differences between control (8.20 ± 0.55 % day⁻¹) and 0.5% probiotic (9.20 ± 1.61 % day⁻¹). Furthermore, the value of feed efficiency was significantly increased in 1% probiotic ($93.44 \pm 4.27\%$) compared control ($77.20 \pm 3.23\%$) and there are no significant between control and 0.5% probiotic ($87.35 \pm 8.78\%$). This result is supported by [21], dietary probiotic *Lactobacillus acidophilus* of African catfish feed was increased growth and feed conversion ratio than control. [22] noted that application of Bacilli (*Bacillus subtilis* and *Bacillus licheniformis*) can improve growth performance and feed efficiency of white shrimp (*Litopenaeus vannamei*) postlarvae. Effect probiotic also has reported can increase several commodities of aquaculture, namely on tilapia with probiotic cocktail [23], on freshwater prawn *Macrobrachium rosenbergii* with *Lactobacillus sporogenes*, *Bacillus subtilis* and yeast as probiotic [24], on rohu, *Labeo rohita* with probiotic *Geotrichum candidum* [25].

Probiotic can produce digestive enzyme in host digestive tract [6, 26, 27]. [11] has been reported that supplementation of *Bacillus* NP5 as probiotic could increase protease, lipase and amylase activity in digestive tract of Dumbo catfish. At the present study, the high value of daily growth rate in 1% probiotic might due to probiotic can increase the population of bacteria in digestive tract. This will increase of feed absorption so that catfish in 1% probiotic treatment increased. The study of [9] was found that the addition of probiotic can improve the population

of microbiota and digestive enzyme in digestive tract of tilapia. In the present study, we obtained no significant different between control and 0.5 % probiotic. That is probably due to the low dose of 0.5% probiotic treatment, so that administration probiotic cannot increase daily growth rate of catfish in this treatment. The similar result has investigated by [28] on white shrimp with application *Bacillus* into feed. He noted that the low doses of *Bacillus* not influence on growth of white shrimp.

In our study, we found that there was no significant different ($P>0.05$) in survival rate. The value of survival rate in control of $96.67\pm5.77\%$, 0.5 probiotic of $96.67\pm2.89\%$ and 1% probiotic of $100\pm0.00\%$. this result indicates that administration *Bacillus* NP5 as probiotic did not effect on fish health of catfish. Similar effect has been reported by [28], supplementation of *Bacillus* in the feed showed not significant different on survival rate of white shrimp *Litopenaeus vannamei*. [29] also reported that administration of the mixed probiotics (*Bacillus subtilis*, *B. licheniformis* and *Enterococcus faecium*) was found not influence on survival rate of rainbow trout (*Oncorhynchus mykiss* Wabbaum).

B. Body Composition

The beneficial effects of *Bacillus* genus as probiotic on aquaculture have been observed, such as *Bacillus* spp. [26, 30, 31], *Bacillus subtilis* [22, 32, 33], *Bacillus* NP5 [10,12,13], *Bacillus* sp. [34], *Bacillus licheniformis* [22], *Bacillus cereus* [35], *Bacillus mycoides* [36], *Bacillus coagulans* [37]. Effects of administration of probiotic *Bacillus* NP5 was showed Table 2.

TABLE II. BODY COMPOSITION OF CATFISH WITH DIFFERENT PROBIOTIC DOSES IN THE FEED.

Treatments*	Control	0.5% probiotic	1% probiotic
Parameters			
Crude protein (%)	10.34 ± 0.06^a	10.08 ± 0.04^a	14.24 ± 0.34^b
Crude lipid (%)	5.02 ± 0.04^a	5.08 ± 0.11^a	5.49 ± 0.13^b
Fibre (%)	0.32 ± 0.03	0.29 ± 0.01	0.32 ± 0.01
Nitrogen-free extract (%)	0.40 ± 0.11	0.82 ± 0.20	0.52 ± 0.16
Ash (%)	2.98 ± 0.68	2.57 ± 0.14	3.87 ± 0.04
Moisture (%)	80.94 ± 0.57^b	81.16 ± 0.03^b	76.56 ± 0.42^a

* The value in the same row with different superscript are significantly different ($p<0.05$).

The result showed that protein composition was significantly increased in 1% probiotic ($14.24\pm0.34\%$). In the present study was observed no different ($P>0.050$) between control and 0.5% probiotic ($10.34\pm0.06\%$, $10.08\pm0.04\%$) in protein composition. The same result was found in lipid composition, the highest value of lipid composition was observed in 1% probiotic ($5.49\pm0.13\%$) and no different ($P>0.05$) between control ($5.02\pm0.04\%$) and 0.5% probiotic ($5.08\pm0.11\%$). In the present study no significant difference ($P>0.05$) was showed in the data of fibre, nitrogen-free extract and ash. Body composition at the present study in agreement with the result of [22], who noted that the addition of *Bacilli* (*Bacillus subtilis* and *Bacillus licheniformis*) in the feed had

higher on crude protein and crude lipid than control of whiteleg shrimp (*Litopenaeus vannamei*) postlarvae. [37] also reported that supplementation of probiotic can improve body composition of white shrimp. Body compositions are related to growth performance of fish. Therefore, the highest value of crude protein and crude lipid on 1% probiotic treatment might due to the value of daily growth rate on this treatment.

C. Water Quality

The role of probiotic on water quality in aquaculture has been reported by researchers, such as on Nile tilapia [38], larvae shrimp (*Penaeus vannamei*) [39], blue swimming crab, *Portunus pelagicus* (Linnaeus, 1758) [40], and white shrimp (*Litopenaeus vannamei*) [41]. The range water quality in this study presented Table 3.

TABLE III. WATER QUALITY OF CATFISH WITH DIFFERENT PROBIOTIC DOSES IN THE FEED.

Treatments	Control	0.5% probiotic	1% probiotic
Parameters			
Temperature (°C)	27.13-28.63	27.17-28.80	27.13-28.63
Dissolved oxygen (mg/L)	5.30-7.10	5.67-7.23	5.70-7.13
pH	5.70-7.97	5.80-7.93	5.77-7.94

Temperature is important factor which can influence in fish metabolism and fish physiological [42]. The result show that the range temperature of control of 27.13-28.63°C, 0.5% probiotic of 27.17-28.80°C and 1% probiotic of 27.13-28.63 °C. This is indicated that temperature in this study is in accordance with the catfish culture. According to [43], the best temperature of catfish rearing is 27-30 °C. Oxygen is the limiting factor for water organism. The result show that the value of dissolved oxygen is 5.30-7.10 mg/l in control, 5.67-7.23 mg/L in 0.5% probiotic, and 5.70-7.13 mg/L in 1% probiotic. This value within the range suitable for catfish farming. The range of dissolved oxygen for catfish culture is >3 mg/L [43]. The role of pH on the fish culture is a measure the acidity of water. The range of pH for catfish culture is 6.50 - 8.50 [42]. In this study, the range of pH is 5.70-7.97 which indicates the value within the range of suitable for catfish culture.

IV. CONCLUSION

The administration of *Bacillus* NP5 as probiotic show the best result on daily growth rate, feed efficiency, and protein and lipid composition of catfish. the value of daily growth rate was significantly highest ($P<0.05$) in 1% probiotic (11.32%), followed by 0.5% probiotic (9.20%) and control (8.20%). The value of protein and lipid composition was significantly in 1% probiotic (14.24%, 5.49%, respectively) than the other treatment.

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