

Growth, Carcass and Gut Morphology of Broiler Finisher Chickens Fed Raw and Processed Soybean Seed Meal

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Abstract: This study evaluated the effects of inclusion of raw, toasted and cooked (boiling) soybean seed meal at 20% in the ration of broiler finisher chickens on the growth, carcass and gut morphology in a four-week feeding trial. The results showed that feed intake, weight gain and feed:gain ratio of broilers fed 20% Cooked soybean seed meal were similar ($p>0.05$) to the Control group. However, they differed significantly ($p<0.05$) from broilers fed 20% raw or toasted soybean seed meal. The dressed weight and gizzard were similar ($p>0.05$) between birds fed on 20% cooked soybean seed meal and the control group, but, they differed significantly ($p<0.05$) from broilers on 20% raw and 20% toasted soybean seed meal. Higher ($p<0.05$) liver weights were observed in broilers fed on 20% raw and 20% toasted soybean seed meal. The gut morphology parameters were similar ($p>0.05$) between broilers fed on 20% cooked and control group, but they differed significantly ($p<0.05$) from broilers fed on 20% raw and 20% toasted soybean seed meal. However, the Colo-Rectum length and Colo-Rectum width were similar ($p>0.05$) between the treatment groups. The results obtained in broilers fed on 20% cooked soybean seed meal confirmed the superiority of the diet over those with 20% raw and toasted soybean seed meal. Cooking (boiling) soybean seed improved the palatability and efficiency of nutrient utilization of the seed meal.

Key words: Soybean seed meal, carcass, gut morphology, broilers

INTRODUCTION

Soybean (*Glycine max*) is now the most popular plant protein source for poultry nutrition in Nigeria due to its high energy and protein content (Nworgu *et al.*, 1999, Ekenyem and Onyeagoro, 2006). The total production of soybean in Nigeria ranges from 500-1,000 tonnes per year (Tion, 1999). The outstanding advantage of soybean over the other legume seeds is that it is high in some essential amino acids. Analysis of full-fat soybean portrayed the presence of crude protein 44.8%, fat 17.7 g, crude fibre 4.2 g, ash 5 g, calcium 226 mg, phosphorus 586 mg, nitrogen free extract 26.05% (Oyenuga, 1987). There is increasing interest in the use of full-fat soybean in poultry diets taking advantage of the high protein and energy content (Tion, 1999; Tion and Adeka, 2000).

The attendant problems in the use of soybean in poultry diets have been those associated with legume peas. In the raw state, it is known to have a lot of anti-

nutritional factors like the haemagglutinins and phytins (Liener and Kakade, 1990; Tion and Adeka, 2000) and these are inimical to the health and growth of animals (Liener and Kakade, 1990). However, most of these anti-nutritional factors could be inactivated by heat treatment (Isikwenu and Bratte, 1999) with humid or moist treatment preferred to dry heat treatment. The thermal treatment should not be expensive and readily available if soybean is to be used as a feed ingredient by the local farmers.

This study was therefore, carried out to investigate the growth, gut morphology and carcass organ characteristics of broiler finisher chickens fed raw and processed soybean seed meal.

MATERIALS AND METHODS

Management of experimental birds: One hundred and twenty Anak broiler birds aged 4 weeks were used for this study. The birds were reared in a deep litter system. The

Table 1: Chemical composition of the soybean seed meal

Parameters	Raw	Toasted	Boiled (%)
Moisture	10.52	12.06	10.26
Crude fibre	12.80	15.70	15.80
Crude protein	38.52	37.21	39.40
Ether extract	6.00	6.10	6.90
Ash	16.60	6.20	5.90

Table 2: Nutrient composition of the experimental diets

Ingredients	Control %	20% Raw	20% Toasted	20% Boiled
Maize	54.70	52.84	52.84	52.84
Palm kernel cake	9.95	7.96	7.96	7.96
Fish meal	14.92	7.96	7.96	7.96
Wheat offal	16.18	6.96	6.96	6.96
Soybean	0	20.00	20.00	20.00
Bone meal	3.73	3.73	3.73	3.73
Methionine	0.04	0.04	0.04	0.04
Salt	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Calculated				
Crude protein	17.17	20.55	20.11	20.37
Crude fibre	3.46	3.70	3.70	3.70
Calcium	2.29	1.87	1.87	1.87
Phosphorus	1.01	0.80	0.80	0.80
Lysine	1.02	1.16	1.16	1.16
Methionine	0.49	0.44	0.44	0.44
ME (Kcal kg ⁻¹)	2851	2898	2898	2898

*To provide: Vit. A, 10,000 iu; Vit. D2, 2000 iu; Vit. E, 5 iu; Vit. K, 2 mg; Riboflavin, 4.20 mg; Vit. B, 120.01 mg; Pantothenic acid, 5 mg; nicotinic acid, 20 mg; folic acid, 0.5 mg; chloride, 3, mg; Mg, 56 mg; Fe 20 mg; Cu, 10 mg; Iodine 0.8 mg

birds were weighed individually at the beginning of the experiment and weekly thereafter. Feed and water were supplied *ad libitum* and routine management practices were ensured.

Preparation of soybean seed meal: The soybean seed used for this study was subjected to 3 processing methods namely raw, toasting and boiling. Twenty five kilogram of soybean seed was toasted for 30 min at 14°C according to IFSP (1988) using a big local frying pan with firewood as source of heat. The soybean seed was then cooled and ground in a hammer mill to pass through a 15 mm sieve and packed in a bag ready for use. Another 25 kg of soybean seed was cooked at 100°C for 40 min in a big cooking pot containing water. The water was allowed to boil before pouring in the soybean seed. The cooked soybean seed was later removed and sun-dried for 3 days, ground in a hammer mill to pass through a 15 mm sieve and packed in a bag for use. The proximate composition of raw, toasted and boiled soybean seed meal is shown in Table 1. The proximate composition of the soybean seed meal was carried out by the methods of AOAC (1995).

Experimental diets and design: The one hundred and twenty broiler birds were divided into 4 treatment groups

of 30 birds per group. Each treatment group was further replicated 3 times with 10 birds per replicate. The groups were then randomly allotted to the four treatment diets at 0, 20% raw, 20% toasted and 20% boiled soybean seed meal inclusion levels in a Completely Randomized Design (CRD) shown in Table 2.

Growth performance: Average feed intake as well as live weights gained were monitored weekly for each replicate and feed:gain ratio was then calculated from the data obtained.

Gut morphology and carcass evaluation: At the 28th day which was the end of the experiment, four birds were randomly selected from each replicate and kept off feed for 24 h but not water and weighed before slaughtering. Each bird was killed and dressed weight was obtained. After evisceration, the organs and gastro-intestinal tracts were removed and weighed accordingly by the methods described by Ogbonna *et al.* (2000).

Data analysis: All the data collected from this study were subjected to analysis of variance Steel and Torrie (1980, 1990), while differences between treatment means were separated using Duncan's New Multiple Range Test as described by Obi (1990).

RESULTS AND DISCUSSION

Table 3 show the average daily weight gain, daily feed intake and feed:gain ratio of broilers fed the control diet and the diet with 20% cooked soybean meal were not significantly different ($p>0.05$), but, they were significantly different ($p<0.05$) from broilers on diets with 20% raw and 20% toasted soybean meal which were similar ($p>0.05$) between the treatments. The improvement in the performance of broilers fed cooked soybean meal could be that boiling improved the palatability of the diet by eluting the water-soluble polyphenols and possibly other anti-nutritional substances as observed in previous studies (Joseph and Abolaji, 1997; Iheukwumere *et al.*, 2008).

There is also an indication that wet cooking (boiling) is more effective than dry cooking (toasting) in eliminating some of the anti-nutritional factors, probably because of the eluting property of boiled water (Tion and Adeka, 2000; Amaefula *et al.*, 2005).

Mortality rates observed in all the treatments were similar ($p>0.05$) and normal, an indication that the soybean seed meals were not detrimental to the well being of the broilers.

Table 3: Growth performance of broilers fed diets containing raw and processed soybean seed meal

Parameters	Treatment (Soybean seed meal)				SEM
	Control	20% Raw	20% Toasted	20% Boiled	
Average daily feed intake (g)	102.40 ^a	96.41 ^b	96.56 ^b	101.56 ^a	1.20
Average daily weight gain (g)	44.28 ^a	40.30 ^b	41.54 ^b	43.00 ^a	0.02
Feed:Gain ratio	2.31 ^a	2.45 ^b	2.41 ^b	2.36 ^a	0.04

a'b: Means within row with different superscripts are significantly different ($p < 0.05$)

Table 4: Carcass and gut morphology of broiler chickens fed raw and processed soybean seed meal

Parameters	Treatment (Soybean seed meal)				SEM
	Control	20% Raw	20% Toasted	20% Boiled	
Live weight (kg)	1.23 ^a	1.14 ^b	1.13 ^b	1.20 ^a	0.04
Dressed weight (kg)	0.96 ^a	0.68 ^b	0.71 ^b	0.94 ^a	0.06
Dressed weight as % of live weight	76.0 ^a	60.35 ^b	61.54 ^b	74.0 ^a	2.74
Gizzard (g)	56.24 ^a	43.21 ^b	44.18 ^b	54.36 ^a	1.36
Liver (g)	46.85 ^b	56.65 ^a	55.54 ^a	43.35 ^b	2.40
Gut morphology crop-oesophagus (cm)	18.61 ^a	16.23 ^b	15.45 ^b	17.85 ^a	0.31
Proventriculus (g)	6.42 ^a	5.14 ^b	5.25 ^b	6.35 ^a	0.24
Duodenum fold length (cm)	28.34 ^a	22.14 ^b	23.21 ^b	29.34 ^a	1.02
Jejunum width (cm)	2.58 ^a	1.24 ^b	2.26 ^b	2.58 ^a	0.07
Ileum length (cm)	2.15 ^a	1.82 ^b	1.83 ^b	2.25 ^a	0.03
Caecum length (cm)	16.35 ^a	12.21 ^b	13.14 ^b	17.45 ^a	0.63
Caecum width (cm)	5.85	4.66	4.75	5.87	0.07 ^{NS}
Small intestine (g)	70.85 ^a	64.25 ^b	62.41 ^b	71.21 ^a	1.82
Colo-Rectum length (cm)	12.00	11.12	11.30	13.00	0.84 ^{NS}
Colo-Rectum width (cm)	5.07	4.58	4.98	5.13	1.01 ^{NS}
Gut-Gizzard length (cm)	23.21 ^a	20.75 ^b	20.84 ^b	24.35 ^a	0.27

a' b: Means within row with different superscripts are significantly different ($p < 0.05$)

The effect of raw and processed soybean seed meal on the carcass, gut morphology of broilers is shown in Table 4. The results indicate that live weight, dressed weight and dressed weight expressed as percentage of live weight were similar ($p > 0.05$) between broilers fed on 20% raw diets and 20% toasted soybean meal diets, but they differed significantly ($p < 0.05$) from broilers on 20% boiled soybean meal and the control diet.

The gizzard weights followed the same pattern as in the carcass weight. The insignificant differences observed in the carcass quality and gizzard weight of broilers fed control diet and the diet with 20% cooked soybean seed meal further confirmed the fact that cooking (boiling) improved the efficiency of nutrient utilization of the seed meal in the diet. The increase in weight of the liver of broilers fed diets with 20% raw and 20% toasted soybean seed meal indicate the presence of certain toxic substances (Hemening, 1992; Amaefula *et al.*, 2005) in the unprocessed or toasted soybean seed meal.

The results of feeding raw and processed soybean seed meal got morphology Table 4 indicate that the Crop-oesophagus, proventriculus, duodenum fold length and width, jejunum width, ileum length, caecum length and small intestine were similar ($p > 0.05$) between broilers fed on 20% cooked soybean seed meal and the control diet. However, they differed significantly ($p < 0.05$) from broilers fed on 20% raw and 20% toasted soybean seed meal in all the gut morphology evaluated. The

insignificant differences observed in the gut morphology of broilers fed cooked (boiling) confirmed the palatability and improved efficiency of nutrient utilization (Amaefula *et al.*, 2005). In this study, there was no significant difference ($p > 0.05$) between the treatment groups in Colo-Rectum length and Colo-Rectum width. This observation in this study is in agreement with the findings of Ogbonna *et al.* (2000) in broiler chickens. The Gut-Gizzard length was not significantly different ($p > 0.05$) between broilers fed on the 20% cooked soybean seed meal and the control diet, however, they differed significantly ($p < 0.05$) from broilers fed on 20% raw and 20% toasted soybean seed meal. The observed differences in this study may be attributed to certain toxic substances in the raw and toasted soybean seed meal. This is in agreement with the findings of Awosanya *et al.* (1999) and Amaefula *et al.* (2005).

CONCLUSION

This study has shown that cooking (boiling) of soybean seed improved the palatability and efficient utilization of the seed meal. Considering the broilers growth performance, carcass and gut morphology results obtained in this study, it appears that up to 20% cooked soybean seed meal can be incorporated into broilers diets without deleterious effects on the birds.

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