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EFFECT OF REPLACING COCOA HUSK FOR WHEAT BRAN ON INTERNAL ORGANS, CARCASS YIELD, SERUM METABOLITE AND ECONOMICS OF PRODUCTION OF GROWING COCKERELS

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ABSTRACT

Carcass yield, serum metabolites and economy of production of cockerels were studied for 12 weeks to determine the effect of replacing wheat bran with cocoa husk at 0, 25, 50, 75 and 100% levels. Results of eviscerated yield were statistically different ($P<0.05$). Highest eviscerated yield of 70.52% was obtained from 25% wheat bran replacement by cocoa husk that gave the best result of flesh/bone ratio of 2.73. The weight of the liver, gizzard and size of gastro-intestinal tract increased with increase in the level of cocoa husk in the diet.

Total protein and serum urea concentrations were higher than the reference values. Creatinine concentrations were lower on all the cocoa husk diets compared with the control. Wheat bran can be replaced by 25% cocoa husk in the finisher diet of cockerels to produce good quality carcass at reduced cost without adverse effects on serum metabolites.

INTRODUCTION

Many crop residues in Nigeria are presently underutilized. They are either discarded or allowed to rot away. The common ones include cocoa husk, cowpea husk, melon husk, corn cobs and maize straws. Cocoa husk in particular has been found to be useful in animal feeds. It contains high amount of ash (Abiola and Tewe, 1991) which can contribute to the palatability of the diets. Other studies have demonstrated that cocoa husk can replace a fair amount of feed ingredients in both ruminants and non-ruminant diets (Devendra, 1977; Adeyanju et al. 1975).

The potentials of cocoa husk as a feedstuff in poultry rations have been investigated (Abiola and Tewe, 1992; Sobamiwa and Longe 1994). Expectedly, the current introduction of new and improved varieties of cocoa seedlings to farmers by agricultural extension agents will boost cocoa production particularly in South Western Nigeria and make more cocoa husk available as unconventional feed ingredient for livestock.

Wheat bran that is frequently used in poultry diets to increase bulk is becoming expensive due to increase in production cost. The price per ton of wheat bran has skyrocketed by about 200% within the last five years. Besides, research study indicated that wheat bran depressed chick performance by reducing utilization of dietary manganese (Halpin and Baker, 1986).

The objective of this study was to determine the carcass yield, serum metabolites and economics of production of cockerels fed finisher diets in which wheat bran was replaced with cocoa husk.

MATERIALS AND METHODS

Preparation of experimental diets

The cocoa husk used for the study was obtained from Cocoa Research Institute of Nigeria (CRIN). The husk was sun-dried for four days and later milled into granular forms with a hammer mill model SAS 2 THM. Five experimental finisher rations were formulated in which cocoa husk replaced wheat bran at 0, 25, 50, 75 and 100% levels. The diets were made to be isocaloric and isonitrogenous. Proximate composition of cocoa husk is presented in Table 1.

Management of birds

A total of 110 eight- week old Harco cockerels were allocated randomly to the five experimental diets with 22 birds per treatment and 11 birds per replicate. All the birds were de-wormed with piperazine powder at the beginning of the study. The experiment which was replicated twice lasted for twelve weeks. Feed and water were supplied ad libitum.

Blood collection and carcass analysis

At the age of 20 weeks, four birds per replicate were randomly selected and bled by neck decapitation. The serum was collected in universal bottles and later used for the analysis of blood constituents. The procedures used for determination of total protein, albumin, globulin, serum urea and creatinine were those described by Hyduke (1975). All the slaughtered birds were prepared for carcass analysis as described by Oluyemi and Roberts (1979).

Experimental Design and Statistical Analysis

Experiments were laid in completely randomized design(CRD). So, collected data were subjected to analysis of variance (ANOVA) in CRD. Treatment means were separated using Duncan's Multiple Range Test (Gomez and Gomez, 1985).

RESULTS AND DISCUSSION

Results on the performance of cockerels on cocoa husk based diets in both the starter and finisher phases have been reported (Abiola and Tewe, 1992). In the current study, average live-weight of cockerels decreased significantly ($P<0.05$) with increase in the level of cocoa husk in the diet as shown in Table 3. The lowest value of 1.22kg average live-weight obtained from birds on 100% replacement of wheat bran by cocoa husk was not significantly different from the value of 1.30kg average liveweight of birds on the 75% replacement diet. Dressed carcass weights expressed as percentage of live-weight showed no significant differences due to the treatments. However, the 25% wheat bran replacement by cocoa husk produced the highest eviscerated yield of 70.52%, which was slightly lower than the value of 73.07% reported by Aina (1990) for cockerels at 20 weeks of age. Although all the diets in the current study were made to be isocaloric, the diet with 25% replacement of wheat bran by cocoa husk produced the highest eviscerated yield. The diet probably contained optimum nutrients for maximum production of edible meat. A positive correlation between dietary energy and eviscerated yield has been documented (Holsheimer and Ruesink, 1993).

Flesh/bone ratio non-significantly decreased as the level of cocoa husk increased in the diet. The highest value of 2.73 flesh/bone ratio was obtained from birds on 25% replacement of wheat bran by cocoa husk. The high fibre content of the diets containing high amount of cocoa husk must have imposed physical limitations upon the intake of digestible nutrients resulting in carcass with less flesh and more bone. The implication of fibrous diets on nutrient utilization was reported by Sosulki and Cadden (1982) who concluded that high fibrous diet depressed nutrient utilization with adverse effects on growth rate.

Liver weight tended to increase with increase in the level of cocoa husk in the diet except for 50% replacement of wheat bran by cocoa husk which had the least value of 1.44%. The non-significant increase in liver weight with increase in cocoa husk in the diet could be due to an attempt by the organ to detoxify the toxic material (theobromine) in cocoa husk. Liver hypertrophy implicated theobromine (Odunsi and Longe, 1995a and b). Results obtained for gizzard, small intestine, caecum and large intestine showed similar trend of progressive increase in the weight of the organs

as the level of cocoa husk increased in the diet. The increase in the crude fibre content of the diet as the amount of cocoa husk increased must have stimulated the muscular wall of the gut in an attempt to cope with the digestion of the fibrous diets. Similar findings of increase in size of gastro-intestinal tract with increase in intake of fibrous diets have been documented (Brenes et al. 1993).

The results of serum metabolites of cockerels are presented in Table 4. Values obtained for total protein, albumin and globulin on all the diets were statistically different ($P<0.05$). A wide range of 7.93-13.54g/100ml was obtained for total protein. The reason for the inconsistency in the result of total protein in this study cannot be fully explained moreso that the diets were made to be isonitrogenous. However decrease in the levels of plasma protein is often associated with impaired protein synthesis or disease of the digestive systems or the liver. Adequate levels should therefore be maintained in animal body since these proteins usually bind to metal ions, lipids and hormones. Results of serum urea were not statistically different ($P>0.05$). A mean value of 11.45mg/100ml was obtained for serum urea at the age of 20 weeks compared with the reference value of 5.08mg/100ml obtained at the age of 16 weeks for old Brown Leghorn cockerels by Ross et. al.(1978) who indicated that higher mean uric acid level might reflect the occurrence of kidney damage. Doornenbal et. al. (1986) observed increase in urea concentrations with increase in age of birds. An imbalance of amino acids in diets could also elevate blood urea concentrations.

Results obtained for creatinine were statistically different ($P<0.05$). Lower values were recorded on cocoa husk diets compared with the control. The lowest value of 1.33mg/100ml was obtained on diet 5. This finding indicates poor protein utilization and complete muscular wastage. Creatinine concentration is a good predictor of lean tissue mass in the body (Doornenbal et. al. 1986).

Both weight gain and cost/kg. of feed decreased with increase in the level of cocoa husk in the diet (Table 5). The lowest value of N18.80/kg. of feed was obtained on diet 5 with 100% replacement level of wheat bran with cocoa husk. This is so because cocoa pod is usually obtained free of charge in most of the plantations while processing cost is very minimal. Relative cost (%) also decreased with increase in the level of cocoa husk in the diet. However, result obtained on gross margin was superior on diet 2 where highest gross margin value of N122.01 was recorded. This shows that the use of cocoa husk in poultry diet can assist in the maximization of profit. Ukachukwu and Anugwa (1995) reported that minimization of input or maximization of output in poultry business results in higher profit. However, inclusion of the cocoa husk beyond 50% replacement level decreased gross margin.

CONCLUSION

Results of this study showed that cocoa husk could replace up to 505% of wheat bran in finisher diet of cockerels to produce good quality carcass at reduced cost. With the rising prices of agro-industrial by-products such as wheat bran and brewers grain, better exploitation of available crop residues such as cocoa husk would amplify the feed resources for the poultry industry particularly in the tropical countries.

Table 1: Proximate Composition of Cocoa Husk

Components	%
Dry Matter	92.7
Crude protein	8.0
Crude Fibre	43.9
Ether extract	1.1
Ash	15.3
N.F.E.	31.8
Gross energy (kcal g-1)	5.1

Source: Abiola and Tewe (1991)

Table 2: Percentage composition of experimental diets

Ingredients (%)	Levels of replacement of wheat bran by cocoa husk				
	25%	50%	75%	100%	
Groundnut Cake	27.00	23.00	19.00	15.00	11.00
Wheat bran	4.06	8.06	12.06	16.06	20.06
Cocoa Husk	63.06	47.09	31.93	15.97	-
Fish Meal	15.97	31.93	47.89	63.86	
Bone Meal	1.50	1.50	1.50	1.50	1.50
Oyster Shell	2.00	2.00	2.00	2.00	2.00
Vit./Min. Premix*	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25
Total	0.25	0.25	0.25	0.25	0.25
Maize	100	100	100	100	100
Calculated Analysis					
Crude Protein (%)	16.36	16.32	16.27	16.27	16.21
Crude Fibre (%)	6.19	11.96	17.73	23.51	29.29
M. E. (kcal/kg)	22.70	22.70	22.70	22.60	22.60
Calorie/Protein Ratio	138.58	139.09	139.52	139.91	139.42

*Vit/Min. premix contained (per kg diet): Vit. A 25,000 iu, Vit. D3 27,500iu, Vit. E 25mg, Manganese 125mg, Magnesium 250mg, Iron 200mg, Zinc 112.5mg, Copper 15mg, Iodine 6.5mg, Cobalt 2mg

Table 3: Carcass yield of cockerels fed cocoa husk based diets

	Levels of replacement of wheat bran by cocoa husk					
	0%	25%	50%	75%	100%	SEM
Average live weight (LW) kg	2.01[a]	1.93[ab]	1.81[b]	1.30[c]	1.22[c]	0.06
Dressed weight (%LW)	94.01	94.35	92.52	91.63	94.29	1.29
Eviscerated weight (%LW)	67.70[ab]	70.52[a]	66.56[ab]	62.30[c]	64.87[abc]	1.48
Flesh/Bone Ratio	2.12	2.73	2.57	2.30	1.97	0.22
Liver (% LW)	1.93	1.92	1.44	2.01	2.09	0.19
Gizzard (%LW)	2.43[b]	2.36[b]	2.83[ab]	3.23[a]	3.24[a]	0.22
Length small intestine (%LW)	7.62[b]	7.47[b]	8.97[ab]	10.69[ab]	13.05[a]	1.10
Caeca (%LW)	1.07[b]	1.09[b]	1.16[b]	1.54[a]	1.66[a]	0.08
Length large intestine (%LW)	0.69[a]	0.54[a]	0.54[a]	0.77[ab]	0.80[a]	0.03

a, b = Means in any row followed by different superscripts are significantly different ($P<0.05$)

Table 4: Serum metabolites of cockerels fed cocoa husk based diets.

Parameters	Levels of replacement of wheat bran by cocoa husk					
	0%	25%	50%	75%	100%	SEM
Total Protein (g/100ml)	8.61[a]	7.93[a]	13.54[a]	10.84[a]	8.98[a]	0.71
Albumin (g/100ml)	4.62[ab]	4.83[a]	5.54[a]	4.47[ab]	5.66[a]	0.28
Globulin (g/100ml)	3.99[ab]	3.98[a]	7.91[a]	5.57[b]	3.25[b]	0.59
Serum Urea (mg/100ml)	11.75	11.46	11.46	11.17	11.48	0.16
Creatinine (mg/100ml)	3.48[a]	2.48[b]	1.41[c]	1.51[bc]	1.38[c]	0.24

a, b, c = Means in any row followed by different superscripts are significantly different ($P<0.05$)

Table 5: Economic analysis of cockerels fed cocoa husk based diets

Parameters	Levels of replacement of wheat bran by cocoa husk					
	0%	25%	50%	75%	100%	SEM
Weight gain (g/bird/day)	13.63	12.33	11.97	10.86	10.04	2.77
Feed conversion ratio	9.86	10.43	12.19	11.64	14.27	2.95
Cost/Kg. Feed (₦)	23.60	22.40	21.20	20.00	18.80	1.09
Relative Cost (%) 100	94.92	89.83	84.75	79.66	4.32	
Feed cost /kg weight gain (₦)	232.70	233.63	258.43	232.80	268.28	28.37
Gross margin (₦) from wt. gain	110.31[a] 122.01[a]	106.39[a]	51.91[b]	72.09[b]	4.86	

a,b,c,d - Means in any row followed by different superscripts are significantly different (P<0.05)
₦ = Naira (Nigeria's official currency)

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REFERENCES

Abiola, S. S. and Tewe, O. O. (1991). Chemical evaluation of cocoa by-products.

Trop. Agric. (Trinidad) 68(4): 371-375.Abiola, S. S. and Tewe, O. O. (1992). The effects of cocoa husk on the performance of cockerels. *Jour. Agric. Sci. and Tech. 2(2):* 131-134.

Adeyanju, S.A; Ogutuga, D.B.A; Ilori, J.O. and Adegbola, A. A.(1975). Cocoa husk in poultry diets. Malaysia Agric.Research 4: 131-136.

Aina, A.B.J. (1990). Replacing maize with cassava peels in finisher ration of cockerels. The effects on cut-up pieces of the eviscerated carcass. *Nig. Jour. Animal Prod. 17:* 17-22

Brenes, A., Smith, M.; Guenter W. and Marquardt R. R. (1993). Effect of enzyme supplementation on the performance and digestive tract size of broiler chickens fed wheat and barley-based diets. *Poult. Sci. 72: 1731-1739.*

Devendra, C. (1977). The utilization of cocoa-pod husk by sheep. Malaysia Agric. Jour.51: 179-186.

Doornenbal, N., Tong, A.K.W. and Sethar, A. D. (1986). Relationship among serum characteristics and performances and carcass in growing pigs. *Jour.Animal Sci. 62*: 1675-1681.

Gomez, A. K. and Gomez, A. A. (1985). Statistical procedures for agricultural research. Wiley New York.

Halpin, K. M. and Baker, D. H. (1986). Long-term effects of corn, soybean meal, wheat bran and fish meal on manganese utilization in the chick. Poult. Sci. 65: 1372-1374

Holsheimer, J. P. and Ruesink, E. W. (1993). Effect of performance, carcass composition, yield and financial return of dietary energy and lysine levels in starter and finisher diets fed to broilers. *Poult. Sci. 72: 806-815.*

Hyduke, R. R. (1975). The university of Iowa Medical Technology program. Chemical Biochemistry Laboratory Manual, U.S.A. Iowa, Iowa city.

Odunsi, A. A. and Longe, O. G. (1995a). Cocoa bean cake in poultry diets (1): Chemical composition and nutritive value of cocoa bean cake in pullet chick diets. *Jour. App. Anim. Res. 7*: 91-98.

Odunsi, A. A. and Longe, O. G. (1995b). Cocoa bean cake in poultry diets (2): Effects of feeding cocoa bean cake on growth and laying performance of pullets. *Jour App. Anim. Res. 7*: 137-144.

Oluyemi, J. A. and Roberts, F. A. (1979). Poultry production in warm wet climates. 1st Ed. The Macmillar Press Ltd. Lond. Pg. 162-166.

Ross, J. G.; Christie, G.; Halliday, W. G. and Morley, R.; Jones, R. (1978). Haematological and blood chemistry "Composition values" for clinical pathology in poultry. *Vet. Record. 102*: 29-31.

Sobamiwa, O. and Longe, O. G. (1994). The nutritive value of alkali-treated cocoa husk meal in broiler chick diets. *Anim. Feed. Sci.& Tech. 46:* 321-330.

Sosulki, F. M. and Cadden, A. M. (1982). Composition and physiological properties of several sources of dietary fibre. *Jour. Food Sci. 47*: 1472-1476.

Ukachukwu, S.N.and Anugwa, F.O.I.(1995). Bioeconomics of feeding raw or heat-treated soyabeans to broilers. Nig. Jour. Animal Prod. 22(2): 137-140.