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GROWTH AND HAEMATOLOGICAL INDICES OF BROILER FINISHER CHICKENS FED GRADED LEVELS OF FERMENTED CASTOR SEED MEAL

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Abstract
Feeding broiler chickens with graded levels of fermented castor seed meal (FCSM) to evaluate the effect on growth performance and haematological parameters was carried out in an experiment which lasted for 29 days. A total of 300 ROSS 308 broiler chicks (431-448g) were randomly allotted to the experimental diets using a complete randomized design and replicated 4 times with 15 birds per replicate. Five experimental diets were formulated to be isocaloric (3,000kcal/kg) and isonitrogenous (19% crude protein) such that the FCSM was included at 0, 25, 50, 75 and 100% representing T1, T2, T3, T4 and T5, respectively. The results show that birds fed 50%FCSM had higher final body weight (1,912.19g/bird), total body weight gain (1,473.71g/bird) and weight gain/day (52.63g/bird) than those fed control diets. Feed intake significantly reduced as the level of FCSM increases in the diets while feed conversion ratio was better in 75%FCSM (1.09) followed by 50%FCSM (1.13) as compared to control (1.39) and T5 (1.59). Protein intake reduced as the inclusion of FCSM increased across the treatments. However, protein efficiency ratio and energy efficiency ratio significantly increased in birds fed 50%FCSM (2.21 and 49.12) than those in the control diet with similar but lower values (2.08 and 46.07). Similarly, there was improvement in packed cell volume (38.50%) and haemoglobin (13.30g/dl) for birds fed 75%FCSM only. Based on the findings, FCSM may be included as a replacement for full-fat soybean in the diets of broiler chickens with little or no deleterious effects.
Keywords: Broiler, growth performance, haematology, fermentation, castor seed.

Introduction

The challenges facing Nigerian livestock industry today is the high cost of conventional feedstuff used in compounding animal feeds. The conventional or primary protein sources like soya beans, groundnut cake, fishmeal and cotton seed cake are not only expensive but also competed for by humans and other industrial users (Akinmutin, 2001). The importance of utilizing cheaper non-conventional feedstuffs has been emphasized due to the increasing cost of these animal feed ingredients. The non-conventional feedstuff considered in this study is castor seeds and castor seed cake. The effort to use castor seed and the cake, if successful, may reduce the cost of feed production and subsequently that of animal production in general and may increase the livestock sub-sector of Nigerian Agriculture (Annongu *et al.,* 2008).

Castor seed cake is obtained after oil is pressed-out from the castor seeds. The practical use of castor seeds and its cake in livestock feeding is however the best way of reducing competition between man and livestock feed millers in terms of soybean and groundnut cake (Ani *et al.,* 2009). The use of castor seeds and castor seed cake as a feed ingredient in poultry rations has reduced

feed intake, growth rate as well as assimilation of basic nutrients in broilers. This is due to the presence of phytotoxins, primarily ricin and ricinine (Liener, 1986). This necessitates the fermentation of castor seed meal and testing its efficacy in broiler production.

The application of fermentation on any feed stuff is to reduce the presence of phytotoxins thereby, enhancing the nutritional value. This could be done either by fermenting the feedstuff or by fermenting other materials that may be used as additives to supplement the original feed. Also, fermentation extends the shelf life, inhibit spoilage and pathogenic microorganisms, impart desirable sensory qualities, and digestibility of the feed stuff (Harris *et al.,* 1995). On this note, fermentation of castor seeds is necessary to possibly reduce the phytotoxins, so that there may be little or no effects on growth performance and haematological indices when fed to broiler chickens.

Materials and Methods

Experimental Site

The experiment was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture, Nasarawa State University Keffi, Shabu-Lafia Campus. It is located in the guinea savannah zone of middle belt of Nigeria. It lies on Latitude 6^0 15'N and 9^0 30'E and longitude 6^0 30'N and $11^0$0'E. The mean annual rainfall is about 823mm (NIMET, 2010).

Source of Feed Ingredients and Fermentation of Castor Seeds

All the feed ingredients used in this study were sourced locally within Lafia metropolis. A total 100kg of castor seed was divided into 4 equal parts in different batches soaked in 20litres of clean water and covered with polythene materials and allowed to ferment for 72hours after which the water was drained and a sample was oven dried ground to powder using a grinding machine and processed for proximate composition determination. The processed samples were sent to Livestock Laboratory, IAR & T, Moor Plantation, Ibadan, for proximate analysis (see table 1) according to the procedures of AOAC (2010).

Table 1: Proximate Composition of Raw and Fermented Castor Seed Meal

Parameters (%)	Raw castor seed	fermented castor seed
Crude protein	18.59	18.69
Crude fibre	6.89	6.14
Ether extract	43.12	37.58
Ash	5.75	5.37
NFE	21.22	28.19
Dry matter	95.57	95.97
Metabolizable energy kcal/kg ME	4938.172	4740.031

Experimental Diets

Five experimental diets tagged T1, T2, T2, T4 and T5 were compounded to be isocaloric (3,004 to 3,010kcal/kg ME) and iso-nitrogeneous (21%CP) for broiler finisher diets. Treatment T1 contained soybean cake which serve as control, while T2 contained 25% FCSM, T3 (50%FCSM), T4 (75%FCSM) and T5 (100%FCSM), respectively and were offered to the birds for 29 days. The diets were balanced to meet the nutrients requirements of the birds (see table 2).

Table 2. Gross Composition of the Experimental Diets for Broiler Finisher Chickens

Ingredients (%)	T1 (0%FCSM)	T2 (25%FCSM)	T3 (50%FCSM)	T4 (75%FCSM)	T5 (100%FCSM)
Maize	36.00	36.00	36.00	36.00	36.00
Maize bran	8.20	8.20	8.20	8.20	8.20
Rice offal	6.00	6.00	6.00	6.00	6.00
Groundnut cake	19.00	19.00	19.00	19.00	19.00
Soybean cake	23.00	17.25	11.5	5.75	0.00
*FCSM	0.00	5.75	11.5	17.25	23.00
Limestone	1.30	1.30	1.30	1.30	1.30
Bone meal	3.00	3.00	3.00	3.00	3.00
Blood meal	2.00	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25	0.25
**Premix	0.25	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25
Toxin binder	0.50	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis					
Energy***	3,004.88	3,005.42	3,008.96	3,009.50	3,010.04
Crude protein	21.83	21.72	21.62	21.51	21.41
Crude fibre	3.90	3.97	4.04	4.11	4.17
Ether extract	4.76	4.89	4.02	4.15	4.28
Ash	3.79	3.84	3.89	3.95	4.00
Calcium	1.48	1.47	1.46	1.45	1.43
Available Phosphorus	0.50	0.50	0.50	0.50	0.50
Lysine	1.23	1.32	1.41	1.50	1.59
Methionine	0.54	0.59	0.65	0.69	0.75

***FCSM= fermented castor seed meal, **The vitamin- mineral premix supplied the following per 100kg of diet: vitamin A15,000 I.U, vitamin D3 300,000 I.U., vitamin E 3,000 I.U., vitamin K 2.50mg, vitamin B_1 (thiamine) 200mg, Riboflavin (B_2) 600mg, pyridoxine (B_6), Niacin 40.0mg, vitamin B_{12} 2mg, Pantothenic acid 10.0mg, folic acid 100mg, Biotin 8mg, choline chloride 50mg, anti-oxidant 12.5mg, manganese 96mg, zinc 6mg, Iron 24mg, Copper 0.6mg, Iodine 0.14mg, Selenium 24mg, cobalt 214mg. ***energy kcal/kg ME was calculated using formula by Pauzenga (1985) ME=37 x % CP+81.1x % EE+35.5 x % NFE.**

Experimental Design

The birds were distributed randomly to five treatments in a completely randomized design with fifteen birds per replicate. Each treatment was replicated four times and the diets were formulated using feed win software®.

Experimental Birds and Management

A total of three hundred unsexed day old broiler chicks (ROSS 308 strain) were obtained from a commercial hatchery in Ibadan, Nigeria. The initial body weight was taken. The birds were brooded together under a deep litter house for the first five days of age to enable them acclimatized to the environment. At seven days of age they were randomly distributed into different

compartment separated from each other by wire mash which was supported with wooden frame work. They were provided with one 200 watt bulbs to supply light and heat for brooding through electricity. Feed and water were provided to the birds throughout the experiment period.

Growth Parameters

The growth performance indices included body weight gain which was computed as the difference between the final weight and the initial weight of the birds, feed intake determined as the difference between the amount of feed fed and the leftover. Feed conversion ratio was calculated as the rate of feed intake to live weight gain/day and other parameters like protein intake (PI), protein efficiency ratio (PER) and energy efficiency ratio (EER) were calculated from the data obtained according to Alu (2013).

Haematological Studies

At the end of the feeding trial, blood samples were collected from two experimental birds per replicate using 5mls sterile disposable syringes and needles through the jugular vein of the birds. Blood samples were collected in sample bottles containing Ethylene-diamine-tetra-acetic acid (EDTA) as anticoagulant to prevent clothing of blood. The parameters considered were red blood cells count, white blood cell count, haemoglobin level, packed cell volume, mean cell volume and mean corpuscular haemoglobin and mean haemoglobin concentration as described by Ari *et al.* (2016)

Statistical Analysis

Data collected were subjected to one way analysis of variance using SPSS (2007) model. Significantly different means were separated using Duncan's Multiple Range Test (DUNCAN, 1955).

Results

The phytochemical profile of raw and fermented castor seed meal is shown in table 3. The result indicated that fermentation reduced the level of phytate from 0.061 to 0.042**%**, oxalate from 0.042 to 0.023**%**, tannin from 0.073 to 0.048**%**, saponin from 0.225 to 0.196**%** and trypsin from 6.78 to 0.72**%**. This apparently indicated that subjecting castor seed meal to 72hours of fermentation, may improve the nutritional value.

Table 3: Phytochemical Profile of Raw and Fermented Castor Seed Meal

Phytochemicals (%)	**Raw castor seed**	**fermented castor seed**
Phytate	0.061	0.042
Oxalate	0.042	0.023
Tannin	0.073	0.048
Saponin	0.225	0.196
Trypsin	6.78	0.72

The growth performance of broiler finisher chickens fed graded levels of fermented castor seed meal is presented in table 4. The result showed significant ($P<0.05$) increase in the final body weight (1,830.56, 1,598.35, 1,912.19, and 1,768.81g/bird), total body weight gain (1,382.28,

1,158.18, 1,473.71, 1,333.08 and 655.55g/bird) and weight gain/day (49.36, 41.36, 52.63, 47.61 and 23.41g/bird). Birds fed 50%FCSM had higher final body weight (1,912.19g/bird), total body weight gain (1,473.71g/bird) and weight gain per day (52.63g/bird) than those fed control diets (1,830.56, 1,382.28 and 49.36g/bird), respectively. Feed intake significantly reduced (P<0.05) as the level of FCSM increases in the diets (67.77, 61.77, 58.98, 52.01 and 37.05 representing T1, T2, T3, T4 and T5). Feed conversion ratio was better in 75%FCSM (1.09) followed by 50%FCSM (1.13) as compared to control (1.39), 25%FCSM (1.50) and 100%FCSM (1.59). Protein intake showed significant reduction (P<0.05) as the inclusion of FCSM increases across the treatments (14.23, 12.97, 12.38, 10.92 and 7.78). However, protein efficiency ratio and energy efficiency ratio significantly increased (P<0.05) in birds fed 50%FCSM (2.21 and 49.12) than those on control diets with similar but lower values (2.08 and 46.07).

Table 4. Growth Performance of Broiler Finisher Chickens Fed Graded Levels of Fermented Castor Seed Meal

Parameters	T1 (0%FCSM)	T2 (25%FCSM)	T3 (50%FCSM)	T4 (75%FCSM)	T5 (100%FCSM)	SEM	LOS
IBW (g/bird)	448.27	440.16	438.48	435.73	431.95	5.05	ns
FBW (g/bird)	1830.56^{a}	1598.35^{b}	1912.19^{a}	1768.81^{ab}	1087.50^{c}	72.36	*
TBWG (g/bird)	1382.28^{a}	1158.18^{b}	1473.71^{a}	1333.08^{ab}	655.55^{c}	71.82	*
WG/day (g/bird)	49.36^{a}	41.36^{b}	52.63^{a}	47.61^{ab}	23.41^{c}	2.56	*
FI (g/bird/day)	67.77^{a}	61.77^{b}	58.98^{b}	52.01^{c}	37.05^{d}	2.50	*
FCR	1.39^{a}	1.50^{a}	1.13^{b}	1.09^{b}	1.59^{a}	0.05	*
PI (g/bird/day)	14.23^{a}	12.97^{b}	12.38^{b}	10.92^{c}	7.78^{d}	0.52	*
PER	2.08^{a}	1.74^{b}	2.21^{a}	2.00^{ab}	0.98^{c}	0.10	*
EER	46.07^{a}	38.60^{b}	49.12^{a}	44.43^{ab}	21.85^{c}	2.39	*

abc= means on the same row having different superscript differ significantly (p<0.05); NS = not significantly different (p>0.05); SEM = standard error of mean; LOS = level of significant; IBW = Initial body weight; FBW =Final body weight; TBWG = Total Body weight gain (g); WG :weight gain; FI=Feed intake (g); FCR = Feed conversion ratio; , PI: protein intake ; PER: protein efficiency ratio; EER energy efficiency ratio.

The haematological indices of broiler finisher chickens fed graded levels of fermented castor seed meal is presented in table 5. The results showed significant improvement (P<0.05) in the level of packed cell volume (31.00, 33.00, 33.00, 38.50 and 35.50%) and haemoglobin (10.30, 11.05, 11.20, 13.30 and 11.60g/dL) as the level of fermented castor seed meal increased in the diets. Birds fed 75%FCSM based diet, had higher values of PCV (38.50%) and HB (13.30g/dL) while birds on the control diet (0%FCSM) had the least values of PCV (31.00%) and Hb (10.30g/dL). Red blood cell (x10^{12}/L, white blood cell (x10^{9}/L, mean cell volume (fl), mean cell haemoglobin (pg) and mean cell haemoglobin concentration (g/dL) values (insert the range of values) were not significantly influenced (P>0.05) by the inclusion of fermented castor seed meal.

Table 5. Haematological indices of broiler finisher chickens fed fermented castor seed meal

Parameters	T1 (0%FCSM)	T2 (25%FCSM)	T3 (50%FCSM)	T4 (75%FCSM)	T5 (100%FCSM)	SEM	LOS
PCV (%)	31.00^{b}	33.00^{ab}	33.00^{ab}	38.50^{a}	35.50^{ab}	1.05	*
Hb (g/dL)	10.30^{b}	11.05^{b}	11.20^{b}	13.30^{a}	11.60^{ab}	0.37	*
RBC ($x10^{12}$/L)	3.31	3.44	3.47	3.99	3.59	0.10	NS
WBC ($x10^{9}$/L)	106.50	93.00	153.50	118.00	112.00	9.24	NS
MCV (fl)	92.50	95.00	94.00	96.00	100.00	1.28	NS
MCH (pg)	30.50	31.50	31.50	32.50	32.50	0.36	NS
MCHC (g/dL)	33.50	35.00	33.50	34.50	33.00	0.31	NS

ab= means on the same column having different superscripts differ significantly (p<0.05); NS = not significantly different (p>0.05); SEM = standard error of mean; LOS = level of significant. *: asterisk; PCV= packed cell volume, Hb= haemoglobin; WBC= white blood cell; MCV=mean cell volume; MCHC mean cell haemoglobin concentration.

Discussion

The reduction in the level of phytate from 0.061 to 0.042%, oxalate from 0.042 to 0.023%, tannin from 0.073 to 0.048%, saponin from 0.225 to 0.196% and trypsin from 6.78 to 0.72%, were probably due to fermentation. This indicated that fermentation improves the value of castor seed by reducing the phytochemicals in the castor seed meal when subjected to 72hours. This corroborate the report of Nissar *et al.,* (2017) and Agbugui *et al.,* (2010) who observed reduction of phytate, oxalate, tannin and saponin through, fermentation of sourdough, boiling of Bauhinia monandra and soaking of Moringa leaves respectively.

The improvement in the final body weight (1,912.19g/bird), TBWG (1,473.71g/bird) and WG/day (52.63g/bird) observed in birds fed 50%FCSM, may be due to the inclusion of fermented castor seed meal. This apparently indicated that the FCSM supplied more energy needed for the birds to increase growth and performance. This observation is in line with the earlier work of Mustapha *et al*. (2015) reported an improvement in the daily feed intake, daily body weight gains and feed conversion ratio of broiler chickens fed graded levels of raw castor (*Ricinus cummunis*) seed meal to broilers. However, birds fed on castor seed meal boiled for 30 minutes and fermented for 3 days appeared to be higher compared to others.

The reduction in the feed intake observed and better feed conversion ratio values seemingly indicated that castor seed meal may supply the basic nutrients needed for the birds thus, eat less yet convert to flesh in most of the castor seed included diets. Similarly, the reduction in protein intake probably meant no disturbance in the performance of the birds. However, improvement in the PER and EER observed in birds fed 50%FCSM, indicated that the birds possibly utilized most of the needed nutrients for growth and development.

Improvement in the level of packed cell volume (38.50%) and haemoglobin (13.30g/dL) in birds fed 75%FCSM based diet, could be an indication that the test ingredient supported the physiological functions of the birds by the supply of ferrous iron which provided oxygen for normal respiration, thus preventing anaemia. These values were within the normal range of PCV (31-36%) as reported by Chauhan and Roy (1996). But contradicted earlier report of Ayorinde *et al.* (2017), who studied haematological and serum biochemical parameters of broiler chickens fed varying dietary levels of fermented castor oil seed meal and reported that, dietary inclusion of fermented castor seed meal at higher levels of 100 and 150g/kg had adverse effects on haematological and serum biochemical parameters of broiler chickens.

Conclusion

The findings revealed that FCSM up to 75% may replace full-fat soybean in the diets of broiler chicken. Hence, 50% inclusion level may be recommended for better growth with little or no deleterious effects in the physiological performance of broilers.

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