Probiotics Utilization in Feed to Increase Hepatosomatics Value Index (HSI) and Gonado Somatic Index (GSI) in Catfish (Clarias sp.) Broodstock

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ABSTRACT

Probiotics gave positive influence to the fish by improving microorganisms balance in digestive tract, its greatly assist the process of food absorption. Probiotics contributions on increasing follicle growth phase was indicated by the increase of Gonado Somatic Index (GSI) value. Histological observation of ovaryan zebrafish which was treated with probiotics, showed an increasing in follicle vitelligenic, and by followed increasing of Hepato Somatic Index (HSI). The purpose of this study was to determine the effect of probiotics in feed to increase the value of HSI and GSI male and female Catfish (Clarias sp.) broodstocks. Using 4 treatments (without probiotics, 5 ml, 10 ml, and 15 ml probiotics) and repeated 3 times. The parameters observed was increasing of HSI and GSI of catfish broodstock. The results showed there was significantly increasing (P <0.05) in the HSI and GSI value of catfish broodstock. Extra doses of 5 ml probiotics in feed was optimal for increasing HSI and GSI the value of catfish broodstock (male and female) compared to the addition of probiotic treatment 10 ml and 15 ml in the catfish food.

Keywords: Catfish, Gonado Somatic Index (GSI), Hepato Somatic Index (HSI), Probiotics

Introduction

The addition of probiotics in the right amount of feed will give a positive influence on the performance of cultivated fish indicated by the rate of growth and conversion of feed better than fish that are only fed without probiotics. The failure of most fish farming is due to the low quality of gametes produced by male and female parents. Where the quality of gametes is greatly influenced by the quality of feed. Feed quality related to costs that must be incurred. Feed is one of the important elements in fish farming activities to support growth, reproduction, and survival of fish. Fish feed is generally derived from the factory-made feed, and feed needs account for 60–70% of total production cost [1].

The results showed that the addition of probiotics in feed can stimulate more efficient use of energy for the growth, reproduction, and survival of cultured fish. The same researcher stated that the addition of probiotics in feed can improve the balance of microorganism communities in the digestive tract so that the presence of microorganisms greatly helps the process of absorption of food in zebrafish, besides that several other studies also show that the addition of probiotics can increase nutritional value by synthesizing important nutrients such as (vitamins, proteins and essential fatty acids) and enzymes (amylase, protease and lipase) in order to accelerate the maturity of the gonads and increase the number of vitelligenic follicles, GSI, and higher ovulated eggs [2; 3]. The results of this study indicate that...
the nutrient content in foods containing protein, fat, vitamin E, vitamin C, and minerals is one of the determining factors in supporting the success of the mother to achieve optimal gonadal maturity.

Quality feed linkages with gonadal maturation can be explained as follows, starting with an increase in GnRH, it will stimulate the release of gonadotropin hormone from the pituitary (GtH-I and GtH-II). The release of GtH-I produces steroid hormones such as estrogen. Estrogen is produced by granulosa cells of the ovarian follicles, then estrogen through the bloodstream to the liver cells and will affect vitellogenin production. Vitellogenin is carried by the bloodstream to be absorbed and accumulated in developing oocytes, as a result, the oocytes become large and mature [4]. As for Shafei et al., [5] and Taghizadeh et al. [6] stated that changes in estrogen levels are closely related to oocyte development. The release of GtH-II from the pituitary plays a role to stimulate late gonadal maturation, ovulation, and spawning. The development of mature oocytes is characterized by increasing values of HSI and GSI [7].

Furthermore, Araoye [8] and Laleye et al., [9], Shinkafi et al [10] state that the value of HSI and GSI reaches a maximum before spawning and then decreases after spawning. The results of various studies show that the quality of feed largely determines the quality of sperm and eggs produced by both male and female Zebras. From the results of these studies, efforts need to be made to further improve the quality of sperm and eggs in catfish by improving nutrition in the main feed, especially protein. Protein is one of the macronutrients needed by the parent fish in the reproductive process. The results of this study inspired researchers to examine more deeply whether the addition of probiotics (EM-4) to catfish parent feed can increase the protein content that is easily digested and absorbed by the digestive system. It is expected that the results of this study can give the same effect as the Zebra fish that have been studied to improve sperm and egg quality in terms of increasing the value of the Hepato Somatic Index (HSI) and the value of Gonado Somatic Index (GSI) from catfish (Clarias sp.) male and female.

This experimental study was conducted in 8 fish tanks with a size of 1.5 m x 2m x 60 cm. They been cleaned and dried in the sun for two days, after which each tank was filled with water to a depth of ± 50 cm. The broodstock used comprised 24 males (950-1,015 grams) and 24 females (1,005 to 1,015 grams). Furthermore, 4 tanks was filled each with 6 male and four other tanks was filled each with 6 females, and then adapted for 2 weeks before the treated. Feed with protein content of 36% of production of Prima type 781-3 CV is added to the probiotic type Effective Microorganism 4 (EM-4) 0 ml, 5 ml, 10 ml and 15 ml. Giving as much as 5% of body weight every morning and evening for 1 month of maintenance. After 1 month, both men and women are weighed and biopsied to take gonads and liver. Gonad and hepar weight can be used to determine the value of GSI and HSI.

The value Hepato Somatic Index (HSI) was counted using:

\[ HSI \% = \frac{Wh}{Wt - Wh} \times 100 \]

**HSI**: Hepato Somatic Index

**Wh**: Weight hepar (g)

**Wt**: Weight body (g)

Furthermore, to determine the value Gonado Somatic Index (GSI) using this formula:

\[ GSI \% = \frac{Wg}{Wt - Wg} \times 100 \]

**GSI**: Gonado Somatic Index

**Wg**: Weight gonad (g)

**Wt**: Weight body (g)

**Data analysis**

Measurement of HSI and GSI value then analyzed using one-way ANOVA Gen Stat program version 15, to see the difference between the control treatment and the addition of probiotics in feed to. If the F count > F table with a significance of 5% and 1% then tested further by Duncan test 5%.

**Results and Discussion**
Increasing of the value of HSI and GSI in female catfish given probiotics in the feed was higher than the control group (Table 1).

Table 1. Mean and standard deviation of HSI and GSI in given probiotics and the control groups of female catfish

<table>
<thead>
<tr>
<th>Dose of Probiotic (ml)</th>
<th>Mean ± Standard Deviation (HSI)</th>
<th>Mean ± Standard Deviation (GSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16.5±0.95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>85.0±7.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>23.1±2.33&lt;sup&gt;b&lt;/sup&gt;</td>
<td>119.7±6.1&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>10</td>
<td>15.6±1.00&lt;sup&gt;b&lt;/sup&gt;</td>
<td>95.7±5.8&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>15</td>
<td>18.4±0.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>96.0±6.2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: Value in columns followed by different superscript showed different signification (P<0.05)

The male parent catfish given probiotics in feed have higher HSI and GSI values compared with the control group (Table 2).

Table 2. Mean and standard deviation of HSI and GSI in given probiotics and the control groups of male catfish

<table>
<thead>
<tr>
<th>Dose of Probiotic (ml)</th>
<th>Mean ± Standard Deviation (HSI)</th>
<th>Mean ± Standard Deviation (GSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14.9±0.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.9±0.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>24.6±1.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14.6±0.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>10</td>
<td>18.0±2.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.3±0.7&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>15</td>
<td>20.6±0.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>5.4±0.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: Value in columns followed by different superscript showed different signification (P<0.05)

The average value of HSI and GSI for male and female catfish parents given probiotics in feed showed a significant difference (P<0.05) when compared to catfish parents which were only given formula feed. The results showed that the addition of probiotics in feed can increase the value of HSI and GSI male and female catfish parents. This is possible because the addition of 5 ml of probiotics in the feed can accelerate the mature gonad catfish parent, as an indicator that the gonadal mature catfish parent is shown by weighing the weight of male and female catfish parents and weighing their gonadal weight and weight. The results of measurements of body weight, liver, and gonadal catfish showed that there were an increase in body weight and liver weight and gonads, the results of these measurements were used to determine the value of HSI and GSI. The increase in the value of HSI and GSI is then used to determine whether the catfish mother is ready to be spawned to produce many seeds, boxing, and quality.

Giving probiotics in feed can increase spermatogenesis and oogenesis, if the nutrients in the feed given for basic life necessities are still excessive, then nutrition will be used for growth, development, maturation of gonads and for the development of eggs into embryos after hatching. Whereas the male and female catfish mothers who were only given formula feed without probiotics were also able to increase the value of HSI and GSI but the development was not optimal. This shows that feed quality is an important factor to influence the quality of sperm and eggs produced by male and female catfish parents, it is thought that protein and fat in these feeds have been degraded into amino acids and essential fatty acids which are subsequently used as basic ingredients for vitellogenin synthesis in liver and hormone synthesis in the gonad on male and female catfish parents before the parent is spawned.

The results of this study are in accordance with those stated [2;3] stating that the addition of probiotics in feed can help degrade proteins in feed into macronutrients and micronutrients and to produce enzymes to increase digestibility in the fish digestion system. Several other studies also show that probiotics can increase nutritional value by synthesizing important nutrients such as (vitamins, proteins, and essential fatty acids) and enzymes (amylase, proteases, and lipases) which can further affect reproductive activity, such as gametogenesis in male parents and Zebrafish female. The relationship between nutrition and reproductive activity is very important to ensure that reproductive activities must be in harmony with the availability of nutrients in the feed to ensure survival [11]. Furthermore, Sotolu [12] states that the protein content of feed can affect the increase in gonad size and weight. In addition, Akankali et al. [13] also stated that fish must be fed with enough protein, fat, calcium and phosphate to produce quality eggs. Whereas in quality male feed catfish can increase the synthesis of steroid hormones such as testosterone which play a role in spermatogenesis. The results of this study are similar to the findings of Msiska [14], stating that the addition of probiotics in feed can help
improve reproductive performance and maturation of gonads. This is also consistent with the results of studies reported by Ghosh et al. [1] that reproductive performance can be improved by adding probiotics to their feed. This can be attributed to the production of important nutrients such as certain essential fatty acids produced by probiotic bacteria in fish intestines [2].

Adequacy of protein in fish feed is related to the adequacy of amino acids contained in the feed and determining the amount of egg protein content indicated by increasing the size and weight of gonads of fish. The more accumulation of egg yolk in the oocyte, the greater the diameter of the oocytes and the GSI value of fish increases. With the increase in the number of oocytes filled with egg yolk, the diameter of the egg gets bigger and heavier, as a result, the GSI value increases. As an illustration, according to Effendi [15], the value of GSI ranges from 10-25%, where fish with a GSI value of 19% indicate that fish have matured gonads and fish are ready to be spawned. The contribution of probiotics in the feed given to the follicular growth phase has been shown to increase the value of the Gonado Somatic Index (GSI) indicated by ovarian histological observations in the parent given probiotics in which there are increased vitellogenin follicles [16].

The mechanism of adding probiotics to male and female catfish main feed can be explained as follows: proteins in the feed that have been degraded by probiotics will be used as a source of energy for catfish to be spawned. At first, the feed protein that has been degraded by probiotics enters the digestive system, then the protein will be absorbed by the intestinal epithelium. From the intestinal epithelium, the protein is carried by the bloodstream to the liver, brain, and gonads. In the liver protein is used for the basic ingredients of vitellogenin synthesis, in the brain protein is used for synthesis hormone. Whereas in the gonads protein is used for growth, development, and maturation of sperm and fish eggs. Vitellogenin is a protein precursor of fish egg yolk. Vitellogenin synthesis can run optimally if the nutrients in the main feed, especially protein are met because protein will be used for the formation of egg yolk. This physiological activity will not work well if the mother catfish is only fed without probiotics. The results of this study in accordance with the findings [17;1] state that bacteria in probiotics can increase enzyme secretion in order to increase the effectiveness of digestion of proteins and fats easily digested and absorbed in the fish digestion system. Furthermore, Ling et al., [18] and Ghosh et al., [1] states that there is a positive correlation between the presence of proteins and fatty acids in reproductive-related main food such as the development and maturation of oocytes will be better and the size and diameter of the eggs produced is greater [18;1]. Thus, the availability of nutrients, especially proteins in parent feed, must contain high protein, because this protein will be needed in vitellogenesis to produce vitellogenin. Vitellogenin will affect the seeds produced. This reveals that the addition of probiotics in feed can help improve the reproductive performance of male and female catfish parents. The results of this study are consistent with that reported by Ghosh et al. [1] that reproductive performance can be improved by adding probiotics to feed associated with the production of important nutrients, especially essential fatty acids produced by probiotic bacteria in fish digestion systems [2;1]. Several studies have shown the importance of the composition of unsaturated fatty acids in feeds such as arachidonic acid, docosahexaenoic acid, and eicosapentaenoic acid because the unsaturated fatty acids have been shown to improve reproductive performance in the parent and the quality of the resulting larvae is optimal [19;18]. In addition, essential fatty acids can also increase energy to support spawning[18;1].

Conclusion

It can be concluded that:

1. The addition of 5 ml probiotics in the feed gave significant effect to the increasing value of HSI and GSI in male and female catfish broodstock.

2. The application of probiotics in the feed proved to be particularly useful to help improve the reproductive performance of female parent is indicated by the increasing number of mature eggs ready to be ovulated, while in the male parent is shown by increasing the synthesis of testosterone that plays a role in spermatogenesis.

3. The addition of probiotics in the diet proved to help degrade complex feed into macronutrients, micronutrients, enzymes
that are useful for improving digestibility and help synthesize essential nutrients such as vitamins, proteins and essential fatty acids for the fish body.

4. There are many valuable probiotics available in the market. However, research on optimizing the addition of probiotics in the diet to improve reproductive performance is still not revealed much so it needs to do more in-depth research about the positive effects on the offspring produced, as well as negative effects to how long the productivity of the parent can maintain its quality.

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