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EFFECT OF GRADED LEVELS OF DIETARY BIOCHAR ON CARCASS CHARACTERISTICS AND EATING QUALITY OF FINISHER BROILER CHICKENS

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Abstract

This study was conducted to determine the effects of dietary biochar on carcass characteristics, sensory attributes and proximate composition. A total of 40 broiler chickens were randomly selected from 120 birds fed diets containing 0% (control) (T1), 1.5% (T2), 3% (T3) and 6% (T4) biochar. The birds were slaughtered after 8-hour feed withdrawal, dressed and chilled for 24 hours. The visceral were separated into gizzard, spleen, heart and intestines and were weighed. The cold carcasses were also sectioned into the various carcass joints and weighed. The breast muscles were used for sensory analysis while the thigh muscles were used for laboratory analyses. The results indicated that biochar inclusion up to 1.5% improved (P<0.05) breast muscle, thigh and wing weights. Sensory characteristics of the meat were similar (P>0.05). Proximate components of the meat in terms of dry matter, crude protein, crude fat and ash were not also affected (P>0.05). Inclusion of charcoal up to 1.5% in the diets of broiler chickens improved breast muscle, thigh and wing weights of birds, but up to 6% inclusion did not affect sensory and proximate components of the meat.

Key words: Carcass, Charcoal, False Yam seed, Broiler chicken, Meat Quality, Chicken Feed

Introduction

The role of the poultry industry in improving the nutritional and economic status of Ghanaians cannot be over-emphasized. The industry has played a great role in improving employment opportunities and the provision of quality animal protein (Dazala *et al.*, 2010).

Despite these potentials, the industry is unable to provide adequate protein for the rapidly increasing population due to the high cost of conventional feed resources. There is, therefore, the need to seek out for alternative additives that can improve the health and utilization of commercial feeds by poultry in Ghana. Gerlach and Schmidt (2012) described the usefulness of biochar (charcoal) as a substance that promotes digestion, improves feed efficiency, and thus in particular energy absorption via the feed. Toxins such as dioxin, glyphosate, mycotoxins, pesticides and polycyclic aromatic hydrocarbons (PAHs) are efficiently bound by the biochar, thereby obviating any adverse effects on the digestive system and intestinal flora. The health, activity and balance of the animals will also be improved, as will meat and egg production. The inclusion of charcoal is to evaluate its usefulness in improving the weights of carcass, organ, primal cuts as well as the eating quality of broiler chickens.

In general, the consumers judge meat quality from its appearance, texture, juiciness, water holding capacity, firmness, tenderness, odour and flavour. According to Cross et al. (1986), those meat features are among the most important and perceptible features that influence the initial and final quality judgment by consumers.

However, the type of feed given to animals is reported to have significant effect on the carcass and sensory characteristics of the meat (Teye et al., 2006). This study was therefore conducted to determine the effects of feeding commercial broiler finisher ration with varying levels of charcoal on the carcass and eating qualities of the meat.

Materials and Methods

The experiment was conducted at the Meat Processing Unit and Laboratories of the University for Development Studies, Tamale, Ghana.

Experimental birds and design

Four treatments comprising of a (Control) 0% (T1), and diets containing charcoal as substitute for whole diet (Commercial broiler finisher diet) at 1.5% (T2), 3% (T3), and 6% (T4) and each treatment was replicated 5 times in a Completely Randomized Design.

The composition of the commercial broiler finisher mash were protein (19.45%), fat (3.95%), fibre (3.50%), cystine (0.21%), calcium (1.00%), available phosphorus (0.60%), lysine (1.00%), methionine (0.44%) and metabolizable energy (2800 kcal/kg). Powdered charcoal was added to the commercial broiler finisher mash at the above stated levels. The experimental diets were fed in mash form from 4 to 8 weeks of age. Feed and water were provided for *ad libitum* consumption and light was provided 24 h daily to stimulate feed intake during cooler night temperatures.

Both the feed and birds were weighed weekly to determine feed intake and live weight gain respectively. Feed conversion ratio was defined as live weight gain per unit feed consumed and mortality was recorded when it occurred.

At the end of the growth study, a total of forty (40) male broiler chicken (Cobb-500) at eight weeks old were selected from 120 birds raised in the poultry unit of the University for Development Studies. Carcass yield was expressed as a percentage of the carcass dress weight over live weight.

Slaughtering of birds

Each live bird was weighed with an electronic scale (Sartorius, CP 245S) after 8-hours feed withdrawal. The birds were then stuck with a sharp knife to cut the jugular veins and allowed to bleed for approximately 2 minutes, after which they were scalded in warm water (60°C). The feathers were plucked manually and head and shanks detached. An incision was then made at the vent area to remove the viscera, and the hot carcass weight was taken after washing with water at room temperature.

Carcass yield

The viscera were separated into intestines, gizzard, liver and spleen. The dressed carcass was chilled for 24 hours and cold carcass weight taken. Primal cuts were made from the chilled carcass, and weighed. The breast and thigh muscles were packed separately in transparent polythene bags and vacuum-sealed, then frozen (2°C) for sensory and laboratory analyses.

Sensory analysis

A total of fifteen (15) panelists, comprising staff members and students of the University, were randomly selected and trained according to the British Standard Institution guidelines (BSI, 1993) to evaluate the products. The breast muscles were thawed and grilled to a core temperature of 70°C in an electric oven (Turbofan, Blue seal, UK). The products were sliced into uniform sizes (about $2cm^3$) and wrapped with coded aluminium foils and presented to the panelists. Each panelist was provided with water and pieces of bread to serve as neutralizers between the products.

A five-point category scale was used to evaluate the sensory characteristics of the chicken as shown in Table 1.

Table 1: Five-point category scale for sensory analysis (Lim, 2011)

	Scale				
Attribute	**1**	**2**	**3**	**4**	**5**
Colour	very pale red	pale red	intermediate	dark red	very dark red
Aroma	very weak	weak	intermediate	strong	very strong
Tenderness	very tender	tender	intermediate	tough	very tough
Flavour intensity	very weak	weak	intermediate	strong	very strong
Flavour-liking	like very much	like	intermediate	dislike	dislike very much
Over-all liking	like very much	like	intermediate	dislike	dislike very much

Proximate compositions of the meats

The proximate compositions of the products were conducted according to the methods described by AOAC (1999).

Data Analyses

Data obtained were analyzed using the General Linear Model (GLM) of Analysis of Variance (ANOVA) of the Minitab Statistical Package, version 15 (MINITAB, 2007). Where significant differences were found, the means were separated using Tukey Pair Wise comparison, at 5% level of significance.

Results and Discussion

Primal cuts and carcass characteristics

The primal cuts and carcass characteristics of the chicken are presented in Table 2.

There was a significant difference in dress weight but not carcass dressing among the treatment groups. Birds fed diet containing 1.5% charcoal had the highest ($P>0.05$) dress weight. All the organs weighed did not show significant difference. Perhaps, the usefulness of biochar (charcoal) as substance that promotes digestion and improves feed efficiency in broilers (Gerlach and Schmidt, 2012) might have been efficient at 1.5% inclusion level in promoting feed utilization, hence increased dress weight.

Among the cut up parts, breast muscle, thigh and wing weights were higher ($P<0.05$) in birds fed with 1.5 % biochar diet. Those birds fed diets containing 0, 3% and 6% charcoal had similar ($P<0.05$) cut up parts. The significantly higher weight of the breast, thigh and the wing in the birds fed 1.5% charcoal could be due to the higher ($P<0.05$) dress weight recorded in this treatment group, probably because cut up parts yield generally increases with increasing body weight. The type and nutrient composition of a diet given to animals is reported to have significant effect on the carcass and sensory characteristics of the meat (Teye et al., 2006). In this study, 1.5% charcoal addition improved dress weight, breast muscle, thigh and wing weights respectively. The live weight of chickens can affect the chicken carcass composition and the meat quality properties (Sauveur, 1997). The weight variability of the chickens can be very important within a batch (Gigaud and Berri, 2007). This variability can be tied to individual variability but also to the sexual dimorphism. However, the weight variability in this study can be tied to the effect of 1.5% charcoal addition to the diet of the broiler chickens.

Table 2: Effect of adding graded levels of charcoal in finisher broiler diets on their primal cuts

Parameter	Control	1.5% C	3% C	6% C	±SED	P. value
Dress weight (Kg)	2.34^{b}	2.60^{a}	2.17^{b}	2.18^{b}	0.102	0.012
Carcass dressing (%)	75.22	75.62	74.87	74.86	0.764	0.726
Breast muscle (g)	242.7^{b}	311.3^{a}	208.7^{b}	226.3^{b}	25.63	0.018
Thigh (g)	190.0^{b}	207.7^{a}	183.3^{b}	186.0^{b}	8.74	0.042
Drumstick (g)	138.0	168.7	140.7	145.3	13.98	0.192
Wing (g)	124.0^{b}	140.0^{a}	112.0^{b}	118.0^{b}	6.68	0.015
Liver (g)	65.3	64.0	49.7	56.7	9.64	0.393
Spleen (g)	2.67	4.00	3.33	3.33	1.155	0.728
Gizzard (g)	48.7	48.0	39.3	46.0	5.81	0.412
Heart (g)	12.67	14.00	12.00	10.00	1.886	0.272
Whole intestine (g)	131.3	132.7	114.0	113.3	11.75	0.258
Head (g)	58.7	68.7	59.3	59.3	7.17	0.486
Shank (g)	43.3	53.3	47.3	46.0	9.20	0.742
Neck (g)	131.3	117.3	102.7	112.7	10.62	0.132

C= Charcoal, P= Probability, means with the different superscript are significantly different

Sensory evaluation of the products

Sensory evaluation of the products is indicated in Table 3.

Charcoal inclusion in the diets of broilers did not affect all the sensory parameters tested.

The sensory characteristics of chicken meat depend on the specific raw materials used in the feed composition (Sauveur, 1997). This could be that addition of charcoal to chicken diets might not influence sensory characteristics of their meat. Sensory characteristics of meat are very important factors consumers consider when buying meat and meat products (Bell and Weaver, 2002), and since no significant difference was observed in the sensory parameters, it suggests that consumers might not detect any sensory difference due to different levels of charcoal used. Meat purchasing decisions are influenced more by product appearance than any other quality factor (Lawrie and Ledward, 2006); colour and flavour represent perceived freshness and are of vital importance to the meat industry and meat science research (Mancini and Hunt, 2005). Colour is a major indicator of quality of meat, as the appearance of meat and meat products influence consumer acceptability (Van Oeckel et al., 1999; Bell and Weaver, 2002). Odour and flavour are other important parameters considered by consumers in making their buying decisions (Omojola and Adesehinwa, 2007).

Table 3: Effect of graded levels of charcoal in finisher broiler diets on carcass eating quality

Parameter	Control	1.5% C	3% C	6% C	±SED	P. value
Colour	2.27	2.00	2.13	1.93	0.315	0.724
Aroma	3.20	2.73	2.93	2.73	0.335	0.462
Tenderness	2.60	2.40	2.47	2.67	0.372	0.887
Flavour intensity	3.40	2.87	3.33	3.13	0.379	0.500
Flavour liking	3.65	3.13	2.87	2.87	0.354	0.090
Over-all liking	3.87	3.07	3.20	3.07	0.359	0.089

SED= Standard error of difference, C= Charcoal, P= Probability

Proximate composition of products

Proximate composition of the products is presented in table 4.

The inclusion of charcoal in the diets of broilers did not affect (P>0.05) the proximate composition of the carcass. According to Touraille (1994), the quality of poultry meat can be defined from a certain number of accurate features including the nutritional quality as well as the sensory quality.

The nutritional quality is tied to the ability of consumers to meet their needs for protein, lipids and carbohydrate from the consumption of such products. In addition to the contribution of nutriments, the meat must preserve the consumer's health. Charcoal is an inert material and in my view, it does not take part in digestive processes but rather serves as a catalyst to improve efficiency of feed utilization in poultry. In view of the nature of charcoal, it might not influence broiler meat composition when added to their diets.

Table 4: Effect of graded levels of charcoal on proximate composition of broiler chicken meat

Parameter	Control	1.5% C	3% C	6% C	±SED	P. value
Dry matter (%)	45.72	44.74	45.76	49.59	3.524	0.482
Crude protein (%)	59.81	55.25	60.87	56.71	2.913	0.612
Crude fat (%)	16.33	18.75	15.34	19.65	2.250	0.332
Ash (%)	3.70	3.68	4.66	2.77	0.986	0.146

C= Charcoal, P= Probability, means with the different superscript are significantly different

Conclusion

From the results of this study, it can be concluded that the inclusion of charcoal up to 1.5% in the diets of broiler chickens improved dress weight and cut up parts such as breast muscle, thigh and wing weights of birds, but up to 6% inclusion did not

affect sensory and proximate components of the meat.

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