



Nutrient Digestibility and Growth Performance of Broiler Chickens Fed Graded Levels of Raw Tropical Sickle Pod (*Senna obtusifolia* (L)) Seed Meal Based-Diets

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Abstract A feeding trial was conducted for fifty-six (56) days to investigate the nutrient digestibility and productive performance of broiler chickens fed graded levels of raw *Senna obtusifolia* seed meal (RSOSM) based-diets. The experimental diets contained RSOSM included at concentrations of 0, 5, 10, 15, 20 and 25% in diets designated as T1, T2, T3, T4, T5 and T6, respectively. One hundred and eighty broiler chickens were randomly allotted to the six dietary treatments in a randomized complete block design with 3 replicates of ten (10) chicks each and pen location served as the blocking factor. Data were collected on nutrient digestibility, feed intake, weight gain, feed conversion ratio and mortality. Data collected were subjected to analysis of variance using Statistix 9.0. The result of nutrient digestibility revealed a significant ($P < 0.05$) depressive trend as the level of RSOSM increases from 0 to 25%. Crude protein digestibility for instance, was observed to decline from 87.66% to 50.37% in T1 to T6, respectively. The productive performance revealed that feed intake, weight gain and feed conversion ratio were significantly ($P < 0.05$) depressed as the concentration of RSOSM increases in the diets. Daily feed intake and weight gain were observed to decline from 89.35 to 71.96 g and 30.81 to 16.69 g, respectively. The results on a general trend indicated that nutrient digestibility and productive performance steadily declined as the level of RSOSM increased in the experimental diets. In conclusion, incorporation of RSOSM in the diets of broiler chickens beyond 5% had depressive effects on nutrient utilization and productive performance of broiler chickens. Therefore, utilization of RSOSM as feed ingredient for broiler chickens requires adequate processing to reduce the anti-nutritional factors in RSOSM.

Keywords Nutrient utilization, productive performance, *Senna obtusifolia* seed, broiler chickens

Introduction

The growing feed crises in the Nigerian livestock industry can be addressed through the promotion and utilization of under-utilized wild legumes such as *Senna obtusifolia*. *Senna obtusifolia* is an annual or biennial shrub growing up to 2.5 m tall, but usually less than 2 m in height. The leaves are pinnate and alternately arranged along the stem, borne on petioles 15-20 mm long. The flowers are yellow (10-15 mm across) while the fruit is slender, strongly curved downward (sickle shape), and pod (6-18 cm long and 2-6 mm wide). The seeds (3-6 mm long) are dark brown in colour, shiny in appearance with rhomboid or irregular shape [1]. [2] further pointed out that, of the many legume species, only few have been used and many others are yet to be exploited. [3] observed that lesser-known legumes can be used together with other conventional legumes in order to combat protein malnutrition prevalent in the third world countries. Studies conducted by [4] and [5] on the chemical properties of *Senna obtusifolia* revealed that the seed has good nutritional properties which qualifies it to be an alternative cheaper protein source for livestock. However, base-line information on the effects of



RSOSM on the nutrient digestibility and productive performance seems to be very scanty hence the need to bridge such information gap. It was in view of the above that, this study was conducted to evaluate nutrient digestibility and productive performance of broiler chickens fed graded level of raw *Senna obtusifolia* seed meal.

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°30 and 11°North of the equator and longitudes 13° and 13° 45' East of the Greenwich meridian. The temperature regime in Mubi area is warm to hot throughout the year. However, there is usually a slight cold period between November and February. There is a gradual increase in temperature from January to April. The minimum and maximum temperatures of the area are 18.1°C and 32.8°C. The mean annual rainfall ranges from 900-1050 mm [6].

Chemical Analysis

The chemical composition of *Senna obtusifolia* seed meal and the experimental diets were determined using standard procedure of [7].

Experiment Stock and their Management

One hundred and eighty (180) day-old broiler chicks were managed on deep litter pens. The broiler chicks were fed broiler starter diet for five (5) weeks and the finisher diets fed from 6th to 9th weeks. The chicks were vaccinated against Gumboro (2 and 4 weeks of age) and Newcastle disease (3 and 5 weeks of age). The chicks were managed using standard poultry management practices as described by [8]. The chickens were properly medicated.

Experimental Diets and Treatments

Six experimental diets for both starter (23% CP) and finisher (20% CP) phases were formulated to contain 0, 5, 10, 15, 20 and 25% of raw *Senna obtusifolia* seed meal designated T1, T2, T3, T4, T5 and T6, respectively. The 0% SOSM (T1) inclusion level served as the control diet. The composition of the experimented diets is presented in Tables 1 and 2.

Experimental design

The chicks were randomly allotted to the six (6) 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 ten (10) birds each.

Parameters Measured

Daily feed intake was determined by obtaining the difference between daily feed offered and daily feed leftover. Final weight was measured at the end of the experiment and the overall weight gain was obtained by subtracting the initial weight from the final weight. Feed conversion ratio (FCR) was calculated using the formula below:

$$FCR = \frac{\text{feed intake}}{\text{weight gain}}$$

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

Ingredients (%)	Level of inclusion of RSOSM					
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 (25%)
Maize	50.00	50.00	50.00	50.00	50.00	50.00
Soyabean meal (full-fat)	27.00	22.00	17.00	12.00	7.00	2.00
Groundnut cake	10.00	10.00	10.00	10.00	10.00	10.00
RSOSM	0.00	5.00	10.00	15.00	20.00	25.00
Fishmeal	5.00	5.00	5.00	5.00	5.00	5.00



Salt (NaCl)	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	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
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						
Crude protein (%)	23.47	23.07	22.67	22.55	22.47	22.45
Crude fibre (%)	3.09	3.87	3.92	3.99	4.11	4.33
Calcium (%)	1.69	1.70	1.72	1.73	1.74	1.76
Phosphorus (%)	0.75	0.72	0.70	0.68	0.65	0.63
*Energy (kcal/kg)	2892.14	2857.50	2822.14	2788.21	2753.57	2718.93

RSOSM = Raw *Senna obtusifolia* seed meal, *Metabolizable energy (ME) calculated according to the formula of [9] $ME = 37 \times \%CP + 81 \times \%EE + 35.5 \times \%NFE$. Where ME = metabolizable energy; CP = crude protein; EE = ether extract; NFE = nitrogen free extract

Table 2: Ingredient and Calculated Chemical Composition of the Experimental Broiler finisher

Ingredients (%)	Level of inclusion of RSOSM					
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 (25%)
Maize	54.00	54.00	54.00	54.00	54.00	54.00
Roasted soyabean	27.00	22.00	17.00	12.00	7.00	2.00
Groundnut cake	7.00	7.00	7.00	7.00	7.00	7.00
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
RSOSM	0.00	5.00	10.00	15.00	20.00	25.00
Salt (NaCl)	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	0.30	0.30	0.30	0.30	0.30	0.30
Lysine	0.15	0.15	0.15	0.15	0.15	0.15
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						
Crude protein (%)	21.01	20.61	20.21	19.85	19.76	19.45
Crude fibre (%)	3.69	4.11	4.23	4.38	4.49	4.51
Methionine (%)	0.70	0.72	0.72	0.73	0.75	0.77
Lysine (%)	1.04	1.13	1.38	1.41	1.44	1.42
Calcium (%)	1.14	1.14	1.16	1.18	1.21	1.23
Phosphorus (%)	0.68	0.61	0.59	0.51	0.49	0.45
*Energy (kcal/kg)	2948.38	2900.03	2879.09	2856.46	2821.01	2778.37

RSOSM = Raw *Senna obtusifolia* seed meal, *Metabolizable energy (ME) calculated according to the formula [9] $ME = 37 \times \%CP + 81 \times \%EE + 35.5 \times \%NFE$ where ME = metabolizable energy; CP = crude protein; EE = ether extract; NFE = nitrogen free extract.

Determination of Nutrient Digestibility

At the last week of the experiment, three (3) broiler chickens were randomly selected from each replicate and placed in individual battery cage for faecal collection. The birds were allowed five days adjustment period. Measured quantity of feed was given to each bird every morning and the leftover weighed the next morning to obtain daily feed intake for each bird. Faecal collection lasted for five days. The faecal samples collected from each treatment group were bulk, milled and analyzed for proximate composition according to the procedure of [7] Nutrient digestibility coefficient (NDC) was calculated using the formula below:



$$(\text{NDC}\%) = \frac{(\text{Nutrient in diet} \times \text{feed intake}) - (\text{Nutrient in faeces} \times \text{faecal output})}{\text{Nutrient in diet} \times \text{feed intake}} \times 100\%$$

Statistical Analysis

Data obtained were subjected to analysis of variance (ANOVA) of the randomized complete block design (RCBD) using Statistix 9.0. Significant differences were considered at 0.05 level of probability.

Results and Discussion

The result of the proximate composition of *Senna obtusifolia* seed meal is presented in Table 3. The seed meal has fair protein content (23.40%). This qualifies it to be an alternative protein source. However, the protein content is comparatively lower than full-fat soya bean (37.8%). The anti-nutritional component (Table 4) revealed that the seed meal have higher concentration of tannins followed by phytates, alkaloids and oxalates. The analyzed composition of the experimental diets (Tables 5 and 6) indicated that the diets have adequate nutrients to meet the nutritional requirements of broiler chickens at all phases of growth.

However, the levels of the anti-nutritional factors were observed to increase as the level of RSOSM increased in the diets.

Table 3: Proximate Composition of Raw *Senna obtusifolia* Seed Meal

Components	(%)
Dry matter	91.00
Crude protein	23.40
Crude fibre	14.50
Fat	8.70
Ash	7.70
Nitrogen-free extract	47.40

Table 4: Anti-nutritional Factors of *Senna obtusifolia* Seed Meal (mg/100g)

Anti-nutritional factors	
Tannin	378.50
Alkaloids	248.60
Phytates	247.20
Saponin	190.30
Oxalate	102.40

Table 5: Analysed Chemical Composition of the Experimental Broiler Starter Diets (%)

	Level of inclusion of RSOSM					
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 (25%)
Dry matter (DM)	93.18	92.29	93.15	93.02	93.49	93.57
Crude protein (CP)	2.15	20.08	21.25	22.92	21.00	20.89
Crude fibre (CF)	4.51	6.16	6.23	6.28	6.51	6.58
Ether extract (EE)	6.12	5.98	6.08	7.02	7.09	7.21
NFE	50.75	50.51	50.46	49.66	49.58	48.87
*Energy (kcal/k)	3116.89	3020.44	3070.06	3119.65	3064.40	3040.83
Tannin	0.03	0.16	0.38	0.47	0.58	0.61
Total phenols	0.07	0.46	0.57	0.68	0.86	0.97

*Metabolizable energy (ME) calculated according to the formula of [9] ME = 37 x % CP + 81 x % EE + 35.5 x % NFE, NFE = Nitrogen free-extract, RSOSM = Raw *Senna obtusifolia* seed meal

Table 6: Analysed Chemical Composition of Experimental Broiler Finisher Diets (%)

	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 (25%)
Dry matter (DM)	93.05	93.40	92.77	93.40	93.26	93.54
Crude protein(CP)	20.05	19.06	19.64	19.31	19.26	20.00
Crude fibre (CF)	8.78	8.42	8.63	8.77	8.81	8.95
Ether extract	7.03	7.45	7.52	7.63	8.43	8.93



NFE	54.70	53.47	50.23	49.66	49.19	46.13
*Energy (kcal/k)	3252.83	3206.86	3118.97	3095.43	3141.70	3100.95
Tannin	0.02	0.24	0.40	0.47	0.51	0.68
Total phenols	0.05	0.43	0.61	0.73	0.79	0.86

, *Metabolizable energy (ME) calculated according to the formula of [9], *ME (kcal/kg) = 37 x % CP + 81 x %EE + 35.5 x %NFE, RSOSM = Raw *Senna obtusifolia* seed meal;NFE = Nitrogen free-extract

Nutrient Digestibility of Broiler Chickens Fed Raw *Senna obtusifolia* Seed Meal (RSOSM)

The effects of raw *Senna obtusifolia* seed meal on nutrient digestibility of broiler chickens are presented in Table 7. The result indicated that chickens fed 0 and 5% RSOSM significantly ($P<0.05$) had better nutrient digestibility than chickens fed 10, 15, 20 and 25% RSOSM. Nutrient digestibility declined as the proportion of RSOSM increased in the diets. This could be attributed to the increase in the concentration of anti-nutritional factors in the diets as the level of RSOSM increased from 0 to 25%. This also agreed with the report of [10] who observed decrease in nutrient digestibility of broiler chickens fed graded levels of raw pigeon pea seed meal. [11] further explained that anti-nutritional factors such as tannins and phytates inhibit the activity of digestive enzymes which consequently affect digestion and availability of nutrients. The author further reported that anti-nutritional factors such as tannins and other phenols have the tendency to cause gut filling effects associated with undigested feed materials.

Table 7: Nutrient Digestibility Coefficient of Broiler Chickens Fed Raw *Senna obtusifolia*

Parameters (%)	Level of inclusion of RSOSM						SEM
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 (25%)	
Dry matter	84.00 ^a	82.00 ^a	66.23 ^b	59.72 ^{bc}	58.01 ^c	57.37 ^c	1.59 [*]
Protein	87.66 ^a	75.70 ^b	65.25 ^c	59.79 ^c	51.16 ^d	50.37 ^d	1.63 [*]
Crude fibre	39.76 ^a	36.21 ^b	34.27 ^c	32.71 ^c	31.88 ^c	29.93 ^d	1.36 [*]
Ether extract	67.94 ^a	66.29 ^b	64.41 ^b	59.81 ^{abc}	56.76 ^c	51.39 ^b	1.87 [*]
NFE	83.33 ^a	69.22 ^{ab}	64.74 ^{abc}	63.69 ^{abc}	46.49 ^c	61.29 ^b	1.67 [*]
Energy (kcal/kg ME)	85.74 ^a	77.70 ^b	74.37 ^{bc}	70.18 ^{cd}	66.00 ^d	65.78 ^d	1.55 [*]

a,b,c,d = Means in the same row with different superscripts are significantly different ($P<0.5$)

* = significant at 0.05; SEM= Standard error of mean, RSOSM = Raw *Senna obtusifolia* seed meal; NFE = Nitrogen free-extract.

The result of the productive performance of broiler chickens fed raw *Senna obtusifolia* seed meal (RSOSM) is presented in Table 8. The results revealed that feed intake did not significantly ($P>0.05$) differ among broiler chickens fed 0 and 5% RSOSM. However, broiler chickens fed 10, 15, 20% and 25% RSOSM recorded lower ($P<0.05$) feed intake compared to broiler chickens fed 0 and 5% RSOSM. The general trend was declined in feed intake as the level of RSOSM increased from 10 to 25%. The significant ($P<0.05$) decrease in feed intake at 10, 15, 20 and 25% levels of inclusion may be attributed to the presence of the anti-nutritional factors (tannins, saponins, oxalates and phytates). These anti-nutritional factors usually exert negative influences on the digestibility of feeds which may cause gut filling effects associated with undigested feedstuff [1]. Similar findings were reported by [12], [13] and [14] who similarly feed raw unconventional feed ingredients (*Napoleona imperialis*, *Vicia ervilia* and *Cajanus cajan* seed meals). [15] and [16] also pointed out that anti-nutritional factors such as saponins and phytates can adversely affect feed intake due to reduction of protein digestibility and bioavailability.

Table 8: Productive performance of Broiler Chickens Fed Graded Levels of Raw *Senna obtusifolia* seed meal (RSOSM)

Variables	Level of inclusion of RSOSM						SEM
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)	T6 25%)	
Initial weight (g)	217.67	214.33	225.67	218.33	211.00	211.00	9.73 ^{NS}
Final weight (g)	2158.70 ^a	1884.80 ^b	1627.30 ^b	1318.60 ^c	1274.90 ^c	1262.90 ^c	13.48 ^{**}



Overall weight gain (g)	1941.03 ^a	1670.47 ^b	1401.63 ^c	1100.27 ^d	1063.90 ^d	1051.90 ^d	3.21 ^{**}
Daily feed intake (g)	89.35 ^a	86.44 ^a	85.21 ^c	71.26 ^b	71.27 ^b	71.96 ^b	1.60 ^{**}
Daily weight gain (g)	30.81 ^a	26.51 ^b	25.42 ^c	17.46 ^d	16.89 ^d	16.69 ^d	1.30 ^{**}
Feed conversion ratio	2.90 ^c	3.26 ^b	3.83 ^b	4.36 ^a	4.59 ^a	4.63 ^a	0.30 ^{**}
Mortality (number)	3.00	0.00	1.00	2.00	0.00	3.00	-

a,b,c, d = Means in the row with different superscripts are significantly different * = significant at 5% level of probability, NS = Not significant, SEM = Standard error of the means, RSOSM = Raw *Senna obtusifolia* seed meal

The result for final live weight and weight gain of broiler chickens fed RSOSM showed that chickens fed 0% RSOSM recorded significantly ($P < 0.05$) superior final live weight compared to the chickens fed 5, 10, 15, 20 and 25% RSOSM. However, broiler chickens fed 5 and 10% RSOSM recorded similar final live weight and daily weight gain which are significantly ($P < 0.05$) better than chickens fed 15, 20, and 25% RSOSM. The poor feed intake of broiler chickens fed 10, 15, 20 and 25% actually translated to the final lower live weight and daily weight gain observed in these groups. This is attributed to the negative effects of the anti-nutritional factors in the experimental diets. This is in accordance with earlier findings of [17] who also reported similar adverse effects of raw mucuna seed meal on weight gain of broiler chickens.

The result of feed conversion ratio revealed similar pattern as that of feed intake and weight gain. This is because feed conversion ratio is directly responsible for productive performance parameters (feed intake and weight gain). The depression in feed intake and growth rate is reflected in the feed conversion ratio among broiler chickens fed 15, 20 and 25% RSOSM and this suggests poor nutrient utilization. This agreed with the reports of [18] and [19] that anti-nutritional factors such as tannins, protease inhibitors, goitrogens, alkaloids, glycosides, oxalates and phytates can impair the availability of nutrients, depress feed intake, feed conversion ratio and reduce growth rate in chickens that consume feed containing these anti-nutritional factors. The groups of broiler chickens fed 20 and 25% RSOSM recorded the poorest productive performance.

The low mortality rate recorded suggests that broiler chickens can tolerate up to 25% RSOSM. This result is also similar to the finding of [12] who fed up to 15% raw *Napoleona imperialis* seed meal and recorded low mortality. Tannin levels from 0.2 to 0.5% can cause depression in growth and egg production and levels from 3 to 7% can cause death. Tannin levels of up to 0.3% can be tolerated by chickens [20]. The level of tannins in the diets had depressive effect on performance but not enough to cause mortality.

Conclusion

Conclusively, inclusion of raw *Senna obtusifolia* seed meal (RSOSM) beyond 5% in the diets of broiler chickens had adverse effects on nutrient digestibility and growth performance. The digestibility and growth performance of broiler chickens were more depressed at 20 and 25% level of inclusion. It is therefore recommended that RSOSM can be included in the diets of broiler chickens up to 5% beyond which adequate processing of the raw seed meal is required.

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