Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 17 Issue 3 Version 1.0 Year 2017
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effects of Replacing Groundnut Meal with Cotton Seed Meal or Palm Kernel Meal on the Performance, Blood Metabolite and Cost on Return of Finishing Cockerels

By Okosun S.E. & Ehebha, E. T. E
Ambrose Alli University

Abstract- Three hundred day-old black Harco cockerel chicks were started on a standard fish meal diet containing 2.65 Kcal/g ME at 21% crude protein for the first four weeks. At the end of which one hundred and forty of the birds were allocated to another diet of 2.65 Kcal/g ME at same 21% protein but without fish meal. The remaining 160 birds were maintain alongside on a fish meal diet containing 2.65Kcal/g ME and 21% protein till they were eight weeks old. At the finisher phase the two set of birds were assigned to eight experimental rations in a 4x2 factorial design; differently maintained. The diets were a control which contain fish meal and groundnut meal (GNM) as the major protein source. The next had only GNM as the major protein source. In the next consecutive diets, one-third, two-third and all of the GNM protein contribution was replaced by corresponding protein value of cotton seed meal (CSM) and palm Kernel meal (PKM).

Keywords: *cockerels, groundnut meal, cottonseed meal, palm kernel meal and fish meal.*

GJSFR-D Classification: *FOR Code: 820301*

Strictly as per the compliance and regulations of :

Effects of Replacing Groundnut Meal with Cotton Seed Meal or Palm Kernel Meal on the Performance, Blood Metabolite and Cost on Return of Finishing Cockerels.

Okosun S.E. [α] & Ehebha, E. T. E [σ]

Abstract- Three hundred day-old black Harco cockerel chicks were started on a standard fish meal diet containing 2.65 Kcal/g ME at 21% crude protein for the first four weeks. At the end of which one hundred and forty of the birds were allocated to another diet of 2.65 Kcal/g ME at same 21% protein but without fish meal. The remaining 160 birds were maintain alongside on a fish meal diet containing 2.65Kcal/g ME and 21% protein till they were eight weeks old. At the finisher phase the two set of birds were assigned to eight experimental rations in a 4x2 factorial design; differently maintained. The diets were a control which contain fish meal and groundnut meal (GNM) as the major protein source. The next had only GNM as the major protein source. In the next consecutive diets, one-third, two-third and all of the GNM protein contribution was replaced by corresponding protein value of cotton seed meal (CSM) and palm Kernel meal (PKM). The feed consumption figures of cockerels fed CSM or PKM were similar with no significant difference ($P>0.05$) recorded among dietary treatments; although birds previously on fish meal formulated diet tend to consume more. A 66.6% replacement of GNM with either CSM or PKM gave better overall performance ($P<0.05$) in terms of weight gain and efficiency of feed conversion. There was no detectable difference ($P>0.05$) in serum total protein and uric acid between birds fed varying levels of CSM or PKM. Serum cholesterol decreased ($P<0.05$) with increasing levels of CSM; and for PKM up to 66.6% replacement level ($P>0.05$). A 66.6% partial replacement of GNM with either CSM or PKM gave highest income to feed cost ($P<0.05$). For cockerel finisher from an all-plant protein formulation, 66.6% either of CSM or PKM replacement of GNM will be ideal.

Keywords: cockerels, groundnut meal, cottonseed meal, palm kernel meal and fish meal.

I. Introduction

The feed crisis in terms of cost, quality consistency and availability besetting livestock production in Nigeria strongly point to finding alternative sources of raw material for feed formulation. Cockerel chicks because of its longer period of production to meet market weight tend to be most unappealing to local medium scale farmers particularly when conventional commercial feeds for broilers and pullets are used. Of all the ingredients use for feed compounding protein sources in terms of cost is second to none, and is either soya bean meal (mostly use) or groundnut meal (next alternative). These feedstuffs of recent has become prohibitive in term of cost.

The need to encourage cockerel production point not only to defining their nutritional norms (Okosun 1987) but also making efforts to reducing their cost of production. In an earlier study of starting cockerel chick Okosun and Oyedeji (2016) recommended a 20% and 10% for cotton seed meal (CSM) and palm kernel meal (PKM) respectively for raising cockerels till when they are 8 weeks old without fish meal incorporation in their diet. This present study is designed to look at possible alternatives to the less expensive groundnut meal (plant protein) in finishing cockerels. Cotton seed meal (CMS) has been tolerated by both broilers (NAPRI, 1984) and cockerels chicks (Okosun and Oyedejie, 2016) but unfortunately contains gossypol, a naturally occurring polyphenolic factor which is injurious to non-ruminants (Albrecht *et al,* 1972; Clawson *et al,* 1975). This has been the major criticism against its incorporation in diets for non-ruminants. Palm kernel meal on the other hand is limited in its use as livestock feedstuff because of its grittiness, dryness in texture and unpalatability (Oyenuga 1968). These two aforementioned protein sources are cheap and readily available. This study, designed to investigate their effects in replacing groundnut meal on performance and economics of finishing cockerels is aim primarily to encouraged cockerel production. Some blood protein parameters were also analysed.

II. Materials and Methods

a) Management of birds

This research work was conducted at the poultry unit of the Teaching and Research farm of the University of Ibadan, south- west Nigeria. Three hundred day-old black Harco cockerel chicks were started on a standard fish-meal diet containing 2.65 Kcal/g ME at 21% crude protein level for the first four weeks. At the end of which one hundred and forty of the birds were allocated to another diet of 2.65kcal/g ME at same 21%

Author α σ: Department of Animal Science, Faculty of Agriculture, Ambrose Alli University, Ekpoma. e-mail: theoehebha@yahoo.com

protein but without fish meal (table 1). The remaining 160 birds were maintained alongside on a fishmeal diet containing 2.65Kcal/g ME and 21% protein till they were eight weeks old. At the finisher phase, the 160 birds were continued on finisher rations indicated in table 2 while the 140 birds on diets without fish meal were distributed to diets 2 to 8 differently maintained alongside others. All the treatments were in triplicate of 6 birds each. The chicks were divided in such a manner that the average initial weight of each group was identical. The study lasted till the birds were thirteen weeks old.

Anti-stress mineral-vitamin were given in water for the first three days and a few days after vaccination Routine vaccination and necessary medication were administered. Feed and water were provided *ad libitum*.

Table 1: Composition (%) of rations used at the starter phase (0-8weeks) of cockerels fed varying diets with and without fish meal

Ingredients	0-4 Weeks	5-8 Weeks
Maize	43.40	43.15
Groundnut meal	20.00	28.00
Fish meal	5.00	-
Wheat offals	27.35	24.60
Bone meal	2.00	2.00
Oyster shell	1.00	1.00
Premix*	1.00	1.00
Salt	0.25	0.25
Calculated		
Metabolisable energy	2.65	2.65
(kcal/g)	21.24	21.10
Crude protein (%)	4.24	4.35
Crude fibre (%)		
Determined (DM Basis)	21.40	20.62
Crude protein (%)	5.21	5.10
Crude fibre (%)	4.53	5.10
Ether extract (%)		

Starter Chicken: A vitamin trace mineral mix manufactured by Pfizer Feed Company, Lagos, for starting chickens to supply/Kg feed the following: Vit. A (I.U.) 10,000; Vit, D_3 (I.U.), 2,000; Vit, E (I.U.) 2.5; Vit, K 2.0mg; Riboflavin (mg) 4.2 Pantothenic acid (mg) 5.0; nicotinic acid (mg) 20.0; choline (mg) 300.0; folic acid (mg) 0.5; methionine (mg) 0.225; Mn 1(mg) 56.0;1 (mg) 1.0, Fe (mg) 20.0; Cu (mg) 10.0; (mg) 10.0; Zn (mg) 50.0; C. (mg) (12.5).

b) *Experimental rations*

Eight experimental rations were formulated. The dietary treatments were made up of the control, diet 1, which contain fish meal and groundnut meal as major protein sources. Diet,2, had only groundnut meal as the major protein source (table1). In the next consecutive diets, one-third, two-third and all of the groundnut meal protein contribution (C.P. 45%) was replaced by corresponding protein value of CMS (C.P. 37%) and PKM (C.P. 27%). The percentage ingredients composition of the diets are indicated in table 2 for the finisher phase.

c) *Chemical analysis*

The proximate composition of the protein sources and the diets were determined by using the AOAC (2000) methods. At the 13^{th} week blood of two birds from each replicated treatments were collected and the serum separated were used for some metabolites determination. Total serum protein was determined by the biuret method as described by Weichelbaum (1946). Serum creatinine and uric acid were obtained by the method of Scott (1965) and Caraway (1955) respectively; while cholesterol levels were determined according to method of Roschlauet *al* (1974). Serum albumin was assessed by the method of Doumas and Briggs (1972) and globulin by the method of Rodkey (1965).

d) *Cost analysis*

Current price of feed ingredients at Ibadan and prevailing prices of chicken at the University meat shop were used to estimate cost and revenue indices.

e) *Statistical analysis*

A 4 x 2 factorial analysis with factor A consisting of four diets (plant protein; 33.3%, 66.6% and 100%) and factor B at with and without fish meal was used in this finisher phase (8-13 weeks). A Duncan multiple range test (Steel and Torrie, 1980) at 5 percent level of probability was used to assess significant differences.

Table 2a: Composition (%) of rations used at the finisher phase (9-13weeks) of cockerels fed varying levels of CMS/PKM replacement of GNM

Ingredients	Rations							
	1	2	3	4	5	6	7	8
Maize	27.08	27.08	26.73	26.22	26.34	24.92	25.86	22.71
Groundnut meal	3.31	4.11	3.04	3.31	1.62	2.09	-	-
Cotton seed meal	-	-	1.52	-	3.23	-	5.34	-
Palm kernel meal	-	-	-	1.66	-	4.18	-	8.48
Fish meal	1.50	-	-	-	-	-	-	-
Wheat offals	21.33	18.00	18.00	18.00	18.00	18.00	18.00	18.00
Dried brewers grains	42.53	46.56	46.56	46.56	46.56	46.56	46.56	46.56
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Premix*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
CALCULATED								
Metabolisable								
Energy (kcal/g)	2.25	2.29	2.28	2.28	2.27	2.26	2.26	2.22
Crude protein (%)	16.13	15.99	16.04	16.00	15.99	16.00	16.00	16.00
Crude fibre (%)	11.76	11.59	11.71	11.73	11.84	11.95	12.00	12.31
DETERMINED (DM Pasis)								
Crude protein (%)	18.27	18.42	18.15	17.65	18.36	17.66	17.49	15.97
Crude fibre (%)	12.70	12.49	13.89	15.29	13.53	15.00	13.74	16.12
Ether extract (%)	3.53	3.56	4.10	3.49	4.15	3.00	3.49	4.45

Growing Chicken: Vit A (I.U.) 7500; Vit. D_3 (I.U.) 1.0; Vit K (mg) 2.0; Riboflavin (mg) 4.0; pavtothenic acid 9.0; Nicacin (mg) 20.0; choline chloride (mg) 1500.0; Vit B_{12} (mg) 110.0; C. (mg) 0; Cu (mg) 2.0;1 (mg) 1.2; Zn (mg); 50; Mn (mg) 80.0; Fe (mg) 25.0

Table 2b: Calculated amino acid composition as percentages of experimental finisher ration

Amino acids	Rations							
	1	2	3	4	5	6	7	8
Arginine	1.08	1.08	2.15	1.30	1.11	1.18	1.13	1.28
Histidine	0.38	0.38	0.39	0.38	0.39	0.38	0.40	0.37
Isoleucine	1.03	1.02	1.40	1.03	1.03	1.03	1.03	1.05
Leucine	1.70	1.70	1.70	1.79	1.70	1.71	1.70	1.73
Lysine	0.69	0.64	0.65	0.65	0.66	0.58	0.67	0.68
Methionine	0.29	0.28	0.29	0.29	0.29	0.30	0.30	0.31
Phenyalanine	0.95	0.95	0.96	0.95	0.97	0.95	0.98	0.96
Threonine	0.69	0.68	0.69	0.69	0.70	0.70	0.71	0.71
Tryptophan	0.27	0.27	0.27	0.27	0.27	0.26	0.27	0.26
Valine	1.05	1.05	1.06	1.06	1.07	1.08	1.09	1.11

Table 3: Effect of replacing GNM with CSM on the performance of cockerels (9-13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Daily weight gain (g)	13.58^{ab}	12.99^{b}	14.44^{a}	13.65^{ab}	0.39	14.04	13.29	0.16
Feed intake (g/bird)	119.71	119.79	125.14	126.09	13.49	122.18	109.74	7.98
Feed conversion ratio	8.85	9.31	8.69	9.27	0.33	8.72	9.33	0.88
Protein intake (g)	22.05^{ab}	21.74^{b}	22.98^{a}	22.05^{ab}	0.32	22.11	22.29	0.28
Protein efficiency ratio (per)	1.63	1.69	1.59	1.62	0.06	1.58^{2}	1.69^{1}	0.88
Mortality (%)	0.00	0.00	2.50	5.00	0.00	0.50	0.00	0.00
Feed cost (₦)	2.07	2.03	2.04	1.97	0.03	2.02	2.04	0.03
Total weight gained (kg)	0.48	0.46	0.51	0.48	0.01	0.50	0.48	0.01
Feed cost/kg live weight (₦)	4.28	4.39	3.96	4.08	0.15	4.05^{2}	4.31^{1}	0.01

a,b,/2,3 Means without common superscripts in horizontal rows are significantly different (P<0.05)

Table 4: Effect of replacing GNM with PKM on the performance of cockerels (9-13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Daily weight gain (g)	13.58^{ab}	13.64^{ab}	14.28^{a}	12.23^{b}	0.49	13.74	13.12	0.35
Feed intake (g/bird)	119.71	120.79	119.15	119.34	0.86	118.41	120.58	0.89
Feed conversion ratio	8.85^{ab}	8.93^{ab}	8.30^{b}	9.85^{a}	0.38	8.74	9.22	0.35
Protein intake (g)	22.05^{a}	21.32^{b}	20.86^{b}	18.98^{c}	0.16	20.64	20.96	0.12
Protein efficiency ratio (per)	1.63	1.57	1.47	1.57	0.06	1.52	1.60	0.06
Mortality (%)	0.00	0.00	3.00	0.00	0.00	1.50	0.00	0.00
Feed cost (₦)	2.07^{a}	2.03^{a}	1.89^{b}	1.75^{c}	0.01	1.92	1.95	0.01
Total weight gained (kg)	0.48^{ab}	0.48^{ab}	0.51^{a}	0.44^{b}	0.02	0.49	0.47	0.01
Feed cost/kg live weight (₦)	4.28	4.21	3.78	4.06	0.18	3.98	4.18	0.13

a,b,/2,3 Means without common superscripts in horizontal rows are significantly different (P<0.05)

Table 5: Overall performance characteristics of cockerels fed varying GNM replacement levels with CSM (4-13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Daily weight gain (g)	12.08	12.05	12.65	12.22	0.19	12.45^{1}	12.05^{2}	0.02
Feed intake (g/bird)	72.58^{c}	74.44^{bc}	75.35^{b}	78.84^{a}	0.72	75.11	75.49	0.59
Feed conversion ratio	6.02^{ab}	6.19^{ab}	5.96^{b}	6.46^{a}	0.14	6.04	6.27	0.06
Final body weight (kg)	1.14	1.13	1.19	1.15	0.02	1.17^{1}	1.13^{2}	0.00
Mortality (%)	0.00	0.00	2.50	5.00	0.00	0.50	0.00	0.00
Feed cost (₦)	4.54^{ab}	4.59^{a}	4.47^{ab}	4.38^{b}	0.05	4.64	4.35	0.06
Feed cost/kg liveweight (₦)	4.01	4.05	3.76	3.82	0.10	3.98	3.85	0.07
Income/feed cost (₦)	32.03^{b}	31.28^{b}	35.87^{a}	36.32^{a}	0.04	31.26^{2}	34.49^{1}	0.05

a,b,/2,3 Means without common superscripts in horizontal rows are significantly different (P<0.05)

Table 6: Overall performance characteristics of cockerels fed varying GNM replacement levels with PKM (4-13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Daily weight gain (g)	12.08^{a}	12.30^{a}	12.21^{a}	10.87^{b}	0.19	12.37	11.36	0.20
Feed intake (g/bird)	72.58	71.64	70.90	72.08	1.15	70.95	72.66	0.96
Feed conversion ratio	6.02^{b}	5.86^{b}	5.82^{b}	6.69^{a}	0.18	5.76	6.43	0.19
Final body weight (kg)	1.14^{a}	1.15^{a}	1.15^{a}	1.02^{b}	0.02	1.16	1.07	0.02
Mortality (%)	0.00	0.00	0.00	3.00	0.00	1.50	0.00	0.00
Feed cost (₦)	4.54^{a}	4.45^{a}	4.20^{b}	3.90^{c}	0.04	4.54^{1}	4.01^{2}	0.00
Feed cost/kg liveweight (₦)	4.01^{a}	3.87^{ab}	3.65^{b}	3.81^{ab}	0.10	3.92	3.75	0.67
Income/feed cost (₦)	32.03^{b}	29.94^{c}	34.97^{a}	36.87^{a}	1.43	33.52	33.93	0.52

a,b,/2,3 Means without common superscripts in horizontal rows are significantly different (P<0.05)

Table 7: Serum components and cholesterol levels of cockerels fed replacement levels of GNM with CSM (at 13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Creatinine (mg/100ml)	0.73^{ab}	0.67^{ab}	0.55^{b}	0.83^{a}	0.05	0.82	0.57	0.02
Uric acid (mg/100ml)	1.39	1.65	1.21	1.49	0.20	1.49	1.38	0.01
Total protein (g/100ml)	5.93	6.28	5.73	5.59	0.39	5.94	5.83	0.02
Albumin (g/100ml)	2.79	4.10	3.99	3.73	0.36	3.86	3.45	0.09
Globulin (g/100m)	3.10^{a}	2.18^{b}	1.73^{b}	1.86^{b}	0.15	2.07	2.37	0.12
A/G*	0.89	1.91	2.47	2.23	0.27	2.11	1.64	0.25
Cholesterol (mg/100ml)	318.63^{a}	305.13^{a}	304.38^{a}	272.53^{b}	6.63	302.93	297.39	0.79

** Albumin to globulin ratio*

a, b means without common superscripts in horizontal rows are significantly different (P<0.05)

Table 8: Serum components and cholesterol levels of cockerels fed replacement levels of GNM with PKM (at 13 weeks)

Parameters	Replacement Levels					Fish Meal Effect		
	0%	33.3%	66.6%	100%	S.EX	+FM	-FM	S.EX
Creatinine (mg/100ml)	0.73[c]	0.85[c]	1.96[b]	3.24[a]	0.25	2.27[1]	1.12[2]	0.06
Uric acid (mg/100ml)	1.39	1.11	1.26	1.60	0.24	1.40	1.28	0.15
Total protein (g/100ml)	5.93	5.85	6.00	5.57	0.41	5.72	5.95	0.06
Albumin (g/100ml)	2.79[b]	4.22[a]	3.78[ab]	3.43[ab]	0.28	3.57	3.54	0.11
Globulin (g/100m)	3.10[a]	1.62[b]	2.22[b]	2.16[b]	0.21	2.14	2.41	0.05
A/G*	0.89[b]	2.79[a]	1.71[b]	1.67[b]	0.29	1.93	1.60	0.19
Cholesterol (mg/100ml)	318.63	300.65	282.75	301.46	10.46	299.94	301.81	5.39

** Albumin to globulin ratio*

a, b means without common superscripts in horizontal rows are significantly different (P<0.05)

III. Results

The crude protein, crude fibre and ether extract of the CSM used were 37.08%, 13.75% and 12.05% while those for PKM were 27.34%, 8.94% and 7.32% respectively. Calculated and determined nutrient composition as well as the calculated amino acid profile of the various diets are indicated in table 2a and 2b respectively.

Results of the finisher phase with CSM or PKM replacement of GNM are indicated in tables 3 and 4 respectively. The feed consumption figures of cockerels fed CSM or PKM were similar with no significant difference (P>0.05) recorded among dietary treatments. However, birds previously (5-8 weeks) on fish meal formulated diet tend to consume more feed than those fed rations without fish meal only with the CSM supplemented GNM. Birds fed complete replacement of GNM with CSM, recorded no significant difference (P>0.05) in weight gain from those fed 0% and 33.3% replacement although the 66.6% replacement level recorded highest daily weight gain of 14.44g/bird/day. With the PKM (tables 4), cockerels fed the 66.6% level gave highest weight gain though statistically similar (P>0.05) to 0% and 33.3% replacement dietary treatments. Cockerels previously fed fish meal diet at the starter phase recorded higher daily weight gain than those denied fish meal while birds on CSM formulation tended to stimulate better weight gain of birds than the PKM formulated dietary treatments. Feed conversion ratio of birds fed CSM rations resulted in no significant difference (P>0.05) between treatments unlike what obtains with PKM. However, a 66.6% replacement of GNM with either CSM or PKM gave better overall (P<0.05) feed conversion ratio similar to birds fed GNM-diets without CSM or PKM supplementation (tables 5 and 6). Birds fed fishmeal diet during the starter phase gave better efficiency of feed utilization.

Mortality record from CSM treatments occurred at higher levels of replacement (66.6% and 100% levels). Although mortality with PKM dietary treatment similarly occurred at high replacement (66.6%), it was far lower in the latter than with the former. Overall performance data shown in tables 5 indicated the highest weight gain and better utilization of feeds from birds fed partials replacement of GNM with CSM at 66.6%. Similar result for PKM (table 6) show a 33.3 level for the former and a 66.6% level for the latter parameter. Generally, birds fed fish meal diets gave better performance in terms of daily weight gain and efficiency of feed utilization when compared to those that were denied fish meal in their starter (5-8 weeks) ration. However, mortality increased on these.

There was no detectable difference (P>0.05) in serum total protein and uric acid between birds fed the varying levels of CSM or PKM. Serum cholesterol decreased (P<0.05) with increasing levels of CSM (table 7). Although no decrease in cholesterol level was observed from the 66.6% to 100% replacement level of PKM for GNM (table 8), a progressive decrease was observed from the 0% to 66.6% replacement level. An increase in the albumin fraction with increasing level of total protein was evidence from both CSM and PKM dietary treatments. The globulin levels among varying levels of CSM or PKM (P<0.05) were relatively stable; while the albumin to globulin ratio (A/G ratio) decrease as serum protein increased.

At this finisher phase, a 100% and 66.6% replacement of GNM by either CSM and PKM gave least feed cost and feed cost per kg live weight respectively. In general, a 66.6% partial and above replacement of GNM with either CSM or PKM gave highest income to feed (income/feed) cost which were significantly higher (P<0.05) than what was realized from lower level (tables 5 and 6)

IV. Discussion

The crude protein content of CSM used in this study was lower than value obtained by Phelps (1966) but higher in ether extract than value reported by Nwokolo *et al* (1976). The fibre content of PKM was relatively lower than value obtained by Nwokolo *et al* (1984). The variation in nutrient composition of these ingredients from values obtained by earlier workers might be due to possible varietal differences and methods of processing. The crude protein, crude fibre and ether extract content of PKM is relatively lower than that for CSM.

The 66.6% level of GNM replacement with either CSM or PKM gave the best results. This goes to complement results by Nzekwe and Olomu (1979), NAPRIL (1984), that at least up to 50% of GNM in finisher rations of broilers could be replaced with CSM without adverse effects on weight gain and feed efficiency. The lower value of daily weight gain from birds on PKM when compared to their counterpart on CSM might be due to unavailability of amino acids for growing chicks (Nwokolo, Bragg and Witts, 1976). The overall performance data followed the same trend for CSM as in the finishers phase. However, for PKM, a 33.3% replacement level gave highest weight gain and efficiency of utilization. This compliment the preliminary reports of Yeong and Robert (1977) that PKM could be used up to 30%in diet for chicken. Oyenuga (1968) reported that PKM causes heavy salivation during mastication and this can affect their utilization capacity by poultry particularly at a much higher level of inclusion in diets.

Mortality record at the finisher phases was as a result of snake bites that occurred in the unit at week eleven. The attack was on cockerels fed fish meal diets at the starter phase. This study suggest the possibility of replacing 50% of an all-plant GNM protein with CSM and a level of not more than 33.3% PKM replacement for cockerel production at the finisher phase. Generally, the weight gain, feed consumption of birds, feed conversion ratio and final live body weight of birds given rations with fish meal were higher than those of birds fed rations without fish meal. This obviously is explained by the better amino acid profile of rations with fish meal with a concomitant better carry-over effect of such starter diets on their overall biological productivity.

The data presented in this study demonstrated from values of creatinine and uric acid level (tables 7 and 8) that the 66.6% replacement of GNM with CSM and 33.3% for PKM is optimal for satisfactory protein utilization in finishing cockerel development. The low level values recorded on both parameters signified no observable muscular wastage brought about by inadequacy of protein. It is of particular interest to note that serum proteins and cholesterol levels of the different dietary treatments were relatively stable; an indication of appropriate balancing of protein for protein in the substituted and substituting ingredient in the various treatments. As pointed out by Allison (1955), total protein or serum albumin is an indication of the protein reserves in an animal. The increase in serum albumin and therefore total serum protein with reducing levels of CSM or PKM inclusion levels reflected the ability of the chicks on low CSM or PKM to store "reserve" proteins, when the animal has reached its maximum capacity for depositing tissue or less "labile" protein. The data of Seeler and Ott (1945) demonstrate the importance of the protein reserves of the chick in resisting stress. The relative stability of serum globulins as compared to serum albumin with either CSM or PKM dietary treatments is in accord with previous observations in the chick (Leveille*et al,* 1956). The resulting albumin globulin (A/G) ratios, however decreased after a threshold with either the CSM or PKM supplementation. Alteration in the A/G ratio have been reported as a consequence of a vitamin E deficiency in the chick (Goldstein and Scott, 1956); Bieri and Pollard, 1959) and various other pathological conditions in the chicken (Shelton and Olson, 1960). Since this study precluded these possible factors for A/G ratio variations, it will be impossible to account for such slight variation. The depression in cholesterol level with increasing levels of CSM contradicts the reports by Johnson *et al* (1958); Leveille and Fisher (1958); Leveille*et al*, (1960) that an inverse relationship exist between serum cholesterol and dietary protein levels. The diets used in this study was relatively iso-nitrogenous.

It has been observed that feed cost/kg of liveweight gain is lower with partial replacement of GNM (66.6%) with either CSM or PKM supplementation in cockerel diets (tables 4,5 and 6). Complete replacement improved income over feed cost significantly ($P<0.05$) because of the lower cost per unit of CSM or PKM in relation to GNM. Feed cost of birds fed diets fortified with fish meal were higher and gave lower income over feed cost when compared to those that were not fed fish meal diet.

Although maximum growth rate is an important objective for a feed compounder selling cockerel feeds, it may not be the only important criterion for cockerel production. At present fish meal is expensive and not easily available and were available there is problem of adulteration. Reasonable growth rate at cheaper production costs could be obtained by its complete elimination from the 5th week of age. The question remains as to what extent depression in performance could be acceptable in relation to the cost of cockerel feeds and elimination of fish meal. More information from research is needed in this respect.

V. Conclusion

In conclusion from data generated from this study in finishing cockerels, it is obvious that:

- Fish meal fortification although more expensive at the starter phase (0-8weeks) gave better efficiency of feed utilization.
- CSM gave better performance results than PKM substitution for GNM in finishing cockerels.
- For an all-plant protein formulation it is recommended that 60% of either CSM or PKM substitution of GNM will be ideal.

References Références Referencias

1. Alberecht J.E. Clawson, A.J. and Smith F.H. (1972). Rate of depletion and route of diminution of intravenously injected gossypol in swine . *J. Anim. Sci* 25: 941-956.
2. Allision, J.B. (1955) Biological evaluation of proteins *Physiol. Rev*. 365:664-669.
3. AOAC (2000)Official ,method of analytical chemist 10thEdn, Arlington, V.A. As cited by Njike, M.C. (1978).
4. Bieri, J. G. and Polland, C. J. (1959) Serum protein changes in vitamin E-deficient chicks. *J.nutr*. 69:301-309.
5. Caraway, T. (1955) Determination of uric acid in serum by a carbonate method. *Am. J. Clin. Pathol*. 25:840-845
6. Clawson, A.J.; Maner, J.H; Gomex, G; Flores Z and Buitraga J. (1975). Unextracted cotton seed in diets for monogastrict animals. The effect of boiling and oven Vs sun drying following treatment with fe 504 soultion. *J. Amin. Sci.* 40: 648 – 654.
7. Doumas, B.T. and Briggs, H.G. (1972) Serum albumin by Bromcresol Green binding. *Stand. Methods Clin. Chem*. 7:175-179.
8. Goldstein, J and Scott, M.L. (1956) Anelecetrophoretic study of exudative diathesis in chicks. *Ibid.* 60:34-51.
9. Johnson. D. Leveille G.A and Fisher, H. (1958) Influence of amino acid deficiencies and protein level on the plasma cholesterol of the chick. *J. Nutr.* 66:367-370.
10. Leveille G.A. and Fisher, H. (1958) Plasma cholesterol in growing chicken as influence by dietery protein and fat. *Proc. Soc. Exp. Boil. Med*. 98:630-634.
11. Leveille, G.A, Feigenbaum, A.S. and Fisher H. (1960) The effect of dietary protein, fat and cholesterol on plasma cholesterol and serum protein components of the growing chicks. *Arch. Biochem. Biophys*. 86:67-69.
12. National Animal Production Research Institute (NAPRI), (1984) Highlight of research achievements on animal feeds. *Fed.Min.Edu.Sci.Tech*., Lagos.
13. Nwokolo, E., Kpapunam, M. and Ogunjimi, J. (1984) Effect of varying levels of dietary fibre on mineral availability in poultry diets. Paper presented at the *Nigerian Society for Animal production conference*, University of Nigeria, Nsukka, March 25-29;1984
14. Nwokolo, E.N., Bragg, D.B. and Witts, W.D. (1976) A method of estimating the mineral availability in feedstuffs. *Poult. Sci*. 55:2217-2221.
15. Nzekwe, K.M. and Olomu, J.M. (1979) Cotton seed meal in Broiler finisher diet. Paper presented of the 6th annual *Conf. of Nig. Soc.for Animal Production*, Benin-city, Sept. 1979.
16. Okosun, S.E (1987) Studies on calorie and protein requirement of cockerels. Ph.D. Thesis, University of Ibadan, 1987.
17. Okosun, S.E and Oyedeji J.O. (2016). Effect of replacement groundnut meal mixed with fish/cotton seed meal or fish meal/palm kernel meal on performance of cockerel chicks. *Journal of Agriculture and forestry* 5(1); 150-158.
18. Oyenuga, V.A. (1968) In: Nigeria's Feed and Feeding stuffs. Their chemistry and nutritive values. Ibadan University Press: 3rd. Ed.
19. Phelps, R.A. (1966) Poultry production in Nigeria. Proc. of 1st. *Nat. Seminar on Poult. Prod*., Zaria, 1979, pp 284-325.
20. Rodkey, F.L. (1965) Globulin by direct determination. *Clin. Chem*. 11:486-489.
21. Roschlau, P; Bernt, E. and Gruber, W. (1974) EnzymatischeBestimmung. desGesamtcholesterins in serum *J. Clin. Biochem*. 12:403-407
22. Scott, C. (1965) Plasma creatinine determination. A new and specific Jaffe reaction method. *Scand. J. lab. Invest*. 17:381-385.
23. Seeler A.O and OTT, W.H (1945) Studies on nutrition and avian malaria in protein deficiency *J. Infect Dis*. 77:181-186
24. Shelton, D.C. and Olson, N.O (1960) Serum protein of chicks with infectious and mycoplasma synovitis *Poult. Sci*. 39: 112-114.
25. Steel, R.D.G and Torrie, J.H (1980) Principles and procedures of statistics. A biometrical approach International Students edn. McGraw Hill, London.
26. Weighbaum, T.E. (1946) Total protein determination. *Amin. J. Path*. 16:40-43.
27. Yeong, L.G. and Robert, E.J.(1977) The energy value of fats and fatty acids for chicks. II metabolisable energy *Poult. Sci*. 40:1228-1231.

This page is intentionally left blank