EFFICACY OF SOYA BEAN RESIDUE IN MODIFYING HAEMATOLOGY AND SERUM BIOCHEMISTRY OF BROILER CHICKENS

Lawan, I.[1], Marte, U. M.[2], Makinta A. A.[3], Benishiekh A. A.[3], Marte, A. M.[3] and Aliyu, A. M.[4]
[1]Department of Animal Science, University of Maiduguri, Maiduguri. Borno State, Nigeria.
[2]Department of Animal Health and Production, Mohamet Lawan College of Agric, Maiduguri.
[3]Department of Animal Health and Production, Ramat Polytechnic, Maiduguri.
[4]National Agricultural Extension and Research Liaison Service, Ahmadu Bello University, Zaria.
Lawan020@gmail.com Tel: +234 8065291101

ABSTRACT
A 28-day feeding trial was conducted to assess the efficacy of soya bean residue (SBR) fed as replacement for soya bean meal (SBM) as modifiyer of 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 results obtained for haematological parameters showed significant ($P<0.05$) difference in all treatments indices with the exception of mean corposcular 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 showed significant ($P<0.05$) difference compared to control group and was concluded that, soya bean residue can replace soya bean meal up-to 100% as protein source in broiler finisher diet.
***Key**: 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. Several studies conducted by various researchers have indicated in one way or the other that different diets have different effects on haematological parameters of different species of birds (Etim *et al*., 2014). 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. Bush (1991), reported that low blood glucose indicate 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, Adamu *et al*. (2001) showed 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 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. Situated on latitude 11^0 15'N, longitude 30^0 05'E and altitude of 354m above sea level (Adamu *et al.*, 2001), 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 used for the experiment. Five finisher experimental diets was 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% in the five diets (Table 1). Feeding was *ad libitum* from 4th week up to the age of 8th weeks.

Blood collection and Response Criteria: At the end of the feeding trial, three birds were randomly selected from each replicate. The ventral part of the left wing was carefully defeathered to locate the veins. About 7 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. Determination of RBC and WBC (along with DLC) were carried out according to Docie and Lewis, (1991) while MCV, MCH and MCHC were deduced according to Jain (1986) as follows:

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	10.00	10.00	10.00	10.00	10.00
Fish meal	4.50	4.50	4.50	4.50	4.50
Bone meal	01.70	01.70	01.70	01.70	01.70
Min-Vit Premix*	0.30	0.30	0.30	0.30	0.30
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20	0.20
NaCl	0.10	0.10	0.10	0.10	0.10
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 Chioride = 70,000mg, Cobalt = 80mg, Copper = 1200mg, Iodine = 400mg, Iron = 8,000mg, Manganese =16,000mg, selenium=80mg, Zinc=12,000mg and Antioxidant=500mg.*

MCV (fl) = PCVX10/RBCX10; *MCH (pg) = HbX10/RBC (10^6)*; *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-, AS AT and ALAT) were determined by Standard Enzymatic method as outlined by Bush (1991). Serum Cholesterol was determined by *Burchad reaction.*

Statistical Analysis: Data collected were subjected to analysis of variance using Completely Randomized Design (CRD) (Steel and Torrie, 1980). Significant differences among treatment means were compared using Duncan's Multiple Range Test (1955).

RESULTS AND DISCUSSION

The results of haematological parameters and differential leukocytes counts are presented in Table 2. There were no significant ($P>0.05$) differences among treatment groups for all the haematological parameters except mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and neutrophils count compared to control group. The mean values recorded for MCV, MCH and MCHC in this study were all significantly ($P<0.05$) different among all treatment groups. The range of 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, were lower than the values reported by Wikivet (2013) and Adamu *et al.* (2015) except for MCHC value, which was higher than the value reported by (Etim *et al*., 2014) and similar to the values reported by Wikivet (2013) as normal ranges for chickens. The variation in values and significant differences may be link to the treatment diets containing test material (SBR). However, 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 were within normal range for chickens thus, the birds had normal physiological status (Anon, 1980). Moreover, PCV, Hb and RBC values in all the treatments showed normal and adequate nutritional status of the broiler diets which indicated the nutritional status of the birds. The WBC count and differential leukocytes counts revealed no significant ($P>0.05$) difference among all the treatment groups except the neutrophils which differ significantly ($P<0.05$) among treatment groups which may be attributed to the test material. This shows that SBW inclusion in poultry pose no detrimental effect on WBC count. The neutrophils showed significant ($P<0.05$) difference among the treatment groups. Treatment 3 was significantly higher (44.0%), followed by treatment 2 while treatment 4 and 5 were similar compared to the control group (30.67%), despite higher values recorded, no sign of ill health condition was observed (neutrophilia). Bush (1975) reported that, increase in the number of neutrophils (neutrophilia) generally indicates the existence of recent (acute) infection, usually with bacteria such as streptococci and staphylococci especially in septicemia and it may also be due to an acute loss of RBC particularly in acute haemolytic anaemia, while decrease in the number of neutrophils (neutropenia) occurs in overwhelming bacterial infection and it may indicate bone marrow damage by toxins (Bush, 1975), thus too low or too high a value is caused by variety of possible health conditions with medication effect and bacterial infection responsible for lower values as reported by Merck (2012). The increase in number of neutrophils indicates that there is no sign of bacterial infection or ill-health especially as the values fall within the normal physiological limits of chickens (Rastogi, 2007). However, these values are slightly higher than values (32.67 to 43.67%) reported by Adamu *et al.* (2015). Therefore, feeding soya bean residue to broiler finisher chickens posed no detrimental effect on haematological indices and is in agreement with the report of Etim, (2010).

Table 2: Haematological parameters of broiler chickens fed varying levels of soya bean residue (SBR) as replacement for soya bean meal (SBM) 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
Packed cell volume (%)	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 ($x10^6/mm^3$)	20.63	20.78	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 (%)	30.67^b	39.00^{ab}	44.00^a	31.67^{ab}	31.67^{ab}	5.98*
Neutrophils	0.00	0.33	0.00	0.00	0.00	0.18^{NS}
Monocytes	1.33	2.33	1.33	1.67	3.67	1.44^{NS}
Eosinophils	0.00	0.00	0.00	0.00	0.00	0.00
Basophils	64.67	58.33	54.67	66.67	64.67	6.55^{NS}
Lymphocyte						

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.

The serum biochemical indices obtained in this study are presented in Table 3. There were no significant (P>0.05) differences among all treatments with respect to direct bilirubin, conjugate bilirubin, cholesterol, aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), sodium, chloride, and hydrogencarbonate (HCO^-_3) while total protein, albumin, globulin, glucose, creatinine, urea, alkalinephosphatase (PO_4) and potassium (K) showed significance (P<0.05) differences among all the treatment groups. The total blood protein ranged from 48.67 to 69.67 g/dl, treatments 2 and 5 were significantly higher followed by treatments 3 and 4 compared to the control group. This revealed that protein content of the diet was adequate and was efficiently utilized and produce adequate amount of plasma protein (Ochei and Kolhatkar, 2000). 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 (32.33 to 40.67g/dl) for albumin implies that, osmotic pressure of the blood plasma was maintained indicating normal systemic protein utilization (Wikivet, 2013). 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) and falls within normal range (50 to 70 mmol/l) reported by Jain (1986). 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 (Jain, 1986). 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) than the normal levels (2.34 to 3.12 mmol/l) are associated with protein quality, all the values observed were above the range of 2.5 to 5.8 mmol/l reported by Dong (2005) who fed soya

bean residue meal as replacement for SBM for ducks. The results of alkaline phosphatase (PO_4) obtained were significantly ($P<0.05$) different among all treatment groups. The values (44.33 to 93.00 μ/l) observed were lower than the values reported by Kwari *et al.* (2014) and Adamu *et al.* (2015). Despite the fact that some values recorded were significant ($P<0.05$), there was no negative results on performance, physiological activities and status, no sign of ill-health was observed and is within the range values postulated by Anon (2007)

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

CONCLUSION

This study observed slightly high values of some haematological parameters with no ill health condition. Therefore, soya bean residue (SBR) can replace soya bean meal (SBM) with no negative effect on haematology and serum biochemistry of broiler finisher chicken. Further more, it can serve as good ingredient for poultry feeds manufacturing.

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