Evaluation of Carcass Characteristics, Organ Weights and Cost-Benefits of Feeding Broiler Chickens With Raw or Processed Tropical Sickle Pod (*Senna obtusifolia*) Seed Meal Based-Diets

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Abstract: A feeding trial was conducted for eight (8) weeks to evaluate the effects of feeding raw or processed *Senna obtusifolia* seed meal (SOSM) based-diets on carcass yields, organ weights and economic performance of broiler chickens. Six experimental diets were compounded to contain 0% and 20% each of the raw, boiled, soaked, sprouted and fermented SOSM designated as T1, T2, T3, T4, T5 and T6, respectively. Two hundred and sixteen (216) broiler chickens were randomly allotted to the six dietary treatments in a randomized complete block design with pen location serving as the blocking factor. The chicks were replicated three times with each replicate containing twelve (12) chicks. Data were collected on live weight, dressed weight, dressing percentage, cut-up parts (drumstick, thighs, wings and breast), organ weights (gizzard, heart, pancrease and liver). Cost-benefits of using SOSM as feed ingredient for broiler chickens was also assessed. The results indicated that broiler chickens fed the neutral diet (0% SOSM) and 20% fermented SOSM based-diets significantly ($P<0.05$) recorded the best dressing percentage of 78.08% and 75.44%. The lowest dressing percentage (58.13%) was observed in the group of broiler chickens fed the raw SOSM based-diet. The cut-up parts showed similar trend as that of the dressing percentage. The highest yields for cut-up parts on percentage live weight basis for thighs, drumstick and breast (10.87, 9.09 and 17.71%) and (11.09, 8.76, and 16.96%) were observed in the groups of broiler chickens fed the 0% and 20% fermented SOSM based-diets. The poorest cut-up parts on percentage live weight basis for thighs, drumstick and breast (7.23, 5.65 and 10.34%) were observed in the broiler chickens fed the raw SOSM based-diets. The weights of organs were significantly ($P<0.05$) affected by the dietary treatments. The highest weights for liver were observed in the groups of broiler chickens fed the raw (2.64 g), soaked (2.30 g), and sprouted (2.19 g) SOSM based-diets. On economic grounds, the use of processed SOSM especially the boiled and fermented SOSM were cost-effective because they indicated the lowest feed cost of ₦195.52 and ₦208.00 per kilogram body weight gain. However, the raw SOSM which indicated the lowest feed cost per kilogram (₦64.72) was observed to record the highest feed cost per kilogram body weight gain (₦260.17). In conclusion, the groups of broiler chickens fed the fermented SOSM indicated better carcass yield and economic benefits compared to the broiler chickens fed the raw, boiled, soaked and sprouted *Senna obtusifolia* seed meal based-diets and is therefore recommended for feeding of broiler chickens.
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Introduction

The Nigerian poultry industry has long been faced with the scarcity and high cost of feeds. This therefore calls for all stakeholders to intensify effort to searching for alternative feed materials that could augment the costly conventional feed ingredients. Igene *et al*. (2012) suggested the use of alternative feed ingredients as a means of reducing cost of feeding poultry in Nigeria. Lesser-known legumes such as *Senna obtusifolia* seed has been identified as protein source for domestic chickens (Augustine *et al*. 2017a). The chemical composition of the seeds as reported by Augustine *et al*. (2017b) revealed that they have good nutritional value (23.40% crude protein) as source of protein for chickens. However, the authors further revealed that the seeds contained some anti-nutritional factors such as tannins, oxalates, phytates and saponins. This therefore necessitate some forms of processing of the seeds before incorporation in poultry diets. Processing methods such as boiling, soaking and fermentation have been documented to be effective in reducing the anti-nutritional factors of *Senna obtusifolia* seeds (Augustine *et al*. 2017b). However, some processing methods have been reported to

reduce the nutritional value of a feed material (Nsa *et al*., 2011; Augustine *et al*., 2017b). Therefore, it is important to evaluate the best processing method (s) that will enhance optimal utilization of *Senna obtusifolia* seeds. At the moment, based-line information on carcass characteristics, organ weights and cost-benefits of broiler chickens fed processed or raw *Senna obtusifolia* seed meal based-diet seems scanty hence the need to conduct more studies and bridge such information gap. In view of this, the present study was conducted to evaluate carcass characteristics organ weights and cost-benefits of feeding broiler chickens with raw or processed *Senna obtusifolia* seed meal based-diets in Mubi area of Adamawa State, Nigeria.

Materials and Methods

Location of the study area

The research was conducted at the Poultry Unit of the Department of Animal Production Livestock Teaching and Research Farm, Adamawa State University, Mubi. The area is located between latitudes $9^{o}30^{l}$ and 11^{o} North of the equator and longitudes 13^{o} and 13^{o} 45^{l} East of the Greenwich meridian (Adebayo, 2004). The dry season of the area normally start by early October and last up to April while the wet season begins from May and reach its peak in July and August and declines in September. The average temperature and rainfall of the area are 25.4^{o}C and 935 mm (Climate-Data. Org, 2018).

Experimental stock and their management

Two hundred and sixteen (216) day-old broiler chicks were managed on deep litter. The chicks were vaccinated against Gumboro disease first and second doses at 2 and 4 weeks, lasota vaccine at 3 weeks. The experimental broiler starter diets were supplied from 0- to 4 weeks while the finisher diets were supplied from 5 to 8 weeks, respectively. The experimental diets and water were supplied *ad-libitum*. The experiment lasted for eight (8) weeks.

Experimental diets (treatments)

The processed *Senna obtusifolia* seed meals (boiled, soaked, sprouted and fermented) and raw were included at 20% level each in the diets of broiler chickens at both starter and finisher stages (Tables 1 and 2). The six experimental diets were designated as T1, T2, T3, T4, T5 and T6, respectively. Diet T1 (0% SOSM) served as the positive control while Diet T2 (20% SOSM) served as the negative control.

Table 1:Ingredient Composition and Calculated Analysis of the Experimental Broiler Starter Diets

Level of inclusion of the raw or processed SOSM						
¤ Ingredients	**T1 (0% OSM)**	**T2 (20% RSOSM)**	**T3 (20% BSOSM)**	**T4 (20% SkSOSM)**	**T5 (20% SPOSM)**	**T6 (20% FSOSM)**
Maize	50.00	50.00	50.00	50.00	50.00	50.00
Maize offal	4.00	4.00	4.00	4.00	4.00	4.00
Roasted soya bean	23.05	9.05	9.05	9.05	9.05	9.05
SOSM	0.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	6.00	5.00	5.00	5.00	5.00	5.00
GNC	13.00	8.00	8.00	8.00	8.00	8.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis						
Protein (%)	23.15	22.23	22.15	22.78	22.48	22.65
Fibre (%)	2.88	3.13	3.12	3.08	3.11	2.98
Methionine (%)	0.77	0.76	0.77	0.75	0.73	0.70
Lysine (%)	1.39	1.38	1.36	1.32	1.29	0.75
Calcium (%)	1.31	1.30	1.32	1.30	1.29	1.33
Phosphorus (%)	0.73	0.73	0.74	0.73	0.71	0.75
ME energy (kcal/kg)	2912.44	2906.80	2905.08	2903.40	2907.24	29011.00

**2.5 kg Vitamin–Mineral Premix (Animal Care) supplies the following: Vitamin A 12,000,000 vit. D_3 3000,000, vit. E30, 000 mg vit. K_3 2,500 mg, folic acid 1,000 mg, niacin 40,000, calpan 10,000 mg, vit. B_2 5000 mg, vit. B_{12} 20 mg, vit. B_1 2,000 mg, vit. B_6 3,500 mg, biotin 80 mg, antioxidant 125,000 mg, cobalt 250 mg, selenium 250 mg, iodine 1,200 mg, iron 40,000 mg, manganese 70,000mg, copper 8,000 mg, zinc 60,000 mg and chloride 200,000 mg*, **Metabolizable energy (ME) Calculated according to the formula of Pauzenga, (1985) ME= 37 × % CP + 81×% EE + 35.5 × % NFE, GNC=Groundnut cake, SOSM = *Senna obtusifolia* seed meal, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SkSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal and FSOSM = Fermented *Senna obtusifolia* Seed meal.

Table 2: Ingredient Composition and Calculated Analysis of the Experimental Broiler Finisher Diets

Level of inclusion of the raw or processed SOSM						
Ingredients	**T1 (0% SOSM)**	**T2 (20% RSOSM)**	**T3 (20% BSOSM)**	**T4 (20% SkSOSM)**	**T5 (20% SPSOSM)**	**T6 (20% FSOSM)**
Maize	54.00	54.00	54.00	54.00	54.00	54.00
Maize offal	6.00	7.00	7.00	7.00	7.00	7.00
Roasted Soya bean	20.15	5.15	5.15	5.15	5.15	5.15
SOSM	0.00	20.00	20.00	20.00	20.00	20.00
Fishmeal	5.00	6.00	6.00	6.00	6.00	6.00
Groundnut cake	11.00	4.00	4.00	4.00	4.00	4.00
Salt	0.20	0.20	0.20	0.20	0.20	0.20
Bone meal	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculate Analysis						
Protein (%)	19.99	19.45	19.55	19.95	19.65	20.01
Fibre (%)	3.40	3.61	3.91	3.90	4.01	3.20
Methionine (%)	0.61	0.75	0.70	0.73	0.79	0.83
Lysine (%)	1.36	2.70	2.74	2.69	2.61	2.92
Calcium (%)	1.25	0.64	0.63	0.58	0.65	0.59
Phosphorus (%)	0.69	0.65	0.64	0.66	0.63	0.68
ME energy (kcal/kg)	3119.39	2930.39	2910.50	2903.02	2931.98	2922.11

**2.5 kg Vitamin–Mineral Premix (Animal Care) supplies the following: Vitamin A 12,000,000 vit. D_3 3000,000, vit. E30,000 mg, vit. K_3 2,500 mg, folic acid 1,000 mg, niacin 40,000, calpan 10,000 mg, vit. B_2 5000 mg, vit. B_{12} 20 mg, vit. B_1 2,000 mg, vit. B_6 3,500 mg, biotin 80 mg, antioxidant 125,000 mg, cobalt 250 mg, selenium 250 mg, iodine 1,200 mg, iron 40,000 mg, manganese 70,000mg, copper 8,000 mg, zinc 60,000 mg and chloride 200,000 mg,* Metabolizable energy (ME) Calculated according to the formula of Pauzenga, (1985) ME= 37 × % CP + 81 × % EE + 35.5 × % NFE, SOSM = *Senna obtusifolia* seed meal, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled S*enna obtusifolia* seed meal, SkSOSM = Soaked *Sennaobtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal and FSOSM = Fermented *Senna obtusifolia* seed meal

Experimental design and parameters measured

The 216 broiler chickens were randomly allotted to the six dietary treatments in a randomized complete block design (RCBD) with pen location serving as the blocking factor. Each treatment group was replicated three times with 12 chickens per replicate.

Parameters measured

Feed intake

Daily feed intake was determined by the difference between daily feed offered and daily feed leftover while the total feed intake was obtained by cumulatively adding the daily feed intake for the entire experimental period.

Carcass evaluation

At the end of the experiment, three (3) broiler chickens were randomly selected from each replicate in each treatment. The broiler chickens were deprived of feed over-night but allowed access to water and the fasted live weights of individual chickens were recorded in the morning. The birds were slaughtered and bled by severing the jugular vein. The chickens were dipped in warm water and plucked. The plucked carcass weights were recorded and thereafter eviscerated through a slit made between the end of the keel bone and the rectum. Dressed weight (DW) was determined by weighing the dressed chickens and dressing percentage (DP) was calculated using the formula:

$$DP=\frac{\text{Carcass weight}}{\text{Live weight}} \times 100$$

The cut-up parts (drumsticks, thighs wings and breast) and the organs (gizzard heart, pancreas and liver) were weighed and recorded.

Cost-benefit of using *Senna obtusifolia* as feed ingredient for broiler chickens

The cost-benefit analysis of using *Senna obtusifolia* as feed ingredient for broiler chickens was assessed by computing feed cost per kilogram, total

cost of feed intake and feed cost per kilogram body weight gain.

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) of the randomized complete block design (RCBD) using Statistix 9.0. Least Significant Difference (LSD) was used to separate the treatment means where significant differences occurred. Significant difference was considered at 5% level of probability.

Results And Discussion

The results of carcass characteristics and some organ measurements of broiler chickens fed raw or processed *Senna obtusifolia* seed meal based-diets are presented in Table 3. The result revealed significant ($P<0.05$) variation for live weight, plucked weight, dressed weight, dressing percentage and cut-up parts of the broiler chickens. Broiler chickens fed the raw *Senna obtusifolia* seed meal based-diet recorded lower live weight, plucked weight, dressed weight, dressing percentage and cut-up parts compared to the broiler chickens fed the processed *Senna obtusifolia* seed meal based-diets. Significant difference ($P<0.05$) for weight of organs (gizzard, heart, liver and pancreas) was observed. The poor carcass yield of broiler chickens fed the RSOSM may be attributed to smaller sizes of the chickens fed the raw seed meal based-diet. Similar finding was reported by Tuleun and Igba (2007) who fed raw and processed mucuna seed meal to broiler chickens and reported that the chickens fed the raw seed meal recorded lower carcass yield.

Table 3: Carcass Characteristics and Organ Weights of Broiler chickens fed Raw or Processed *Senna obtusifolia* Seed meal Based-diets

Inclusion levels of the raw or processed SOSM							
Parameters	**T1 0% SOSM**	**T2 20%RSOSM**	**T3 20% BSOSM**	**T4 20%SKSOSM**	**T5 20% SPSOSM**	**T6 20%F SOSM**	**SEM***
Live weight (g)	2433.30^{a}	1266.70^{e}	1766.70^{d}	1483.30^{d}	1566.70^{c}	1900.00^{b}	15.63
Dressed weight (g)	1900.00^{a}	736.37^{e}	1266.70^{c}	983.30^{d}	966.70^{d}	1433.30^{b}	11.90
DP	78.08^{a}	58.13^{e}	71.35^{b}	66.29^{d}	61.70^{c}	75.44^{a}	3.43
Cut-up parts expressed as percentage of live body weight							
Drumstick	9.09^{a}	5.65^{c}	8.82^{a}	6.89^{c}	8.23^{b}	8.76^{a}	0.43
Thighs	10.87^{ab}	7.23^{c}	10.59^{a}	8.25^{bc}	9.06^{b}	11.09^{a}	0.80
Wings	6.81^{a}	3.70^{ab}	6.32^{a}	4.64^{b}	4.78^{b}	6.91^{a}	0.38
Breast	17.71^{a}	10.3^{c}	16.43^{a}	12.12^{b}	12.93^{b}	16.96^{a}	1.10
Organ weights (g)							
Gizzard	2.43^{b}	3.72^{a}	2.79^{b}	2.60^{b}	2.34^{b}	2.20^{b}	0.32
Heart	1.19^{a}	0.30^{b}	0.51^{b}	0.61^{b}	0.60^{b}	0.66	0.16
Pancrease	0.36^{a}	0.26^{b}	0.36^{a}	0.25^{b}	0.23^{b}	0.19	0.03
Liver	1.53^{b}	2.64^{a}	1.76^{b}	2.36^{ab}	2.19^{ab}	1.40^{b}	0.06

a, b, c,d, e = Means in the same row with different superscript are significantly different at $P<0.05$ SEM = standard error of the mean; DP = Dressing percentage; SOSM = *Senna obtusifolia* seed meal; RSOSM = Raw *Senna obtusifolia* seed meal; BSOSM = Boiled *Senna obtusifolia* seed meal; SKSOSM = Soaked *Senna obtusifolia* seed meal; SPSOSM = Sprouted *Senna obtusifolia* seed meal; and FSOSM = Fermented *Senna obtusifolia* seed meal

The poor carcass yield observed in the broiler chickens fed the raw *Senna obtusifolia* seed meal based-diet could be attributed to the depressive effect of the anti-nutritional factors present in the raw seed meal. This growth depressing effects were similarly observed by Emenalom and Udedibie (1998) in finisher broiler chickens fed raw and processed *Mucuna pruriens* seed meals and Esonu *et al*. (2001) for broiler starter chickens fed urea-toasted mucuna seed meal. The superior live weight, dressing percentage and cut-up parts observed in the group of broiler chickens fed processed *Senna obtusifolia* seed meal based-diets could be as a result of improved feed and nutrient utilization due to the reduction of the anti-nutritional factors in the seed by the different processing methods. However, broiler chickens fed fermented *Senna obtusifolia* seed meal based-diet recorded the highest carcass yield followed by those fed the boiled *Senna obtusifolia* seed meal based-diet. Tuleun *et al*. (2011) in a similar study fed fermented mucuna seed meal to broiler chickens and reported similar findings. Dressing percentage, obtained in this study fell within the range of 65–77% reported by Oluyemi and Roberts (2007) as the recommended dressing percentage for well finished broiler chickens. The thighs, drumstick and wings obtained percentage live weight basis from the different processing methods were however, slightly lower than the values

of 12.95, 11.67 and 8.21%, respectively reported by Oluyemi and Roberts (2007).

The broiler chickens fed raw, soaked and sprouted *Senna obtusifolia* seed meal based-diets recorded higher (P<0.05) liver weight compared to the other treatment groups. This is an indication that the unprocessed seed meal contains high concentration of anti-nutritional factors while the soaked and sprouted seed meal had high concentration of residual anti-nutritional factors, thus affecting the physiological functions of the liver resulting to comparatively heavier weight. Tuleun and Igba (2007) similarly stated that liver size is known to increase in response to the effects of toxic components. This also agrees with the report of Omeje (1999) and Ogundipe *et al*. (2003) that hypertrophy of liver and other organs do occur as a result of their attempt to increase protein availability or in the process of detoxifiying anti-nutritional factors in the body of chickens. This result contradicts the earlier findings of Carew *et al*. (1998) who observed that raw velvet bean had no effect on liver size. However, decreased liver weight was reported by Ukachukwu *et al*. (2003) in chickens fed mucuna seed meal.

The cost-benefits of feeding broiler chickens with diets containing raw or processed *Senna obtusifolia* seed meals is summarized in Table 4. The results indicated that cost of feed per kilogram and cost of daily feed intake were significantly (P<0.05) higher in the positive control diet (0% SOSM) compared with the *Senna obtusifolia* seed meal based-diets. This is an indication that inclusion of the processed SOSM had reduced the cost of the feed and feed intake. Augustine *et al*. (2017c) in a similar study fed cockerels with *Senna obtusifolia* seed meal and reported reduction in feed cost/kg and daily cost of feed intake. Tuleun *et al*. (2011) pointed out that unconventional feed ingredients reduced cost since most of them can be obtained at little or no cost and are quite rich in nutrients. However, the chickens fed the raw seed meal significantly (P<0.05) showed higher cost of feed per kilogram live body weight gain indicating poor nutrient utilization and slow growth rate. This is in line with the report of Emiola *et al*. (2013) who observed that anti-nutrients adversely exert effects on protein metabolism, utilization and consequently hampering efficiency of feed utilization and weight gain.

Feed cost per kilogram weight gain were lower (P<0.05) in broiler chickens fed fermented *Senna obtusifolia* seed meal based-diets followed by those fed sprouted, boiled and soaked *Senna obtusifolia* seed meal based-diets. Similar effect was reported by Tuleun *et al*. (2011) who fed broiler chickens with fermented mucuna seed meal and reported that the seed meal did not suppress physiological development of the chickens resulting to better weight gain of the birds. This therefore revealed that fermentation is economically efficient as a processing method.

Table 4: Carcass Characteristics and Organ Weights of Broiler chickens fed Raw or Processed *Senna obtusifolia* Seed meal Based-diets

Parameters	T1 0% SOSM	T2 0%RSOSM	T3 0% BSOSM	T4 0%PSKSOSM	T5 0% PSOSM	T6 0%F SOSM	
Total feed intake (kg)	5.30^{a}	3.26^{e}	3.92^{c}	3.78^{c}	3.45^{d}	4.47^{b}	1.02
Feed cost (₦)	78.00	64.72	67.82	65.72	67.50	69.80	-
Total feed cost (₦)	413.40	210.98	265.85	248.42	232.88	212.01	-
Total weight gain (kg)	1.89^{a}	0.81^{e}	1.36^{c}	1.19^{c}	0.89^{d}	1.54	-
Feed cost/kg gain (₦)	217.62	260.17	195.32	225.42	259.88	208.00	-

Conclusion

The outcome of this study revealed that among the broiler chickens fed the different processed *Senna obtusifolia* seed meals, those fed the 20% fermented seed meal based-diet had the best carcass yield and better economic benefits and is therefore recommended for feeding broiler chickens.

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