Utilization of Shellfish Processing Industry Waste Slurry on the Performance of Broiler Chickens


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Abstract

The study was carried out to evaluate the effect of shellfish processing industry waste slurry (SPIWS) on the growth performance of broilers. The research trial was conducted for 6 weeks period on 320 day old straight run broiler chicks of strain Cobb-430Y. The chicks were randomly distributed into 4 groups of eighty chicks into each group, which were further subdivided into 4 replicates of 20 chicks each. The dietary treatment groups were, A (Basal diet), B (Diet having 2% SPIWS), C (Diet having 4% SPIWS) and D (Diet having 6% SPIWS). The weekly live body weight, weekly weight gain, weekly feed intake, weekly feed conversion ratio and daily mortality were recorded and the economics of production was calculated at the end of the experiment. Results showed that, all the SPIWS supplemented groups given significantly higher body weights and weight gain than control group. However B group had shown numerically higher body weight and weight gain than group D and C. Feed intake was significantly higher in D group. The better feed efficiency was observed in B group. Economically 2% SPIWS had given higher profit as compared to other experimental and control groups. It was concluded that 2% inclusion of SPIWS in feed gave improved body weight, weight gain, feed intake, FCR and profit than control birds.

Keywords: Broiler chicken, Performance, Shellfish processing, Industry waste slurry.

1. Introduction

Feed comprises of around 60- 70% of the total expenditure of broiler production (Thirumalaisamy et al., 2016). Presently broiler feed costs has reached almost up to Rs 35/kg. The required poultry feed of India is around 32 million metric tonne/year contributing the grain needed is 65% forming 20 million metric tonne. Our nation produces 24 million metric tonne of maize. The poultry industry has switched from fish meal to soya. By producing 11 million metric tonne of soya/year, the livestock industry can get 7 million metric tonne of de-oiled soya within the nation which is required (DADF, 2017). On comparing the scenario in 2015-16 and our goals in 2022, chicken meat production was 3.26 million tonnes that is likely to go up to 6.20 million tonnes. The count of commercial broilers will rise from 3326 million to 5167 million. Looking through the considerations, 3.5 kg feed per bird with FCR of 1.7, total feed required was 12 million metric tonne that is likely to go up to 15.5 million metric tonne as 3 kg/bird and FCR of 1.6. Requirement of the feed ingredients; for eg. Maize at 40% is raising from to 6.2 from 4.8 million metric tonnes and of soya at 20% to 3.1 from 2.4 million metric tonne. Meat availability/person will go up to 3.21 from 2.22 Kg/year in 2014-15 kg/year (DADF 2017).

Availability as well as cost of suitable grains is the determining factors of the economic production of meat and egg. Nutrition plays a vital role to support the expected growth and production compliance of birds. Clause of better quality feed with all the essential nutrients must be taken into account to have impressive digestion, absorption and metabolism of ingredients (Ahaotu, 2018).

Feed is a major investment with the constraint of its swaying costs based on raw materials in poultry production (Agashe et al., 2017; Ahaotu et al., 2018a, b).

The only source of vegetable protein that is used in poultry ration and essential poultry feed ingredient is soybean. Its instable production and indiscriminate exports cause its shortage for the poultry sector resulting to its high costs. The soybean production in the country is about 16.8 million metric tonnes that is going to rise to 18.9 million metric tons by 2030 (Singh, 2011).

In India aquaculture industry is also increasing rapidly with growth rate of 6% per annum. This industry includes shell fish like prawns, lobsters and krills etc., also called crustaceans. With this rising industry, waste generation is also rising. The generated wastes from...
crustaceans are head, body scraps and tail which are called as crustacean (shells/wastes) and are used for production of chitin. Crustacean wastes are one of the major sources for producing value-added products like chitin and chitosan (Mizani and Aminlari, 2007). Shellfish processing industries fulfills large levels of main commercial sources of chitin that are shells of crustaceans such as shrimps, lobsters, crabs and krill. The shrimp processing industry in our country handles more than 1.25 lakh tons of shell and head waste per year which leads to huge problem of environmental pollution. India has a capacity of production of 10,000 tons of chitin per year from prawn shell only. Recently, the chitin industry in India is using less than 20% of shell waste with the profit of Rs. 100 crores/year (CIFT, 2009). This prawn waste is also utilized for producing chitin, chitosan and glucosamine hydrochloride that is consumed in the pharmaceutical industry. During the chitin extraction process, the prawn shells are restrained to deproteinisation causing formation of chitin precipitate and protein slurry containing around 6-7% proteins. The shell waste slurry was utilized in layer diet by coating the same on DORB (Vichare, 2013) and broiler diet (Purohit, 2013; Subbarayudu, 2015). Recently, the shell waste coated on sunflower extraction substituting soybean meal at 25% level in broiler diet, assisted in recording better live weights, gain in weights and feed intake (Avari et al., 2018). Considering above facts, this research has been planned to study the effect of shellfish processing industry waste slurry on the performance of broiler birds.

2. Materials and Methods

Three hundred twenty straight run commercial day-old broiler chicks, purchased from private hatchery were equally and randomly distributed in to four treatment groups. Each treatment groups were further divided into four replicates with twenty chicks in each replicate. The dietary treatment groups were, A (Basal diet), B (Diet having 2% SPIWS), C (Diet having 4% SPIWS) and D (Diet having 6% SPIWS) as presented in Table 1. The chicks were reared on deep litter system in pens up to 6 weeks of age. The broiler pre-starter feed was provided up to seven days, later on broiler starter and broiler finisher feeds were provided from second to third, and fourth to six weeks of age respectively. Birds from each group were weighed individually on day one and at weekly intervals, thereafter. Mean live body weight gain (g/bird) was computed at different growth phases of study. Measured quantity of feed was offered every day and the left over feed was recorded after 24 hours. The difference between the feed offered and feed left over was worked out to know the actual feed consumed by each group on a particular day. The feed consumption was calculated and expressed as g/b. On the basis of weekly live weights and weekly feed consumption, the values of feed conversion ratio (FCR) of each group were calculated. The feed cost per kg body weight gain in broilers reared under different treatment regimen of the present study was calculated on the basis of feed consumption during the experimental (0-42 days) period. The data obtained on various parameters studied during this experimental trial were subjected to statistical analysis as per Snedecor and Cochran (1994)

3. Results and Discussion

3.1 Body Weight and Weight Gain

The body weight and weight gain was significantly higher in group B (2% SPIWS) followed by group D (6% SPIWS), group C (4% SPIWS) and control (Table 2). The increase body weight in SPIWS diet might be due to the quality protein obtained by birds from the same. This statement was supported by Rosenfeld et al. (1997) who stated that the majority of the crude protein supplemented by a vegetable source is being replaced with a higher quality protein from an animal source. However, amino acid content and protein quality of animal protein sources tend to be superior to those of vegetable sources (Gernat, 2001). Santiago and Maldonad (2004) stated that shrimp meal could be a potential feed ingredient to supply part of the dietary protein requirements of broilers up to 6% of the diet to sustain adequate growth performance which supports the present findings. Khambualai et al. (2008) reported increased body weights in broilers fed with diet supplied with chitosan. Okonkwo et al. (2012) observed the matching live body weights in broilers when fed with shrimp waste meal. Purohit (2013) proposed that the birds from 5% soybean meal protein replacement by soluble proteins obtained from crustacean shells recorded highest live weight and gain in weight. Rahman and Koh (2016) stated that formic acid-treated shrimp meal can be used as a potential protein source in broiler diets. Avari et al. (2018) recorded better live weights in broilers when the shellfish slurry coated onto sunflower extraction replacing soybean meal at 25% level with enzyme supplementation. Similarly, Aktar et al. (2011) found beneficial effect on body weight of broilers when shrimp waste fed to broilers diets.

3.2 Feed Consumption and Feed Efficiency

3.2.1 Feed Consumption

The broilers fed with SPIWS groups (D, C and B) consumed significantly higher (P< 0.05) feed than bird with control group (A). Among the SPIWS supplemented groups, the FI of broilers was higher in group D than that of other SPIWS supplemented groups (C and B). These results are attributed with Nair (1987) reported an increase of 5% feed intake in the birds fed on chitin showing better appetite than in control group. Gernat (2001) reported –
Table 1: Ingredient (%) and nutrient composition of experimental diets

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Feed Ingredients/ Nutrients</th>
<th>Pre-starter ration/ Experimental Groups A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Starter ration/ Experimental Groups A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Finisher ration/ Experimental Groups A</th>
<th>B</th>
<th>C</th>
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<tr>
<td>1.1</td>
<td>Maize</td>
<td>53.73</td>
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<td>57.3</td>
<td>55.28</td>
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<td>Slurry</td>
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<td>4</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
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<td>1.3</td>
<td>Vegetable Oil</td>
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<td>1.78</td>
<td>1.68</td>
<td>1.62</td>
<td>3.27</td>
<td>3.18</td>
<td>3.11</td>
<td>3.01</td>
<td>4.18</td>
<td>4.09</td>
<td>4</td>
<td>3.905</td>
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<td>1.4</td>
<td>Soya DOC</td>
<td>40.36</td>
<td>40.48</td>
<td>40.54</td>
<td>40.76</td>
<td>37.93</td>
<td>38.01</td>
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<tr>
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<tr>
<td>1.12</td>
<td>Methionine</td>
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<td>0.16</td>
<td>0.16</td>
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<td>0.17</td>
<td>0.17</td>
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<tr>
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<td>Lysine</td>
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<td>0.07</td>
<td>0.08</td>
<td>0.08</td>
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<tr>
<td>1.14</td>
<td>Toxin binder</td>
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Significant higher feed consumption when 40 or 80% shrimp meal was used in the diet concluding that processed shrimp meal can be used at high levels relatively to replace soybean meal in layer diets without causing adverse effects on performance. Maigualema and Gernat (2003) showed that chicks fed 0, 25 and 50% tilapia by-product meal had significantly higher feed consumption throughout the growing period as compared to the other treatments and control group. Agunbiade et al. (2004) reported that average daily feed intake was significantly increased by dietary treatments containing whole cassava root meal with total replacement for maize. Okoye et al. (2005) showed that the dietary inclusion of shrimp waste meal at 20% had significant higher feed intake than control diet. Ingweye et al. (2008) stated that 25% level of shrimp waste meal instead of fish waste meal was better for improved broiler performance. Asafa et al. (2012) showed that average feed intake was numerically higher for 100% fish meal replacement by crayfish waste meal fed chickens than 50% replacement and control diet. Vichare (2013) reported significant increase in the feed intake of the layer birds fed protein from chitin industry by-product sprayed on de-oiled rice bran, replacing soybean meal at 25% and 50% than in control group. Subbarayudu (2015) reported the lower feed intake in control group than treatment groups in which shrimp waste extracted chitin was included as prebiotic at 1% and 2%. Avari et al. (2018) stated that diet having coated sunflower extract replacing soybean meal at 25% level recorded better feed consumption in broilers. The cumulative feed intake was increased in birds fed SPIWS might be due to animal origin fishy flavor which helps to consume more feed by the birds.

3.2.2 Feed Efficiency

The significantly improved FCR was observed in group B (SPIWS group) than control diet followed by Group D (6% SPIWS) and group C (4% SPIWS). The improved feed efficiency was observed in SPIWS might be due to the slurry obtained from shrimp fish processing waste. The certain study reported that shrimp waste in broiler diet enhance the butyrate concentration (Khempaka et al., 2011), van der Wielen et al. (2002) reported that volatile fatty acids have a bacteriostatic effect on certain enteric bacteria, like Salmonella Typhimurium,. Furthermore they do not inhibit beneficial gastrointestinal tract bacteria, such as Lactobacillus, in birds. A significant negative correlation between cecal propionate concentrations and Salmonella colonization in young chickens has also been reported Nisbet et al. (1996). Moreover, van der Wielen et al. (2002) reported that increased concentrations of butyric acid were related to decreased amounts of Enterobacteriaceae. Therefore, the high concentration of butyric acid produced in the ceca of broilers may play a vital role in the mechanism that inhibits E. coli and Salmonella colonization.
Table 2: Influence of dietary supplementation of shellfish processing industry waste slurry on body weight and weight gain (g/bird/wk) of broilers in different treatments

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Body weight</th>
<th>Body weight gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st week</td>
<td>3rd week</td>
</tr>
<tr>
<td>A</td>
<td>181.50±3.92</td>
<td>724.38±18.64b</td>
</tr>
<tr>
<td>B</td>
<td>184.65±3.88</td>
<td>828.34±29.05a</td>
</tr>
<tr>
<td>C</td>
<td>192.01±3.53</td>
<td>811.50±18.84a</td>
</tr>
<tr>
<td>D</td>
<td>182.08±2.35</td>
<td>831.54±18.14a</td>
</tr>
</tbody>
</table>

CV: 3.757 5.420 3.866 4.790 10.585 8.888
CD: NS 66.722 138.726 NS 59.300 77.622

Subbaraydu (2015) found significantly higher feed efficiency when 1 or 2% shrimp waste meal added in the broilers diet. Purohit (2013) reported marginally better feed efficiency when bird fed with crustaceans shell soluble protein supplied on soybean meal up to 5 or 10%. Okoye et al. (2005) reported improved feed efficiency when shrimp waste meal added in broiler diet up to 10%. Avari et al. (2018) recorded better feed efficiency in broilers when the shellfish slurry coated onto sunflower extraction replacing soybean meal at 25% level. Atkar et al. (2011) reported improved feed efficiency when 12% shrimp waste used in broiler diet. Agunbiade et al. (2004) observed significantly better feed efficiency by replacing up to 50% supplemental protein of soybean meal with equal proportion of supplemental protein from combination of shrimp waste and cassava leaf meal. Maigualema and Gernat (2003) reported birds fed with 25 or 50% tilapia fish by-product meal had significantly improved feed conversion throughout the 42 day growing period which stated that tilapia fish by product meal can be substituted for soybean meal crude protein up to a 50% level without negatively affecting bird performance or carcass quality. The comparable FCR observed by Mahata et al. (2008) who noted that comparable feed conversion ratio by substituting 8% level of shrimp waste hydrolysate for fish meal in broiler diet. In another study related to shellfish were observed by Shi et al. (2005) found increased feed conversion efficiency quadratically with increasing chitosan inclusion in diets containing 0.5 and 1.0 g/kg chitosan. Nair et al. (1987) reported the feed efficiency ratio was improved from 2.5 to 2.38 due to incorporation of chitin in the feed.

3.3 Economics

The broilers were sold on live body weight basis. It was observed that the profit calculated was the highest in group B (Rs. 25.18/kg), followed by group D (Rs. 22.78/kg), group C (Rs. 21.74/kg), and group A (13.08/kg) groups. Although group B group showed better growth, better feed conversion ratio, than other treatment groups.

4. Conclusions

Overall, it was concluded that inclusion of 2% shellfish processing industry waste slurry in feed improved body weight, weight gain, feed intake, FCR and profit than corn-soya based diet without any ill effect on the health and production performance of the birds.

References


Ghorpade et al…Utilization of Shellfish Processing Industry Waste Slurry on The Performance of Broiler Chickens


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