

EFFECT OF GRADED LEVELS OF BEAN (*Phaseolus vulgaris*) SIEVATE ON CARCASS AND INTERNAL ORGAN CHARACTERISTICS OF FINISHER BROILER CHICKENS

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Abstract

A 56 - day feeding trial was conducted to evaluate the effect of different levels of bean sievate (*Phaseolus vulgaris*) on carcass and internal organ characteristics of broiler finisher chickens. One hundred and fifty (150) day - old Arbor Acre broiler chicks were used in the study. The birds were randomly assigned to five dietary treatment groups in a Completely Randomized Design (CRD) to represent treatments T_1 , T_2 , T_3 , T_4 and T_5 respectively. Each treatment had thirty (30) birds and replicated thrice with ten (10) birds per replicate. The inclusion levels were 0, 5, 10, 15 and 20% respectively. Treatment one (T_1) served as the control and had no bean sievate meal. Feed and water were given ad-libitum to the birds, while other management procedures were equally adhered to. Data on carcass characteristics were obtained by selecting two birds per replicate with weight closest to the group average for carcass evaluation. Internal organs were weighed and recorded accordingly. Results obtained were subjected to one way ANOVA. Results indicated that final live weight (1.70-1.94kg) and dressed weight (1.25-1.41kg) showed significant ($p < 0.05$) differences in all the treatment groups as the replacement levels of bean sievate increases in the diets. Internal organs also followed the same trend. Weight of liver, heart, gizzard and intestine also showed significant ($p < 0.05$) differences, except kidney. The study therefore concluded that 15% inclusion level of fermented bean sievate in the diets of finisher broiler birds could improve carcass yield and internal organ development.

Keywords: Carcass and organ parameters, bean sievate, finisher broiler chickens, soybean meal

Introduction

The poultry industry plays a significant role in global food security, providing a readily available and relatively affordable source of animal protein (FAO, 2020). Broiler chickens, specifically bred for rapid growth and efficient meat production, constitute a major component of this industry. Feed costs represent a substantial portion (60-70%) of the total production expenses in broiler farming (Khan *et al.*, 2018), making the identification and utilization of cost-effective and locally available feed ingredients crucial for sustainable poultry production, particularly in developing countries, like Nigeria (Khan *et al.*, 2018).

Soybean meal (SBM) is widely recognized as the standard protein source in poultry diets due to its high crude protein content (approximately 44 - 48%), excellent amino acid profile, and good digestibility (Ravindran, 2015). However, the cost of soybean meal can fluctuate significantly due to factors such as high demand, transportation costs, and availability, often posing a challenge to small and medium-scale poultry farmers.

This economic reality has driven research into alternative protein sources that can partially or completely replace soybean meal in poultry diets without compromising growth performance, carcass quality and overall profitability. Bean sievate, a by-product of common bean (*Phaseolus vulgaris*) after processing can present a suitable alternative due to its availability which is often discarded as waste (Archibong *et al.*, 2024).

However, its utilization in poultry diets is often limited by the presence of anti-nutritional factors (ANFs) such as trypsin inhibitors, lectins (phytohaemagglutinins), and tannins, which can negatively impact nutrient digestibility, growth performance, and overall health of the birds (Ugwu and Onyimonyi, 2018). Various processing methods, including soaking, boiling or toasting and sieving, have been employed to reduce the levels of these ANFs and improve the nutritional value of bean sievate for poultry feeding (Oladunjoye *et al.*, 2010). Beans sievate, the residue obtained after processing beans for various culinary purposes (e.g. "moi-moi" or "akara" in Nigeria), is often considered a waste product with limited economic value. However, this sievate still contains significant amount of protein, fibre, and other nutrients, suggesting its potential as a feed ingredient for livestock, including poultry. Utilizing beans sievate not only offers a cost-effective alternative to soybean meal but also contributes to reducing agricultural waste and promoting sustainable resource utilization (Oladunjoye *et al.*, 2010).

Therefore, the purpose of this study was to evaluate the effect of different levels of bean sievate on carcass and internal organ characteristics of broiler finisher chickens.

Materials and Methods

Location of the Study

The study was conducted at the Poultry Unit of the Teaching and Research Farm, University of Calabar, Calabar, Cross River State, Nigeria (from May to July, 2025). Calabar is geographically located within the tropical rainforest zone of Nigeria with a landmass of 233.2 square miles (604 km²) and lies between Latitude 4°57' N to 415°39' N of the equator and Longitude 18°1E of the Greenwich meridian. The relative humidity is 70 - 90% with an elevation above sea level of 28 meters. The annual rainfall is approximately 2,750 mm and temperatures ranging from 24° - 32°C (NiMet., 2022).

Collection and Processing of Test Material (*Phaseolus vulgaris*)

Fermented bean sievate, a by-product of *Phaseolus vulgaris* was obtained from local food processing vendors in Calabar Metropolis. The fermented bean sievate was sundried for 72 hours to constant weight. The dried sievate was milled to achieve a uniform particle size (2 mm) suitable for incorporation into poultry diets.

Experimental Diets

Five experimental diets were formulated at both starter and finisher phases, representing T₁, T₂, T₃, T₄ and T₅ respectively. T₁ was the control diet (0%) while T₂, T₃, T₄ and T₅ had 5%, 10%, 15% and 20% inclusion levels of bean sievate meal, respectively. The gross composition of the experimental diets for both starter and finisher phases are presented in Tables 1 and 2, respectively.

Experimental Birds and Management

A total of one hundred and fifty (150), day-old arbor acre strain of broiler chicks were purchased from a renowned hatchery in Ibadan. They were randomly allotted to five (5) dietary treatments in a Completely Randomized Design (CRD). Each treatment group had thirty (30) birds with three (3) replicates of ten (10) birds each. The birds were managed for fifty-six (56) days (8 weeks) in a deep litter system. Feed and water were given *ad-libitum*, while other routine management procedures were adopted properly to ensure maximum health and productivity.

Determination of carcass and internal organ characteristics

At the end of the finisher phase, two (2) birds from each replicate with weight closest to the group average were selected for carcass evaluation. Only feed was withdrawn from the birds twelve (12) hours before slaughtering and standard operating procedures were adopted during pre-slaughter and slaughter processes. The birds were weighed before slaughtering manually by severing both the carotid arteries and the jugular veins at once using a sharp knife. The slaughtered birds were dipped in hot water for 1 - 2 minutes and manually defeathered. The carcass was carefully eviscerated and split open to remove the entire gastrointestinal tract. Live weight, dressed weight, eviscerated weights were taken and recorded. Internal organ weights of gizzard, heart, kidney, liver and intestines, were determined accordingly with the use of electronic weighing scale (model 3052). Cut - up parts including breast, back cut, shanks, thigh and wings were cautiously removed and weighed and expressed as a percentage of their respectively live body weight.

Statistical Analysis

Data obtained from this study were subjected to one- way analysis of variance (ANOVA) for CRD, and the significant means were separated using the Duncan Multiple Range Test (Steel and Torrie, 1980).

The experimental model used was as follows:

$$Y_{ij} = \mu + T_i + \epsilon_{ij}$$

Where:

Y_{ij} = Observed value

μ = Overall mean value

T_i = Random effect of the replacement level of the bean sievate to soybean meal

ϵ_{ij} = Random residual error

Table 1: Gross composition of experimental starter diets

Ingredient	T₁ (Control)	T₂ (5%)	T₃ (10%)	T₄ (15%)	T₅ (20%)
Maize	56.75	56.75	56.75	56.75	56.75
Soybean meal	30.00	25.00	20.00	15.00	10.00
Bean sievate	0.00	5.00	10.00	15.00	20.00
Wheat offal	7.00	7.00	7.00	7.00	7.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Bone meal	2.50	2.50	2.50	2.50	2.50
Vit/min premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00

Calculated analysis:

Crude protein (%)	24.11	23.84	23.51	23.34	23.11
ME (Kcal/kg)	2950.50	2937.56	2920.64	2903.88	2889.55
Crude fibre (%)	3.98	4.30	4.52	4.90	5.17
Ether extract (%)	3.52	3.53	3.56	3.60	3.63
Calcium (%)	1.25	1.25	1.23	1.23	1.20
Phosphorus (%)	0.83	0.84	0.84	0.86	0.88

Determined values:

Crude protein (%)	23.57	23.31	23.10	22.68	22.20
ME (Kcal/kg)	2948.09	2940.45	2935.22	2912.25	2888.34
Crude fibre (%)	4.01	4.17	4.34	4.75	4.95
Ether extract (%)	3.51	3.53	3.55	3.58	3.61
Calcium (%)	1.23	1.23	1.21	1.19	1.17
Phosphorus (%)	0.80	0.82	0.84	0.88	0.92

*Vitamin/mineral premix containing the following per kg. Vitamin A, 10,000,000 IU; Vitamin D3, 2,000,000 IU; Vitamin E, 20,000 IU; Vitamin 500 mg; K, 2,250 mg; Thiamine, 1,750 mg; Riboflavin B2 5,000 mg; Pyridoxine B6, 2,750 mg; Antioxidant, 125 g; Niacin, 27,500 mg; Vitamin B12, 15 mg; Pantothenic acid, 7,500 mg; Biotin, 50 mg; Choline chloride 400 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 1.2 g; Selenium, 200 mg; Cobalt, 200 mg.

Results and Discussion

Result of the carcass parameters (Table 3) showed that only live weight and dressed weight showed significant ($p < 0.05$) differences. There was a consistent increase in the values (dressing weight 1.25-1.41 kg, live weight 1.70-1.94kg) as the inclusion levels of bean sievate increased in the diets. However, T_1 and T_2 were observed to be statistical similar in all the carcass parameters.

The results were in tandem with that of Ugwu and Onyimonyi (2018) who reported increase in values of dressing weight (1.30-1.65Kg. when fed levels of common bean in broiler diets as the replacement level of bean sievate increased in the diets. This also had a direct reflection on the live weights.

Similarly, the results of dressed weight followed the same trend. The average dressed weight (1.25kg) of birds fed 0% bean sievate were similar to birds fed 5% bean sievate which weighed 1.26kg, but significantly ($p < 0.05$) varied from birds fed 10, 15, and 20% bean sievate. This finding agreed with that of Ugwu and Onyimonyi (2018), who stated that eviscerated weight of birds fed bean sievate followed same pattern as final body weight.

The birds had dressing percentages of 73.80, 73.83, 74.66, 75.25 and 79.00% for birds fed 0, 5, 10, 15 and 20% graded levels of bean sievate respectively. It also revealed similarity with the results of live weight and dressed weight. This is in agreement with Musa *et al.* (2016) who stated that the distribution of muscle is influenced by total carcass muscle and not by nutritional treatment. This is typical of the results on wings, thigh and breast, though no significant ($p > 0.05$) difference was realized. This is also in support of Iyayi *et al.* (2005) who also stated that eviscerated weight increased as the brewer's dried grain, increased in the diets. Thus, the result shows that 15% inclusion level of bean sievate is optimum especially in live weight, considering the outstanding performance of this treatment relative to the control.

Table 2: Gross composition of experimental finisher diets

Ingredients	T₁ (Control)	T₂ (5%)	T₃ (10%)	T₄ (15%)	T₅ (20%)
Maize	59.75	59.75	59.75	59.75	59.75
Soybean meal	28.00	23.00	18.00	13.00	8.00
Bean sievate	0.00	5.00	10.00	15.00	20.00
Wheat offal	8.00	8.00	8.00	8.00	8.00
Fish meal	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00
Vit/min premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	20.50	20.25	20.00	19.75	19.50
ME (Kcal/kg)	3102.5	3098.4	3094.48	3090.38	3086.2
Crude fibre (%)	5.31	5.91	6.32	6.39	7.22
Ether extract (%)	3.39	3.41	3.54	3.75	3.98
Calcium (%)	1.24	1.24	1.24	1.25	1.25
Phosphorus	0.80	0.82	0.84	0.86	0.89
Determine values (%):					
Crude protein	20.36	20.19	20.06	19.88	19.88
Crude fibre	5.17	5.29	5.40	5.78	6.20
Ether extract	3.48	3.50	3.65	3.80	4.18
ME (Kcal/kg) calculated	3091.74	3087.63	3065.54	3051.93	3033.75
Calcium	1.25	1.25	1.26	1.26	1.27
Phosphorus	0.79	0.81	0.83	0.85	0.87

*Vitamin/mineral premix containing the following per kg. Vitamin A, 8,000,000 IU; Vitamin D3, 1,600,000 IU; Vitamin E, 5,000 IU; Vitamin K, 2,000 mg; Thiamine, 1,500 mg; Riboflavin B2 4,000 mg; Pyridoxine B6, 1,500 mg; Antioxidant, 125 g; Niacin, 1,500 mg; Vitamin B12, 10 mg; Pantothenic acids, 5,000 mg; Folic acid, 500 mg; Biotin, 20 mg; Choline chloride 200 g; Manganese, 80 g; Zinc, 50 g; Iron, 20 g; Copper, 5 g; Iodine 1.2 g; Selenium, 200 mg; Cobalt, 200 mg.

The result of internal organ weights is presented in Table 4. It shows that the relative weight of liver tended to increase from 40.98 - 42.70g as the level of replacement of bean sievate with soybean increased in the diets. Liver is known as a detoxification organ. The higher value obtained in T₅ (42.70g) could be connected to detoxification of some metabolites inherent in the bean sievate. Dayal *et al.* (2018) also documented higher liver weight when cassava was incorporated in the diets of broiler birds. This however did not show any health challenge to the birds. The kidney showed no significant ($p>0.05$) difference among the treatment groups, while heart and gizzard weights were significantly ($p<0.05$) different among the treatment groups. The heart tended to increase as the replacement levels of bean sievate increased in the diets. Values of the kidney and heart followed same trend as they reduced with increasing levels of bean

sievate. Higher weights were however observed for gizzard which is attributed to muscle expansion arising from the stress of chumming of the feed materials. However, this was in variance with the gizzard as it tended to reduce as the replacement levels of bean sievate increased in the diets.

Table 3: Carcass parameters of broiler birds fed graded level of bean sievate

a, b, c, on the row	T ₁ (0%)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)	T ₅ (20%)	SEM	means same having
	26.98 ^c	26.99 ^c	27.27 ^b	27.39 ^b	28.09 ^a	2.33	
)	16.52 ^c	16.49 ^c	16.72 ^b	16.95 ^a	16.98 ^a	1.86	
	5.87 ^a	5.84 ^a	5.46 ^c	5.5 ^b	5.52 ^b	1.01	
	13.25 ^a	13.14 ^a	12.98 ^c	13.34 ^a	13.31 ^a	1.97	
	14.12 ^c	14.16 ^c	14.11 ^c	14.33 ^b	15.01 ^a	2.91	
	28.41 ^c	28.02 ^c	29.01 ^b	29.20 ^a	29.21 ^a	2.69	

different superscript letters are significantly different (p<0.05)
 S.E.M = Standard error of mean

Table 4: Internal organs of broiler birds fed diets containing bean sievate as a replacement for soybean meal

Parameters (g)	Treatments					SEM
	T ₁ (0%)	T ₂ (5%)	T ₃ (10%)	T ₄ (15%)	T ₅ (20%)	
Liver	2.39 ^c	2.36 ^c	2.50 ^b	2.59 ^a	2.60 ^a	0.02
Kidney	1.46	1.48	1.49	1.51	1.51	0.03
Heart	0.38	0.38	0.39	0.50	0.50	0.05
Gizzard	2.05 ^c	2.08 ^c	2.17 ^b	2.30 ^a	2.28 ^a	0.01

a,b,c means on the same row having different superscript letters are significantly different (p<0.05)
 S.E.M = Standard error of mean

Conclusion

It could be concluded that 15% inclusion level of soybean meal with fermented bean sievate in broiler finisher diets can improve carcass yield and internal organ development.

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