Agro-Science Journal of Tropical Agriculture Food, Environment and Extension
Volume 6 Number 1 January 2007 pp. 89 – 97

ISSN 1119-7455

EFFECTS OF GRADED LEVELS OF DEHULLED AND COOKED CASTOR OIL BEAN (*Ricinus communis* L) MEAL AND SUPPLEMENTARY L-LYSINE ON PERFORMANCE OF BROILER FINISHERS

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ABSTRACT

One hundred and forty-four commercial unsexed broiler finishers (Anak strain) were used in an experiment to investigate the effects of dehulled and cooked castor oil bean (Ricinus communis L) meal supplemented with L-lysine on growth performance and certain blood parameters of broiler finishers. The birds were randomly divided into 12 groups of 12 birds each and fed 12 isocaloric (12.13 MJ of ME/kg) and isonitrogenous (21% CP) diets for 4 weeks in a 4 x 3 factorial arrangement involving four levels (0,10,15 and 20%) of delulled and cooked castor oil bean meal (CBM) and three L-lysine levels (0,0.25 and 0.5%). Results revealed that body weight at 10 weeks, average daily weight gain (ADWG), average daily feed intake (ADFI), feed conversion ratio (FCR), protein efficiency ratio (PER), packed cell volume (PCV) and haemoglobin concentration (Hb) differed significantly (P<0.05) among treatments. Body weight at 10 weeks. ADWG, ADFI, feed conversion efficiency and PER declined significantly (P<0.05) with the increasing levels of CBM in the diets. PCV and Hb were not adversely affected by increasing levels of CBM in the diets. There were also significant differences (P<0.05) among treatments in apparent retention (% of intake) of nutrients (dry matter, nitrogen, ether extract and nitrogen-free extract). There were significant (P<0.05) CBM x L-lysine interaction in ADWG, FCR, and PER and in DM and ether extract (E.E) retention. Lysine supplementation significantly (P< 0.05) improved ADWG, feed conversion efficiency, PER, E.E and DM retention at the 0, 15 and 20% levels of CBM inclusion. The results indicate that dehulled and cooked CBM can be incorporated into broiler finisher rations at 10% level without L-lysine supplementation and at 15% level with L-lysine supplementation to obtain normal growth in broiler birds.

Key words: Castor oil bean meal, L-lysine, broiler finishers, effects, performance

INTRODUCTION

The importance of animal protein in the diet of man cannot be over-emphasized. According to FAO (1997), there is acute shortage of animal protein in the diets of average Nigerians. The best logical solution to the problem of animal protein shortage is to increase the production and consumption of pigs, poultry and rabbits and make their products readily available at affordable cost. These animals are known to be highly prolific and very efficient in converting feed nutrients into high quality animal protein (Fielding, 1991; Serres, 1992; Smith, 2001). One of the major factors that militate against increased livestock production in Nigeria is the high cost of feed which arises largely from fluctuations in feed supplies, rising prices of feed ingredients, poor quality feeds and inefficiencies in feed production. A possible solution to the problem of high cost of feed and feed ingredients is to explore the use of alternative and nutritionally adequate non-conventional feed ingredients. The alternative feed ingredient being considered in this study is castor oil bean (*Ricinus communis* L) meal, a by-product of castor oil extraction industry. Castor oil bean is widely cultivated in the middle belt and southern states of Nigeria. Castor oil bean meal (CBM) with 35-39.8% crude protein has potential as a vegetable protein- rich feed ingredient in livestock feeding (Okorie *et al.*, 1985; Browning *et al.*, 1990; Obioha, 1992). Its practical use in livestock feeding has been documented (Martins *et al.*, 1982; Okorie and Anugwa, 1987; Ani and Okorie, 2002). However the use of castor oil bean meal as a feed ingredient in poultry rations is limited by the presence of phytotoxins, primarily ricin and ricinine (Liener, 1986), extremely portent allergen (Horton and Maurice, 1989) and high fiber levels in undehulled seeds (Browning *et al.*, 1990). Besides, castor bean protein is known to be deficient in lysine and sulphur-containing amino acids (Satar *et al.*, 1979; Browning *et al.*, 1990). According to Okorie *et al.* (1985), roasting the castor bean seeds at 140^0C for 20 min was effective in eliminating the ricin. However, reports of Okorie and Anugwa (1987), Okoye *et el.* (1987) and Okorie *et al.* (1988) showed cases of mortality in some chicks fed the diets containing such heat-treated CBM. Moreover, the presence of fibre has been shown to contribute to reduced feed intake in chickens (Lee *et al.,* 1978; Abdelsamie *et al.*, 1983). Against this background, this study was undertaken to determine the effects of graded levels of dehulled and cooked CBM and supplementary L-lysine on growth performance and some haematological parameters of broiler finishers.

MATERIALS AND METHODS

Processing of castor oil bean seeds

Castor bean seeds used in this feeding trial were the large mottled variety that was purchased from Orba market near Nsukka in Enugu State. The seeds were dehulled manually by carefully cracking them between two stones. Decorticated seeds were obtained by separating the hulls from the cotyledons. The dehulled seeds were cooked in two stages at 100^0C for 50 min per cooking as described by Ani and Okorie (2006). The seeds were cooked in two stages to ensure proper detoxification. The cooked samples were dried overnight in the oven at 100^0C, ground in a hammer mill and defatted using a mechanical oil press. The processed castor oil bean meal was used to formulate the broiler finisher diets as presented in Table 1.

Animals and management

One hundred and forty-four 6-week old commercial unsexed broiler birds (Anak strain) were randomly divided into 12 groups of 12 birds each. The groups were randomly assigned to 12 isocaloric (12.13 MJ of ME/kg) and isonitrogenous (21.00% crude protein) diets in a 4 x 3 factorial arrangement involving four levels (0,10,15 and 20%) of dehulled and cooked CBM and three L-lysine levels (0,0.25 and 0.5%). Each treatment was replicated 3 times with 4 birds per replicate in deep litter pens of fresh wood shavings. The experiment lasted for 4 weeks during which feed and water were provided *ad libitum*. Known quantity of feed was weighed out and offered to the birds daily and the left over weighed to determine the daily feed intake. The birds were weighed at the beginning of the experimental feeding and subsequently on weekly basis to determine the weight gain. Feed conversion ratio and protein efficiency ratio were computed from weight gain and feed intake. The birds were subjected to routine broiler management procedure.

Apparent nutrient retention study
During week 4 of the experiment, a seven-day excreta collection from three birds per group (one bird per replicate) was carried out to determine the apparent retention of the proximate components. During this period, the birds were housed in metabolism cages and weighed quantity (180g) of feed was offered to each bird 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. At the end of the collection period, all faecal samples from each bird were bulked and preserved for further analysis.

Table 1: Percentage composition of broiler finisher diets containing cooked castor oil bean meal supplemented with L-lysine

Castor oil bean meal levels (%)	0			10			15			20		
L-lysine levels (%)	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5
Ingredients (%) / Treatments	1	2	3	4	5	6	7	8	9	10	11	12
Maize	58.48	58.57	58.62	54.22	54.49	54.47	52.39	52.38	52.38	50.27	50.27	50.27
Wheat offal	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Soya bean meal	23.02	22.68	22.38	17.28	16.76	16.53	14.11	13.87	13.63	11.23	10.98	10.73
Castor oil bean meal	0.00	0.00	0.00	10.00	10.00	10.00	15.00	15.00	15.00	20.00	20.00	20.00
Fish waste (33.5%CP)	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50	6.50
L-lysine	0.00	0.25	0.50	0.00	0.25	0.50	0.00	0.25	0.50	0.00	0.25	0.50
Bone meal	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Iodized salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit/Min Premix*	0.25	0.25	0.25	0.25	0.25	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	100.00	100.00	100.00	100.00	100.00
Calculated analysis:												
Crude protein	21.04	21.04	21.05	21.09	21.02	21.06	21.01	21.04	21.08	21.03	21.06	21.09
Energy (Mcal of ME/kg)	2.94	2.93	2.93	2.93	2.96	2.96	2.97	2.97	2.96	2.98	2.98	2.97

*To supply the following per kg of diet: vitamin A, 12.500 IU; vitamin D_3, 2500 IU; vitamin E, 50.00mg; vitamin K, 2.50mg; vitamin B_1, 3.00mg; vitamin B_2, 6.00mg; vitamin B_6, 6.00mg; niacin, 40mg; calcium pantothenate, 10mg; biotine, 0.08mg; vitamin B_{12}, 0.25mg; folic acid, 1.00mg; chlorine chloride, 300mg; manganese, 100mg; iron, 50mg; zinc, 45mg; copper, 2.00mg; iodine, 1.55mg; cobalt, 0.25mg; selenium, 0.10mg; growth promoter, 40.00; antioxidant, 200mg.

Table 2: Proximate composition of broiler finisher diets containing cooked castor oil bean meal supplemented with L-lysine

	Diets											
	1	2	3	4	5	6	7	8	9	10	11	12
Crude protein	21.00	21.03	21.03	21.00	21.00	21.00	21.97	21.00	21.01	20.96	21.99	21.00
Either Extract	4.85	4.75	4.60	6.95	6.85	6.85	8.81	8.75	8.75	13.75	13.19	12.50
Crude fibre	7.50	7.26	7.00	7.65	7.60	7.36	7.60	7.04	7.35	7.80	7.72	7.70
Ash	10.35	10.07	10.00	9.89	9.00	9.30	10.11	10.01	10.06	10.44	10.50	10.00
Moisture	10.50	9.64	9.00	10.50	10.14	10.00	10.05	10.64	10.00	10.01	10.39	10.05
Nitrogen-free extract	45.80	47.25	48.37	44.01	45.41	45.46	42.46	42.56	42.86	37.03	37.21	38.75
Gross energy (Kcal/g)	4652	4651	4654	4683	4693	4694	4721	4723	4722	4744	4742	4741

Haematology

During week 4 of the experiment, 3 birds were randomly selected from each treatment group (one per replicate) and blood samples were collected from their jugular veins with sterile needles. The blood samples were collected into properly labelled sterilized bottles containing EDTA (Ethylene diamine tetra-acetic acid) for haematological analysis. The packed cell volume (PCV) was determined using the microhaematocrit centrifuge, while the haemoglobin concentration (Hb) was determined by the cyanomethaemoglobin method (Lamb, 1991).

Proximate and statistical analyses

Proximate analyses were carried out on the diets and faecal droppings according to A.O.A.C. (1990). Data collected were subjected to analysis of variance (Snedecor and Cochran, 1980), and differences between treatment means were separated using Duncan's New Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

The effects of dietary castor oil bean meal (CBM) and supplementary L-lysine on performance and blood parameters of broiler finishers are presented in Table 3. There were significant (P<0.05) differences among treatments in body weight at 10 weeks, average daily weight gain (ADWG), average daily feed intake (ADFI), feed conversion ratio (FCR), protein efficiency ratio (PER), packed cell volume (PCV) and haemoglobin concentration (Hb). Birds on treatments 1-3 and 4 - 6 (0 and 10% CBM diets respectively with or without lysine) had comparable final body weights, while birds on treatments 1-3, 4-6 and 7-9 (0,10 and 15% CBM diets respectively with or without lysine) also had comparable final body weights. Birds on treatment 3 (0% CBM with 0.5% lysine) had significantly (P<0.05) higher ADWG than birds on treatments 7-12. The ADWG of birds on treatments 4-6 and the ADWG of birds on treatments 1 and 2 were similar. Birds on treatments 4-6 and those on treatments 7-9 had comparable ADWG. Birds on treatments 2 and 3 had significantly (P<0.5) higher ADFI than those on treatments 4 and 7-12. The feed intake of birds on treatments 1, 4- 6, 8 and 9 were comparable. Birds on treatment 3 had the best FCR, which was comparable to the FCR of birds on treatments 1, 2, 4 and 6. The best PER was observed also in birds on treatment3 and this was similar to the PER of birds on treatment 1.

Table 3: Effects of cooked castor oil bean meal supplemented with L-lysine on performance, packed cell volume and haemoglobin concentration of broiler finishers

tor oil bean ıl levels%	0			10			15			20			
ysine levels	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	
ameters	1	2	3	4	5	6	7	8	9	10	11	12	SEM
ly weight at 10 weeks	2515.52^{ab}	2519.80^{a}	2529.79^{ab}	2498.97^{ab}	2499.17^{ab}	2504.88^{ab}	2433.99^{b}	2463.98^{b}	2489.13^{b}	1729.34^{c}	1776.91^{c}	1812.23^{c}	±31.01
erage daily l intake (g)	169.07^{ab}	169.18^{a}	169.39^{a}	168.05^{bcd}	168.48^{abc}	168.54^{abc}	167.23^{d}	167.92^{bcd}	168.00^{bcd}	146.80^{e}	147.30^{e}	147.41^{e}	±0.33
erage daily ght gain (g)	61.01^{ab}	61.02^{ab}	61.45^{a}	60.48^{bc}	60.52^{bc}	60.65^{b}	59.16^{e}	59.71^{d}	60.02^{cd}	44.15^{h}	44.97^{g}	45.57^{f}	±0.02
d version o	2.77^{gh}	2.77^{gh}	2.76^{h}	2.78^{fgh}	2.79^{fg}	2.78^{fgh}	2.82^{d}	2.81^{de}	2.80^{efg}	3.32^{a}	3.28^{b}	3.23^{c}	±0.01
tein ciency	1.72^{ab}	1.71^{bc}	1.73^{a}	1.71^{bc}	1.71^{bc}	1.71^{bc}	1.69^{e}	1.69^{e}	1.70^{cd}	1.43^{h}	1.45^{g}	1.47^{f}	±0.04
o(feed/gain) ked cell ume (%)	30.00^{d}	30.00^{d}	28.00^{f}	29.00^{e}	26.00^{g}	30.00^{d}	29.00^{e}	31.00^{c}	30.00^{d}	36.00^{a}	33.00^{b}	31.00^{c}	±0.29
emoglobin centration /100ml	9.71^{c}	9.71^{c}	9.29^{d}	9.29^{d}	8.44^{e}	9.71^{c}	9.29^{d}	9.71^{c}	9.71^{c}	11.82^{a}	10.56^{b}	9.71^{c}	±0.03

, c…,h = means on the same row with different superscripts are significantly (P<0.05) different. SEM = ndard error of the mean.

Table 4: Effects of cooked castor oil bean meal supplemented with L-lysine on apparent retention (% of intake) of nutrients by broiler finishers

Castor oil bean meal levels (%)	0			10			15			20			
L-lysine levels (%)	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	
Parameters	1	2	3	4	5	6.	7	8	9	10	11	12	SEM
Dry matter	81.81^{a}	81.94^{a}	82.17^{a}	79.72^{b}	79.71^{b}	80.01^{b}	78.15^{d}	78.27^{cd}	78.73^{c}	67.69^{e}	67.58^{e}	69.98^{e}	±1.1713
Ether extract	79.75^{a}	79.97^{a}	80.12^{a}	77.49^{b}	77.53^{b}	77.76^{b}	75.82^{c}	76.03^{c}	76.39^{c}	63.72^{d}	63.96^{d}	64.21^{d}	±0.2025
Nitrogen-free extract	90.93^{c}	91.63^{b}	92.28^{a}	90.51^{c}	90.70^{c}	90.80^{c}	83.08^{d}	83.10^{d}	83.50^{d}	77.00^{e}	77.25^{e}	77.48^{e}	±0.1966
Nitrogen	80.11^{a}	80.38^{a}	80.72^{a}	77.57^{b}	77.97^{b}	78.06^{b}	76.53^{d}	76.76^{d}	77.03^{d}	63.62^{e}	63.97^{e}	64.17^{e}	±0.2183

a,b,…,e = means on the same row with different superscripts are significantly (P<0.05) different. SEM = Standard error of the mean.

Table 5: Simple regression equations and correlation coefficients relating each response parameter (Y) of broiler finishers to % dietary castor oil bean meal (X)

Predictand (Y)	Prediction equation	R	R^2	Syx	Probability of significar correlation
Average daily feed intake (g)	Y=179.80-6.67X	-0.81	0.65	2.29	P<0.01
Average daily weight gain (g)	Y=68.99-4.97X	-0.82	0.67	1.62	P<0.01
Feed conversion ratio	Y=2.52+0.16X	0.82	0.67	0.05	P<0.01
Protein efficiency ratio	Y=1.85 -0.08X	-0.82	0.68	0.03	P<0.01
Packed cell volume (%)	Y =26.83+137X	0.63	0.40	0.79	P<0.01
Haemoglobin concentration (mg/100ml)	Y = 8.80 + 0.38X	0.54	0.30	0.28	P<0.01
Dry matter retained (%)	Y=88.00-4.41X	-0.90	0.81	1.01	P<0.01
Nitrogen retained (%)	Y = 86.76 – 4.95X	-0.89	0.80	1.17	P<0.01
Ether extract retained (%)	Y = 98.33 – 5.06X	-0.96	0.93	0.67	P<0.01
Nitrogen-free extract retained (%)	Y = 87.38 – 5.05X	-0.88	0.78	1.26	P<0.01

Birds on treatments 10-12(20%CBM diets with or without lysine) had significantly (P<0.05) lower final body weight, ADFI, ADWG, feed conversion efficiency and PER than birds on other treatments. Birds on treatment 10 (20% CBM without lysine) had significantly (P<0.05) higher PCV and Hb than birds on other treatments. The PCV values of birds on treatments 1,2, 6 and 9 were comparable, while the Hb values of birds on treatments 1,2,6,8,9 and 12 were similar. Birds on treatment 5 had significantly (P<0.05) lower PCV and Hb values than birds on other treatments. There were significant (P<0.05) CBM x L-lysine interaction in ADWG, FCR and PER. L-lysine supplementation significantly (P<0.05) improved ADWG, FCR and PER at the 15 and 20% levels of CBM inclusion. The results of this study indicate that CBM inclusion level at 20% resulted in feed intake depression. Ani and Okorie (2002) made a similar observation. The depression in feed intake may be attributed to poor palatability of the diets containing high level (20%) of CBM. Okorie *et al.* (1988) made similar suggestion. The presence of appetite depressing factor in the heat-treated CBM might also have contributed to the depressed feed intake. Appetite depressing castor allergen in processed CBM has been implicated in feed intake depression (Clemens, 1963; Ani and Okorie, 2005). There was a decline in final body weight and ADWG as the level of CBM in the diets increased above 15% (Table3). This result agrees with the reported findings of Lee *et al.* (1978) and Ani and Okorie (2002). The observed growth depression may be attributed to low feed intake and poor efficiency of feed conversion of birds fed the 20% CBM diets. The implication is that the birds may not have had enough nutrients required for normal growth. The presence of residual ricin in the processed CBM might also have contributed to the growth depression. Ani and Okorie (2006) reported the presence of residual ricin in two-stage cooked CBM. Ricin has been shown to interfere with the digestion and absorption of nutrients in the gastro-intestinal tract and to inhibit protein synthesis (Goldstein and Poretz, 1986; Liener, 1986). Lysine was included in some of the diets because castor bean protein has been shown to be low in lysine (Satar *et al.*, 1979; Browning *et al.*, 1990). The inclusion of lysine in the CBM-containing diets significantly improved performance at the 15 and 20% levels of CBM inclusion. Lysine might have improved the quality of the CBM protein. Polit and Sgarbieri (1976) cited by Ani and Okorie (2004a) showed that supplementation of the diets for chicks and weanling rats resulted in improved performance. Data on growth performance indicate therefore, that supplementation of dietary CBM with L-lysine is necessary at 15 and 20% levels for enhanced performance of broiler finishers. As observed in Table 3, PCV and Hb were not adversely affected by increasing levels of CBM in the diets. The significant increase in PCV and Hb of birds on treatments 10 and 11 (20% CBM diets with 0 and 0.25% lysine respectively) may be attributed to the increased production of red blood cells in these birds as they tried to develop immunity to the toxic effect of residual ricin. Radeleff (1970) cited by Ani and Okorie (2004b) reported that ricin as a protein is capable of inducing immunity in animals consuming it in small quantities over a period of time. However, the inclusion of lysine in some of the diets did not have any significant effect on PCV and Hb of the treated birds. Table 4 shows the effects of cooked castor oil bean meal and supplementary L-lysine on apparent retention (% of intake) of nutrients by broiler finisher birds. There were significant differences in nutrient retention among treatments. Birds on treatment 3 had the highest ether extract retention while the lowest retention of dry matter (DM), nitrogen, ether extract (EE) and nitrogen-free extract (NFE) was shown by birds on treatments 10 – 12 (CBM diets with or without L-lysine). As shown in Table 4, the retention of nutrients by the broiler birds declined as the levels of castor oil bean meal in the diets increased beyond 15%. The reduction in apparent retention of nutrients with increasing level of CBM has been attributed to the effect of residual ricin (Ani, and Okorie 2005), which might have interfered with the digestion and absorption of nutrients in the gastro-intestinal tract of the birds. Table 5 gives the simple regression and correlation coefficients relating the response parameters to dietary dehulled and cooked CBM levels. There were significant ($P < 0.01$) correlations between CBM levels and feed intake ($r = -0.96$), weight gain ($r = -0.96$), FCR ($r = 0.94$), PER ($r = -0.94$), PCV ($r = -0.36$), and Hb ($r = -0.52$). There were also significant ($P < 0.01$) correlations between CBM levels and percentage retention of DM ($r = -0.95$), nitrogen ($r = -0.96$), EE ($r = -0.91$) and NFE ($r = 0.89$).

CONCLUSION

The results of this study indicate that dehulled and cooked CBM can be incorporated into broiler finisher rations at 10% level without L-lysine supplementation and at 15% level with L-lysine supplementation to obtain normal growth in broiler birds.

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