

Effect of feeding processed and raw cola rostrata (monkey cola) seed meal on growth performance of male wistar albino rats

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Target audience: Animal Nutritionist, Scientists and Farmers

Abstract

Cereal grains especially maize used in compounding animal feed is scarce and fluctuates both in price and quantity due to high demand for consumption by man. This has led to the search for alternative feedstuffs that have appreciable amount of energy, easily available, cheap and rarely consumed by man. This study was carried out to investigate the effect of feeding processed and raw Cola rostrata seed meal (CRSM) on the performance of male wistar albino rats. Maize was replaced with processed CRSM (either boiled, boiled then fermented, fermented, and toasted). Sixty (60) weanling male albino wistar rats between 6 to 7 weeks of age with an average initial weight of 97.00g - 97.34g were used for this investigation. The rats were randomly divided into six treatment groups (T_1 T_2 T_3 T_4 T_5 T_6), each group was replicated twice with five rats per replicate in a Completely Randomized Design (CRD). T_1 serving as the control received maize-based diet while T_2 received boiled CRSM, T_3 received boiled then fermented CRSM and T_4 received fermented CRSM. T_5 and T_6 received toasted and raw CRSM respectively. The feeding experiment lasted for 21 days and data collected were weekly body weight, final body weight, feed intake, body weight gain, feed conversion ratio (FCR), protein intake (PI) and protein efficiency ratio (PER). The mean weekly body weights varied significantly ($P < 0.05$) among the treatments. The final body weight of the raw seed treatment group (106.20g) was significantly lower than that of the control (119.35,) and the boiled seed (123.05) treatment groups respectively. FCR, PI and PER followed the same trend. T_2 had significantly ($p < 0.05$) superior performance in terms of FCR, PI, & PER (4.00, 10.31 and 2.15) compared with T_6 (7.85, 7.15 and 1.27) respectively. Apart from T_1 (control), rats on T_2 (boiled for 30minutes) had superior performance in terms of the final weight (g), feed intake/ rat/21days (g), weight gain (g), PI (g), FCR and PER than rats fed T_3 T_4 T_5 and T_6 diets. Based on the results of this study, Cola rostrata seed meal processed by boiling for 30minutes can be used as replacement for maize in animal diets without adverse effect on growth performance.

Keywords: Effect; processed/raw Cola rostrata seed meal; rats and performance.

Description of problem

There is significant increase in the price of maize which has contributed to the current high prices of animal feed. The resultant effect being the increase in prices of animal products (meat, eggs milk etc) Therefore, the need for alternative feedstuffs that have appreciable amount of nutrients especially energy, which can be sourced easily, cheap and rarely eaten

as food by man (1). One of such alternative feedstuff which could be of value for feeding livestock is Cola rostrata seed meal (CRSM).

Cola rostrata seed meal (CRSM) has the potential as an alternative energy source in monogastric nutrition. (2, 3) The potentials are well pronounced in areas where they are found in abundance like the lowland rain forest and the coastal areas in Nigeria (4). However, its

use appears limited as a result of the anti-nutrients found in it (2, 5).

There are about 50 known species of *Cola* in West Africa and over 600 species have been described in Africa (4, 6). *Cola rostrata* is one of the popular species found in the lowland rain forest and coastal areas in Nigeria and has two varieties; yellow mesocarp and white or colourless mesocarp types (7). The mesocarps of *Cola rostrata* are widely consumed in the southern parts of Nigeria as ordinary fruits, while the seeds are often thrown away (2, 4, 7). As reported by (2, 5), the starch component of the seed is about 83.42% and gives an indication that the seed has a nutritional potential as an energy source.

It is imperative to determine the safety of new feed material for humans and animals using the appropriate toxicity test, approved by government regulatory agencies such as National Agency for Food and Drug Administration Control (NAFDAC), Researchers use animal feeding trials to test whether their products are safe for animal and human consumption.

As common with most non-conventional feedstuffs, a relatively large number of anti-nutritional substances have been reported in *Cola rostrata* seed. Various anti-nutritional constituents associated with *Cola rostrata* seed include; oxalic acid, phytic acid, hydrocyanic acid, tannin and caffeine. (3 & 5). Anti-nutritional contents of feedstuff have deleterious effect on human/animal nutrition mainly by aiding the risk of renal calcium absorption, causing corrosive gastroenteritis and renal damage and formation of kidney stones (8). Therefore, using appropriate methods of processing of the materials helps in reducing the anti-nutritional contents of the feed material thus enhancing its usage in animal feed formulation. Works by several authors revealed that boiling, toasting and fermenting of seeds lowers their anti-nutritional contents and increase their Crude

Protein (CP), Nitrogen Free Extract (NFE) and Crude Fat (CF) contents (9; 10; 11 & 12).

Cola rostrata seed as a potential alternative animal feedstuff has received little research attention and it is for this reason, that this study is carried out to determine the effect of the seed meal (boiled, boiled/fermented, fermented, toasted and raw) on the growth performance of male wistar albino rats.

Materials and methods

Experimental site

The proximate analysis of the diets and feeding trial was conducted at the Department of Animal Science laboratory and Animal house, Akwa Ibom State University, Obio-Akpa Campus, Oruk Anam Local Government Area, Akwa Ibom State, Nigeria. Obio Akpa is located within the southern zone of Nigeria at a Latitude of 4°50N of the Equator and Longitude of 7°45E is and 7° 55E of the Greenwich Meridian. The area is in the hot humid tropics with a climate characterized by two seasons (rainy and dry seasons). The rainy season spans between April and October while the dry season spans between November and March. Temperatures are uniformly high throughout the year ranging between 26°C and 28°C. Solar radiation ranges from 4.11 to 4.95mm, partly because of the high values of insulation and temperature (13)

Sourcing and processing of *Cola rostrata* seed into meals.

Mature *Cola rostrata* seed (yellow variety) used in this experiment were collected from Obio Akpa village, cleaned to remove dirt by washing in clean tap water and then divided into five (5) batches. The first batch was boiled in water for 30 minutes in a pot that had been pre-heated to boiling point at a temperature of 100°C, while the second batch which was also boiled for 30 minutes in a pot of water that has been pre-heated to boiling at

a temperature 100⁰C was thereafter fermented using tap water at room temperature for 3 days in a plastic container. The third batch was fermented for 3 days in a plastic container with tap water at room temperature, while the fourth batch was toasted for 30 minutes in a pot with sand which had been pre-heated to 120⁰C. The fifth batch was the raw sample. The thermally

processed seeds (boiled and toasted) were spread on a clean corrugated iron roofing sheet to cool. All the seeds were chopped into sizeable chips for easy drying in the sun. The processed and the raw seeds were then milled using a Hammer mill with 0.05 screen, and stored in well-labelled containers until needed for feed formulation.

Ingredients	Processing Method					
	Control	Boiled	Boiled/fermented	Fermented	Toasted	Raw
Maize	91.49					
<i>Cola rostrate</i>	0	88.26	87.90	88.04	<u>87.90</u>	87.79
Soybean	1.41	3.99	4.28	4.17	4.28	4.37
Fish meal	0.35	1.0	1.07	1.04	1.07	1.09
Palm oil	3.0	3.0	3.0	3.0	3.0	3.0
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Oyster shell	1.0	1.0	1.0	1.0	1.0	1.0
Bone meal	2.0	2.0	2.0	2.0	2.0	2.0
Vitamin premix*	0.5	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100	100
Calculated Nutrients						
Crude Protein (%)	10	10	10	9.99	10	10
Metabolizable Energy (ME)(Kcal/g)	3239.9	3256.5	3177.5	3177.1	3194.5	3175.0
Analysed nutrients (%)						
Crude Protein (CP)	10.09	10.02	9.95	9.97	10.08	9.91
Ether Extract (EE)	2.18	3.11	2.98	2.90	3.02	2.83
Crude fibre (CF)	1.36	1.08	1.27	1.16	1.33	1.87
Calcium (Ca)	0.97	1.07	0.99	0.95	0.86	0.94
Phosphorus (P)	2.04	2.57	2.31	1.93	2.84	2.15
Nitrogen Free Extract (NFE)	77.19	78.93	76.18	76.04	75.86	75.73
Metabolizable Energy (ME)(Kcal/g)	3078.90	3427.16	3316.30	3305.53	3313.0	3286.58

Note: Each 2.5kg of grower finisher vitamins and mineral premix contains 800,000 iu of Vit. A, 1600,000 iu of Vit. D3; 5,000 iu of Vit. E; 2000 mgr of Vit. K; 1500 mgr of B1; 4000 mgr of B2; 80 gr of manganese, 50 gr of Zinc; 20gr of Iron; 5 gr of Copper, 15000 mg of Niacin; 10mg of B12; 5000mg of Pantothenic acid, 5000mgr of Folic acid, 20 mgr of Biotin, 125 mgr of Antioxidant; 200gr of Selenium; 200mgr of Cobalt and 200 mgr of Choline chloride.

Experimental diets formulation

A total of six experimental diets (T₁ T₂ T₃ T₄ T₅ T₆) were formulated as shown in Table 1. T₁ which served as control was prepared with maize as the major source of energy with no *Cola rostrata* seed meals. T₂ was prepared with the boiled seed meal; T₃ was formulated with boiled then fermented seeds and T₄ was prepared with fermented seed. T₅ and T₆ were prepared with toasted and raw seeds respectively. The differently processed *Cola*

rostrata seeds were used to replace maize completely in their different diet treatments (see table 1). The processed and raw seeds with other feed ingredients were milled using a Hammer mill with 0.05 screen. All the diets were formulated to furnish the required 10% crude protein required by rats for optimum growth.

Management of experimental animals and design

A total of sixty weanling male albino rats with an average initial weight of 97.00g to 97.34g were purchased from the Animal house of the Department of Biochemistry, University of Calabar and used in a 21day feeding trial. The rats were assigned into six treatment groups of ten rats. Each treatment was replicated twice with five rats per replicate in a Completely Randomized Design (CRD). Each treatment group was given a compounded diet of CRSM processed using different methods. The rats were housed in metabolic cages under standard condition of 27°C ambient temperature and 45% relative humidity daily with a 12hr light day cycle and had access to clean water and treatment diets *ad-libitum*.

Data collection

The following parameters were measured during the course of this study. These included; Initial body weight (IBW), Weekly Body Weight (WBW) and Final Body Weights (FBW) which were measured using an electronic sensitive scale (Salter Electronic Scale) at the start, weekly intervals and at the end of the experiment. Total weight gain (TWG) was calculated by working the difference between the final and initial weights in the experiment, Feed intake (FI) was determined by measuring the initial weight of the feed for each replicate before serving the rats and weighing the feed left over every morning to determine feed intake by the difference. A summation of all the daily feed intakes per treatment, gave total feed intake

per treatment. Total feed intake per rat was determined by dividing total feed intake by the number of rats per treatment. The Feed conversion ratio (FCR) was calculated using the formula: $FCR = \frac{Weight\ gain}{Feed\ intake}$

Protein intake (PI) $\frac{Feed\ intake}{Diet\ \%CP}$ where %CP is

the percentage crude protein in the diet

Protein Efficiency Ratio $\frac{Weight\ gain}{Protein\ intake}$

Chemical Analysis

The six experimental diets compounded including the raw and processed seeds were analysed for their proximate compositions using procedure described by (14). From the proximate analysis, (Table 1 & 3) the Metabolizable Energy (ME) of the six diets and were calculated according to (15) using equation 1. The Metabolizable Energy of differently processed cola seed were also calculated as shown in Table 3.

$$M.E = 37 (\%CP) + 81.8 (\%EE) + 35.5 (\%NFE) \quad (1)$$

Statistical analysis

All the data generated from the growth study were subjected to a One-way Analysis of Variance (ANOVA) using SAS (16). Significant means were separated using Duncan's New Multiple Range Test (17)

Results and Discussion

Performance of rats fed the processed and raw *Cola rostrata* seed meal (CRSM)

The biological assessment of the *Cola rostrata* seed meal samples showed that although approximately the same amount of protein level was offered (9.99-10.0%) in the diets, the performance of the rats varied considerably among the treatments (Table 2). The lowest mean feed intake (71.48g) was recorded for the raw seed meal treatment group, while the highest feed consumption level (123.05g) was recorded for the T₂. There were significant differences (P<0.05) among

the treatment means. The reduced feed intake in the raw seed treatment group in this study may be due to the non-palatability of the seed meal as a result of the availability of tannin and other anti-nutrients in the seed as reported by (2, 5)

The results of the final body weight and body weight gain of the rats are also presented in Table 2. Although the initial body weights were approximately the same (97.00g - 97.34g) among the treatment groups, the mean final body weights varied significantly ($P < 0.05$) among the treatments. The final body weight of the raw seed treatment group (106.20g) was significantly lower than that of the control (119.35) and the boiled seed (123.05) treatment groups respectively. T₂ had superior performance regarding body weights. This probably indicates that the processing method (boiling) eliminated the anti-nutrients in the seed and make other nutrient available in the feed as reported by (10 & 12).

FCR, PI and PER followed the same trend. T₂ had significantly ($p < 0.05$) superior performance (4.00, 10.31 and 2.15) compared with T₆ (7.85, 7.15 and 1.27) respectively. These parameters (FCR, PI and PER) indicate efficient utilisation of the experimental feed by T₂ animals to deposit body weight. This result agrees with (18) who observed that the biological value of a protein source is based on the quality of such protein, which is retained,

that can provide for growth and maintenance of health. The reduction in the biological value of protein of the raw seeds may be an indication of the inadequacy of its protein contents compared with that of the control and boiled seeds treatment groups.

Table 3 indicated that the thermal processing methods (boiling and toasting) increased significantly ($p < 0.05$) the ether extract content of the seed and this is in agreement with the works of (10 & 12). NFE content of the *Cola rostrata* boiled seed meal was significantly higher than other treatments. This could be that boiling cause the breakdown of granules, soften the cellulose and make the starch to be more available as reported by (3 & 10). Crude fibre content of the boiled seed meal was significantly lowered compared with other groups. This is an indication that boiling was effective in softening the cell wall of the seeds which also agrees with the works of (10 & 12). Moreso, the metabolizable energy (ME) was significantly ($p < 0.05$) higher for boiled and toasted groups (3581.81 and 3575.89 Kcal/g) compared with other treatment groups. This increase may be attributed to the disruption of the cell structures and membrane partitions of the seeds by heat, causing the fat to melt and be easily released from the seeds. This adds to the ME increase from the computation (see equation 1).

Table 2: Performance of Albino rats fed processed *Cola rostrata*-based diets

Parameters	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	SEM
Initial body weight (g)	97.04a	97.25a	97.34a	97.29a	97.0a	97.10a	±3.84
Average final body weight(g)	119.35ab	123.05a	106.95c	114.40b	113.80b	106.20c	±5.37
Feed intake/rat/21 days (g)	115.00 ^a	103.10 ^b	95.20 ^b	81.42 ^{bc}	76.86 ^c	71.48 ^c	±2.77
Weight gain (g)	22.32 ^{ab}	25.80 ^a	9.61 ^c	17.11 ^b	16.80 ^b	9.10 ^c	±1.92
Feed Conversion Ratio (FCR)	5.15 ^{ab}	4.00 ^a	9.90 ^c	5.77 ^{ab}	4.58 ^{ab}	7.85 ^b	±1.78
Protein intake (g)	11.5 ^a	10.31 ^a	9.52 ^a	8.51 ^{ab}	7.69 ^{ab}	7.15 ^b	±4.60
Protein Efficiency Ratio (PER)	1.93 ^{ab}	2.51 ^a	1.01 ^b	2.01 ^a	2.18 ^a	1.27 ^b	±0.86
Mortality	0	0	0	0	0	0	

Note: ^{abc} Means along the rows with different superscripts are significantly different ($P < 0.05$)

Table 3: Proximate composition of the raw and processed *Cola rostrata* seeds g/100g

Nutrient	B	BF	F	T	R
Crude Protein (CP)	8.60 ^a	8.44 ^a	8.63 ^a	8.44 ^a	8.39 ^a
Ether Extract (EE)	3.69 ^a	2.96 ^b	2.93 ^b	3.57 ^a	2.98 ^b
Crude Fibre (CF)	2.05 ^b	3.77 ^a	3.78 ^a	4.14 ^a	3.81 ^a
Ash	2.25 ^b	4.68 ^a	4.66 ^a	4.53 ^a	4.68 ^a
Nitrogen Free Extract	83.42 ^a	80.15 ^b	80.00 ^b	79.32 ^b	80.14 ^b
ME (Kcal/g)	3581.81 ^a	3399.73 ^b	3398.98 ^b	3575.89 ^a	3399.16 ^b

Where; B = Boiled; BF = Boiled/Fermented; F = Fermented; T = Toasted; R = Raw

Conclusion and application

1. *Cola rostrata* seed meal (boiled for 30 minutes) could be used to completely replace maize as an alternative energy source in the diets of animals without adverse effects on growth parameters.
2. Replacement of maize with *Cola rostrata* seed meal in diets of animals by farmers, could go a long way in reducing the cost of animal feed by so doing increase their profit levels.

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