Effects of Fish By-product Meal Inclusion in Broiler Feeds on Growth Performance

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Authors’ contributions

This work was carried out in collaboration among all authors. Author AAA contributed in research proposal writing, data collection, data analysis, data interpretation and article writing. Author KMH contributed in research data collection, data analysis, data interpretation and article writing. Authors OO and TG contributed in proposal development and presentation. All authors read and approved the final manuscript.

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ABSTRACT

Background: The presence of inadequate and inconsistent feeds to the chicken resulted in lower performance of chick production in Ethiopia. Broilers are meat type chickens with fast income generation and depend on high quality feed. Feed costs alone currently account for over 65-70% of poultry production in third world countries, there has been recent interest in determining the feeding value of different locally available alternative feeding resources. As fish is generally appreciated as one of the healthiest and cheapest source of protein and it is available in Gambella water bodies, this research is intended to investigate the effects of fish by-product inclusion in broiler feeds on growth performance. Two hundred and forty (240) day old broiler chicks (Cobb 500) were reared and assigned to four treatments for 42 days. Treatment one was the control without fish by-product meal, treatment 2 contained 2% fish by-product meal, treatment 3 contained 3% fish by-product meal and treatment 4 contained 5% fish by-product meal. Each treatment was replicated 3 times with 20 birds per replicate in a completely randomized design. Parameters measured for the experiment were the initial body weight, final weight, daily feed intake while weight gain and feed...
conversion ratio (FCR) were calculated. Data were analyzed using General linear model procedure of statistical analysis software (SAS) version 9.2.

**Results:** This study indicated that the average daily feed intake of broiler significantly increased (P<0.05) in 3 and 5% fish by-product meal level to the diets during 11-20 days of age. At the age of 32 – 42 days the average body weight and daily feed intake at the age of 21-32 days were significantly (P<0.05) increased in 3 and 5% fish by-product meal level compared to control and 2% fishmeal diet.

**Conclusion:** This study revealed that inclusion of fish by-product meal in the diet improved the performance of broiler. To utilize and exploit the potential of fish by-product meal as broiler feed in Gambella region, farmers should get training on preparation and utilization of fish by product.

**Keywords:** Broiler; feed; fish by-product meal; Gambella; performance.

**ABBREVIATIONS**

ABW: Average body weight; ADG: Average daily gain in gram; AFCR: Average feed conversion ratio; AFI: Average feed intake; CF: Crude fiber; CP: Crude protein; DM: Dry matter; FCR: Feed conversion ratio; ME: Metabolisable energy; NFE: Nitrogen free extract; SAS: Statistical analysis software.

1. **BACKGROUND**

Even though Ethiopia have an estimated chicken population of 60 million [1], but the productivity in general is ruined by scarce and uneven amount of feed that would support to improve the productivity [2].

From different chicken breeds broilers are identified for meat production and generate an income in forty five days. In third world countries about 65 to 70% of chicken production cost incurred for feeding, this fact forced to look for alternative high-quality feed from economical and locally available sources [3].

Fish by-product is one of the known appreciated protein source in broiler feed supplement [4,5]. The presence of higher cysteine, safe and cheap price protein found from fish than other sources [6,7]. Also, fish meat has little lipids and more water when compared to chicken or beef meat and chosen than white and red meats [8,9]. As a result, it supplements deficiencies of protein of vegetable and soybean source feed [10]. The nutritional value of fish meat encompasses its nutrient contents, high energy value and lesser cholesterol content than meat [11,12].

Gambella region is gifted with numerous water resources and more than 7.7% of the region is covered with rivers, lakes, reservoirs, ponds and huge floodplain areas with 15, 417- 17, 308 tons/year fish production potential [13]. As of [14] near 107 fish species grouped to 54 genera and 23 families in the White Nile in the territory of Ethiopia and the fish marketplace are ruled by 19 genera and more than 20 species with low-cost [13]. Yearly from the water lands of the country over 10,000 tons [15] fish of which nearly 5,700 tons of offal (1900 tons of DM) could be produced and give rise to fish by-product.

Looking for cheaper feed stuffs has been the concern of animal nutritionists in the present day in the tropics due to high price of conventional feed stuffs and feed. To mitigate critical livestock scarcity a substantial amount of work has been reported using fish by-product in animal diet in general and broiler diet in particular elsewhere, much less has been studied on the nutritive value of locally made fish by-product meal in Gambella, Ethiopia. Therefore, this research is intended to investigate the effects of fish by-product meal blend inclusion in broiler feeds on growth performance.

1.1 **General Objective**

1.1.1 **General objective**

- The purpose of this study was to investigate the effects of fish by-product meal inclusion in broiler feeds on growth performance.

1.1.2 **Specific objectives**

To investigate the performance of broiler under different feeding level of fish by-product inclusion.

To evaluate feed conversion ratio of feed based on inclusion level of fish by-product.
2. MATERIALS AND METHODS

2.1 Experimental Site

This research was conducted in South-western part of Ethiopia, located at Gambella town in the Gambella region’s and has 767 km distance from Addis Ababa in the Western part of Ethiopia. It extends between 7°N to 8.17°N latitude and 33°E to 35.02°E longitude. The annual rainfall of the region with an elevation of 400 – 500 m. a. s. l is 900 mm – 1500 mm. While it reaches up to 1900–2100 mm as the elevation increased to 2000 m. a. s. l. The mean monthly temperature ranges from 27°C – 33°C. The absolute maximum temperature reaches 45°C in mid-March and minimum 10.3°C in December. The relative air humidity increases during the wet season (70-80%) and abruptly decreases in the dry season (43-60%). Sometimes the maximum daily relative air humidity during the wet season reaches 100% while the minimum daily relative air humidity reaches 9% in the dry season. The region has wet season (May-October) and dry season (November-April) [16]. The major crops grown are Maize, Sorghum, Seasam, Cotton, Groundnut and monkey beans.

2.2 Source and Processing of Fish By-product Meal

Fish by-products (includes the bones & head parts) were collected from hotels and restaurants within Gambella town. Fish by-product meal was prepared by drying and grinding the fish by-products.

2.3 Experimental Diet and Design

Four (4) iso-nitrogenous and iso-caloric diets were formulated to meet the [4] nutrient requirement for the experimental chicken. Table 1 shows the composition of the treatment diets and T1- control without fish by-product meal, T2 -2% fish by-product meal, T3- 3% fish by-product meal and T4- 5% fish by-product meal. Each of the diet constituted a treatment and each treatment were replicated 3 times with 20 birds per replicate in a completely randomized design.

2.4 Laboratory Analysis

Prior of formulation, proximate analysis and other analyses were performed on samples of fish by-product. Samples of diets were analyzed for proximate analysis, for crude protein (CP), dry matter (DM), Crude fibre (CF), Ether extract and Ash. Calcium concentration was determined by atomic absorption spectrophotometer and Phosphorus content was analyzed with colorimetric method, by spectrophotometer. NFE was determine using the following formula: NFE = 100 – (CP + CF + EE + ash). The proximate analysis was carried out according to the method of [17].

2.5 Parameters Monitored and Management of Birds

The experiment was conducted for 42 days. Two hundred and forty (240) unsexed day-old broiler chicks (Cobb 500) were reared at floor space of 1 m x 2 m (0.10 m²/bird). Rice straw was used as litter at a depth of 3 cm. Fumigation was done 2 weeks prior to the arrival of the chicks. Chicks were brooded under convenient temperature for 0-3 weeks; feed and water were given ad-libitum. They were vaccinated against Newcastle and infectious bursal diseases (Gumboro) on the 7th and 12th days, respectively, mortality of birds was recorded as it occurred.

Parameters measured for the experiment were the initial body weight, final body weight, daily feed intake, feed to gain ratio, and feed conversion ratio (FCR).

\[
FCR = \frac{Total \ feed \ consumed}{Total \ weight \ gain}
\]

2.6 Data Analysis

Data were recorded and stored on Microsoft excel for analysis. Data were analyzed using General linear model procedure of SAS version 9.2. Significance test among treatments were determined using Duncan’s Multiple Range Test in the SAS package.

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Diets

The chemical composition of the treatment diets used in the feeding trial is presented in Table 2. The CP contents of the diets varied between 18.76 to 19.44% which is within the range recommended (20% and 18.5%) by [18] for grower and finisher broilers, respectively. The increased amount of ash, calcium and phosphorus were due to fish by-product meal and it is not beyond recommended range for broilers [19].
3.2 Performance of Broiler under Different Feeding Level of Fish By-product Meal

The results of inclusion of fish by-product on broiler performance were presented in the Table 3. There was no significance (P>0.05) difference in average body weight, daily gain, and feed conversion ratio due to addition of fish by-product up to 20 days of age. But, the average daily feed intake of broiler significantly increased (P<0.05) in 3 and 5% fish by-product level to the diets during period 11-20 days of age. At the age of 32 – 42 days the average body weight and daily feed intake at the age of 21-32 days were significantly (P<0.05) increased in 3 and 5% compared to control and 2% fish by-product meal diet.

Chicks fed with diets containing treatment 3 and treatment 4 had higher body weight and average feed intake compared with those fed diets without of fish by-product.

The average daily gains of the broilers were not significantly affected by fish by-product inclusion level of the first three treatments. Over the whole experimental period, the average chicks daily gain and feed intake were significantly (P<0.05) improved by 5% fish by-product supplementation to the diets. These gain was noted due to increased feed intake and average feed conversion ratio was not significantly (P>0.05) influenced by dietary fish by-product. This study showed that the advantage of fish by-product on broiler performance becomes significant at 5% inclusion. The use of fish by product as chicken feed is very important in solving one of the main poultry production problems, which is feed shortage in quantity and quality of the study area. Similar to this study [19] confirms that the beneficial effects of fish by-product on broiler performance become most evident at higher inclusion level.

3.3 Feed Conversion Ratio of Feed Based on Inclusion Level of Fish By-product

The average feed conversion ratios of the broilers on the experimental feeds were not significantly affected by fish by-product inclusion level of the experimental treatments.

Table 1. Percentage of feed ingredients as fed basis of experimental diets

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>34.1</td>
<td>34.1</td>
<td>34.1</td>
<td>34.1</td>
</tr>
<tr>
<td>Wheat bran</td>
<td>21</td>
<td>24.32</td>
<td>30.16</td>
<td>34.7</td>
</tr>
<tr>
<td>Soybeans meal</td>
<td>27</td>
<td>21.88</td>
<td>15.2</td>
<td>10.3</td>
</tr>
<tr>
<td>Noug cake</td>
<td>16</td>
<td>15.8</td>
<td>15.64</td>
<td>14</td>
</tr>
<tr>
<td>Fish by-product meal</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Lime stone</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Vitamin premix</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Table 2. Nutrient content and energy value of the experimental diets

<table>
<thead>
<tr>
<th>Composition (% of DM)</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM (%)</td>
<td>93.41</td>
<td>92.81</td>
<td>92.68</td>
<td>92.96</td>
</tr>
<tr>
<td>Ash</td>
<td>6.92</td>
<td>8.69</td>
<td>8.69</td>
<td>8.95</td>
</tr>
<tr>
<td>CF</td>
<td>0.96</td>
<td>11.57</td>
<td>11.75</td>
<td>12.99</td>
</tr>
<tr>
<td>CP</td>
<td>18.76</td>
<td>18.89</td>
<td>19.82</td>
<td>19.44</td>
</tr>
<tr>
<td>NFE</td>
<td>52.32</td>
<td>50.72</td>
<td>53.19</td>
<td>53.2</td>
</tr>
<tr>
<td>Fat</td>
<td>10.65</td>
<td>7.96</td>
<td>7.5</td>
<td>7.66</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.85</td>
<td>1.3</td>
<td>1.45</td>
<td>1.45</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.52</td>
<td>0.63</td>
<td>0.61</td>
<td>0.83</td>
</tr>
<tr>
<td>ME</td>
<td>2808</td>
<td>2890</td>
<td>2947</td>
<td>2980</td>
</tr>
</tbody>
</table>

CF: Crude fiber; CP: Crude protein; DM: Dry matter; ME: Metabolisable energy in (kcal ME/kg DM); NFE: Nitrogen free extract
The fish by products were collected for free except for insignificant cost of labour. This is because the usages of fish by products is neither practiced for chicken feed nor used for other purpose. In accordance with this study [20] states that the use of fish by-product as poultry feed could reduce market competition with human food in one hand and improve the profitability of poultry framing by lowering the prices.

**4. CONCLUSION**

This study revealed that inclusion of fish by-product in the diet improved the performance of broiler and is a cheap source of broiler feed. The average daily gain and feed intake of chicks were increased by 3 and 5% fish by-product inclusion to the diets.

To utilize and exploit the potential of fish by-product as broiler feed in Gambella region, Ethiopia smallholder farmers should get training on preparation and utilization of fish by product.

**DECLARATION**

We declare that this research is done under the support of Ethiopian Institute of Agricultural Research.

**ETHICAL APPROVAL AND CONSENT**

All procedures and experimental protocols were conducted in accordance with the guide for the care and use of agricultural animals in research and approved by department of animal production and technology of Gambella University.

**AVAILABILITY OF SUPPORTING DATA**

The datasets are used and/or analyzed during the current study available from the corresponding author on request.

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**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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