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 positives 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:

\[
FI (%) = \frac{F_t}{F_o} \times 100
\]

(1)

Where \(FI\) is feed intake, \(Fo\) is total feed at the beginning, and \(Ft\) is total feed at the end.

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

(2)

Where \(DGR\) is daily growth rate, \(Wt\) is final body weight, \(Wo\) is initial body weight, and \(t\) is days.

\[
FE \text{ (%)} = 100 \times \left( \frac{W}{F} \right)
\]

(3)

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

\[
SR \text{ (%)} = 100 \times \left( \frac{N_t}{N_o} \right)
\]

(4)

Where \(SR\) is survival rate, \(Nt\) is total individual at the end and \(No\) 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.

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

*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±4.27%) compared control (77.20±3.23%) and there are no significant differences between control and 0.5% probiotic (87.35±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, Baitus subtilis and yeast asprobiotic [24], on rohu, Labeo rohitua 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±5.77%, 0.5% probiotic of 96.67±2.89% and 1% probiotic of 100±0.00%. This result indicates that administration Bacillus NPS 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 Wabamu).

**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 NPS [10,12,13], Bacillus sp. [34], Bacillus licheniformis [22], Bacillus cereus [35], Bacillus mycoides [36], Bacillus coagulans [37]. Effects of administration of probiotic Bacillus NPS was showed Table 2.

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

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

* 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±0.34%). In the present study we observed no different (P>0.05) between control and 0.5% probiotic (10.34±0.06%, 10.08±0.04%) in protein composition. The same result was found in lipid composition, the highest value of lipid composition was observed in 1% probiotic (5.49±0.13%) and no different (P>0.05) between control (5.02±0.04%) and 0.5% probiotic (5.08±0.11%). 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 was significantly increased in 1% probiotic (P<0.05) in survival rate. The similar result has investigated by [28] on white shrimp with application Bacillus into feed. He noted that the addition of Bacilli (Bacillus subtilis and Bacillus licheniformis) in the feed had 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.

**C. Water Quality**

The role of probiotic on water quality in aquaculture has been reported by researchers, such as 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 DOES IN THE FEED.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>0.5% probiotic</th>
<th>1% probiotic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved oxygen (mg/L)</td>
<td>5.30-7.10</td>
<td>5.67-7.23</td>
<td>5.70-7.13</td>
</tr>
<tr>
<td>pH</td>
<td>5.70-7.97</td>
<td>5.80-7.93</td>
<td>5.77-7.94</td>
</tr>
</tbody>
</table>

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.

**ACKNOWLEDGMENTS**

This research was supported by funds from Islamic development bank with scheme of Research Grand IsDB-
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