Nutritional evaluation of differently processed piper (*Canavalia plagiosperma*) seed meal (CPSM) in broiler starter diets

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Abstract

A feeding trial was conducted with the aim of improving the nutritive value of *Canavalia plagiosperma* seedmeal (CPSM) for broiler starter rations. One hundred and fifty kilogram (150kg) of *Canavalia plagiosperma* seeds were cracked and thereafter divided into three batches. Two batches were soaked in water while the third batch was soaked in alkaline solution (2 % palm bunch ash by weight of the cracked seeds) in different plastic containers for 48 hours, before draining off the soaking solutions. The first, second and third batches were boiled in different pots for 1 hour, 2 hours and 1 hour respectively. They were separately sundried for 4 - 5 days and milled to produce cracked soaked in water and boiled for 1 hour (CSWB1), cracked soaked in water and boiled for 2 hours (CSWB2) and cracked soaked in alkaline and boiled for 1 hour (CSAB1), *Canavalia plagiosperma* seedmeals (CPSM) respectively. The meals were used to formulate seven broiler starter rations at 0 %, 10 % and 20 % dietary inclusion levels, respectively (Table 3). Each of the seven broiler starter rations was fed to a group of 42 one-week-old broiler chicks for 28 days, to evaluate the performance of the birds and economic implications. There were significant differences ($P < 0.05$) in daily feed intake, daily body weight gain and feed conversion ratio. Results from this trial suggests that CPSM could be included in broiler starter diets up to 20 % without adverse effect if cracked, soaked in water and boiled for an hour.

Keywords: *Canavalia plagiosperma* seeds, broiler starter, cracked, soaked, alkaline, boiled.

Introduction

The poultry industry in Nigeria is undergoing a turbulent period and some farmers have closed down and others forced to reduce their production capacity due to high cost of feed and feedstuffs (Esonu *et al.*, 2013). The major reason for this scarcity and increased cost of poultry feed has been attributed to increased competition between man and livestock for major feedstuffs such as maize, groundnut and many others, which supply the protein and other nutritional needs of the birds (Okorie, 2006). Ogunji (2003) reported that the problem is more with proteinous feeds. The utilization of unconventional feed sources especially those that are not directly edible

to man will help to produce balanced and economic diets for the birds and reduce dependence on the conventional sources. Tuleun and Patric (2007) reported that increased usage of conventional feed sources resulted in high cost, shortage and scarcity of feedstuffs such as soybean and groundnut cake. The high cost and irregular supply of the conventional feed sources have stimulated researches into unconventional feed materials that are biologically qualitative (Akpodiete, 2008) locally available, less expensive and non-edible to man such as *Canavalia plagiosperma* seeds (Ekenyem *et al.*, 2008).

Canavalia plagiosperma is a high forage

and high seed yielding tropical legume with high energy and high protein content and quality (Odoemelam, 2007). The plant is a relatively unknown legume that is neither used as human food nor as animal feed in Nigeria and yields up to 3 tons per hectare in experimental study (Agbabiaka, 1999), with seed about five times the size of soybean (Odoemelam and Ahamefule, 2006). The crude protein content of ripe seed ranged from 26 – 36 % on dry matter basis and the protein has relatively good amino acid profile (Anumni, 2010). Currently the use of legume has been limited by the presence of some anti-nutritional factors like trypsin inhibitor, hydrogen cyanide, tannins and most especially concanavalin A (Esonu *et al.*, 2013). This study evaluated the possibilities of improving the feeding value of *Canavalia plagiosperma* seeds for broiler starter chicks through some locally adaptable processing techniques.

Materials and methods

Location of the experiments

The research was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology Owerri, Imo State, Nigeria.

Sources and processing of the test materials

The *Canavalia plagiosperma* seeds for the research were obtained from Ikwuano-Umuahia in Abia State of Nigeria. The *Canavalia plagiosperma* seeds were cracked and thereafter divided into three batches. Two batches were soaked in water while the third batch was soaked in alkaline solution (2 % palm bunch ash by weight of the seeds) in different plastic containers for 48 hours, before draining off the soaking solutions. The first, second and third batches were boiled in different pots for 1

hour, 2 hours and 1 hour respectively (Time of boiling was taken from when the material submerged in water in the pot started boiling). They were separately sundried for 4 - 5 days and milled to produce cracked soaked in water and boiled for 1 hour (CSWB1), cracked soaked in water and boiled for 2 hours (CSWB2) and cracked soaked in alkaline and boiled for 1 hour (CSAB1), *Canavalia plagiosperma* seedmeals (CPSM) respectively. The sundried seeds were separately bagged, later milled in a hammer mill with sieve size of 3.36mm to produce the seed meals and stored for the trial. Samples of the raw, CSWB1, CSWB2 and CSAB1 seedmeals respectively were analysed, using standard methods (AOAC 1990) to determine the nutrients composition (Table 1)

Experimental diets

Seven (7) experimental broiler starter diets were formulated such that the differently processed *Canavalia plagiosperma* seedmeals CSWB1, CSWB2 and CSAB1, were included at 0%, 10% and 20% dietary levels respectively as shown on Table 2. Feed and water were offered *ad-libitum*.

Experimental birds and design

Two hundred and ninety-four (294), one-week-old Marshal Strain broiler chicks were divided into seven groups of 42 birds each. Each group was further sub-divided into three replicates of 14 birds each and randomly assigned to the seven treatment diets in a completely randomized design (CRD). During the 28 days trial period, routine medications were applied, litter changed regularly and other routine poultry management practices maintained.

Data collection

The birds were weighed at the beginning of the trial period and subsequently on weekly basis. Feed intake was determined by obtaining the difference between the quantity of feed offered and quantity left

Table 1: Proximate and Phytochemical analysis of the differently processed *Canavalia plagiosperma* seed meal (% Dry matter)

Components	Raw	CSWB1	CSWB2	CSAB1
Dry matter (%)	80.65	81.65	81.15	79.25
Crude protein	36.11	26.12	33.93	26.25
Crude fibre	5.15	6.30	6.80	7.10
Ether extracts	5.48	3.41	3.16	4.67
Ash	1.80	1.40	1.60	2.10
NFE	51.46	62.77	52.51	59.88
Phytochemical Analysis				
Concanavalin A(iu)	8.820	3.690	3.690	2.880
Saponin (%)	4.500	2.000	2.000	0.500
Glycoside(%)	0.114	0.106	0.110	0.107
Alkaloid (%)	8.520	5.600	6.800	4.440
Lectin (iu)	9.800	4.100	4.100	3.200
Tannin (%)	0.640	0.120	0.133	0.133

NB:- CSWB1 = Cracked, soaked in water for 48 hours and boiled for 1 hour

CSWB2 = Cracked, soaked in water for 48 hours and boiled for 2 hours

CSAB1 = Cracked, soaked in alkaline solution and boiled for 1 hour

Raw = raw or unprocessed *Canavalia plagiosperma* seedmeal**Table 2: Gross Composition of experimental broiler starter diets**

Ingredients	Inclusion levels of differently processed CPSM						
	CSWB1			CSWB2		CSAB1	
	0%	10%	20%	10%	20%	10%	20%
Maize	50.00	50.00	50.00	50.00	50.00	50.00	50.00
Soybean Meal	30.00	20.00	12.00	20.00	12.00	20.00	12.00
CPSM*	0.00	10.00	20.00	10.00	20.00	10.00	20.00
Fish Meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Palm Kernel Cake	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Wheat Offal	10.00	10.00	8.00	10.00	8.00	10.00	8.00
Bone Meal	3.50	3.50	3.50	3.50	3.50	3.50	3.50
TM/Vit. Premix **	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Common Salt	0.25	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	100.00
Calculated analysis							
Crude protein	22.26	21.15	20.58	21.15	20.58	21.15	20.58
Crude fibre	4.52	4.58	5.01	4.58	5.01	4.58	5.01
Ether extract	3.80	3.70	3.83	3.70	3.83	3.70	3.83
Ca	1.48	1.49	1.50	1.49	1.50	1.49	1.50
P	0.95	0.92	0.93	0.92	0.93	0.92	0.93
ME (Kcal/Kg)	2837.02	2912.12	3090.42	2912.12	3090.42	2912.12	3090.42

* CPSM = processed *Canavalia plagiosperma* seedmeal** To provide the following per kg of feed: Vit. A, 10,000iu; Vit. D₃, 1,500iu; Vit. K, 2 mg; riboflavin, 3 mg; Pantothenic acid, 6 mg; Niacin, 15 mg; Choline chloride, 3 mg; Vit. B₁₂, 0.08 mg; Folic acid, 4 mg; Mn, 8 mg; Zn, 0.5 mg; Iodine, 1.0 mg; Co 1.2 mg; Cu, 10 mg; Fe, 20 mg;

CSWB1 = Cracked, soaked in water for 48 hrs and boiled for 1 hr

CSWB2 = Cracked, soaked in water for 48 hrs and boiled for 2 hrs

over after 24 hours the next morning. Weight gain was determined by the difference between the initial weight and final weight. Daily weight gain was calculated by dividing the weight gain by the number of days the trial lasted. Feed conversion ratio was computed by dividing the average daily feed intake by the average daily body weight gain. Feed cost per kg was calculated by summing up the feed ingredients cost of 100 kg and divided by 100. Feed cost per kg meat produced was calculated by multiplying the feed cost per Kg by the feed conversion ratio. The trial lasted 28 days.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) as outlined by Snedecor and Cochran (1980). Where significant differences were observed between treatments, means were compared using Duncan's New Multiple Range test (DNMRT) as outlined by Obi (1990).

Results and Discussion

The proximate composition of the raw, CSWB1, CSWB2 and CSAB1 were shown on Table 1. The CP values of the raw and processed *Canavalia plagiosperma* seedmeal (36.11 - 26.12%) were higher ($P < 0.05$) than that reported for most legumes (17 - 30%) (Seena *et al.*, 2006). This protein value makes *Canavalia plagiosperma* seed a probable supplement to cereal based diets with CP of 8.55% or below (Sagarika *et al.*, 1999) and alternative vegetable protein source than most other unconventional tropical legumes (Seena *et al.*, 2006). The CP of the processed *Canavalia* seedmeal decreased due to solubilisation and loss of nitrogenous compounds. The CSWB2 had higher CP value than CSWB1 and CSAB1 respectively. This agrees with the report of

Akanji, *et al.* (2003) that prolonged boiling periods increased CP values due to destruction of anti-nutrients contained in the seeds.

The Crude fibre content falls within the reported range (6.49 - 12.87%) of other *Canavalia spp* (Udedibie, 1990 and Esonu, 1996). The Crude fibre is less than that of *C. ensiformis* (8.5 %), *C. gladiata* (12.8 %) and *Canavalia maritima* (17.3 %) (Seena *et al.*, 2006). The lipid values ranged from 5.48 - 3.40% respectively for raw and processed CSPM respectively. This is in line with other unconventional legumes such as swordbean (2.94%) (Akinmutimi, 2004), *Atylosias carabaevides* (4.56%) *Neonotonia wightii* (4.64 %) (Arinathon *et al.*, 2003). The appropriate level of ether extract (Ether extract) suggests that the seeds should be considered as an oil seed as it compares with groundnut (6.0%) and higher than soybean (3.5 %) reported by Pfizer Nutrients Master Plan (1995). The NFE values recorded compared favourably with swordbean (50.38%), *Mucuna conchinchinesis* (51.86%) and jackbean (60.20%) as reported by Udedibie (1990), Esonu *et al.* (1997), Esonu *et al.*, (2001), Ukachukwu (2000) and Akinmutimi (2004) respectively for raw jackbean and swordbean. Ash content values were lower than that of *Canavalia ensiformis* (4.64 %), *Canavalia gladiata* (3.72%) and *Canavalia carthatica* (3.36%) (Seena *et al.*, 2006). The increased feed intake of the birds on the diets containing CSWB1, CSWB2 and CSAB1 over the control could be due to high fibre content and solubilisation of some nutrients. Birds must therefore eat to meet their energy requirement to sustain growth and development hence increased feed intake. This agrees with earlier reports (Esonu *et al.*, 2004; Esonu *et al.*, 2007). Data on the performance and economic analysis of the starter broiler chicks fed the

differently processed CPSM were shown on Tables 3 and 4 respectively. Birds on 10% CSWB1 dietary level of inclusion performed best ($P<0.05$) in term of feed intake and feed conversion ratio. This performance could be attributed to higher protein quality content of the test material due to detoxification of the ANFs in the processing methods (Table 1). It was observed that the daily weight gain dropped as the level of the test material increased except with the group on 20 % CSWB1. This confirms that anti-nutritional factors reduced growth rate and feed conversion efficiency (Tamir and Alumot, 1996). However, birds on 10% inclusion levels of CPSM performed better ($P<0.05$) than their counterparts on 20% dietary inclusion

levels. Based on the trial the birds on 20 % CSWB1 dietary inclusion level recorded the least cost (190.48) in N/Kg meat produced than the other groups.

Conclusion

This study suggests that cracked soaked in water and boiled for 1 hour processing method could improve the nutritive value of *Canavalia plagiosperma* seeds for broiler starter at 20 % dietary level.

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Table 3: Performance of starter broilers fed different levels of *Canavalia plagiosperma* seedmeals (CPSM)

Parameter	Inclusion levels of differently processed CPSM							
	CSWB1			CSWB2		CSAB1		SEM
	0 %	10 %	20 %	10 %	20 %	10 %	20 %	
Initial body weight (g)	141.50	150.00	145.83	154.17	154.12	150.00	154.50	1.93
Final body weight (g)	1030.56	1116.67	1170.83	1152.67	966.62	1116.67	933.33	89.62
Body weight gain (g)	889.06 ^b	966.67 ^{ab}	1025.00 ^a	998.50 ^a	812.50 ^b	966.67 ^{ab}	778.83 ^b	29.40
Daily body weight gain (g)	31.75 ^b	34.52 ^{ab}	36.61 ^a	35.66 ^a	29.02 ^c	34.52 ^{ab}	27.82 ^c	1.05
Daily feed intake (g)	83.18 ^c	85.17 ^{bc}	95.44 ^a	88.52 ^b	83.90 ^c	88.31 ^b	81.81 ^c	1.23
Feed conversion ratio	2.62 ^b	2.47 ^c	2.61 ^b	2.48 ^c	2.89 ^a	2.56 ^b	2.94 ^a	0.06
Mortality	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

^{abc} : means within rows with different superscripts are significantly ($P<0.05$) different.

SEM – Standard Error of the Mean.

Table 4: Economic analysis of different dietary inclusion levels of processed CPSM

Parameter	Inclusion levels of differently processed CPSM							
	CSWB1			CSWB2		CSAB1		
	0 %	10 %	20 %	10 %	20 %	10 %	20 %	
Feed cost (N/Kg)	95.78	81.78	72.98	81.78	72.98	81.78	72.98	
Feed cost savings (%)	-	14.62	23.81	14.62	23.81	14.62	23.81	
Feed cost (N/Kg) meat produced	250.94	202.00	190.48	202.81	210.91	209.36	214.56	

CPSM = *Canavalia plagiosperma* seedmeal

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