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POTENTIALS OF SOYA BEAN RESIDUE FED AS REPLACEMENT FOR SOYA BEAN MEAL ON HEMATOLOGY AND SERUM BIOCHEMISTRY OF BROILER CHICKENS

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Abstract:
A 28-day feeding trial was conducted to evaluate the potentials of soya bean residue (SBR) fed as replacement for soya bean meal (SBM) on haematology and serum biochemistry of broiler chickens. A total of one hundred and fifty (150) broiler chicks aged 28 days were randomly assigned to five dietary treatments with 0, 25, 50, 75 and 100% of soya bean meal in the diets being replaced by soya bean residue meal (SBR). Each treatment was replicated thrice with ten (10) birds per replicate in a completely randomize design. The result obtained for haematological parameter showed significant ($P<0.05$) difference in all the treatments indices with the exception of mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and neutrophils. Serum biochemical indices expressed no statistical ($P>0.05$) differences in terms of direct bilirubin, conjugate bilirubin, aspartate amino tranferase (ASAT), alanine amino transferase (ALAT), cholesterol, Na^+, Cl^- and HCO^-_3. Total protein, albumin, globulin, glucose, creatinine, urea, alkaline phosphate and K^+ on the other hand revealed significant ($P<0.05$) difference. it was concluded that, soya bean residue can replace soya bean meal up-to 100% as protein source in broiler finisher diet.

Key words: soya bean residue, haematology, serum biochemistry, broiler finisher

INTRODUCTION

Diets are formulated to provide specific levels of nutrients that are needed for optimum performance. Blood analysis has been suggested as a readily available and fast means of assessing nutritional health status of animals on feeding trials because ingestion of dietary components have measurable effects on blood composition (Wikivet, 2019). Several studies conducted indicated in one way or the other that different diets have different effects on haematological parameters of different species of birds (Marck *et al*., 2020). Malnutrition, especially inadequate protein and energy intake lowers the pack cell volume (PCV) and haemoglobin concentration (Hb). These are microscopic status of the red blood cell and thus an indication of anemia (Wikivet, 2019). Shuaibu, (2021) reported that, low blood glucose is an indication of inadequate energy intake while low blood albumin indicates low protein intake. it has been observed that fast growing animals especially broiler chickens have high serum albumin, haemoglobin concentration glucose and low concentration of potassium. However, Oyeagu *et al.* (2019) reported that, there is rather low correlation between blood glucose and energy consumption, but that plasma free fatty acid are most highly related to energy consumption. The major aim of animal nutritionist is to formulate diets that will enhance the performance of the livestock by supplying the nutrients needed for growth and production without compromising their physiological and health status. This incited the use of many non-conventional feedstuffs as feed component for livestock and poultry (Adeyeye *et al.*, 2021).

Hematological and biochemical values can be helpful in assessing infection, organ function and many diseases. The fact that physiological and pathological factors may cause qualitative and quantitative changes in hematological values makes such studies an important aspect of the diagnostic panel and of the monitoring of sick birds (Alu *et al*., 2018).

Shuaibu *et al.* (2021) and Oyeagu *et al.*, (2019) observed that factors such as age, nutrition, health of the animal, degree of physical activity, sex and environmental factors affect blood values of animals. Therefore, determination of blood constituents for birds are not only relevant diagnostic tools in veterinary medicine, but can also be used as nutritional indicators (Marck, 2020). Therefore, the present study was designed to investigate the effect of soya bean residue on the haematological and serum biochemical indices of broiler finisher chickens.

MATERIALS AND METHODS

Study site: The study was conducted at the University of Maiduguri Teaching and Research farm of the Department of Animal Science. The area is situated on latitude 110 15'N, longitude 300 05'E and altitude of 354m above sea level (Lawan *et al.,* 2019), Maiduguri is a typical Semi arid environment. Diurnal temperature of >350C is not uncommon for most part of the year.

Experimental Stock and Design: A total of one hundred and fifty (150) straight run *Arbor acre* strain broiler chicks were randomly weighed and distribute to five (5) treatment groups of 30 birds each. Each treatment was replicated thrice with 10 birds per replicate in a Completely Randomize Design (CRD). Five finisher experimental diets were formulated with different inclusion levels of soya bean residue (SBR) replacing full-fat soya bean meal (SBM) at 0% as control, 25, 50, 75 and 100% designated as treatment 1(T1), 2(T2), 3(T3), 4(T4) and 5(T5) respectively. (Table 1). Feeding was *ad libitum* from 4th week up to the age of 8th weeks.

Table1. Ingredient composition and calculated analysis of experimental broiler diets

	Dietary Treatments				
Ingredients (%)	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)
Maize	58.00	58.00	58.00	58.00	58.00
Wheat offal	8.00	8.00	8.00	8.00	8.00
Soya bean meal	17.00	12.75	8.50	4.25	0.00
Soya bean waste	0.00	4.25	8.50	12.75	17.00
Groundnut cake	15.00	15.00	15.00	15.00	15.00
Fish meal	6.00	6.00	6.00	6.00	6.00
Bone meal	02.00	02.00	02.00	02.00	02.00
Min-Vit Premix*	0.30	0.30	0.30	0.30	0.30
Methionine	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
NaCl	0.20	0.20	0.20	0.20	0.20
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Analysis					
Crude protein (%)	21.38	20.44	19.21	18.50	17.28
Crude fibre (%)	3.94	5.59	7.25	8.90	10.55
Ash (%)	3.88	3.76	3.64	3.52	3.40
Ether extract (%)	7.84	7.08	6.32	5.52	4.76
NFE (%)	69.08	68.68	68.08	67.52	66.92
ME (Kcal/kg)	3004.85	2983.88	2962.91	2941.94	2921.18

NFE = Nitrogen free extract ME= Metabolizable energy

** = Bio Mix Broiler Finisher Premix supplying the following per Kg of feed: Vitamin A=3,400,000IU, VitaminD_3= 600,000IU, Vitamin E=4,000mg, VitaminK_3 = 600mg, Vitamin B_1 = 640mg, Vitamin B_2 = 1600mg, Niacin = 8,000mg, Pantothenic=2000mg, Vitamin B_6 = 600mg, Vitamin B_{12} = 4mg, Folic acid =200mg, BiotinH_2 = 300mg, Choline Chloride = 70,000mg, Cobalt = 80mg, Copper = 1200mg, Iodine = 400mg, Iron = 8,000mg, Manganese =16,000mg, selenium=80mg, Zinc=12,000mg and Antioxidant=500mg.*

Blood collection and Response Criteria: At the end of the feeding trials, three birds were randomly selected from each replicate. The ventral part of the left wing was carefully defeathered to locate the veins. About (5 ml) of blood was collected via the left wing vein of each of the representative birds using a 10ml gauge syringe and scalp vein needle. About 3ml of the blood was fed in to a sterile bottle containing Ethylene Diethyl Tetra Acetic acid (EDTA), as anticoagulant for haematology Assay. It was placed in an ice-moist jute material to avoid Haemolysis. The remaining 4ml was fed in to yet another sterile but plain bottle. This was later spinned in a haematocrit centrifuge for about 6 minutes at 200 *rpm* to separate serum from the plasma. It was then allowed to stand for 2hrs at room temperature. Sample of the blood with EDTA was drowned in a heprinised capillary tube and PCV was determined by microhaematocrit method. Determination of RBC and WBC (along with DLC) were carried out according to Rastogi, (2007) while MCV, MCH and MCHC were calculated as follows:

MCV (fl) = PCVX10/RBCX10; MCH (pg) = HbX10/RBC (106); MCHC (%) = HbX100/PCV.

From the centrifuged blood sample in plain bottles, serum was collected for biochemical assay. Blood

glucose was determined using *Hexokinase method*. Total protein and albumin were determined by *Biuret method* and *Bromocresol Green method* respectively. Blood Urea Nitrogen (BUN), Creatinin as well as activities of the liver enzymes (ALK-PO4-, ASAT and ALAT) were determined by Standard Enzymatic method. Serum Cholesterol was determined by *Burchad reaction.*

Statistical Analysis: All data collected were subjected to Analysis of Variance (ANOVA) of Completely Randomized Design of the SAS package (SAS, 1999). Where treatment effect differed significantly, means were separated using Duncan Multiple Range Test (Duncan, 1955). All statements of significance were based on 5% level.

RESULTS AND DISCUSSION

The results of haematological parameters and differential leukocytes counts are presented in Table 2. There were no significant differences among treatment groups for most of the haematological parameters except for mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and neutrophils count were significant (P<0.05). The range of values 11.90 to 16.61 Fl and 39.13 to 53.50 Pg for MCV and MCH respectively were lower than the values reported by Wikivet (2019) and Adamu *et al.* (2015). However, the MCHC value was higher than the value reported by (Oyeagu *et al*., 2019), The values 11.90 to 16.61 Fl, 39.13 to 53.50 Pg, and 32.04 to 33.25% for MCV, MCH and MCHC respectively, recorded in the present study were within normal range for chickens thus, the birds had normal physiological status (Marck, 2020). The WBC count and differential leukocytes counts revealed no significant difference among all the treatment groups except the neutrophils which differ significantly (P<0.05) among treatment groups. This shows that SBW inclusion in poultry diets pose no detrimental effect on WBC count. Neutrophils was significantly higher in treatment 3 (44.0%) followed by treatment 2 and, 4 and 5 which were similar compared to the control group (30.67%). However, the range value recorded are lower than range (46.33 – 52.00%) values reported Makinta *et al*. (2021) and are similar with value (32.67 to 43.67%) reported by Adamu *et al.* (2015). This is in agreement with the report of Shuaibu *et al.* (2021) that feeding soya bean by-product to broiler finisher chickens has no

Table 2: Haematological parameters of broiler chickens fed varying levels of soya bean residue as replacement for soya bean meal diets

Parameters	Treatments/Diets					
	T_1 (0%SBR)	T_2 (25%SBR)	T_3 (50%SBR)	T_4 (75%SBR)	T_5 (100%SBR)	SEM
PCV (%)	30.67	30.67	29.33	29.33	28.67	1.35^{NS}
Hb (g/dl)	10.20	10.17	9.63	9.63	9.40	0.43^{NS}
RBC ($x10^6/mm^3$)	2.63	2.780	20.67	17.00	20.08	1.67^{NS}
MCV (fl)	11.90^{b}	12.11^{b}	14.20^{ab}	16.61^{a}	14.29^{ab}	2.69*
MCH (pg)	39.97^{b}	39.13^{b}	46.63^{ab}	53.50^{a}	48.03^{ab}	4.26*
MCHC (%)	33.25^{ab}	33.15^{ab}	32.85^{b}	32.04^{c}	33.01^{a}	0.28*
WBC ($x10^3/mm^3$)	1.82	1.80	1.70	1.57	1.66	0.17^{NS}
Differential Leucocytes counts (%)						
Neutrophils	30.67^{b}	39.00^{ab}	44.00^{a}	31.67^{ab}	31.67^{ab}	5.98*
Monocytes	0.00	0.33	0.00	0.00	0.00	0.18^{NS}
Eosinophils	1.33	2.33	1.33	1.67	3.67	1.44^{NS}
Basophils	0.00	0.00	0.00	0.00	0.00	0.00
Lymphocyte	64.67	58.33	54.67	66.67	64.67	6.55^{NS}

a,b = Means in the same row bearing different superscripts differ significantly (P<0.05), NS = Not Significant (P>0.05)
SEM = Standard Error of Means, *= Significant (P<0.05), **= Values are means of 3 determinations, WBC= White blood cells counts, Hb= Haemoglobin concentration, RBC= Red blood cell counts, MCV= Mean corpuscular volume, MCHC= Mean corpuscular haemoglobin concentration, MCH= Mean corpuscular haemoglobin.

detrimental effect on haematological indices. The results of serum biochemical indices obtained in this study are presented in Table 3. Total protein, albumin, globulin, glucose, creatinine, urea, alkalinephosphatase and potassium varied significanly ($P<0.05$) with the treatment groups. However, direct bilirubin, conjugate bilirubin, cholesterol, aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), sodium, chloride, and hydrogencarbonate (HCO^-_3) did not vary with dietary treatment. The highest total blood protein recorded (48.67 to 69.67 g/dl) was in treatments 2 and 5, followed by treatments 3 and 4 This revealed that protein content of the diet was adequate and was efficiently utilized and produce adequate amount of plasma protein as it was earlier reported by Shuaibu *et al.* (2021) and Makinta *et al*. (2021). The albumin and globulin values ranged from 32.33 to 40.67 g/dl and 16.33 to 29.00 g/dl, respectively. The range for albumin may implies that, osmotic pressure of the blood plasma was maintained indicating normal systemic protein utilization (Merck, 2020). The globulin value was significantly higher in treatments 2 and 5 (29.00 g/dl) followed by treatments 3 and 4 (22.67 g/dl) as compared to the control. Higher values recorded revealed that ration offered to the birds meets their nutritional requirements and support performance. However, these values are higher than 5.00 to 8.00, 2.50 to 4.00, 2.3 to 3.3 g/dl for total protein, albumin and globulin, respectively, postulated as bench mark for chickens as reported by Wikivet, (2019).

Table 3: Biochemical indices of broiler chickens fed soya bean residue as replacement for soya bean meal

Parameters * *	Treatments/Diets					
	T_1(0%SBR)	T_2(25%SBR)	T_3(50%SBR)	T_4(75%SBR)	T_5(100%SBR)	SEM
Total protein (g/dl)	48.67^{b}	69.67^{a}	60.00^{ab}	58.67^{ab}	64.33^{a}	5.46*
Albumin (g/dl)	32.33^{b}	40.67^{a}	37.33^{ab}	36.00^{ab}	35.33^{ab}	3.45*
Globulin (g/dl)	16.33^{b}	29.00^{a}	22.67^{ab}	22.67^{ab}	29.00^{a}	3.85*
Urea (g/dl)	4.77^{b}	8.33^{ab}	8.07^{ab}	7.27^{ab}	10.67^{a}	1.98*
Glucose (iu/l)	5.30^{ab}	4.10^{b}	4.30^{ab}	5.67^{a}	4.60^{ab}	0.70*
Creatinine (mg/dl)	58.00^{ab}	61.33^{ab}	52.67^{b}	82.33^{a}	53.33^{b}	11.96*
Cholesterol (mmol/l)	3.50	3.20	3.47	3.23	3.60	0.31^{NS}
Sodium (mmol/l)	134.33	137.33	142.00	139.67	141.67	5.56^{NS}
Potassium (mmol/l)	4.90^{ab}	4.60^{ab}	3.90^{b}	1.83^{ab}	5.80^{a}	0.60*
Chloride (mmol/l)	98.67	102.33	98.67	96.67	100.67	2.89^{NS}
HCO^-_3 (mmol/l)	24.33	24.67	24.33	23.67	26.33	2.96^{NS}
Alk. Phosphate (iu/l)	44.33^{b}	93.00^{a}	68.00^{ab}	73.33^{a}	83.00^{a}	11.43*
Dir. Biliru. (mmol/l)	3.07	2.37	2.17	3.17	3.57	0.71^{NS}
Conj. Biliru. (mmol/l)	5.27	5.13	5.37	4.67	5.20	0.60^{NS}
ASAL (iu/l)	110.00	107.67	105.67	109.00	119.00	8.27^{NS}
ALAT (iu/l)	54.00	46.00	51.67	48.33	43.33	8.87^{NS}

a,b = means in the same row bearing different superscripts differ significantly ($P<0.05$), NS= Not Significant ($P>0.05$), SEM = Standard Error of Means, *= Significant ($P<0.05$), ** = Values are means of 3 determinations, HCO^-_3= Hydrogencarbonate, ASAT = Aspartate aminotransferase, ALAT= Alanine aminotransferase, Dir. Biliru= Direct bilirubin, Conj. Biliru. = Conjugate bilirubin, Alk. Phosphate = Alkalinephosphate

The higher values recorded in the present study is in agreement with the report of Nanbol *et al,* (2016) who stated that, higher value of blood total protein is an indication of adequate plane of nutrition of the chickens in relation to better protein quality of the feed fed. Therefore, total blood protein, albumin and globulin are generally influenced by total protein intake in which nutritional status are better shown in the albumin than the globulin content of the blood Cholesterol level and did not vary with the treatment groups. The mean values for creatinine ranged from 52.67 to 82.33 mmol/l. The results showed significant ($P<0.05$) differences among the treatment groups. Creatinine values for T4 (75% SBR) was the highest while T3 (50% SBR) recorded the least value. The values recorded were lower than the values (71.67 to 98.00 mmol/l) reported Adamu *et al.* (2015). High concentration of creatinine (>7.00 mg/dl) are usually associated with renal disease and antibody response (Alu et al., 2018) while lower values (<5.00 mg/dl) suggest that, there was muscle wastage and the animal was surviving at the expense of the body reserve (Merck, 2020). Therefore, values recorded in this study, despite significantly ($P<0.05$) different birds were not surviving at the expense of body reserves; hence there were no general weight

losses recorded. Therefore, soya bean residue poses no negative effect on serum creatinine level of the broiler finisher and can be used as feed ingredients. Glucose shows significant (P<0.05) difference among all treatment groups. The values recorded (4.10 to 5.67 mmol/l) were however, within the normal physiological limits (125 to 200 mg/l) for chickens (Wikivet, 2019). Elevated level of glucose that can be detected in healthy animal after feeding and during excitement is associated with anorexia, probably due to acidosis (Marck, 2020) while lower value of glucose may be related with excess insulin and liver damage (Marck, 2020). Therefore, since no sign of ill health was observed during the study, it may be concluded that, the chickens were on adequate nutritional plane. Blood urea was significantly higher (10.67 mmol/l) in treatment 5 while treatments 2, 3 and 4 were similar compared with the control group (4.77 mmol/l). The values recorded were similar with the range of (7.00 to 8.80 mmol/l) reported by Adamu *et al.* (2015), but higher than the 2.50 to 3.80 mmol/l reported by Nanbol *et al.* (2016). Urea analysis did not follow a definite trend, the 100% replacement group was significantly (P<0.05) higher than the 0, 25, 50, and 75% replacement groups. Higher blood urea (4.77 to 10.67mmol/l) recorded may be associated with protein quality (Marck, 2020). However, all our values observed were above the range of 2.5 to 5.8 mmol/l as reported by Alu *et al*., (2018) who fed castor seed meal to broiler chickens. The highest value 10.67 mmol/l in this study justifies the low protein level of treatment 5 compared to (4.77 mmol/l) treatment 1 (control). The values recorded were within normal blood urea extremes postulated by Wikivet, (2019) which imply that, dietary protein is well utilized by the birds. The direct bilirubin means ranged from 2.17 to 3.57 mmol/l while conjugate bilirubin values ranged from 4.67 to 5.37 mmol/l. The highest value (3.57 mmol/l) of direct bilirubin was observed in diet containing 100% SBW while conjugate bilirubin recorded extreme value (5.37 mmol/l) at 50% level of replacement. The direct and conjugate bilirubin values recorded were lower than the range of values (7.00 to 8.33 mmol/l) and (11.00 to 14.67 mmol/l) respectively, reported by Adamu *et al*. (2015) though, similar to the range2.0 to 4.60 mmol/l reported by Alu *et al*. (2018) for direct bilirubin. (Marck, 2020) stated that, the quantity of serum bilirubin is an indication of haemolysis of erythrocytes while conjugate ones combine with glucoronic acid and become water soluble to be excreted by the bile. Excess bilirubin (>8 mmol/l) predisposes animal to jaundice (Adamu *et al.*, 2015). The results of alkaline phosphatase (PO_4) obtained were significantly (P<0.05) different among treatment groups. The values 44.33 to 93.00 µ/l observed were lower than the values reported by Alu *et al.* (2018). However, there was no negative results on performance and physiological activities (Wikivet, 2019), no sign of ill-health was observed which is in agreement with the earlier reports of Merck. (2020).

CONCLUSION

This study concluded that, soya bean residue (SBR) can replace soya bean meal (SBM) with no negative effect on haematology and serum biochemistry of broiler finisher and can be used as poultry feed.

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