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MEAT QUALITY AND AMINO ACID PROFILES OF BROILER CHICKENS FED ON DIETARY SOYBEAN WASTE REPLACEMENT

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ABSTRACT

The feeding trial was conducted to determine the meat quality and amino profile of broiler chicken's meat fed dietary Soybean waste (SBW) supplementation at different inclusion levels. Three hundred day- old Abor- acre chicks were randomly allocated into five dietary treatments with replacement levels of SBW 0% (control), 0.2% (T_2), 0.4% (T_3), 0.6%(T_4) and 0.8%(T_5), in 3 replicates each in a completely randomized design. The feeding trial was for a period of 8 weeks in which the birds were fed diets (23 % CP and 2800 Kcal/kg ME) and (20 % CP and 3000 Kcal/kg ME) at interval of 4 weeks each. Data were collected on meat quality such as Water holding capacity (WHC), colour coordinate, sensory evaluation and amino acid profiles. There is significant influence on the colour of the broiler breast meat by SBW. The supplementation of soybean meal with SBW 0.2 % showed higher ($p<0.05$) WHC value than other treatments. While SBW 0.4 % had higher ($p<0.05$) pH value compared with other treatments. Apart from appearance perception, there were no significant difference in taste, aroma, texture and overall acceptability of the broiler chicken meat on dietary graded levels of soybean waste replacement. The appearance perception of birds on SBW 0.8 % diet were significantly higher ($p <0.05$) compared with other treatments. Dietary birds fed SBW 0 % had higher essential amino acid (methionine, histidine and lysine) compared to other treatments. Replacement of SBW 0.4% is relatively comparable to birds on dietary SBW 0 %, the control treatment.

Keywords: Soybean Waste, Meat Quality, Amino acid Profiles, Replacement

DESCRIPTION OF PROBLEM

Research indicates that substituting soybean waste for a portion of the soybean meal in broiler diets can improve performance, carcass attributes, and meat quality [7]. It can boost meat quality characteristics like tenderness and juiciness as well as growth performance and carcass weight. To achieve performance, it is essential to strike the optimum balance and guarantee proper nutrient content in the feed. The replacement of soybean waste in broiler chicken diets has been the subject of numerous articles. In a study by [1] which examined the results of substituting brewery-dried grains for soybean meal in broiler diets, results showed that adding fermented soybean waste enhanced growth, increasing body weight and feed conversion efficiency. The effects of substituting defatted soybean waste for soybean meal in broiler diets were assessed by [4]. The study found that adding defatted soybean waste improved carcass characteristics (breast muscle yield and decreased abdominal fat deposition). In addition, a study by [5] examined the impact of switching from soybean meal to high-fibre sunflower meal as the main source of protein in laying hens, their findings showed no negative effects on body weight. They claimed that adding soybean hulls improved the qualities of meat, such as increased softness and reduced cooking loss. All the studies mentioned above point to the possibility of improving broiler chicken performance, carcass features, and meat quality by replacing dietary soybean waste. It is crucial to keep in mind that the precise outcomes can change based on the type and processing of soybean waste, as well as the total diet composition. This study intends to ascertain the amount of soybean waste that, when used in place of soybean meal, will produce the same growth performance and good carcass qualities.

MATERIALS AND METHODS

Study Area
The experiment was carried out at the poultry unit of the Teaching and Research Farm of the Department of Animal Production, Kwara State University, Malete, as described by [8].

Experimental Animals and Diets
The experimental animals and the diets used were discussed in the feeding trial previously conducted by [8].

Data Collection
Data were collected on initial body weight, final body weight, feed intake, and feed conversion ratio. [8]. Nutrient digestibility was determined at the 4th and 8th weeks of the feeding trial [8].

Data were collected on meat quality, and the following parameters were used to test for the quality of the meat:

- Water holding capacity, drip loss, cooking loss and pH
- Colour coordinate.
- Sensory evaluation.

Water holding capacity, drip loss, cooking loss and pH
Drip and cooking losses were measured according to the methods described by [9].
Drip loss (%) = $W1 - W2 \div W1 \times 100$ ……..(i)
Cooking loss (%) = $W1 - W2 \div W1 \times 100$…….(ii)

Colour Coordinate
Colour coordinates were measured according to the methods described by [10].
Sensory Evaluation
5g of the breast meat were trimmed free from external fat, labelled and cooked in water bath at 80 °C for 10 minutes. The meat samples were wrapped in aluminium foil cooled and kept in oven at 30 °C until evaluation. A 20 trained panellist was used to determine the sensory evaluation using a 9-point hedonic scale, procedure described by [20]. 9 indicating like extremely and 1 indicating dislike extremely.
Amino acid profiles
Amino acid profiles were determined using procedure described by [17].

Data Analysis
Data obtained from all determined parameters were subjected to ANOVA using the PROC MIXED procedure of the SAS package (2014). Means were separated using the Tukey HSD test at $P<0.05$ significant level.

RESULTS AND DISCUSSION

Result of growth performance, carcass attributes and nutrient digestibility on broiler chickens on dietary soybean waste replacement has been published [8].

The pH of birds on dietary SBW 0.4 % (5.87) were significantly higher ($p <0.05$) than those birds in dietary SBW 0 % and 0.2 % which in turn is significantly higher ($p <0.05$) than SBW 0.6 % (5.79) and 0.8 % (5.80). Birds on dietary supplementation SBW 0.4 % (5.87) performs better than other treatment including the control. This could be because of low content of crude protein in the diet compared to control which after slaughter metabolism stop (anaerobic condition). The glycogen reserved in the tissue will be converted to lactic acid and the more the muscle becomes acidic, the more the softness of the tissue. This result correlated with [11] which findings were fully fit within the pH range (5.40 - 5.99) accepted for poultry meat production. The water holding capacity (WHC) of birds on dietary SBW 0.2 % (22.62) were significantly higher ($p<0.05$) than birds on other treatments. Drip loss (DL) of birds on dietary 0 % (5.37) were significantly higher ($p <0.05$) than birds on dietary SBW 0.2 %, 0.4 %, 0.6 % and 0.8 %. For many years,

drip loss has been widely recognized in meat science as an indicator of meat quality and factor that could be applied to distinguish between deteriorated meats from normal muscle [12]. Meat of good quality is characterized by lesser drip loss. [21] showed the significant effect of ultimate pH on drip loss with a higher level in meat with low pH. Birds on dietary SBW 0.6 % had a lower mean value (1.27) as related to the meat pH. This could be because of low content of crude protein present in the diet.

Lightness (l*) of bird's meat on dietary SBW 0 % (18.87) and 0.2 % (17.52) were similar but significantly higher ($p < 0.05$) than those bird's meat on dietary SBW 0.4 % (5.24) and 0.8 % (8.66). The l* values of bird's meat fed SBW supplementation decreases down as the protein were reduced. Bird's meat on SBW 0 % has the highest mean value (18.87) while SBW 0.4 % has the lowest mean value (5.24). This could be because of high protein concentrate fed to the birds on SBW 0 %. The glycogen reserved in the tissue after slaughtering which is converted to lactic acid result in PSE (pale, soft and exudative) of the breast meat. This result disagreed with [14] who reported that there was no significant difference in dietary supplementation of black soldier fly as a source of protein on breast meat. Redness (a*) of bird's meat on dietary SBW 0.4 % (10.47) and 0.6 % (9.17) were similar but significantly higher ($p<0.05$) than bird's meat on dietary SBW 0.2 % and 0.8 %. Yellowness (b*) of bird's meat on dietary SBW 0.6 % and 0.8 % were similar but significantly higher ($p < 0.05$) than bird's meat on dietary SBW 0 %, 0.2 % and 0.4 %. This could be because of high pH levels in the meat which might be due to lack of glycogen which produces lactic acid and H+ postmortem in the breast muscle [3]. The result obtained from this study is consistent with the observation of [2] who reported that diets with higher fibre content and low metaboliseable energy will increase the WHC, pH, lightness, reduced the redness and yellowness in the breast meat of broiler chicken.

The appearance of bird's meat on dietary SBW 0.8 % (9.00) was significantly higher ($p<0.05$) than bird's meat on 0.2 % (8.67) and 0,6 % (8.00). The good appearance perception of bird's meat on SBW 0.8 % could be because of high dietary fibre in the diet which will not hinder the assimilation and utilisation of essential amino acids present in the diet as compared with the control despite its high content of essential amino acids but its assimilation and utilisation by birds may be hindered by the presence of oil in the diet. The result obtained in this study contradict the result of [2] who reported that there was no significant difference on bird fed with whey protein concentrations in broiler diets.

Table 1: Meat Quality (WHC, Cooking & Drip loss, colour coordinate) of Broiler Chicken Fed Dietary Soybean Waste Meal.

PARAMETER	TREATMENT						
	SBW 0%	SBW 0.2%	SBW 0.4%	SBW 0.6%	SBW 0.8%	SEM	P.VALUE
pH	5.84^{b}	5.82^{b}	5.87^{a}	5.79^{c}	5.80^{c}	0.00	<0.0001
WHC	16.78^{b}	22.62^{a}	16.27^{b}	17.84^{ab}	16.52^{b}	1.19	0.0179
Colour Coordinates							
Cooking Loss	38.65	40.57	41.21	38.78	39.02	0.88	0.2179
Drip Loss	5.37^{a}	1.62^{b}	1.61^{b}	1.27^{b}	1.89^{b}	0.25	<0.0001
Lightness l*	18.87^{a}	17.52^{a}	5.24^{b}	0.00^{c}	8.66^{b}	0.78	<0.0001
Redness a*	6.25^{ab}	3.15^{b}	10.47^{a}	9.17^{a}	4.10^{b}	0.94	0.0010
Yellowness b*	6.07^{b}	5.32^{b}	6.12^{b}	12.39^{a}	11.70^{a}	1.15	0.0026

^{a,b,c} means in the same row having different superscripts are significantly different ($p>0.05$).

Amino acid composition

Glycine acid of bird's meat on SBW 0.6% were significantly higher ($P< 0.05$) than those birds on SBW 0.4% which in turn significantly higher ($P<0.05$) than those on SBW 0% and 0.8%. Valine acid of those birds on SBW 0% were significantly higher ($P<0.05$) than those on SBW 0.4% which in turn higher than those birds on SBW 0.8%. Leucine acid of birds on SBW 0.2% were significantly higher ($P<0.05$) than those birds on SBW 0% treatment. However, there were similarities in leucine values of birds in dietary SBW (0.4%, 0.6% and 0.8%) treatments. Isoleucine acid of birds on SBW 0.6% were significantly higher ($P<0.05$) than those birds on SBW 0% which in turn significantly higher than those birds on SBW 0.8%. Proline acid

of birds on SBW 0.2% were significantly higher (P<0.05) than those birds on SBW 0.6% which in turn were significantly higher than those on SBW 0.8%. Threonine acid of birds on SBW 0.2% were significantly higher (P<0.05) than those birds on SBW 0% which in turn higher than the birds on SBW 0.8%. Methionine acid of birds on SBW 0.4% were significantly higher (P<0.05) than those birds on SBW 0% which in turn were significantly higher (P<0.05) than those on SBW 0.2%. Glutamine acid of birds on SBW 0.8% were significantly higher (P<0.05) than birds on SBW 0.6% which in turn were significantly higher (P<0.05) than SBW 0%. Lysine acid of birds on SBW 0.2% were significantly higher(P<0.05) than SBW 0.8% which in turn significantly higher than those on SBW 0.4%. Histidine acid of birds on SBW 0% were significantly higher (P<0.05) than those on SBW 0.4% which in turn significantly higher than those on SBW 0.6%. Tyrosine acid of birds on SBW 0.6% were significantly higher (P<0.05) than those on SBW 0.8% which in turn were significantly higher than those on SBW 0.2%. Tryptophan acid of birds on SBW 0.8% were significantly higher (P<0.05) than SBW 0.6% which in turn were significantly higher than SBW 0%. The catabolism of amino acid and its metabolic processes through conversion of protein is diet based dependent [16]. Despite its nutritional importance for humans, the amino acid content and profile of chicken meat has been scarcely investigated in literature. Findings of the present study confirmed that essential amino acids; histidine, methionine and valine were well adsorbed by birds on dietary treatment SBW 0 %. Lysine, phenylalanine, leucine and threonine are abundant in birds' meat on dietary SBW 0.2 %. Isoleucine in SBW 0.6 % diet and tryptophan in SBW 0.8 % diets were found to be deposited on the bird's meat. This could be because of the birds' ability to synthesize available essential amino acids in the diet. This finding is consistent with the result obtained by [17]. This result also agrees with [18] who observed that the glutamine amino acid level of broiler chickens fed low crude protein diet under tropical condition increased the amino acid digestibility.

Table 2: Sensory Evaluation of Broiler Chicken Meat Fed Dietary Soybean Waste Meal

PARAMETER	TREATMENT						
	SBW 0%	SBW 0.2%	SBW 0.4%	SBW 0.6%	SBW 0.8%	SEM	P-VALUE
Appearance	7.67^{c}	8.67^{b}	7.00^{c}	8.00^{b}	9.00^{a}	0.42	0.0470
Taste	8.33	9.00	7.67	8.67	8.33	0.47	0.4083
Texture	7.67	8.33	8.00	8.00	8.67	0.45	0.5962
Aroma	8.67	9.00	8.67	8.67	8.67	0.30	0.9032
Overall Acceptability	8.00	8.67	8.00	8.33	7.67	0.52	0.7091

^{a,b,c} means in the same row having different superscripts are significantly different (p>0.05).

CONCLUSION AND RECOMMENDATION

The results obtained showed that broiler chickens with replacement level of 0.4 % could also be an effective means of meat quality improvement. As a result, broiler chickens' diets containing soybean meal could be replaced with up to 0.4 % of soybean waste.

TABLE 3: Dietary Soybean Waste Supplementation on Amino Acid Profile of Broiler Chicken Meat

	Treatments						
Amino acid	SBW0%	SBW0.2%	SBW 0.4%	SBW0.6%	SBW0.8%	SEM	P value
Glycine	27.02^{c}	1.00^{e}	36.82^{b}	37.12^{a}	7.54^{d}	0.0027	<0.0001
Valine	18.58^{a}	0.00^{d}	16.32^{b}	0.00^{d}	12.21^{c}	0.00008	<0.0001
Leucine	0.06^{b}	22.98^{a}	0.00^{c}	0.00^{c}	0.00^{c}	0.00005	<0.0001
Isoleucine	15.65^{b}	0.00^{e}	13.42^{d}	23.75^{a}	15.40^{c}	0.0009	<0.0001
Proline	9.30^{c}	23.70^{a}	14.70^{b}	23.61^{a}	14.72^{b}	0.006	<0.0001
Threonine	4.08^{b}	6.68^{a}	0.00^{d}	0.00^{d}	2.17^{c}	0.0001	<0.0001
Methionine	0.73^{a}	0.47^{c}	0.65^{b}	0.00^{d}	0.00^{d}	0.0001	<0.0001
Cysteine	0.06^{d}	0.00^{e}	2.86^{a}	0.16^{c}	0.68^{b}	0.0001	<0.0001
Glutamine	1.07^{c}	0.12^{d}	0.00^{e}	5.48^{b}	9.39^{a}	0.0001	<0.0001
Lysine	0.33^{d}	8.74^{a}	1.06^{c}	0.20^{e}	3.28^{b}	0.0002	<0.0001
Histidine	36.22^{a}	0.00^{d}	0.44^{b}	0.24^{c}	0.00^{d}	0.0001	<0.0001
Tyrosine	0.32^{d}	0.42^{c}	0.21^{e}	1.63^{a}	0.67^{b}	0.0002	<0.0001
Tryptophan	0.36^{c}	0.00^{e}	0.27^{d}	0.52^{b}	11.03^{a}	0.0001	<0.0001
Alanine	0.00^{d}	1.46^{c}	0.00^{d}	6.61^{b}	20.63^{a}	0.0001	<0.0001
Asparagine	0.00^{b}	3.51^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00002	<0.0001
Phenylalanine	0.00^{b}	0.14^{a}	0.00^{b}	0.00^{b}	0.00^{b}	0.00002	<0.0001
Serine	0.00^{c}	0.00^{c}	3.27^{a}	0.00^{c}	1.95^{b}	0.00005	<0.0001
Aspatic acid	0.00^{d}	0.00^{b}	0.00^{b}	0.65^{a}	0.00^{b}	0.00002	<0.0001

$^{a-e}$ means in the same row with different superscripts differ significantly(P<0.05). SBW – soybean waste

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