Asian Research Journal of Agriculture

9(1): 1-8, 2018; Article no.ARJA.41409
ISSN: 2456-561X

Effect of Graded Levels of Slaughter House Residues on Growth Performance and Haematological Parameters in Broiler Chicken's Ration

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Authors' contributions

This work was carried out in collaboration between all authors. Authors SA and MAI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MJU and MEH managed the analyses of the study. Author MJU managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ARJA/2018/41409
Editor(s):
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(2) Tancredo Souza, Centre for Functional Ecology, Department of Life Sciences, University of Coimbra, Portugal.
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Complete Peer review History: http://www.sciencedomain.org/review-history/25011

Original Research Article

Received 22nd March 2018
Accepted 31st May 2018
Published 6th June 2018

ABSTRACT

This study was aimed to investigate the effect of graded levels of slaughterhouse residue (SHR) on performance and haematological parameters of broiler chickens over the period of 35 days. One hundred day-old chicks were fed diets containing SHR at 0 (control), 5, 10 and 15% dietary levels represented as T1, T2, T3 and T4, respectively. Diets were fed to experimental birds in a completely randomized design (CRD). Each treatment was replicated five times consisting 5 birds

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per replicate (25 chicks/ treatment). The control diet was a commercial feed in the experiment. The parameters of performance considered were weight gain, feed intake, feed conversion ratio (FCR), dressing percentage, weight of breast, thigh, wing and abdominal fat. Similarly, the parameters of haematology were haemoglobin (Hb), packed cell volume (PCV) and erythrocyte sedimentation rate (ESR). Heart, liver, spleen, proventriculus and gizzard weights were also measured and recorded. The final body weights of broiler chickens fed T1, T2, T3 and T4 were found 1732.20 g, 1731.12 g, 1776.20 g and 1930.80 g, respectively. The total feed intake of treatment groups (T1, T2, T3 and T4) were 2711.64 g, 2707.94 g, 2720.89 g and 2751.18 g, respectively. The FCR was predicted by calculation for T1, T2, T3 and T4 (1.57, 1.56, 1.53 and 1.43 respectively). On the other hand blood parameters (Hb, PCV and ESR) were found statistically similar. It is concluded that the use of SHR as an alternative source of protein can be included in the diet of broiler chicken up to 15% dietary level as it might enhance the overall performance of broiler chickens without any adverse effect on growth with some reduction in the cost of production.

Keywords: Broiler chickens; slaughter residue; protein; performance and haematology.

1. INTRODUCTION

Chicken is the most important species of poultry group and economically important livestock in Bangladesh. The demand for broiler meat is rising throughout the world; especially in developing countries where population is increasing day by day resulting great demand for lean meat [1]. Unfortunately, excessive feed cost and a shortage of feed ingredients are becoming a constraints factor in poultry meat production. Subsequently, this problem is resulting to failure to meet the demand of meat production. The increasing feed cost which is at an alarming rate accounts for more than 60-65% of the total cost of broiler production, with protein comprising about 13% of total feed cost [2]. Although, the poultry industry is gradually increasing in Bangladesh, but the imported protein concentrates that are being used in formulating diet that might increase production cost that are not feasible in this country. Moreover, cost of different protein concentrates are going high gradually. Alternative and economical protein and energy sources are being searched for by nutritionists to make a low-cost ration. Animal protein, being high in biological value and superior protein supplement to plant protein is a desirable element for poultry feed formulation [3]. Therefore, it is important to add a certain amount of the protein to fulfill the needs of important amino acid [4]. Some wastes like a marine waste, frog and shrimp waste, rumen digesta are being used in poultry diet in Bangladesh as unconventional feeds [5].

Different countries in the world are now using different kinds of wastes including slaughterhouse residue, but in Bangladesh there are very little information on it and need more research as well as more information for the best use of this residue. Some protein sources that are very high price like fish meal-65 Taka/kg, Soyabean meal-50 taka/kg, Oil cake-40 taka and bone meal 60 taka/kg which enhance the production cost [6]. But the slaughterhouse waste (collection, processing and storing cost) costs maximum 3.20 Taka/kg [6]. The scarcity of animal protein in feed may be substituted with alternative and unconventional protein source from SHR [7]. Therefore, they have the potential for use as an inexpensive alternative to currently available protein for the supplementation in broiler feed. So, more studies need to be conducted to evaluate the use of SHR in the diet of broiler in Bangladesh. In these circumstances, this work could play a vital role in increasing the utilization more unconventional protein sources like SHR and eventually boost up the national economy of Bangladesh by reducing the production cost. Therefore, this study was to evaluate the response in performance and haematological changes of broiler chickens fed to slaughterhouse residue as a by-product of slaughterhouse in Bangladesh.

2. MATERIALS AND METHODS

2.1 Experimental Site

This experiment was carried out in a private poultry shed in Baghmara village near Sylhet Agricultural University campus. Prepared protein concentrate (produced from Slaughterhouse residue) and commercial protein concentrate were analyzed in the Animal Nutrition Lab, Sylhet Agricultural University, Sylhet for the determination of Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF), Solid Not Fat (SNF) and

Ash% [8]. The amounts of feed ingredients required were grounded, weighed and thoroughly mixed. Vitamin-mineral premix and coccidiostat were also mixed properly with the feed.

2.2 Experimental Diets, Design and Birds Management

Diets for different treatments prepared separately. Each of the three experimental diets were divided into three equal parts and stored for seven days in separate nine (3X3=9) gunny bags, according to treatments and replications. The layout of the experiment was arranged comprising hundred (100) day old chicks which were randomly distributed into 4 treatments having 25 birds (T1, T2, T3 and T4), birds were fed diets in a completely randomized design (CRD). The litter materials spread on the floor was kept at 2- 4 inches and one square feet space was provided to each chick. The artificial brooding preparation was completed well prepared before the arrival of day-old chicks and the adequate temperature was maintained in the house. Sufficient lighting was supplied for 24 hours in the house. Four experimental diets of broiler starter and finisher were formulated with locally available feed ingredients. Starter diet was fed from 1 to 22 days and finisher diet from 23 to 35 days of age. Feed was supplied *ad libitum* twice daily throughout the experimental period. Freshwater was made available at all the time. All birds were vaccinated against Newcastle, infectious bursal disease (IBD) and infectious bronchitis as recommended schedule at 5, 10, 17 and 22th day respectively.

The temperature of the experimental house was recorded four times a day (6 AM, 12 PM, 6 PM, and 12AM) using a thermometer. Feed intake and chickens weight recorded every week. Different organs of birds were measured and recorded after culling and separation of the organs. FCR found from the following way:

Feed Conversion Ratio (FCR) = [Feed intake (g)/ Weight gain (g)]

The data were analyzed as the means and the standard deviation of the means (Means±SE) with analysis of variance (ANOVA) and means were separated using Duncan grouping in a statistical system (SAS- 2007) software of computer program.

Table 1. Composition of broiler starter and finisher rations

Ingredients (%)	Broiler Starter (1-22 days)				Broiler Finisher (23-35 days)			
	T1	T2	T3	T4	T1	T2	T3	T4
Maize	Commercial feed	52	52	52	Commercial feed	58	57.4	57.4
Rice polish		7.4	7	5		---	---	---
Wheat		6	5	4		7.4	7	5
Soybean meal		25	21.4	19.4		25	21	18
SHB		5	10	15		5	10	15
Soybean oil		3	3	3		3	3	3
DCP		0.6	0.6	0.6		0.6	0.6	0.6
Lysine		0.2	0.2	0.2		0.2	0.2	0.2
Common salt		0.25	0.25	0.25		0.25	0.25	0.25
Vitamin premix		0.25	0.25	0.25		0.25	0.25	0.25
Toxin binder		0.2	0.2	0.2		0.2	0.2	0.2
Enzyme		0.05	0.05	0.05		0.05	0.05	0.05
Coccidiostat		0.05	0.05	0.05		0.05	0.05	0.05
Total		100	100	100		100	100	100
Calculated composition								
ME (Kcal/Kg)	3150	3171	3160	3147	3200	3215	3202	3212
CP (%)	20	20	21	22	19	19	20	21
Ca (%)	0.86	0.88	1.39	1.91	0.80	0.84	1.36	1.90
Av. P (%)	0.38	0.39	0.59	0.79	0.40	0.39	0.59	0.79

T1 = Control (Commercial feed), T2 = 5% Slaughterhouse residue (SHR), T3 = 10% Slaughterhouse residue (SHR), T4 = 15% Slaughterhouse residue (SHR)

3. RESULTS AND DISCUSSION

The experiment was conducted to evaluate the effects of slaughter house residue (SHR) on growth performance of broiler chickens. Body weight, feed intake, FCR, carcass characteristics (dressing%, relative weight of breast, wing, thigh, back, neck and abdominal fat), edible by products relative weight of liver, gizzard, heart, spleen and proventriculus and as well as blood parameters (Hb, PCV, ESR) were considered.

3.1 Survey Regarding Slaughterhouse by- Products

The survey result showed that slaughterhouse residue from different slaughter houses nearly 100% were discarded and rendered useless and there is spoilage with time. This is similar with the previous reported by [6]. It was observed from his opinion that usually they through all of these wastes are dumped near the market or as roadside garbage, which makes it a problem for both the residents and people passing along the road as well as market people.

3.2 Preparation of Alternative Protein Concentrates

The by-products and wastes of slaughterhouse and chickens are perishable, but the processing of waste as alternative protein concentrate as commercial protein concentrate can be of good quality and it could be preserved for a long time and become very useful over time. Protein concentrate from tannery wastes described by [9] is helpful for the preparation of waste protein concentrate but it was not used. Processing of fleshing meal is similar to the preparation of waste protein concentrate as described by [7].

3.3 Chemical Composition

The chemical composition of wastes protein concentrate is shown in Table 2. The chemical composition of wastes protein concentrate on DM basis contains more CP than that of commercial. The crude protein content in commercial is 60% whereas in wastes protein concentrate was 69.77. According to [10] and [11] sun dried flesh contain 69.8% and 68.8% CP respectively that is very close to findings. Table 2 also represents that protein concentrate from slaughterhouse residue (alternative protein) contained better CP (69.77%), ME 3430 (kcal/kg DM) and ash (10.21%). Meanwhile, the commercial protein concentrate (CPC) contained remarkably higher CF (4%) and higher EE (10.0%). It is revealed that alternative protein concentrate could be the best option for alternative feeding commercial broilers.

3.4 Performance of Broilers

The performances of broilers are presented in Table 3. The results of the present research work are stated under the following sub headings to evaluate the effects of formulated diets by replacing commercial protein concentrate (CPC) with slaughterhouse residue (SHR).

3.4.1 Feed consumption

The daily average feed intakes of broilers in different groups were 77.48, 77.37, 77.74 and 78.61 g/bird/day respectively (Table 3). The highest feed consumption was found in T3 group and the lowest feed consumption was found in group T1. But the differences among feed consumption of broiler chickens were very low. It was observed that different feed intake among different treatments groups were highly significant ($P<0.01$). Feed intake was increased gradually with their age. The results were almost similar with the findings of [12,13,14]. They all showed gradual increasing alone with increasing of protein concentrate.

3.4.2 Live weight gain

The weekly average live weight gain of broiler among different treatment groups was 50.95, 50.92, 52.24 and 56.79 g/bird/weeks respectively (Table 3). The live weight was relatively higher in group T4 and almost same live weight was recorded in groups T1 and T2. From the result it found that the weekly mean live weights of broilers increased gradually due to gradual increasing of protein percentage in the diets. It was also observed that the different live weight gain among different treatment groups were highly significant ($P=0.01$). [15] and [11] agree with the finding their study also found different live weight gain among different treatment groups.

3.4.3 Feed conversion ratio (FCR)

Feed conversion ratios of broiler among groups (T1, T2, T3 and T4) were 1.57, 1.56, 1.53 and 1.43 respectively. The result showed that the

Table 2. Chemical composition of prepared waste and commercial protein concentrate

Sample name	Chemical composition (DM)					
	DM (%)	CP (%)	ME (kcal/kg)	CF (%)	EE (%)	Ash (%)
Slaughterhouse by product (SHB)	97.45	69.77	3430	0.83	8.41	10.21
Commercial protein concentrate (CPC)	94.0	60.0	3230	4.0	10.0	8.20

effect of increasing SHR in broiler feed had significant (P=0.01) difference. There was positive effect on FCR where the most efficient was found in broilers of group T3 (1.43). There was gradual decrease of FCR in treated group. Our findings are very close to [16] reports but partially close to [17].

3.5 Carcass Traits

The carcass weight of broilers of different treatment groups (T1, T2, T3 and T4) were 1315.60, 1363.91, 1427.90 and 1452.69 g/b, respectively (Table 4). From the Table, it was found that T4 (feed on 15% SHR containing ration) showed highest carcass weight (1452.69 g/b) while T1 group recorded the least. It is apparent from the data in (Table 4) that continuous increase in the ratio of SHR increases the carcass weight of broiler chickens. The study showed that SHR was a better booster for obtaining high quality broiler meat.

3.6 Weight of Internal Organs

Weights of edible and non-edible parts such as abdominal fat, liver, gizzard, heart, spleen and proventriculus were recorded after the 5th week (Table 5). The results showed that the weights of abdominal fat of broiler of treatments T1, T2, T3 and T4 were 1.97, 2.05, 2.12 and 2.05 of the live weight, weight of liver 4.06, 4.16, 4.14 and 4.26%, weight of gizzard 2.57, 2.48, 2.60 and 2.65%, weight of heart 0.65, 0.67, 0.65 and 0.67%, weight of spleen 0.14, 0.12, 0.13 and 0.15% and weight of proventriculus 0.46, 0.44, 0.51 and 0.48% respectively. It was observed that the abdominal fat, liver, gizzard, heart, spleen and proventriculus weights were also

Table 3. Performance characteristics of broiler chickens fed different treatments containing SHR

Parameters	Treatments				P value	Level of significance
	T1	T2	T3	T4		
Feed intake (g/d)						
Ist wk	22.25^{a}±0.07	22.16^{a}±0.07	21.59^{b}±0.07	21.48^{b}±0.07	0.01	**
2^{nd} wk	45.13^{d}±0.05	48.42^{a}±0.05	46.56^{b}±0.05	45.64^{c}±0.05	0.01	**
3^{rd} wk	73.91^{b}±0.04	72.56^{c}±0.04	73.85^{b}±0.04	79.19^{a}±0.04	0.01	**
4^{th} wk	107.57^{c}±0.01	105.87^{d}±0.01	107.64^{b}±0.01	107.83^{a}±0.01	0.01	**
5^{th} wk	138.53^{c}±0.01	137.85^{d}±0.01	139.07^{a}±0.01	138.89^{b}±0.01	0.01	**
Avg.	77.48^{c}±0.02	77.37^{d}±0.02	77.74^{b}±0.02	78.61^{a}±0.02	0.01	**
Total	2711.64^{c}±0.6	2707.94^{d}±0.6	2720.89^{b}±0.6	2751.18^{a}±0.6	0.01	**
Body wt gain (g/d)						
Ist wk	18.03^{b}±0.02	17.15^{c}±0.02	18.0^{b}±0.02	18.7^{a}±0.02	0.01	**
2^{nd} wk	37.52^{d}±0.03	42.45^{c}±0.03	45.35^{a}±0.03	44.39^{b}±0.03	0.01	**
3^{rd} wk	56.94^{b}±0.03	51.17^{d}±0.03	57.43^{a}±0.03	55.53^{c}±0.03	0.01	**
4^{th} wk	69.87^{b}±0.02	62.90^{d}±0.02	66.65^{c}±0.02	72.97^{a}±0.02	0.01	**
5^{th} wk	65.10^{d}±0.02	73.63^{b}±0.02	66.32^{c}±0.02	84.24^{a}±0.02	0.01	**
Final	1732.20^{c}±0.1	1731.12^{d}±0.1	1776.20^{b}±0.1	1930.80^{a}±0.1	0.01	**
Avg.	50.95^{c}±0.04	50.92^{d}±0.04	52.24^{b}±0.04	56.79^{a}±0.04	0.01	**
FCR	1.57^{a}±0.08	1.56^{b}±0.08	1.53^{c}±0.08	1.43^{d}±0.08	0.01	**

*Values indicate Mean±SE, ** = 1% level of significance. Where, T1= Control diet (Commercial feed), T2= Diet in which 5% SHR, T3= Diet in which 10% SHR and T4= Diet in which 15% SHR; 25 birds in each treatment. P ≤ 0.01. Wk= week, DOC= Day old chick, FCR= Feed conversion ratio, wt= weight*

Table 4. Carcass characteristics of broiler chicken fed different treatments containing SHR

Parameters	Treatments				P value	Level of significance
	T1	T2	T3	T4		
Live wt (g)	1776.78^{c}±3.7	1781.10^{c}±3.7	1822.05^{b}±3.7	1959.89^{a}±3.8	0.01	**
Carcass wt (g)	1315.60^{d}±2.9	1363.91^{c}±2.9	1427.90^{b}±2.9	1452.69^{a}±3.1	0.01	**
Dressing (%)	74.06^{c}±2.9	76.57^{b}±2.9	78.37^{a}±2.9	74.24^{c}±0.3	0.01	**
Breast meat (%)	36.13^{d}±0.05	36.48^{c}±0.05	37.56^{a}±0.05	37.20^{b}±0.05	0.01	**
Wing (%)	9.92^{c}±0.02	10.05^{b}±0.02	10.45^{a}±0.02	10.49^{a}±0.02	0.01	**
Thigh (%)	28.13^{a}±0.06	25.18^{c}±0.06	28.12^{a}±0.06	27.23^{b}±0.06	0.01	**
Back (%)	15.32^{a}±0.03	14.55^{b}±0.03	13.95^{c}±0.03	15.29^{a}±0.03	0.01	**
Neck (%)	6.34^{a}±12.2	6.06^{a}±12.2	5.96^{a}±12.2	6.44^{a}±12.4	0.01	**

*Values indicate Mean±SE, ** = 1% level of significance. Where, T1 = Control diet (Commercial feed), T2 = Diet in which 5% SHR, T3= Diet in which 10% SHR and T4 = Diet in which 15% SHR; 25 birds in each treatment. P ≤ 0.01, wt = weight*

slight increased under increased addition of SHR in feed. However, statistically the differences in the abdominal fat, liver, gizzard, heart, spleen and proventriculus weight under different treatment were significant (P=0.01).The results of the present study for weight of giblets match with the result of [18].

3.7 Evaluation of Haematological Parameters

The Hemoglobin (gm/dl) of broilers in different treatment groups (T1, T2, T3 and T4) were 7.87, 7.57, 7.77 and 7.87 respectively, The Packed cell volume (%) of broilers in different treatment groups (T1, T2, T3 and T4) were 32.67, 32.33, 33.67 and 33.33 respectively and the Erythrocyte sedimentation rate (mm/h) of broilers among different treatment groups (T1, T2, T3 and T4) were 1.8, 1.78, 1.87 and 1.82 respectively (Table 6). The highest and the similar value of Hb content was recorded in group T1 and T4 (7.87 gm/dl) and lowest value was in group T2 (7.57 gm/dl). The highest value of PCV content was recorded in group T3 (33.67%) and lowest in group T2 (32.33%). The highest value of ESR content was recorded in group T3 (1.87 mm/h) and the lowest value was in group T2 (1.78 mm/h). The values among different treated groups did not differ significantly (P>0.05). On the observation of blood profile studies after treatment of different levels of SHR there were increase of Hb, PCV and ESR concentration in the birds but they were not satisfactory significant. [19,20] reported that haematological parameters remain near about unchanged even though after fed different level of protein. There was also an evidence of little increase in Hemoglobin (Hb), Packed cell volume (PCV) and Erythrocyte sedimentation rate (ESR) concentration which indicated the good condition of broiler health [21]. Increased level of SHR leads to increased growth rate rapidly due to protein binding but the values of Hb, PCV and ESR was not increased.

Table 5. Weights of edible and non-edible parts of broiler chickens fed different treatments containing SHR

Parameters	Treatments				P value	Level of significance
	T_1	T_2	T_3	T_4		
Abdominal fat (%)	1.97^{c}±0.03	2.05^{b}±0.03	2.12^{a}±0.03	2.05^{b}±0.03	0.01	**
Liver (%)	4.06^{d}±0.04	4.16^{b}±0.04	4.14^{c}±0.04	4.26^{a}±0.04	0.01	**
Gizzard (%)	2.57^{c}±0.04	2.48^{d}±0.04	2.60^{b}±0.04	2.65^{a}±0.04	0.01	**
Heart (%)	0.65^{b}±0.03	0.67^{a}±0.03	0.65^{b}±0.03	0.67^{a}±0.03	0.01	**
Spleen (%)	0.14^{b}±0.03	0.12^{c}±0.03	0.13^{c}±0.03	0.15^{a}±0.03	0.01	**
Proventriculus (%)	0.46^{c}±0.04	0.44^{d}±0.04	0.51^{a}±0.04	0.48^{b}±0.04	0.01	**

*Values indicate Mean±SE, ** = 1% level of significance. Where, T1= Control diet (Commercial feed), T2= Diet in which 5% SHR, T3= Diet in which 10% SHR and T4= Diet in which 15% SHR; 25 birds in each treatment. P ≤ 0.01*

Table 6. Hematological parameters of broiler chickens fed different treatments containing SHR

Parameters	Treatments				P value	Level of significance
	T_1	T_2	T_3	T_4		
Hb (g/dl)	7.87^{a}±0.03	7.57^{b}±0.03	7.77^{a}±0.03	7.87^{a}±0.03	0.06	NS
PCV (%)	32.67^{a}±0. 03	32.33^{b}±0.03	33.67^{a}±0.03	33.33^{a}±0.03	0.07	NS
ESR (mm/h)	1.80^{a}±0.03	1.78^{a}±0.03	1.87^{a}±0.03	1.82^{a}±0.03	0.33	NS

Values indicate Mean±SE, NS means non-significant, Where, T1 = Control diet (Commercial feed), T2 = Diet in which 5% SHR, T3= Diet in which 10% SHR and T4 = Diet in which 15% SHR; 25 birds in each treatment. P ≤ 0.01. ESR = Erythrocyte Sedimentation Rate, PCV = Packed Cell Volume and Hb = Hemoglobin

4. CONCLUSION

Slaughterhouse by-product (SHB) can be used as an alternative source of broiler feed, which will reduce the feed cost and increase the desired growth at market age. Considering the effects of slaughterhouse residue (SHR) on growth and meat yield, it was observed that replacement of SHR in the diets can be done up 15% without any adverse effect on performance, haematological parameters and carcass characteristics with some reduction in the cost of production economically.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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