Journal of Agricultural Sciences
Vol. 62, No. 4, 2017
Pages 371-384

https://doi.org/10.2298/JAS1704371C
UDC: 636.5.086.37:636.086.37:582.736.2
Original scientific paper

NUTRIENT DIGESTIBILITY AND GROWTH PERFORMANCE OF BROILER CHICKENS FED PROCESSED TROPICAL SICKLEPOD (*SENNA OBTUSIFOLIA* (L.)) SEED MEAL BASED-DIETS

Augustine Clement[1*], Kwari I. Dankasa[2], Igwebuike J. Uchei[2], Adamu S. Bala[2] and Diarra S. Siaka[3]

[1]Department of Animal Production, Faculty of Agriculture, Adamawa State University, Mubi, Adamawa State, Nigeria
[2]Department of Animal Science, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria
[3]Department of Animal Science, University of the South Pacific, Suva Fiji

Abstract: The eight-week feeding trial was conducted to evaluate the nutrient digestibility and growth performance of broiler chickens fed raw or processed *Senna obtusifolia* seed meal (SOSM). Six experimental diets were compounded to contain 0% SOSM and 20% each of the raw, boiled, soaked, sprouted and fermented SOSM respectively. Two hundred and sixteen (216) broiler chicks were randomly allotted to six (6) dietary treatments in a randomised complete block design with three (3) replicates containing 12 chicks each. Data were collected on nutrient digestibility, feed intake, weight gain, feed conversion ratio and mortality. The result of productive performance indicated that feed intake, weight gain and feed conversion ratio were significantly ($P<0.05$) depressed in broiler chickens fed raw, soaked and sprouted *Senna obtusifolia* seed meal. However, broiler chickens fed fermented SOSM showed better ($P<0.05$) productive performance that was close to those fed the positive control diet (0% SOSM). The mortality rate did not reveal any particular trend. However, the low mortality rate recorded in the different treatments indicated broiler chicken can tolerate up to 20% of either raw or processed SOSM. Broiler chickens fed raw SOSM recorded lower values for dry matter (63.06%), crude protein (52.46%), ether extract (53.88%), crude fibre (30.72%) and nitrogen-free extract (46.11%) digestibility than those fed the other processed SOSM. The nutrient digestibility of broiler chickens fed fermented SOSM was significantly ($P<0.05$) better followed by those fed boiled *Senna obtusifolia* seed meal. For instance, broiler chickens fed fermented *Senna obtusifolia* seed meal recorded the highest crude protein and ether extract of 69.91 and 70.03% compared to the other processing methods. It can be concluded that 20% fermented SOSM can be incorporated in the diets of broiler chickens with

[*]Corresponding author: e-mail: audaggai@gmail.com

acceptable depreciation in biological performance. Slightly lower levels of boiled SOSM can be included in the diet of broiler chickens but the levels should be ascertained in further studies.

Key words: broilers, productive performance, nutrient digestibility, sickle pod, seed meal detoxification.

Introduction

The high cost of feeds is the major challenge responsible for the slow growth rate of the Nigerian poultry industry. This is attributed to the scarcity and high cost of conventional protein sources such as soya bean and groundnut cake (Igene et al., 2012). Ukachukwu and Osuagwu (2006) have further reported that feed which accounted for 70% of costs of intensively reared poultry is a major limiting factor to the growth of the poultry industry. Therefore, the search for a cheaper alternative protein source is very necessary. *Senna obtusifolia* seed is one of such alternative that has been neglected in feeding poultry. The proximate composition of the seed as reported by Ingweye et al. (2010) has revealed that it has protein content of 29.54%, which suggests that it may be a good feed source for poultry. *Senna obtusifolia* seed contains some anti-nutritional factors such as tannins and alkaloid which will affect the digestibility and utilization of nutrients (Augustine et al., 2014). These anti-nutritional factors may be harmful to livestock when consumed beyond certain threshed hold. Therefore, before recommending *Senna obtusifolia* seeds as a feed ingredient for poultry, it is important to evaluate the best processing method(s) that will enhance the utilisation of the seed. Information on processing method(s) that will optimally improve the utilisation of *Senna obtusifolia* seed is scanty hence the need to bridge such information gap. This study was therefore conducted to evaluate nutrient digestibility and growth productive performance of broiler chickens fed raw or processed *Senna obtusifolia* seed meals.

Materials and Methods

The research was conducted at the Poultry Unit of the Department of Animal Production, Livestock Teaching and Research Farm, Adamawa State University. It 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 to 1050 mm (Adebayo, 2004).

Experimental stock and their management

Two hundred and sixteen (216) day-old broiler chicks (Anak strain) were brooded and managed in deep litter pens of 0.06 m^2/bird. The broiler chickens were vaccinated against Gumboro (2 and 4 weeks of age) and Newcastle disease (3 and 5 weeks of age). The experimental broiler starter diet was fed *ad-libitum* to the chicks for 35 days while the broiler finisher diet was fed for the remaining twenty one (21) days, respectively. Clean drinking water was similarly supplied *ad-libitum* throughout the period of the experiment.

Processing of *Senna obtusifolia* seeds

Senna obtusifolia seeds were divided into five batches. The first batch was left unprocessed (raw). The second batch was soaked in water for 24 hours. The third batch was boiled in water for 1 hour. The fourth sample was soaked in water for 48 hours and thereafter removed, washed, drained and spread on a jute sack and allowed to sprout. The fifth batch was cooked and placed in an air-tight container and allowed to ferment for 5 days. The differently processed *Senna obtusifolia* seeds were properly sun-dried and milled.

Experimental diets (treatments) and experimental design

Raw and differently processed *Senna obtusifolia* seed meals (soaked, boiled, sprouted and fermented) were included at 20% level each in the diets of broiler chickens at both starter and finisher stages (Tables 1 and 2). There were all together six treatment diets designated T1, T2, T3, T4, T5 and T6. Diet T1 contained 0% *Senna obtusifolia* seed meal and therefore served as the positive control while diet T2 contained raw *Senna obtusifolia* seed meal and served as the negative control. Diets T3, T4, T5 and T6 contained soaked, boiled, sprouted and fermented *Senna obtusifolia* seed meals, respectively. The 216 broiler chickens were randomly allotted to the six dietary treatments in a randomised complete block design (RCBD). Each treatment group was replicated three times with 12 chickens per replicate. The starter and finisher phases of the experiment lasted for 35 and 21 days, respectively.

Chemical analysis

The experimental diets were analysed for proximate composition and level of anti-nutritional factors using standard procedure as described by AOAC (2004).The dry matter content was determined using the oven dry method and crude protein

was determined using the Kjeldahl method. The soxhlet extraction method was used for the determination of ether extract. The fibre content was evaluated using the trichloroacetic method. The tannins and total phenols were determined using the Folin-Denis method as described by Doss et al. (2011).

Table 1. Ingredient composition and calculated analysis of the experimental broiler starter diets.

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM (%)						
Ingredients	T1(0%)	T2(RSOSM)	T3(BSOSM)	T4(SSOSM)	T5(SPSOSM)	T6(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
Soya bean meal	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	6.00	6.00	6.00	6.00	6.00
Groundnut cake	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						
Energy**(kcal/kg)	2912.44	2906.80	2905.08	2903.40	2907.24	2901.10
Protein (%)	23.15	22.23	22.55	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

Vitamin – Mineral Premix (Animal Care) supplies the following per 2.5 kg: 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 70,000 mg, copper 8,000 mg, zinc 60,000 mg and chloride 200,000 mg.

**Metabolisable 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, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

Table 2. Ingredient composition and calculated analysis of the experimental broiler finisher diets.

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM						
Ingredients	T1(0%SOSM)	T2(RSOSM)	T3(BSOSM)	T4(SSOSM)	T5(SPSOSM)	T6(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
Soya bean meal	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
Calculated analysis						
*Energy(kcal/kg)	3119.39	2930.39	2910.50	2903.02	2931.98	2922.11
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

Vitamin – Mineral Premix (Animal Care) supplies the following per 2.5 kg: 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.

**Metabolisable 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, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

Measurement of productive parameters and mortality rate

Daily feed intake was determined by the difference between daily feed offered and daily feed leftover. Final weight was taken 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 shown below:

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

Mortality rate was recorded as it occurred.

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 cages for the digestibility study. The birds were allowed a three-day adjustment period. Measured quantity of feed was given to each bird every morning and the leftover weighed the next morning to calculate feed intake by each bird. Faecal collection lasted for three days. Faecal samples collected from each treatment group were bulked, milled and analysed for proximate composition according to the procedure of AOAC (2004). Nutrient digestibility coefficient (NDC) was calculated using the formula shown below:

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

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) of the randomised complete block design (RCBD) using Statistix 9.0 (Statistix 2003). A significant difference was considered at the 95% confidence level.

Results and Discussion

The results of the proximate composition of the experimental broiler starter and finisher diets are presented in Tables 3 and 4, respectively. The crude proteins for the starter and finisher diets were close to the values (23 and 20% respectively) for starter and finisher diets recommended by Aduku (1995) as the optimum protein requirement for broiler chickens in the tropics. The metabolisable energy contents of the diets ranged from 2883.80 to 2912.44 kcal/kg for the starter diets and 2903.02 to 3119.39 kcal/kg for the finisher diets. These values were close to the values (2800 kcal/kg) for broiler starter diets and (3000 kcal/kg) for broiler finisher diets recommended by Aduku (1995) as the energy requirements of broiler chickens in the tropics.

The levels of tannins and total phenols of the experimental diets revealed that these anti-nutritional factors were relatively high in the diets containing raw *Senna obtusifolia* seed meal compared to the positive control diet (0% RSOSM) and diets containing 20% of each of boiled, soaked, sprouted and fermented *Senna obtusifolia* seed meals. This is an indication that the different processing methods used were effective in reducing the levels of the anti-nutritional factors. These findings concurred with the earlier report of Udedibie and Nkwocha (1990) who found processing methods such as soaking, boiling and fermentation to be effective in reducing anti-nutritional factors in legume grains.

Table 3. Analysed chemical composition of the experimental broiler starter diets (%).

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM (%)						
Nutrients	T1(0%)	T2(RSOSM)	T3(BSOSM)	T4(SSOSM)	T5(SPSOSM)	T6(FSOSM)
Dry matter (%)	92.41	92.50	92.12	93.13	92.84	91.52
Crude protein (%)	22.38	19.82	21.95	19.80	20.70	21.91
Crude fibre (%)	4.80	5.79	6.24	7.17	7.06	5.56
Ether extract (%)	7.52	6.89	6.62	6.38	7.42	6.36
Ash (%)	7.50	5.90	6.64	6.78	6.71	6.70
NFE (%)	46.17	46.86	45.75	46.27	45.08	46.37
*Energy (Kcal/kg)	3076.22	2954.96	2972.50	2954.02	2967.26	2971.97
Calcium (%)	1.07	1.21	1.15	1.11	1.33	1.18
Phosphorus (%)	0.51	0.47	0.68	0.62	0.59	0.63
Tannins (%)	0.001	0.68	0.24	0.30	0.33	0.21
Total phenols (%)	0.003	0.97	0.30	0.36	0.31	0.29

*Metabolisable energy (ME) calculated according to the formula of Pauzenga (1985) ME = 37 × % CP + 81 × % EE + 35.5 × % NFE, NFE = Nitrogen-free extract, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

Table 4. Analysed chemical composition of the experimental broiler finisher diets (%).

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM (%)						
Parameters	T1(0%)	T2(RSOSM)	T3(BSOSM)	T4(SSOSM)	T5(SPSOSM)	T6(FSOSM)
Dry matter (%)	93.05	93.40	92.79	93.40	93.26	93.54
Crude protein (%)	19.25	18.75	18.64	19.72	18.95	19.98
Crude fibre (%)	5.90	6.95	8.84	7.11	6.92	6.09
Ether extract (%)	7.12	6.75	7.55	6.98	6.57	6.71
Ash (%)	7.08	6.97	6.46	6.16	7.08	6.83
NFE (%)	49.13	48.11	47.97	47.68	47.12	46.81
*Energy (kcal/kg)	3033.09	2948.12	3004.17	2961.02	2906.08	2944.53
Calcium (%)	1.87	0.98	1.05	1.17	1.52	1.30
Phosphorus (%)	0.46	0.43	0.48	0.42	0.39	0.47
Tannins (%)	0.00	0.62	0.28	0.32	0.35	0.23
Total phenols (%)	0.00	0.84	0.31	0.34	0.41	0.31

*Metabolisable energy (ME) calculated according to the formula of Pauzenga (1985) ME = 37 × % CP + 81 × % EE + 35.5 × % NFE, NFE = Nitrogen-free extract, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

The productive performances of broiler chickens fed raw or processed *Senna obtusifolia* seed meals (PSOSM) are presented in Table 5. Final live weight and overall weight gain indicated significant (P<0.05) variation among the treatment groups. The average final live weight and overall weight gain of the broiler chickens fed raw *Senna obtusifolia* seed meal (RSOSM) were the lowest (P<0.05) compared to the other groups fed the processed *Senna obtusifolia* seed meals. This could be attributed to the negative effects of anti-nutritional factors such as tannins, oxalates and phytates present in the seed meal. This finding is in line with the report of Emiola et al. (2013) who fed raw mucuna seed meal to broiler chickens and observed a similar depressive effect on the growth of the chickens. The average final live weight and overall weight gain of the broiler chickens fed processed seed meal showed improvement in growth performance compared to the group of chickens fed the raw seed meal. This indicates that the different processing methods used reduced the level of the anti-nutritional factors to tolerable levels. This also concurred with the observations made by some researchers (Orgyeret al., 2009; Udensi et al., 2010; Tuleun et al., 2011; Emiola et al., 2013) who used soaking, boiling and fermentation methods as processing methods for pigeon pea and mucuna seeds and reported a significant reduction in the level of anti-nutritional factors.

Table 5. Productive performance of broiler chickens fed raw or processed *Senna obtusifolia* seed meals.

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM (%)							
Parameters	T1(0% SOSM)	T2(RSOSM)	T3(BSOSM	T4(SSOSM)	T5(SPSOSM)	T6(FSOSM)	SEM
Initial weight (g)	258.33	245.21	255.78	251.11	245.55	249.44	5.94
Final weight (g)	2156.70^{a}	1058.30^{d}	1616.70^{b}	1353.30^{c}	1143.30^{e}	1750.00^{b}	175.05
OWG (g)	1898.37^{a}	813.09^{e}	1360.92^{c}	1102.19^{d}	897.25^{e}	1500.56^{b}	98.69
Daily intake (g)	94.58^{a}	58.37^{e}	69.99^{c}	67.51^{c}	61.72^{d}	79.85^{b}	9.76
DWG (g)	33.90^{a}	14.52^{e}	24.30^{c}	19.65^{d}	16.03^{e}	26.80^{b}	7.08
FCR	2.79^{c}	4.02^{a}	2.88^{c}	3.43^{d}	3.85^{b}	2.98^{c}	0.12
Mortality (No.)	1.00	3.00	1.00	3.00	0.00	2.00	NA

a,b,c,d, e = Means in the same row with different superscripts are significantly different (P<0.05); NA = Not applicable, SEM = Standard error of the mean, FCR = Feed conversion ratio, DWG = Daily weight gain, OWG = Overall weight gain, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

The broiler chickens fed the fermented seed meal (FSOSM) had better (P<0.05) overall weight gain followed by those fed the boiled and sprouted *Senna obtusifolia* seed meal based diets. This concurred with the results obtained by Tuleun et al. (2011) who observed boiling and fermentation to be more effective in

detoxification of anti-nutritional factors. Hong et al. (2004) reported that fermented soya bean meal had high protein content and amino acid composition. This may be the reason for the better performance observed in the group of broiler chickens fed FSOSM. Hirabayashi (1998) has further pointed out that inclusion of fermented feeds in poultry diets improves nutrient digestibility and growth performance. Udedibie et al. (1996) attested that boiling was very effective in reducing saponins compared to soaking in water. The superior performance ($P<0.05$) recorded in broiler chickens fed BSOSM and FSOSM indicated that boiling and fermentation as processing methods proved to be very effective in detoxifying the anti-nutritional components present in *Senna obtusifolia* seed meal. In a similar study, Tuleun et al. (2011) fed broiler chickens fermented mucuna seed meal based diet and reported better performance of the chickens. The superior ($P<0.05$) performance of broiler chickens fed FSOSM may be attributed to improvement in the crude protein content of the seed meal and possibly due to microbial protein that is usually associated with fermented materials as reported by Yashim et al. (2009). Ilyas et al. (1995) have further pointed out that fermented feeds contain biologically active by-products such as probiotic bacteria and lactic acid which exert some beneficial effects in the body of poultry. Daily weight gain showed a similar trend as that of overall weight gain. The feed intake and feed conversion ratio of broiler chickens fed the different experimental diets showed significant ($P<0.05$) variations. The feed intake and feed conversion ratio of broiler chickens fed FSOSM were higher ($P<0.05$) followed by those of the chickens fed BSOSM. The differences in the performance of broiler chickens fed boiled, soaked, sprouted and fermented *Senna obtusifolia* seed meals could be attributed to differences in levels of residual anti-nutritional factors in the diets. A similar finding was reported by Emiola et al. (2013), who fed processed mucuna seed meal to broiler chickens.

Table 6. Nutrient digestibility of broiler chickens fed raw or processed *Senna obtusifolia* seed meals.

Level of soya bean meal replaced with 20% of each of the raw or processed SOSM (%)							
Parameters (%)	T1(0%)	T2(RSOSM)	T3(BSOSM)	T4(SSSOSM)	T5(SPSOSM)	T6(FSOSM)	SEM
Dry matter	77.38^{a}	63.06^{c}	71.31^{b}	68.21^{b}	70.15^{b}	74.66^{b}	9.11
Crude protein	74.13^{a}	52.46^{d}	68.51^{b}	62.48^{c}	67.72^{b}	69.91^{b}	5.21
Ether extract	70.18^{a}	53.88^{e}	64.16^{c}	60.25^{d}	64.90^{c}	70.03^{a}	8.21
Crude fibre	38.12^{a}	30.72^{c}	35.61^{a}	34.78^{b}	33.65^{b}	37.26^{a}	19.01
NFE	72.57^{a}	46.11^{d}	69.04^{b}	68.23^{b}	65.78^{c}	71.05^{a}	14.56

a,b,c,d,e = Means in the same row with different superscripts are significantly different ($P<0.05$), NFE = Nitrogen-free extract, SEM = Standard error of the means, RSOSM = Raw *Senna obtusifolia* seed meal, BSOSM = Boiled *Senna obtusifolia* seed meal, SSOSM = Soaked *Senna obtusifolia* seed meal, SPSOSM = Sprouted *Senna obtusifolia* seed meal, FSOSM = Fermented *Senna obtusifolia* seed meal.

Broiler chickens fed raw *Senna obtusifolia* recorded the lowest values for dry matter, crude protein, ether extract, crude fibre and nitrogen-free extract digestibility than those fed the other processed *Senna obtusifolia* seed meal.

The poor ($P<0.05$) nutrient digestibility observed in broiler chickens fed RSOSM could be attributed to the adverse effects of tannins and other related polyphenols present in the raw seed meal. This conformed to earlier observation made by Amaefule et al. (2011), who fed broiler chickens raw pigeon pea meal based diet and reported depressed nutrient digestibility. Furthermore, Reed (1995) pointed out that anti-nutritional factors can bind with protein in diets and form less digestible complexes and they may also combine with endogenous enzymes and thus depress digestibility. The broiler chickens fed the positive control diet (0% SOSM) exhibited superior ($P<0.05$) nutrient digestibility compared to the groups fed the processed seed meal. This could be due to the effect of residual anti-nutritional factors present in the processed seed meals. Emiola et al. (2013) reported adverse effects of residual anti-nutritional factors in mucuna seed meal on the performance of broiler chickens.

The nutrient digestibility (Table 6) of broiler chickens fed fermented seed meal based diet was significantly ($P<0.05$) better followed by those of broiler chickens fed boiled seed meal based diet and compared to those of broiler chickens fed raw, soaked and sprouted seed meals. This finding is in line with the report of Tuleun et al. (2011), who have reported that boiling and fermentation are more effective in neutralising of anti-nutritional components of the seeds. Osman (2007) further pointed out that the solubilisation of tannins occurred during fermentation resulting in a more significant decrease in the tannin content.

Conclusion

This study revealed that broiler chickens fed the processed *Senna obtusifolia* seed meal performed better than those fed the raw seed meal. Among the broiler chickens fed the differently processed seed meals, those fed the fermented *Senna obtusifolia* seed meal indicated the superior performance in terms of nutrient digestibility and growth performance. Up to 20% of fermented *Senna obtusifolia* can be incorporated in broiler diets with acceptable depreciation in biological performance. A further study should be conducted using raw or processed *Senna obtusifolia* to feed other monogastric animal such as rabbits, pigs and rats.

Acknowledgements

The authors wish to thank the management of the Adamawa State University in Mubi and the Tertiary Education Trust Fund (TET fund) of the Federal Government of Nigeria for providing the first author with a research grant.

References

Adebayo, A.A. (2004). *Mubi region a geograhical sysnthesis* paraclete publishers Yola, Nigeria.

Aduku, O.O. (1995). *Practical Livestock Feeds Production in the Tropics.* S. Asekome and Co Publishers, Samaru Zaria.

Amaefule, K.U., Anyanwu, P.U., & Ukpanah, U.A. (2011). Apparent nutrient digestibility of starter broilers fed raw pigeon pea (*Cajanus cajan* (L) millsp) seed meal diets supplemented with lysine and or methionine. *International Journal of Poultry Science, 10*, 205-211.

AOAC (2004). Association of Official Analytical Chemists. *Official Methods of Analysis* 18th Edition, Washington D.C., USA.

Augustine, C., Abdulraham, B.S., Masudi, B., & Ngiki, Y.U. (2014). Comparative evaluation of the proximate composition and anti-nutritive components of tropical sickle pod (*Senna obtusifolia*) and Coffee Senna (*Senna occidentalis*) indigenous to Mubi Area of Adamawa State Nigeria. *International Journal of Management and Social Sciences*, *3* (2), 9-12.

Doss, A., Pugalenthi, M., Vadivel, V.G., Subbashini, G., & Anitha Subash, G. (2011). Effects of processing technique on the nutritional composition and antinutrients content of under-utilized food legume *Canavalia ensiformis. International Food Research Journal*, *18* (3), 965-970.

Emiola, I.A., Ojediran, T.K., & Ayaji, J.A (2013). Biochemical and haematological indices of broiler chickens fed differently processed legume seed meals. *International Journal of Applied Agriculture and Apiculture*, *1 & 2*, 140-149.

Hirabayashi, M., Matusi, T., Yanoh., & Nakajima, T. (1998). Fermentation of soybean meal with *Aspergillus usamii* reduces phosphorus excretion in chicks. *Poultry Science, 77*, 552-556.

Hong, K.J., Lu, C.H., & Kim, S.W. (2004).*Aspergillus oryzae* GB-107 fermentation improves nutritional quality of food soybean and feed soybean meals. *Journal of Medicinal Food, 7*, 430-435.

Igene, F.U., Isika, M.A., Oboh, S.O., & Ekundayo, D.A. (2012). Replacement value of boiled pigeon pea (*Cajanus cajan*) on growth performance, carcass and haematological response of broiler chickens. *Asian Journal of Poultry Science*, *6*, 1-9.

Ilyas, A., Hirabayashi, M., Matusui, T., Yano, H., Kikushima, T., Takebe, M., & Hayakawa, K. (1995). The role of the removal of phytic acid in soybean meal using *Aspergillus usamii. Asian-Australasian Journal of Animal Sciences*, *8*, 135-138.

Ingweye, J.N., Kalio, G.A., Ubua, J.A., & Umoren, E.P. (2010). Nutritional evaluation of wild sickle pod *(Senna obtusifolia*) seeds from Obanliku, South – Eastern, Nigeria. *American Journal of Food Technology, 5*, 1-12.

Orgyer, M.I., Adeka, I.A., Ikondo, N.D., & Okoh, J.J. (2009). The impact of boiling periods on the proximate composition and levels of some anti-nutritional factors in pipeon pea (*Cajanus cajan*) seeds. *Production Agricultural Technology, 5* (1), 92-102.

Osman, A.M. (2007). Effect of different processing methods on nutrient composition, anti-nutritional factors and *in vitro* protein digestibility on dolichos lablab bean (*Lablab pupureus*). *Pakistan Journal of Nutrition, 6* (4), 299-303.

Pauzenga, U. (1985). Feeding parent stock. *Zootecnia International,* pp 22-25.

Reed, J.D. (1995). Nutritional toxicology of tannins and related polyphenols in forage legumes. *Journal of Animal Science, 73*, 1516-1528.

Statistix (2003). *Statistix for windows manual*. Analytical Software. Version 8.0.

Tuleun, C.D., Adenkola, A.Y., & Orayaga, K.T. (2011). Naturally fermented mucuna seed meal based diets: effect on performance and carcass characteristics of broiler chickens. *Research Journal of Poultry Science*, *4* (4), 50-55.

Udedibie, A.B.I., & Nkwocha, C.O. (1990). Comparative study of jack bean (*Canavalia ensiformis*) and sword bean (*Canavalia gladiate*) as protein supplements for young broiler chicks. *Nigerian Agricultural Journal, 24*, 7-14.

Udedibie, A.B.I., Esonu, B.O., Unachukwu, C., & Iwuoha, N.C. (1996). Two-stage cooking as a method of improving the nutritive value of jackbean (*Canavalia ensifomis*) for broilers. *Nigerian Journal of Animal Production, 23*, 107-110.

Udensi, E.A., Arisa, N.U., & Ikpa, E. (2010). Effects of soaking, boiling duration and autoclaving on the nutrition and quality of *Mucunna flagellipes*. *African Journal of Biochemistry Research, 4* (2), 47-50.

Ukachukwu, S.N., & Osuagwu, N.C. (2006). Digestibility and energy metabolism of raw *Mucuna cocccinchencsis* by growing rabbits. *Journal of Sustainable Agriculture and Environment*, *8*, 141-144.

Yashim, S.M., Abdu, S.B., Alphonsus, L., & Adeniyi, A. (2009). Proximate and mineral composition of castor seed (*Ricinus communis*) cake as influenced by duration of fermentation). *Proceedings of 14th Annual Conference of Animal Science Association of Nigerian. (ASAN)* LAUTECH Ogbomoso, (pp 232-233). Nigeria.

Received: April 13, 2017
Accepted: November 10, 2017

SVARLJIVOST HRANLJIVIH MATERIJA I PERFORMANSE PORASTA BROJLERSKIH PILIĆA HRANJENIH SAMLAVENIM OBRAĐENIM SEMENOM TROPSKE SENE (*SENNA OBTUSIFOLIA* (L.))

Augustine Clement[1*], Kwari I. Dankasa[2], Igwebuike J. Uchei[2], Adamu S. Bala[2] i Diarra S. Siaka[3]

[1]Odsek za stočarsku proizvodnju, Poljoprivredni fakultet,
Državni univerzitet Adamava, Mubi, Država Adamava, Nigerija
[2]Odsek za stočarstvo, Poljoprivredni fakultet,
Univerzitet u Majduguriju, Država Borno, Nigerija
[3]Odsek za stočarsto, Univerziet u Južnom Pacifiku, Suva Fidži

R e z i m e

Eksperiment u trajanju od osam nedelja sproveden je u cilju ispitivanja svarljivosti hranljivih materija i performansi porasta kod brojlerskih pilića hranjenih sirovim ili obrađenim samlevenim semenom *Senna obtusifolia* (engl. *Senna obtusifolia seed meal* – SOSM). Formulisano je šest ekperimentalnih obroka da sadrže 0% semena *Senna obtusifolia* odnosno 20% sirovog, kuvanog, namočenog, naklijalog odnosno fermentisanog semena *Senna obtusifolia*. Dvesta šesnaest (216) brojlerskih pilića su nasumično raspoređeni u šest (6) tretmana (različiti obroci) u potpuno slučajnom blok sistemu sa tri (3) ponavljanja, pri čemu je svako ponavljanje obuhvatalo 12 pilića. Sakupljeni su podaci o svarljivosti hranljivih materija, konzumiranju hrane, prirastu, konverziji hrane i uginuću. Rezultati analiziranih parametara ukazuju da su konzumiranje hrane, ostvareni prirast i efikasnost iskorišćavanja hrane značajno ($P<0,05$) smanjeni kod brojlerskih pilića hranjenih smešom sa sirovim, namočenim i naklijalim semenom *Senna obtusifolia*. Međutim, brojlerski pilići hranjeni fermentisanim semenom *Senna obtusifolia* pokazali su bolje ($P<0,05$) proizvodne rezultate, slične onim brojlerima koji su hranjeni kontrolnim obrokom (0% SOSM). Stopa smrtnosti nije pokazala bilo kakav određeni trend. Ipak, niska stopa smrtnosti zabeležena u različitim tretmanima ukazivala je da brojlerski pilići mogu da tolerišu do 20% bilo sirovog ili prerađenog semena *Senna obtusifolia*. Brojlerski pilići hranjeni sirovim semenom *Senna obtusifolia* zabeležili su niže vrednosti svarljivosti suve materije (63,06%), sirovog proteina (52,46%), sirovih masti (53,88%), sirove celuloze (30,72%) i bezazotne ekstraktivne materije (46,11%), nego kod onih koji su hranjeni obrađenim semenom *Senna obtusifolia*. Svarljivost hranljivih materija brojlerskih pilića hranjenih fermentisanim semenom *Senna obtusifolia* bila je značajno ($P<0,05$) bolja i praćena je vrednostima za seme *Senna obtusifolia*

[*]Autor za kontakt: e-mail: audaggai@gmail.com

tretiranim kuvanjem. Kod brojlera hranjenih mlevenim fermentisanim semenom *Senna obtusifolia* utvrđene su najveće vrednosti za svarljivost sirovih proteina i sirovih masti 69,91 odnosno 70,03% u poređenju da drugim metodama prerade. Može se zaključiti da se 20% fermentisanog mlevenog semena *Senna obtusifolia* može inkorporirati u obroke brojlerskih pilića sa prihvatljivim smanjenjem bioloških performansi. Seme *Senna obtusifolia* obrađeno kuvanjem može biti uključeno u obroke za brojlere u nešto manjoj količini, što može da bude predmet daljih istraživanja.

Ključne reči: brojleri, performanse porasta, svarljivost hraniva, tropska sena, detoksikacija obrađenim samlevenim semenom.

Primljeno: 13. aprila 2017.
Odobreno: 10. novembra 2017.