

EFFECT OF REPLACEMENT OF SOYBEAN RESIDUES FOR GROUNDNUT CAKE ON CARCASS YIELD OF BROILER CHICKENS

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Abstract: A feeding trial was conducted with two hundred (200) Arbor Acre strain of broiler chicks to determine the effect of soybean residue (SBR) on carcass characteristics and visceral organs. Birds were fed for 28 days (starter phase) with formulated diet containing 22% crude protein and 3000Kcal/kg (ME). Five iso-nitrogenous experimental diets were formulated which contain SBR. In the control diet (T₁) groundnut cake was served as the only protein source. Four (4) test diets designated as: T₂, T₃, T₄ and T₅ were formulated with SBR replacing 25, 50, 75 and 100% of groundnut cake respectively in finisher phase. The birds were randomly grouped into five (5) experimental treatment groups in four (4) replicates of 40 birds per treatment in a completely randomized design. The finisher phase lasted for five (5) weeks and the birds were fed and given drinking water *ad-libitum*. All carcass characteristics evaluated differ significantly ($P < 0.05$) among treatment groups except breast and wings. No significant ($P > 0.05$) difference were shown for organs, while shanks was only the residue that was significantly affected by dietary treatment. Soybean residue can be used up to 100% to replace groundnut cake in the diet of broiler chickens thus providing a productive use for this hitherto neglected agro allied waste.

Key words: Soybean residue, carcass yield, organs, offal, finisher phase.

Introduction

Soybean is a popular crop globally, which is usually processed for the extraction of soybean oil mainly used in food industries. After the extraction of the oil, the remaining mass obtained is the soybean meal which has a very high amount of nitrogen (*Chen et al., 2010*). This protein rich soybean meal is basically used as an animal feed for poultry and other livestock etc. Soybean residue a by-product of

soymilk, is produced in large volumes by the soy food industry and is often discarded due to its undesirable flavour. However, the use of the residue in the supplementation for other protein sources is of high importance in animal research (Esonu, 2006). The supply of animal protein in human diets is important since it provides essential amino acids (particularly lysine, methionine) and B-vitamins which the body cannot synthesize from vegetable sources (Aduku and Olukosi, 2000). The need to provide feed is basic to any livestock enterprise including poultry; however, making the feed cheaply available is more compelling to profitability and sustainable livestock development (Ayuk et al., 2009).

Ogundipe et al. (2002) and Tuleun et al. (2011) reported that, in most of the diets prepared for poultry, the conventional dietary source of lysine in the fish meal and soybean meal, when available, are very expensive. In the event of the global feed crisis therefore, the only better approach to solving the escalating prices of feed ingredients is the use of alternative feed ingredients to the conventional ingredients that can partly or wholly replace them without compromising on the health status and performance of the animals (Poultry).

The alternatives to the high cost conventional ingredients are the discovery, processing and harnessing of unconventional sources of poultry feedstuffs for which there is little or no competition from human (Ogundipe et al., 1992). Grains residue or wastes like soybean residue is cheaper and represent unutilized protein sources.

Soybean residue (SBR) has higher lysine content (2.8%) than groundnut cake (1.6%), (Esonu, 2006) and is a good source of protein which makes a good protein (44%) concentrate in poultry ration Abimiku et al. (2017).

The utilization of SBR as a feed resource may help in reducing the pressure on conventional feedstuffs, control environmental pollution caused as a result of indiscriminate discarding of waste. This study was designed to evaluate the effect of replacement of soybean residue for groundnut cake on carcass characteristics and visceral organs of broiler chickens.

Materials and Methods

Experimental Site

The feeding trial was carried out at the Livestock complex, College of Agriculture, Lafia in Nasarawa State of Nigeria. Lafia is located within the Guinea Savanna zone of Central Nigeria. The area is between latitude 07° 52' N - 08° 56' N and longitude 07° 25' E - 90° 37' E. The mean monthly temperature is between 20°C and 34°C, with the hottest months being March and April, and the coolest months being December and January (Layam, 2000).

Sources of experimental soy bean residues

Soybean residue a by-products of soya bean milk or soya bean cheese (“Awara”) production which was collected from the producer in Lafia Local Government Area of Nasarawa state. Soybean seeds are soaked in water for about six to eight hours depending on the temperature of water. The rehydrated beans then undergo milling and filtering to obtain soybean residue and paste for making “Awara” (Soya cheese). The processing method used by the producers was presented in Fig 1. The wet (residue) material was collected and sun-dried to about 10% moisture. The extraction rate of soybean residue is about 0.52kg per 3kg of soybean seed processed into Awara or soymilk. The soybean residue was ground into 0.73mm as recommended by *Beneletti et al. (2011)* to obtain a suitable meal for chemical analysis and broiler chicken diets.

Experimental birds and management

A total of two hundred (200), 28 days old Arbor Acres strain broiler chickens were randomly allotted to five dietary treatment groups replicated four times with ten (10) birds each to give randomized complete design.

The experimental birds were fed a common broiler starter containing 22% CP and 300Kcal/kg (ME) for a period of 4 weeks. Five Iso-nitrogenous diets containing 20% CP broiler finisher were formulated with inclusion varying levels (0%, 25%, 50%, 75%, and 100%) of soybean. residue (Table 1). Feed and water were provided ad libitum. The feeding trial lasted for 35 days.

Data Collection

Parameters measured include carcass yield cuts, organs, and offal. The experiment lasted for thirty five (35) days. At the end of thirty-fifth day, four birds per treatment group were randomly removed and starved (feed only) for 18 hours and were used for carcass studies. Parameter evaluated were expressed as percentage of live weight which include:

- (a) Carcass yield cuts: thigh, drum stick, breast, back and wing
- (b) Organs: liver, gizzard, proventriculus, heart lungs spleen, bursa of fibricus and kidney.
- (c) Offal: head, nick shank and abdominal fat

Data collected were subjected to one-way analysis of variance (ANOVA) using SPSS (2010).

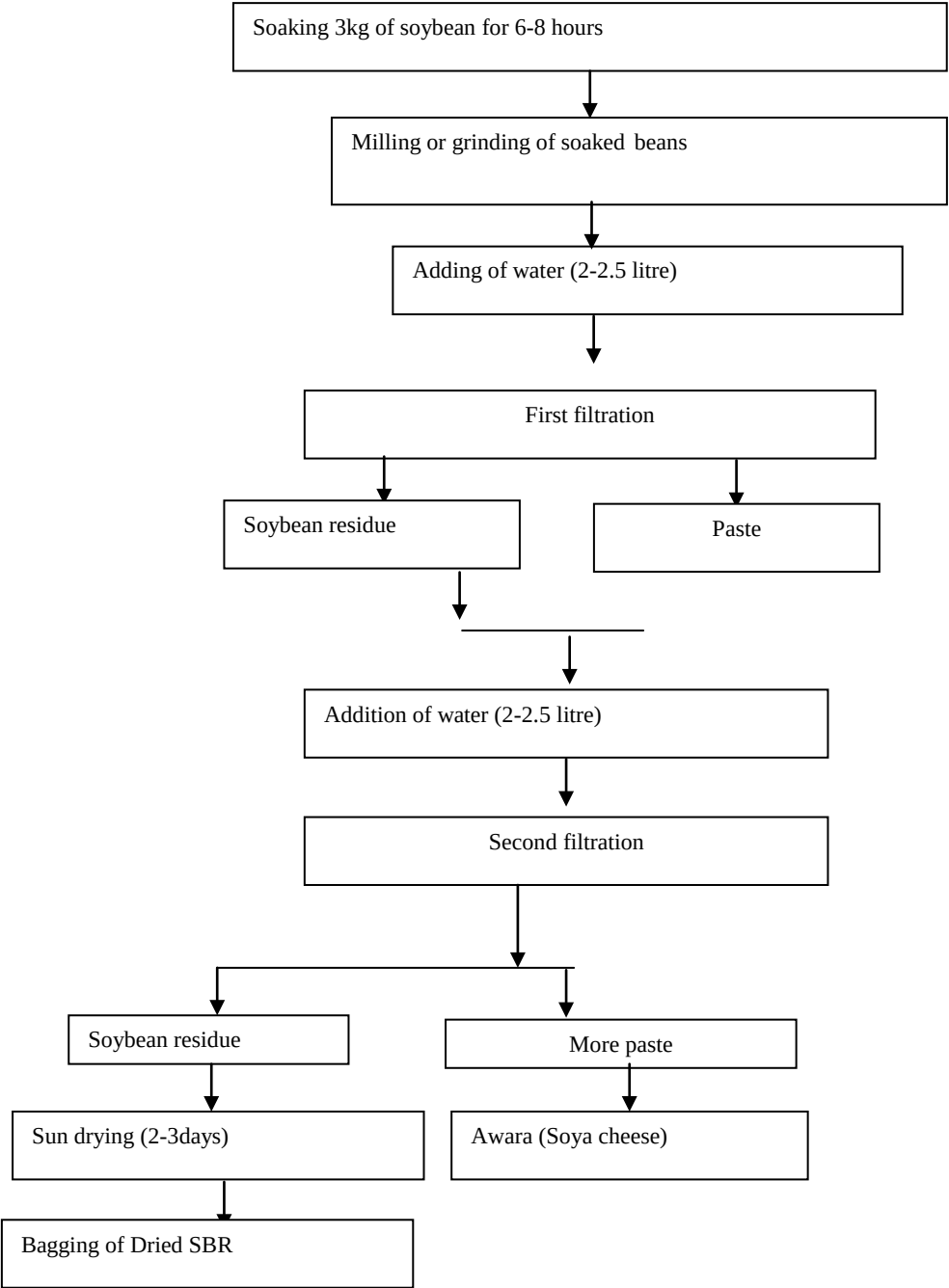


Figure 1. A Flow Chart Showing the Production of Soybean Residue.

Table 1. Composition of experimental diets for finisher broiler chickens (5 –9 weeks) containing graded levels of soybean residue as replacement for groundnut cake

Ingredients	Dietary levels of soybean residue				
	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)
Maize	42.92	42.92	42.92	42.92	42.92
Maize offal	14.30	14.30	14.40	14.30	14.30
GNC	31.78	23.84	17.89	7.94	0.00
SBR	0.00	7.94	17.89	23.84	31.78
Rice offal	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Palm oil	2.10	2.10	2.10	2.10	2.10
Premix'	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100

Calculated Nutrient

ME (Kcal/Kg)	2908	2942	2979	3014	2908
CP (%)	20.00	19.92	19.84	19.80	19.70
CF (%)	4.02	4.19	4.35	4.52	4.68
Ca (%)	1.16	1.17	1.17	1.19	1.19
P (%)	0.64	0.64	0.64	0.64	0.64
Lysine (%)	1.34	1.35	1.55	1.76	1.96
Methionine (%)	0.74	0.58	0.61	0.64	0.67
Feed cost Kg N/kg)	78.66	71.55	67.72	57.31	50.21

T₁ (0%) control diet, T₂ Diet contained 25% SBR, T₃ = Diet contained 50% SBR T₄ = Diet contained 75% SBR and T₅ = Diet contained 100% SBR GNC = Groundnut cake, SBR = Soybean residue, ME = Metabolizable energy. 'Vitamin – mineral premix (Biomix®) will supply per Kg diet, vit. A 500iU, vit. D₃ 888iU, vit. E12, 000mg, vit. K₃ (500mg), niacin 12000mg, pantothenic acid 2000mg, Biotin 1000mg, vit. B₁₂ 300mg, folic acid 1,500kg, choline, chloride 600mg, manganese 1000mg, iron 1,500mg, zinc 800mg, copper 400mg, iodine 80mg, cobalt 400mg and selenium 800mg. ME (kcal/ kg) = 35 x CP% + 81.8 x EE % + 35.5 x NFE % (Pauzenga, 1985).

Table 2. Nutrient composition and metabolizable energy of soybean residue

Nutrient	% Content
Dry matter	71.50
Crude protein	44.00
Crude fibre	5.90
Nitrogen free extract	39.80
Ether extract	4.50
Total ash	5.80
Calcium	0.30
Phosphorus	0.60
*Energy (KcalME kg ⁻¹)	2973.10

*Metabolizable energy (kcalkg⁻¹) calculated by method described by *Pauzenga, 1985*

Statistical analysis

All statistical analyses was done using standard spreadsheet software of excel and one-way analysis of variance of the Statistical Package for Social Sciences (SPSS version 22). The level of statistical significance was defined as ($P < 0.05$). Fisher's Least Significance difference (LSD) was used for separating the treatment means.

Results and Discussion

The mean relative weight of all carcass cuts: thigh, drum stick, breast, back and wing were expressed as percentage (%) of live weight (Table 3). The carcass yield showed significant difference ($P < 0.05$) among treatment means for thigh, drum stick and back. However, there was no particular pattern of variation across the dietary groups. The highest thigh value was observed in T₃ (11.14%) and the lowest in T₂ (8.74%).

The result of the current study is in congruous with the work of *Lukić et al. (2012)* whose results indicate that there were no statistically significant differences in carcass quality between the control and trial groups, in regard to obtained dressing percentages (yields) as well as the amount of abdominal fat in broiler carcass. *Perić et al. (2018)* reported significant difference in the carcass qualities however their report is not in congruous with the result of this finding.

Dosković et al. (2012) reported that the use of different protein levels and enzyme supplementation in broiler diet showed no statistical significance ($P > 0.05$) in dressing percentage of conventionally dressed carcass and percentage of abdominal fat between the experimental groups and it sagree with the result of this findings.

Petričević et al. (2015) have found significantly lower values of carcass yield with an increase in the share of raw soybean in the final mixtures for chickens. Comparing raw and heat-treated soy in the chicken diet, *Beuković et al. (2012)* have found statistically significantly higher yield in case of conventional carcass dressing, carcass „ready to roast“ and „ready to grill“ and share of breast in the carcass of chickens fed heat-treated soybeans compared to raw soybeans. These results also agree with the findings of *Mustafa et al. (2012)* who fed broilers with diets including different percentage of animal protein and plant protein sources and obtained significant ($P < 0.05$) effects on their carcass yield.

Table 3. Effect of experimental diet containing soybean residue for groundnut cake on carcass characteristics of broiler chickens

Carcass indices	Experimental diets					SEM
	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)	
Final live weight (g)	2105.00 ^{ab}	1995.00 ^b	2287.50 ^a	2062.50 ^{ab}	2025.00 ^{ab}	41.72
Dressed wt (g)	1762.50 ^{ab}	1600.00 ^{bc}	1895.00 ^a	1450.00 ^c	1675.00 ^{ab}	44.33*
Dressing (% of LW)	84.49 ^a	79.95 ^{ab}	83.33 ^a	70.42 ^b	81.85 ^{ab}	3.70*
Thigh (% of LW)	10.22 ^{ab}	8.74 ^b	11.14 ^a	10.37 ^{ab}	9.66 ^{ab}	0.31*
Drumstick (% of LW)	27.98 ^{ab}	22.52 ^b	28.17 ^{ab}	29.79 ^a	24.67 ^{ab}	1.04*
Breast (% of LW)	28.61	23.48	33.44	23.29	24.77	1.57 ^{ns}
Back (% of LW)	14.49 ^a	14.55 ^a	13.77 ^{ab}	12.50 ^{ab}	11.84 ^b	0.37*
Wing (% of LW)	8.42	8.11	9.04	8.74	8.52	0.18 ^{ns}

*=($p < 0.05$), a,b,c Means on the same row with different superscripts are significantly different ($P < 0.05$), ns = ($P > 0.05$), SEM = Standard error of mean, T₁ = Control diet, T₂ = Diet containing 25% of soybean residue, T₃ = Diet containing 50% of soybean residue, T₄ = Diet containing 75% of soybean residue, T₅ = Diet containing 100% of soybean residue, % LW = Percent of live weight.

The values obtained for organs were not significantly altered by the dietary treatments (Table 4). This suggests that the processing method in the study i.e. soaking of SBR was adequate and efficient to reduce the anti-nutritional factors in soybean to the required level for raising poultry. This agrees with earlier report by *Church and Pond (1988)* that feeds may be processed to alter the physical form of particle size, to isolate specific parts to preserve, to improve palatability or digestibility and to improve nutrient composition. It is common practice in feeding trials to use weights of some internal organs like liver and kidney as indicators of toxicity. *Bone (1979)* reported that if there was any toxic element in the feed, abnormalities will be observed in the weight of liver and kidney.

Table 4. Effect of experimental diet containing soybean residue for groundnut cake on internal organs of broiler chickens

Internal organs (% of LW)	Experimental diets					SEM
	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)	
Liver	1.73	1.44	1.25	1.81	1.73	0.10 ^{ns}
Gizzard	2.40	2.57	2.36	2.65	2.86	0.12 ^{ns}
Proventriculus	0.57	0.44	0.51	0.55	0.56	0.02 ^{ns}
Heart	0.40	0.35	0.42	0.40	0.36	0.01 ^{ns}
Lungs	0.47	0.54	0.60	0.58	0.61	0.03 ^{ns}
Spleen	0.70	0.55	0.54	0.56	0.69	0.04 ^{ns}
Bursa of fibricus	0.09	0.12	0.09	0.12	0.08	0.01 ^{ns}
Kidney	0.13	0.08	0.09	0.07	0.08	0.01 ^{ns}

ns = Not significant ($P>0.05$), SEM = Standard error of mean, T₁ = Control diet, T₂ = Diet containing 25% of soybean residue, T₃ = Diet containing 50% of soybean residue, T₄ = Diet containing 75% of soybean residue, T₅ = Diet containing 100% of soybean residue, % LW = Percent of live weight.

The mean value of offals namely head, neck, shank, and abdominal fat were not significantly influenced by dietary treatments except the shank (Table 5). Though the result showed significant difference in shank, the values obtained did not follow any particular trend.

The test ingredient (SBR) in this trial did not impact any negative effect on carcass yield of finisher broiler chickens.

Table 5. Effect of experimental diet containing soybean residue for groundnut cake on carcass offals of broiler chickens

Carcass offal (% of LW)	Experimental diets					SEM
	T ₁ (0%)	T ₂ (25%)	T ₃ (50%)	T ₄ (75%)	T ₅ (100%)	
Head	2.53	2.70	2.85	2.53	2.74	0.07 ^{ns}
Neck	4.31	3.66	2.62	3.44	3.35	0.24 ^{ns}
Shank	3.55 ^{ab}	3.01 ^b	3.71 ^a	3.67 ^a	3.56 ^{ab}	0.10*
Abdominal fat	2.23	2.46	1.50	1.50	1.94	0.17 ^{ns}

*=($p<0.05$), a,b, Means on the same row with different superscripts are significantly different ($P<0.05$), ns = ($P>0.05$), SEM = Standard error of mean, T₁ = Control diet, T₂ = Diet containing 25% of soybean residue, T₃ = Diet containing 50% of soybean residue, T₄ = Diet containing 75% of soybean residue, T₅ = Diet containing 100% of soybean residue, % LW = Percent of live weight.

Conclusion

The outcome of this study showed that Soybean residue can be used up to 100% to replace groundnut cake in the diet of broiler chickens thus providing a productive use for this hither to neglected agro allied waste.

Efekat zamene rezidua soje sa pogačom od kikirikija na prinos trupa brojlerskih pilića

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Rezime

Sprovedeno je istraživanje ishrane sa dve stotine (200) pilića brojlera Arbor Acre kako bi se utvrdio efekat rezidua soje (SBR) na karakteristike trupa i unutrašnje organe. Ptice su hranjene 28 dana (početna faza) formulisanom hranom koja sadrži 22% sirovih proteina i 3000Kcal/kg (ME). Formulirano je pet izoazotnih eksperimentalnih obroka koji sadrže SBR. U kontrolnoj ishrani (T1) pogača od kikirikija služila je kao jedini izvor proteina. Četiri (4) ogledne ishrane/obroka, označene kao: T2, T3, T4 i T5, formulirane su sa SBR koji je zamenio 25, 50, 75 i 100% pogače od kikirikija u finišer fazi. Pilići su nasumično grupisani u pet (5) eksperimentalnih grupa u četiri (4) ponavljanja, 40 pilića po tretmanu, u potpuno slučajnom dizajnu. Finišer faza je trajala pet (5) nedelja i ptice su hranjene i dobijale pitku vodu *ad-libitum*. Sve procenjene karakteristike trupa značajno se razlikuju ($P < 0,05$) među grupama tretmana, osim grudi i krila. Nije utvrđena značajna razlika ($P > 0,05$) za organe. Rezidue soje mogu se koristiti do 100% da zamene pogaču od kikirikija u ishrani pilića brojlera, pružajući na taj način produktivnu upotrebu zanemarenom srodnom otpadu.

Ključne reči: rezidue soje, prinos trupa, organi, iznutrice, finišer faza

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Conflict of interest

Authors have affirmed that no competing interests exist regarding the manuscript

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