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Effect of feeding graded levels of boiled sorrel seed meal on growth and blood components of cockerels

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Abstract

A study was conducted to determine the effect of feeding graded levels of boiled sorrel seed meal (BSSM) on the performance of cockerels. Two hundred (200) one week old cockerels were randomly assigned to five dietary treatments with four replicates each in a completely randomized design. The treatments had 0% (control), 5%, 10%, 15% and 20% inclusion levels of BSSM in the experimental diets. Growth performance, cost analysis, heamtological and serum biochemical indices formed the response criteria. Feed and water were provided *ad libitum* throughout the 14 weeks experimental period. Feed consumption, body weight, body weight gain, FCR were significantly ($P<0.05$) better in the group with 20% inclusion level. Feed cost and cost/kg gain were significantly lowered with inclusion of BSSM in the in the diet. Red blood cells (RBC), white blood cells (WBC), heamoglobin (Hb) and packed cell volume (PCV) were significantly ($P<0.05$) higher at 20% inclusion level. Feeding BSSM to cockerels had no adverse effects on serum biochemical indices. It was concluded that up to 20% BSSM can be included in to cockerel diets without compromising performance.

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Introduction

The search for alternative feedstuff in the poultry industry has been a major concern to many nutritionists especially in developing countries like Nigeria. This search was warranted by the escalating cost and competition by man for conventional poultry feedstuff.

Sorrel (*Hibiscus sabdariffa*) is a common plant in Nigeria where it is grown by many farmers. Sorrel plants yield about 0.08Kg seeds/plant. When it is intercropped with sorghum or groundnut, it will yield about 1600Kg seed/ha and when planted alone it can produce up to 19000Kg seeds/ha (Duke, 1999).

The whole sorrel seed flour contains high amount of protein (38%), metabolizable energy (3500Kcal/Kg), crude oil (20.13%), carbohydrate (43.31%) and ash (4.83%) (Al-Wandawi et al., 1998; Kwari et al., 2010). Sorrel seed has a comparable amino acid profile with soya bean with higher Methionine and lysine (Kwari et al., 2010). This indicates that sorrel seed meal has a good potential to serve as an alternative protein source in poultry diets. But despite these potentials, there is little information on its use in feeding cockerels. This study was therefore designed to assess the effect of feeding graded levels of boiled sorrel seed meal on growth performance and blood characteristics of cockerels.

Materials and Methods

Experimental stock and management

Two hundred (200) day old Isa brown X Goldline cockerels were obtained from a reputable commercial hatchery. They were brooded together for seven days. At one week of age, the chicks were randomly assigned to five dietary treatments of 40 birds with four replicates of 10 cockerels each in a completely randomized design. Each group was given one of the experimental diet and clean drinking water *ad libitum* throughout the 14 weeks experimental period.

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Experimental diets

The sorrel seeds were sourced from local markets. It was cleaned and then boiled in tap water at 100^{o}C for 30 minutes. It was sun dried for 72 hours, milled and incorporated into the experimental diets. Five experimental diets (chick and grower mashes) were formulated (Tables 1 & 2). The sorrel seed meal was incorporated at 0% (control), 5%, 10%, 15% and 20% respectively.

Data collection

Performance

Daily feed intake was measured by subtracting the weight of feed leftover from that fed. The cockerels were weighed weekly to obtain weekly live weight while body weight gain was obtained by subtracting the weight of the current week from that of the previous week. Feed conversion ratio was calculated as the ratio of feed intake to weight gain.

Blood collection and analyses

During the last week (week 14) of the experiment, blood samples were collected from four birds in each group (i.e. 1 bird per replicate) for determination of heamatological and biochemical indices. The birds were fasted overnight and blood sample was collected early the next morning via the wing-vein by means of a sterile disposable (21-guage) syringe and needle, and then placed into two sets of sample bottles. One set contained diapotassium salts of ethylene diamine tetra-acetic acid (EDTA) and the sample were used for heamatological study; while the other set were plain bottles and the sample were used for serological studies. Packed cell volume (PCV), red blood cells (RBC), white blood cells (WBC) were analyzed according to the methods outlined by Bush (1975). Mean corpuscular volume (MCV), mean corpuscular heamoglobin (MCH) and mean corpuscular heamoglobin concentration (MCHC) were calculated by the formula of Schalm et al. (1985). The serum biochemical indices measured were the level of total protein, albumin, globulin, urea, sodium, potassium, calcium, bicarbonate, serum glutamic oxalacetic transaminese (SGOT) and Glutamic pyruvic transaminase (SGPT), were analyzed according to the methods outlined by Bush (1975) and WHO (1980). Proximate composition of the experimental diets was carried out according to the methods of AOAC (1980).

Statistical analyses

All data obtained were subjected to analysis of variance (Steel and Torrie, 1980), and significant differences between treatments means were compared using the least significant difference (LSD).

Results and Discussion

The crude protein (CP) for all the diets was within the values (18-20% for chicks and 14–15% for growers mash) reported by Olomu (1995). The values for Ether extract (EE) and ash were within the recommended values by NIS (1989). The crude fibre (CF) levels of 4.50–7.50% and 5.00–7.00 for the chick mash and were similar to the 5% recommended by NIS (1989).

The productive performance of cockerels fed on graded levels of sorrel seed meal are presented in Table 3. The weight of birds at chicks phase showed significant ($P<0.05$) difference. Birds fed on 20% inclusion level of the sorrel seed meal were significantly ($P<0.05$) heavier, followed by birds fed on 5%, 15% and 10%. The least were birds fed on (0% control) diet. The final weights of the birds also indicated significant ($P<0.05$) difference among the dietary levels of sorrel seed meal. The daily weight gain (g/bird) for the chick phase, grower phase and overall (combined); showed significant ($P<0.05$) differences among all the dietary levels of sorrel seed meal in the three phases of the study. The daily weight gain (g/bird) followed similar pattern with the final weight of the birds in all the dietary levels, with birds fed on 15% and 20% inclusion levels of sorrel seed meal for chick phase, growers phase and combined phase gaining significantly ($P<0.05$) more weight than the birds fed on (control) diet, 5%, and 10% dietary levels of sorrel seed meal respectively. This shows that even at the highest level of inclusion, sorrel seed meal does not depress bodyweight. The significant performance of the birds fed on 20% inclusion level of sorrel seed meal could be attributed to functional properties such as degree of water and oil retention of sorrel seed which has been considered to be useful as an indication of performance in several feed formulation (Al-kahtami and Abou-Arab, 1993). The mean range of bodyweight at the chick phase (630.42–685.00g/bird) were comparable to the range (660-795 g/bird) reported by NRC (1984) for cockerel chickens. The mean final live weights in this study were similar to those (1331.05–140.11g) reported by Kwari et al. (2010) when cockerels were feed differently processed sorrel seed meal. The improved daily weight gain and final weights observed in the groups fed the boiled sorrel seed meal may be due to its more balanced amino acid profile compared to whole soybeans. It also shows that the toxic effect of tannin found in sorrel seed meal was not manifested. It has been reported by Ogundipe et al. (2008) that 71.91% tannin content of African locust bean was destroyed after 30 minutes of cooking.

The daily feed intake ranged from 44.66–57.35, 74.80–89.10 and 62.08–66.88 for chick phase, grower phase and (combined) phases respectively and revealed significant ($P<0.05$) differences in all the three phase of

Table 1: Composition of chick mash containing graded levels of boiled sorrel seed meal

	Dietary levels of boiled sorrel seed meal				
Ingredients	0%(Control)	5%	10%	15%	20%
Maize	50.53	49	47.77	46.25	44.57
Soya bean (full fat)	27.22	22.35	19.48	15.5	11.68
Sorrel seed meal	0.00	5.00	10.00	15.00	20.00
Wheat offal	13.00	13.00	13.00	13.00	13.00
Fish meal	5.50	6.00	6.00	6.50	7.00
Bone meal	3.00	3.00	3.00	3.00	3.00
Methionine	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10
Salt	0.30	0.30	0.30	0.30	0.30
Premix *	0.25	0.25	0.25	0.25	0.25
TOTAL	100	100	100	100	100
Proximate Composition					
Crude protein	19.1	19.2	19.5	19.7	19.9
Crude fibre	4.5	5.5	5.5	6.5	7.5
Ether extract	4.0	3.0	4.0	4.5	3.5
Ash	5.5	5.0	6.5	7.1	5.5
Nitrogen free extract (NFE)	56.5	57.4	54.8	52.1	54.5

* Bio-mix chicks supplied /kg Vit. A = 4,000,000.00 IU, Vit. D_3 = 800,000.00 IU Vit. E = 9,200.00mg, Niacin = 11,000.00mg Vit B_1= 720.00mg, B_2 = 2,000.00mg B_6 = 1,200.00mg, 1200.00mg B_{12} = 600mg; K_3 = 800.00mg, Pantothenic acid = 3,000.00mg; Biotin = 2,400.00mg, Folic acid = 300.00mg; Iodine 400.00mg; Iron = 8,000.00mg, manganese = 16, 000.00mg; selenium = 80.00mg; zinc = 12,000.00mg; Anti oxidant = 500.00mg.

Table 2: Composition of grower mash containing graded levels of boiled sorrel seed meal

	Dietary levels of boiled sorrel seed meal				
Ingredients	0%(Control)	5%	10%	15%	20%
Maize	63.96	62.87	60.26	59.39	58.83
Soya bean (full fat)	13.29	8.88	6.49	4.86	2.42
Sorrel seed meal	0	5	10	15	20
Wheat offals	16	16	16	14	12
Fish meal	3	3.5	3.5	3.1	3
Bone meal	3	3	3	3	3
Methionine	0.1	0.1	0.1	0.1	0.1
Lysine	0.1	0.1	0.1	0.1	0.1
Salt	0.3	0.3	0.3	0.3	0.3
Premix*	0.25	25	25	25	0.25
TOTAL	100	100	100	100	100
Proximate composition					
Crude protein	16.4	16.7	16.8	17.2	17.6
Crude fibre	6.3	6.5	6.2	7.0	7.5
Ether extract	5.0	4.0	5.0	4.0	4.0
Ash	2.0	4.0	2.5	3.5	4.5
Nitrogen free extract (NFE)	64.2	59.1	59.9	58.1	57.7

*Bio-mix Grower supplied /kg, Vit. A =4,000,000.00 IU, Vit. D_3 = 800,000.00 IU, Vit. E = 10,000.00mg, K_1 = 200.00mg, B_2 = 1000.00mg; Pantothenic acid = 3,500.00mg, Biotin = 1,500.00mg, Folic Acid = 200,000mg, Choline Chloride = 120,000.00mg, cobalt = 80.00mg; copper = 800.00mg, lodine = 100.00mg, Iron = 15,000.00mg; Manganese = 60,000.00mg Selenium = 400.00mg; Zinc =15,000.00mg, Anti oxidant = 400.00mg.

the study. Generally, the birds on sorrel seed meal ate more than those on the control diet which shows that it does not have a depressive effect on feed intake. The higher feed intake observed in this study was similar to the observation of Duwa et al. (2012) when boiled sorrel seed meal was fed to cockerels. The increased feed intake may be as a result of the lower energy of the boiled sorrel seed compared to that of whole soybean as chickens are known to adjust feed intake to satisfy their energy requirement (Olomu, 1995).

The feed conversion ratio (FRC) indicated significant ($P<0.05$) difference among all the dietary levels of sorrel seed meal in the three phases of the study. This followed the same trend with the weight at chick phase, final weight, daily weight gain and daily feed intake which indicated significant ($P<0.05$) differences in all the three phases of the study. The results of this study indicated that birds fed on 15% and 20% dietary levels of boiled sorrel seed meal with mean range of 3.60–5.01 for the chick phase, 5.30 and 5.86 for the growers phase and 4.51–5.09 for overall

Table 3: Productive performance of cockerels fed on graded levels of boiled sorrel seed meal

Parameter	Dietary levels boiled of sorrel seed meal					
	(Control 0%)	5%	10%	15%	20%	SEM ±
Initial weight g/bird	74.75	73.85	74.00	73.75	71.50	2.423
Weight at chick phase g/bird	630.56^{c}	662.83^{b}	634.24^{c}	661.30^{b}	685.00^{a}	5.302*
Final weight g/bird	1237.10^{e}	1259.50^{d}	1274.50^{c}	1292.80^{b}	1597^{a}	3.382*
Feed Cost N/kg	33.49^{a}	31.64^{b}	30.68^{ab}	29.77^{c}	28.78^{c}	0.281*
Mortality	1	3	1	2	2	
Mortality percentage	2.5	7	2.5	5	5	
CHICK PHASE						
Daily weight gain. g/bird	11.26^{c}	11.47^{b}	12.19^{a}	12.03^{a}	12.23^{a}	0.066*
Daily feed intake g/bird	48.78^{b}	57.35^{a}	48.76^{b}	46.31^{c}	44.66^{d}	0.020*
Feed conversion ratio	4.33^{b}	5.01^{a}	4.00^{c}	3.60^{d}	3.45^{d}	0.066*
Feed cost /kg gain	154.88^{a}	170.09^{a}	131.19^{c}	120.61^{d}	109.26^{e}	2.363*
GROWERS PHASE						
Daily weight gain. g/bird	13.57^{d}	14.12^{c}	14.10^{c}	15.02^{b}	15.98^{a}	0.025*
Daily feed intake g/bird	80.89^{c}	74.80^{e}	76.50^{d}	85.76^{b}	89.10^{a}	0.446*
Feed conversion ratio	5.86^{a}	5.30^{e}	5.42^{d}	5.71^{b}	5.57^{c}	0.018*
Feed cost /kg gain	186.09^{a}	154.95^{c}	154.95^{c}	161.01^{b}	154.11^{c}	1.057*
COMBINE PHASE						
Daily weight gain. g/bird	12.24^{e}	12.80^{d}	13.15^{c}	13.53^{b}	14.11^{a}	0.022*
Daily feed intake g/bird	64.84^{b}	66.08^{a}	62.63^{c}	66.04^{a}	66.88^{a}	0.355*
Feed conversion ratio	5.09^{b}	5.16^{a}	4.71^{c}	4.66^{c}	4.51^{d}	0.017*
Feed cost /kg gain	174.83^{a}	163.34^{b}	146.12^{c}	145.31^{c}	136.41^{d}	0.886*

^{a,b,c}Means within the same row bearing different superscripts differ significantly (P<0.05); SEM – Standard Error of Means; NS – Not significant (P>0.05); *Significant difference (P<0.05)

Table 4: Blood parameters of cockerels fed on graded levels of boiled sorrel seed meal

	Parameters	Dietary levels of boiled sorrel seed meal				
	Control	5%	10%	15%	20%	SEM ±
RBC x 10^{6}/ dl	4.22^{c}	4.20^{c}	6.8^{b}	7.45^{b}	8.50^{a}	0.312*
WBC x 10^{3}/mm^{3}	10.00^{c}	12.40^{d}	18.95^{c}	20.00^{b}	21.50^{a}	0.339*
Hb%	15.11^{d}	17.87^{b}	19.10^{ab}	18.22^{bc}	20.27^{a}	0.383*
MCHC (g/l)	31.95^{c}	34.87^{b}	37.07^{a}	37.77^{a}	35.49^{b}	0.519*
MCH (µg)	25.65^{b}	21.25^{c}	23.95^{b}	28.12^{a}	25.00^{b}	2.285*
MCV ft	112.28^{c}	128.63^{b}	131.13^{b}	142.15^{a}	130.60^{b}	2.285*
PCV%	27.00^{c}	35.00^{ab}	34.00^{b}	28.42^{c}	37.32^{a}	0.754*

^{a,b,c}Means within the same row bearing different superscripts differ significantly (P<0.05); SEM – Standard Error of Means; NS – Not significant (P>0.05); *Significant difference (P<0.05)

Table 5: Serum biochemical parameters of cockerels fed on graded levels of boiled sorrel seed meal

Parameters	Dietary levels of boiled sorrel seed meal					
	0%	5%	10%	15%	20%	SEM ±
Total Protein (g/dl)	4.58	5.72	5.11	5.09	5.62	0.067NS
Albumin (g/dl)	3.14	4.94	3.28	3.37	3.93	0.98NS
Globulin (g/dl)	1.03^{c}	2.04^{a}	2.62a	1.81b	2.52a	0.031*
Urea (mg/dl)	3.12a	2.98b	2.86b	3.55a	4.92a	0.811*
Glucose (mmol/l)	8.86ab	12.31a	9.11ab	10.01ab	7.34c	1.11*
Sodium (Na^{+}) (mmol/l)	135.02a	138.23b	140.60ab	140.87ab	142.18a	1.791*
Potassium (K^{+}) (mmol/l)	3.40c	4.31b	3.27c	4.18b	5.37a	0.142*
Calcium (Ca^{2+}) (mmol/l)	1.74b	1.69b	1.75b	1.96a	1.76b	0.124*
Glutamic oxaloacetic transaminase (SGOT) (µ/l)	11.08	11.13	11.62	10.04	9.37	1.678NS
Glutamic pyruvic transaminase (SGPT) (µ/l)	12.27	10.84	9.37	9.49	11.11	1.389NS

a, b, c, Means within the same row bearing different superscripts differ significantly (P<0.05); SEM – Standard Error of Means; NS–Not significant (P>0.05); *Significant difference (P<0.05)

(combined) phase significantly perform better than the (0% control) birds. The values obtained were similar to the range of 4.66 - 4.81 reported by Kwari et al. (2010) for cockerels fed differently processed sorrel seed meal.

The feed cost (₦/kg) decreased (P<0.05) with increasing levels of sorrel seed meal in the diet. The feed cost per kg gain followed similar pattern with the feed cost (₦/kg). The highest cost of the feed for the three phases of the study (chick phase, growers phase and overall combine) was obtained in birds fed on (control) diet while the lowest cost was recorded in birds fed with 20% inclusion level of boiled sorrel seed meal. This observation agreed with the finding of Smith et al. (1981) who reported that the use of plant protein sources in chicken diet reduced feed cost and gave better returns in terms of feed cost and cost per kg gain.

The results for heamatological parameters (Table 4) showed significant (P<0.05) difference among treatment means for all parameters measured. There were significant (P<0.05) increase in RBC, WBC, Hb and PCV in the group with 20% sorrel seed meal inclusion while MCH and MCV were significantly (P<0.05) reduced in the control group. It has been observed by Esonu et al. (2001) that hematological constituents reflect the responsiveness of the animal to its internal and external environment which include feed and feeding. The values observed in this study for RBC, PCV, WBC and Hb were within the normal ranges reported by Swenson (1970) and CCAC (1980) for healthy chickens.

Table 5 shows the result for serum biochemical indices of cockerels fed graded levels of sorrel seed meal. Feeding sorrel seed meal had no effect (P>0.05) on serum total protein and albumin. Globulin was higher (P<0.05) in all the groups fed sorrel seed. The urea values were lower (P<0.05) in the groups with 5% and 10% inclusion levels of BSSM compared to the other groups although these differences may not be attributed to treatment effect since no definite pattern was observed. The values for total protein are within the range (5-7 g/dl) reported by CCAC (1980) which is an indication that BSSM had no adverse effect on protein metabolism. Significant (P<0.05) differences were observed for sodium and potassium while no differences (P>0.05) were observed among treatment means for calcium, Glutamic oxaloacetic transaminase (SGOT) and Glutamic pyruvic transaminase (SGPT). It is well documented that serum biochemical indices has direct correlation to the quality of the diet (Merck, 2011; Kwari et al., 2011). All the values for serum biochemical indices in this study were similar to the ranges reported by CCAC (1980) for normal non laying adult chicken. This is an indication that inclusion of sorrel seed meal in the diets of cockerels does not have any deleterious effect on blood components. The observation concurs with the report of Kwari et al (2010) and Kwari et al (2011) that sorrel seed meal had no adverse effect on the blood parameters of poultry.

Conclusions

It was concluded that boiled sorrel seed meal can be included up to 20% of the diet of cockerels without adverse effect on performance.

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