The effects of graded levels of dehulled and cooked castor oil bean (*Ricinus communis*, L) meal on performance of broiler starters

A. O. Ani and A. U. Okorie

Department of Animal Science, University of Nigeria, Nsukka, Nigeria.

Abstract

The effects of graded levels of dehulled-and-cooked castor oil bean (*Ricinus communis*, L) meal on the performance of broiler starters were studied. Castor oil bean seeds were dehulled-and-detoxified by cooking in two stages at 100°C for 50 minutes per cooking. Sixty 7-day old unsexed broiler starters (Anak strain) were randomly divided into four groups of 15 birds each in a completely randomized design (CRD). Each group was fed one of four isocaloric (2.88 Mcal of ME/kg) and isonitrogenous (24% crude protein) diets containing 0% (control), 10, 15 and 20% levels of dehulled and cooked castor oil bean meal (CBM), respectively for five weeks. There were no significant ($P > 0.05$) differences between birds fed the control diet and those fed the 10% CBM diets in all the parameters measured with the exception of packed cell volume (PCV). Inclusion levels above 10% caused significant ($P < 0.05$) reduction in average daily feed intake and daily weight gain. However, the reduction in feed conversion ratio and protein efficiency ratio became significant ($P < 0.05$) only at 20% inclusion level. PCV was depressed ($P < 0.05$) by all the inclusion levels of CBM. Overall, the birds fed the 20% dehulled-and-cooked CBM had the worst performance. It was concluded that dehulled-and-cooked CBM could be included at levels of 10 and 15% in broiler starter diets without much adverse effects on the performance of the broiler starters.

Key words: Effects, graded levels, dehulled-and-cooked, castor oil bean meal, broiler starters.

Introduction

Poultry industry occupies a unique position in the livestock sector of Nigeria for the fact that poultry can be reproduced much quicker than other livestock, they are highly prolific and are good feed converters (Obioha, 1992). Babatunde (1980) had suggested that the best logical solution to Nigeria's national meat scarcity is to increase poultry production. However, the high cost of feed ingredients and compound feeds are important factors militating against increased poultry production. In an effort to reduce the cost

of poultry production, poultry nutritionists have tried to harness and utilize by-products and wastes that are not directly utilizable by man. One of such by-products is the castor oil bean (*Ricinus communis*, L) meal from castor oil extraction industry.

Castor oil bean (*Ricinus communis*, L) belongs to the spurge family Euphorbiaceae (Atsmon, 1989). Castor oil plant grows as a perennial in the tropics, and as an annual crop in the temperate climate (Vaughan, 1970). In Nigeria, it is widely

cultivated in the southern and middle-belt states. The dehulled seeds are processed for use as a flavour-enhancing food condiment in the south eastern states of Nigeria. The suitability of castor oil bean meal as a source of vegetable protein in poultry diets has been well recognized (Dacosta and Laun, 1961; Okorie *et al.*, 1985). However, its use in monogastric diets, especially in poultry, has been limited because of possible deleterious effects due to the presence of ricine, a poisonous protein component; ricinine, an alkaloid and thermostable castor allergen (Jenkins, 1963;

Vilhjalmsdottir and Fisher, 1971). Okorie *et al.* (1985) showed that roasting of castor oil bean seeds at 140°C for 30 minutes could destroy the toxin, ricine in castor oil bean. However, Okoye *et al.* (1987) and Okorie *et al.* (1988) reported cases of mortality of some chicks fed with diets containing such heat-treated castor oil bean meal. Considering the aforementioned problems, there is need, therefore, to investigate the potential of dehulled and two-stage cooked castor oil bean meal (CBM) as an alternative feed ingredient in broiler ration. This study was carried out to

Table 1: Percentage composition of broiler starter diets

Ingredients	Dietary levels of Castor oil bean meal (%)			
	0	10	15	20
Maize	53.00	48.84	46.8	44.65
Wheat offal	5.00	5.00	5.00	5.00
Castor oil bean meal	0	10	15	20
Soyabean meal	30.00	24.16	21.2	18.35
Fish meal	7.5	7.5	7.5	7.5
Bone meal	4.00	4.00	4.00	4.00
Iodized salt	0.25	0.25	0.25	0.25
Vit/Min. Premix*	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated composition:				
Crude Protein (%)	24.05	24.03	24.01	24.02
Energy (Mcal of ME/kg)	2.89	2.88	2.88	2.88
Analyzed composition (%):				
Dry matter	90.5	92.00	92.00	92.5
Crude protein	24.01	23.99	23.98	23.96
Ether extract	5.00	7.00	10.00	15.00
Crude fibre	7.00	7.00	6.5	7.11
Nitrogen-free extract	43.14	43.41	40.52	35.43
ASH	11.35	10.6	11.00	11.00
Gross Energy (Mcal/kg)	4.33	4.33	4.34	4.37

* Vit A – 10,000.00 iu., D₃-2,000 iu., B1-0.75g., B2-5g., Nicotinic acid – 25g., K3-2.5g., E-25g., Biotin – 5g., Folic acid – 1g., Choline Chloride 250g., Cobalt –0.400g., Copper 8g., Manganese 64g., Iron –32g., Zn – 40g., Iodine – 0.8g., Flavomycin – 100g., Spiramycin 5g 3-Nitro-50g., DL-Methionine –50g., Selenium 0.6g., B-vit 120g., BAT-5g.

ascertain the effects of levels of inclusion of dehulled-and-cooked CBM on the performance of broiler starters.

Materials and Methods

The castor bean seeds used for the study were obtained from Orba market near Nsukka in Enugu State. The seeds were dehulled manually by cracking them between two stones. The hulls were separated from the cotyledons by winnowing using the principle of density difference. Detoxification of the dehulled seeds was done by using a two-stage cooking method (Udedibie *et al.*, 1996). The dehulled-and-cooked samples were dried over night in the oven at 100°C and milled. The milled samples were defatted by mechanical extraction using an oil press. The processed castor oil bean meal (CBM) was used with other ingredients to formulate broiler starter diets (Table 1).

Sixty 7-day old unsexed commercial broiler starter chicks (Anak strain) were randomly divided into four groups of 15 birds each using a completely randomized design (CRD). Each group was fed one of four isocaloric (2.88 Mcal of ME/kg) and isonitrogenous (24% crude protein) diets containing 0% (control), 10, 15 and 20% levels of dehulled-and-cooked CBM, respectively for five weeks. Each group was further sub-divided into 3 replicates of 5 birds per replicate placed in 2.6m x 3m deep litter pens of fresh wood shavings. Heat was provided by kerosine stoves placed under metal hovers for 21 days. Feed and water were supplied *ad libitum* to the birds from 7 to 42 day of age. The birds were subjected to standard broiler management procedure. Feed intake was recorded daily whereas live weights were recorded weekly for each replicate. Feed conversion ratio was then calculated from these data as quantity (grams) of feed taken per unit (gram) weight gained over the same period. Mortality

record was kept on daily basis. The chicks were vaccinated against New Castle disease in the first and third weeks, and against Gumboro disease in the second week. Propylactic treatment against coccidiosis with Amprolium at 3 weeks of age was also given to the birds. During week 6 of the experiment, a seven-day excreta collection from three chicks per group (one per replicate) was made to determine the apparent retention of the proximate components. During this period, the birds were housed individually in metabolism cages and weighed quantities (about 75g) of feed were offered to each chick daily. Daily feed intake was recorded as the difference between the quantity offered and the quantity left after 24 hours. The birds were allowed two days to adjust to cage environment before droppings were collected. Faecal droppings were collected from separate cages, dried and weighed over a 7-day period. Excreta were collected, dried and weighed over a 7-day period. At the end of the collection period, all faecal samples from each bird were bulked and preserved for further analysis.

Also during week 6 of the experiment, blood samples were collected from the wing veins of three birds from each group at one bird per replicate. Proximate analyses were carried out on the feed and faecal samples according to AOAC (1990). Haematocrit was determined by the micro method (McGowen *et al.*, 1955) and haemoglobin (Hb) by the cyanomethaemoglobin method (Crosby *et al.*, 1954). Gross energy of feeds and faecal droppings was determined in a Parr adiabatic oxygen bomb calorimeter. The data obtained were subjected to analysis of variance and means were separated using Duncan's New Multiple Range Test (Steel and Torrie, 1980; Duncan, 1955).

Results and Discussion

Table 2 shows the effects of dehulled and cooked

Table 2: Effect of graded levels of heat-treated castor oil bean meal on performance, packed cell volume, haemoglobin concentration and mortality of broiler starters.

Parameters	Castor oil bean meal inclusion levels (%)				
	0	10	15	20	SEM
Average daily feed intake (g)	69.08 ^a	68.15 ^{ab}	66.84 ^b	59.89 ^c	± 0.43
Average daily weight gain (g)	28.66 ^a	27.92 ^a	25.98 ^b	19.87 ^c	± 0.59
Feed conversion ratio	2.41 ^c	2.44 ^{bc}	2.58 ^b	3.02 ^a	± 0.47
Protein efficiency ratio	1.73 ^a	1.70 ^{ab}	1.62 ^b	1.38 ^c	± 0.03
Packed cell volume (%)	32.72 ^a	27.67 ^b	28.33 ^b	26.56 ^b	± 0.86
Haemoglobin concentration (%)	11.00	9.09	10.02	9.54	± 0.44
Chick mortality (%)	16.67 ^b	16.67 ^b	33.33 ^{ab}	50.00 ^a	± 6.81

^{a,b,c} Means on the same row with different superscripts are significantly ($P < 0.05$) different.

SEM = Standard error of the mean.

castor oil bean meal (CBM) on performance, packed cell volume (PCV), haemoglobin concentration (Hb) and mortality of the experimental birds. There were significant ($P < 0.05$) differences among treatment groups in average daily feed intake (ADFI), average daily gain (ADG), feed conversion ratio (FCR), protein efficiency ratio (PER), packed cell volume (PCV) and chick mortality rates. Birds fed diets containing 0 and 10% CBM had similar ADFI and ADG and better

feed conversion ratio and protein efficiency ratio ($P < 0.05$) than those birds fed the 15 and 20% CBM diets. Birds fed the 0% CBM diet had significantly ($P < 0.05$) higher PCV than birds fed diets containing 10, 15 and 20% CBM. Birds fed diets containing 10 and 15% CBM had similar ($P > 0.05$) FCR and PER. Birds fed 10, 15 and 20% CBM diets had similar ($P > 0.05$) PCV values. Birds fed 20% CBM diet had significantly ($P < 0.05$)

Table 3: Effect of graded levels of heat-treated castor oil bean meal on apparent retention (% of intake) of nutrients by broiler starters.

Parameters	Castor oil bean meal inclusion levels (%)				
	0	10	15	20	SEM
Crude protein	77.98 ^a	77.42 ^a	76.14 ^b	69.78 ^c	± 0.36
Crude fat	74.43 ^a	72.78 ^{ab}	72.23 ^b	64.59 ^c	± 0.58
Crude fibre	82.61 ^a	82.06 ^a	80.27 ^b	75.73 ^c	± 0.29
Crude ash extract	77.83 ^a	77.24 ^a	75.93 ^b	67.67 ^c	± 0.27

^{a,b,c} Means on the same row with different superscripts are significantly ($P < 0.05$) different.

SEM = Standard error of the mean.

lower ADFI and ADG and poor feed conversion and PER. There were no significant ($P > 0.05$) differences between birds fed 0, 10 and 15% CBM diets in rate of chick mortality, only the 20% diet caused significant ($P < 0.05$) chick mortality.

Table 3 shows the effects of dehulled-and-cooked CBM on apparent retention of nutrients by broiler starters. Birds fed 0% and 10% CBM diet had similar retention of dry matter (DM), nitrogen, ether extract (EE) and nitrogen-free extract (NFE), which were significantly ($P < 0.05$) higher than the retention of birds on the 15 and 20% CBM diets. The lowest ($P < 0.05$) retention of nutrients was observed in birds that fed 20% CBM diet.

Results of the feeding trial show that daily feed intake, daily weight gain, feed conversion ratio and PER declined with increasing levels of CBM in the diets. These results are consistent with the findings of Vilhjalmsdottir and Fisher (1971) and Lee *et al.* (1978) who also reported that birds fed diet containing 20% CBM exhibited the least performance in feed intake, weight gain, feed conversion ratio and protein efficiency ratio.

The observed reduction in feed intake may be attributed to the presence of appetite depressant in the diet containing high level (20%) of CBM. Similar suggestions had been made (Dacosta and Laun, 1964). Reduction in feed intake had been associated with the feeding of high level of CBM (Lee *et al.*, 1978; Okorie and Anugwa, 1987; Ani and Okorie, 2002). The decline in weight gain therefore, may be attributed to reduced feed intake and poor efficiency of feed conversion which implies that the metabolic and production requirements of the birds could not be satisfied. Similar suggestion had been made (Okoye *et al.*, 1997). CBM inclusion levels of 15% and above depressed ($P < 0.05$) dry matter, nitrogen, ether extract, and nitrogen-free extract retention. Similar depression in nutrient digestibility has been

reported by Abdelsamie *et al.* (1983). The adverse effect of increasing CBM levels on nutrient digestibility may be attributed to the effect of residual ricin in heat-treated CBM. Ricin has been shown to interfere with nutrient digestion, absorption and utilization (Jaffe, 1980; Liener, 1986).

Although chicks fed 15% CBM diets had similar FCR and PER with chicks fed 10% CBM diets, the growth performance of chicks fed 0% and 10% CBM diets was better than that of chicks fed the 15% CBM diet. This result is in agreement with the reported findings of Lee *et al.* (1978), Okorie and Anugwa (1987) and Okorie *et al.* (1988) that depressed growth performance was observed in chicks fed diet containing more than 10% CBM.

It could be observed (Table 2) that the growth performance of chicks fed 0% and 10% CBM diets was similar. This result contradicts earlier reports by Okorie and Anugwa (1987) and Okorie *et al.* (1988) that the growth performance of chicks fed 0% roasted castor cake (RCC) diet was better than that of chicks fed 10% RCC diet. The observed improvement in performance may be attributed to method of processing which involved dehulling and detoxification by two-stage cooking at 100°C for 50 min per cooking.

Conclusion

The results of this study indicated that dehulled and two-stage cooked CBM could be included at levels of 10 and 15% in broiler starter diets without much adverse effects on FCR and PER of the broiler starters. However, growth performance was best at the 10% level of inclusion. There may be need to extend the period of cooking for complete elimination of residual ricin, and to supplement CBM – containing diets with DL – methionine and L – lysine which are limiting amino

as a source of castor oil bean protein.

References

- Abdelsamie, R.E., N.P. Ranaweera and W.E. Nana (1983). The influence of fibre content and physical texture of diet on performance of broilers in the tropics. *Poult. Sci.* 24: 383-390.
- Ani, A.O. and A.U. Okorie (2002). The nutritive value of dehulled and cooked castor oil bean (*Ricinus communis*, L) meal to broiler finishers. *Proceedings of the 27th Annual Conference; Nigerian Society for Animal Production, Fed. Univ. of Tech. Akure, Nigeria*. March 17-21, 2002.
- AOAC (1990). Association of Official Analytical Chemists. Official Methods of Analysis 15th ed. Washington, D.C.
- Atsmon, D. (1989). "Castor" Oil Crops of the world. Their breeding and utilization, G. Robelen, R.K. Downey, and A. Ashri (eds). McGraw-Hill Publishing Company, New York. pp. 438-447.
- Babatunde, G.M. (1980). The tottering Nigerian livestock sector: its problems and possibilities. Inaugural Lecture, University of Ibadan, Ibadan, Nigeria.
- Crosby, W.H.; J. I. Hunn and F.W. Hurth (1954). Standardizing a method for clinical haemoglobinometry. *U.S. Armed Forces Med. J.* 5, 693-694.
- Dacosta, B.L. and G.F. Laun (1964). Detoxicated castor bean oil meal for feeding chickens. *Nutr. Abstr. Rev.* 34: 6744.
- Duncan, D. B. (1955). New Multiple Range and Multiple F. Tests. *Biometrics*. 11: 1-42.
- Jaffe, W.G. (1980). Hemagglutinins (Lectins) In: *Toxic constituents of plant foodstuffs*. Liener, I.E. (ed) Acad. Press New York pp 73-102.
- Jenkins, J.P. (1963). Allergenic and toxic components of castor oil bean meal: Review of Literature and studies of inactivation of these components. *J. Sc. Food Agric.* 14: 773-780.
- Lee, K.H.; I.K. Han; and Y. Chuny (1978). Studies of nutritive values of locally produced oil meals. *Food Sci. Technol. Abstr.* 10:12.
- Liener, I.E. (1986). Nutritional significance of lectins in diets. In: *The lectins, Properties, Functions and Applications in Biology and Medicine*. Liener, I.E., Sharon, N and Goldstein, I.J. (eds.) Acad. Press New York. pp. 527-552.
- McGowen, J.J., A.A. R. Jones and, A.G. Steinberg. (1955). The haematocrit of capillary blood. *New England J. Med.* 253, 308-309.
- Obioha, F. C. (1992). A Guide to poultry production in the tropics (1st ed) Acena Publishers, Enugu, Nigeria. 121 pp.
- Okorie, A.U., F.O. Anugwa, G.C. Anamelechi and J. Nwaiwu (1985). Heat-treated castor bean (*Ricinus communis*): a potential livestock protein supplement in the tropics. *Nutr. Reports Intl.* 32: 659-666.

- Okorie, A.U. and F.O.I. Anugwa (1987). The feeding value of roasted castor oil bean (*Ricinus communis*) to growing chicks. *Plant Foods for Human Nutr.* 37:97-102.
- Okorie, A.U., E.A. Enunwonye and F.O.I. Anugwa (1988). Response of broiler chicks to graded levels of heat-treated castor oil bean (*Ricinus communis*) cake supplemented with DL – methionine. *Arch. Geflugelk* 52(3): 127-132.
- Okoye, J.O.A., C.A. Enunwonye; A.U. Okorie and F.O.I. Anugwa (1987). Pathological effects of feeding roasted castor bean meal (*Ricinus communis*) to chicks. *Avian Pathology* 16:283-290.
- Okoye, F.C., F.C. Obioha and Okeke, G.C. (1997). Substitution of dried brewer's yeast for fish meal in the diet of broiler chicks. *J. Agric. Tech.* 5(2): 34-40.
- Steel, R.G.D. and J.H. Torrie (1980). Principles and procedures of statistics, a biometric approach. 2nd ed. McGraw-Hill Publishers, New York.
- Udedibie, A.B.I.; B.O. Esonu; C. Unachukwu and N.C. Iwuoha (1996). Two-stage cooking as a method of improving the nutritive value of jackbean (*Canavalia ensiformis*) for broilers. *Nig. J. Anim. Prod.* 23 (2): 107-110.
- Vaughan, J.G. (1970). The Structure and Utilization of Oil seeds. Chapman and Hall Publishers, London.
- Vilhjalmsdottir, L. and H. Fisher (1971). Castor bean meal as a protein source for chickens. Destruction and determination of limiting amino acids. *J. Nutr.* 101:1185-1192.

(Received 06 October 2003, Accepted 06 October 2004).