Haematological and serum biochemical indices of broiler chickens fed sorghum SK-5912 (*Sorghum bicolor*, L. Moench) variety as a replacement for maize

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Abstract

An eight-week feeding trial was carried out with three hundred unsexed day-old (Marshall) broilers to investigate the effect of sorghum SK-5912 variety as replacement for maize on the haematological and serum biochemical parameters of broiler chickens. Five experimental diets were formulated with SK-5912 replacing maize at 0, 25, 50, 75 and 100% in the diet and labelled as diets 1 (control), 2, 3, 4 and 5, respectively for both starter (23% CP) and finisher (20% CP) phases. The day-old chicks were randomly allotted to the dietary treatments with four replications each and 15 birds per replicate in a completely randomized design (CRD). Feed and water were supplied *ad libitum* and the experiment lasted eight weeks. At the end of the feeding trial eight birds per treatment were randomly selected and blood samples collected for haematological and serum biochemical analyses. Results from blood analysis showed no treatment effect on Packed Cell Volume (PCV), White Blood Cells (WBC), Red Blood Cells (RBC) counts, haemoglobin concentration (Hb) and corpuscular values. Similarly, there were no significant treatment effects among all the groups for serum biochemical indices. It can therefore be concluded that Sorghum SK-5912 can replace maize in the diets of broiler chickens without adverse effects on the haematological and serum biochemical parameters of the birds.

Keywords: Broilers, Haematology, Serum biochemistry, Sorghum SK-5912, Treatments

Introduction

The unavailability and high cost of feed which arise from the competition between man, animals and the industry for available cereal grains (primarily maize) pose a major challenge for poultry production in Nigeria. Cereal grains constitute the major sources of energy in poultry diets in the tropics (Oluyemi and Roberts, 2013). The relative high cost and scarcity of maize presently being experienced in Nigeria because of decline in its production due to unfavourable climate require an urgent attention (Kwari *et al.*, 2011). This has resulted in increased interest for non-conventional alternative feed ingredients with comparable feeding value. The sorghum SK-5912 variety had poor taste when prepared as Tuwo, the traditional stiff porridge, unacceptable black colour and

overnight keeping quality, thereby causing low human consumption among the local farmers. Sorghum SK-5912 have reportedly been utilized in a trial with local turkey grower and results showed that it can replace maize conveniently without any detrimental effect on the health of the birds (Etuk *et al.*, 2015). There is however, paucity of information on its utilization in broiler chickens diet, hence the need to determine its effects on the blood constituents of the birds. This study therefore was conceived to investigate the haematological and serum biochemical indices of broiler chickens fed sorghum SK-5912 based diets.

Materials and methods

The experiment was conducted at the Poultry Production Unit, Gombe. Three

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hundred (300), 1 day-old marshal strain of broiler chicks were randomly allotted to five treatment diets which were replicated four times in a completely randomized design (CRD) of 15 birds per replicate. Feed and clean drinking water were supplied to the birds *ad libitum* during the experiment that lasted 8 weeks. Five experimental diets for both starter (23% CP) and finisher (20% CP) phases were formulated in which sorghum SK-5912 replaced maize at 0, 25, 50, 75 and 100% and tagged as diets 1, 2, 3, 4 and 5, respectively as shown in Tables 1 and 2. At the end of the experimental period, 8 birds per treatment were randomly selected, fasted over night from which blood samples were collected and used for haematological and serological measurements. Haematological samples were collected into sample tubes containing Ethylene Diamine Tetra-acetic acid (EDTA). Haematological parameters analyzed were Packed Cell Volume (PCV), Red Blood Cells (RBC) count, White Blood Cells

(WBC) count, Haemoglobin (Hb) concentration, Mean Cell Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and platelet. They were measured according to the methods of Bush (1991). Serum was obtained after the blood in the anticoagulant free tubes was allowed to stand for two hours at room temperature and centrifuged at 2,000 revolutions per minute for 10 minutes. Total Proteins (TP), Albumin, Globulin, Creatinine, Total cholesterol, High Density Lipoproteins (HDL), Low Density Lipoproteins (LDL), Triglycerides, Total Bilirubin (TB), Conjugated Bilirubin (CB), Alanine Amino Transferase (ALAT), and Aspartate Amino Transferase (ASAT).

Statistical analysis

Data were analyzed using analysis of variance techniques as described by Steel and Torrie (1980). Differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 1: Percentage composition graded levels of sorghum SK -5912 as replacement for maize in broiler starter diets (1-4 weeks)

Ingredients	Diets				
	1	2	3	4	5
Maize	48.55	36.41	24.28	12.14	0.00
Sorghum (SK-5912)	0.00	12.14	24.28	36.41	48.55
Soya bean	33.65	33.65	33.65	33.65	33.65
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
+ Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated analysis					
Crude protein (%)	22.50	22.75	23.00	23.50	24.00
ME (kcal/kg)	2950.00	2900.00	2850.00	2800.00	2750.00
Crude fibre (%)	4.00	4.00	4.00	3.80	3.80
Ether Extracts (%)	4.18	4.43	4.61	4.78	4.93
Calcium (%)	1.44	1.45	1.45	1.46	1.46
Phosphorus (%)	0.74	0.77	0.80	0.82	0.86
Methionine (%)	0.37	0.36	0.35	0.34	0.33
Lysine (%)	1.20	1.21	1.23	1.24	1.25

+Premix: A bio-organics nutrient supplement containing Vit. A 12,500,000 IU; Vit.D3 2,500,000 IU; Vit. E 40,000mg; Biotin 80mg; Vit. B1 3,000mg; Vit.B2 5,500mg; Niacin 55,000mg; Vit.K3 2,000mg; Calcium Pantothenate 11,500mg; Vit. B6 5,000mg; Vit. B 12 25mg; Folic acid 1,000mg; Cholin Chloride 500,000mg; Cobalt 300mg; Copper 8,500mg; Iodine 1,500mg; Iron 100,000mg; Manganese 120,000mg; Selenium 120mg; Zinc 80,000mg; Anti-oxidant 120,000mg.

Table 2: Percentage composition of graded levels of sorghum SK5912 as replacement for maize in broiler finisher diets (5-8 weeks)

Ingredients	Diets				
	1	2	3	4	5
Maize	53.04	39.78	26.52	13.26	0.00
Sorghum(SK-5912)	0.00	13.26	26.52	39.78	53.04
Boiled soya bean	26.16	26.16	26.16	26.16	26.16
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
+ Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100	100	100	100	100
Calculated analysis					
Crude protein (%)	19.50	19.75	20.00	20.25	20.50
ME (kcal./kg)	3000.00	2950.00	2900.00	2850.00	2800.00
Crude fibre (%)	4.24	4.16	4.08	4.00	3.92
Ether Extracts (%)	3.21	3.42	3.57	4.01	4.23
Calcium (%)	1.32	1.32	1.32	1.33	1.33
Phosphorus (%)	0.77	0.80	0.83	0.86	0.89
Methionine (%)	0.49	0.49	0.48	0.47	0.46
Lysine (%)	1.09	1.11	1.12	1.13	1.15

+Premix: A bio-organics nutrient supplement containing Vit. A 12,500,000 I.U; Vit.D3 2,500,000 I.U; Vit. E 40,000mg; Biotin 80mg; Vit. B1 3,000mg; Vit.B2 5,500mg; Niacin 55,000mg; Vit.K3 2,000mg; Calcium Pantothenate 11,500mg; Vit. B6 5,000mg; Vit. B 12 25mg; Folic acid 1,000mg; Cholin Chloride 500,000mg; Cobalt 300mg; Copper 8,500mg; Iodine 1,500mg; Iron 100,000mg; Manganese 120,000mg; Selenium 120mg; Zinc 80,000mg; Anti-oxidant 120,000mg.

Results

Haematology and serum biochemistry of broiler chickens fed graded levels of sorghum (SK-5912) based diets is shown in Tables 3 and 4. The haematological values observed include packed cell volume which ranged between 32.15 (diet 1) to 39.88% (diet 5), white blood cells 245.70 to 257.55 $\times 10^3/\mu\text{L}$ for diets 1 and 5, red blood cells 2.17 to 2.32 $\times 10^6/\mu\text{L}$ for diets 1 and 3, haemoglobin 10.20 to 10.90g/dl on diets 1 and 4 respectively, and mean corpuscular volume (MCV) values ranged between 148.55 to 159.75fl for diets 1 and 5, mean corpuscular haemoglobin (MCH) were between 46.25 to 48.30pg for diets 3 and 4, mean corpuscular haemoglobin concentration (MCHC) values ranged between 29.70 to 31.75g/dl on diets 5 and 1, and platelet 135.00 to 212.75 $\times 10^3/\mu\text{L}$ on

diets 3 and 5, respectively. All of these were not significantly affected by the dietary levels of sorghum SK-5912 variety. The results of the serum biochemical indices observed showed that total protein values ranged between 36.00 to 48.00 g/l on diets 5 and 2, respectively where albumin ranged between 10.50 to 14.00 g/l on diets 4 and 1, and globulin 25.00 to 35.50 g/l for diets 5 and 2. Also values obtained for creatinine are between 2.34 and 7.10 $\mu\text{mol/L}$ on diets 3 and 1, while total cholesterol values were between 2.83 and 7.15 mmol/L on diets 5 and 4, and High Density Lipoprotein values were 1.18 to 2.70 mmol/L on diets 5 and 1, respectively, while Low Density Lipoprotein values of 1.48 to 2.25 mmol/L for 5 and 4, values observed for triglycerides are between 0.50 to 1.90 mmol/L on diets 5 and 1, respectively.

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Similarly, values observed for aspartate amino transferase (ASAT) ranged between 58.75 and 204.00IU/L for diets 5 and 2

respectively, and alanine amino transferase (ALAT) ranged between 14.50 and 68.00IU/L on diet 5 and diets 3 and 4, respectively.

Table 3: Haematological values of broiler chickens fed sorghum SK-5912 based diets

Parameters	Diets					SEM
	1	2	3	4	5	
PCV (%)	32.15	32.98	34.90	34.55	39.88	0.92
WBC ($\times 10^3/\mu\text{L}$)	245.70	250.97	251.25	251.40	257.55	2.52
RBC ($\times 10^6/\mu\text{L}$)	2.17	2.26	2.32	2.26	2.29	0.06
Hb (g/dl)	10.20	10.60	10.70	10.90	10.80	0.26
MCV (fl)	148.55	151.68	150.55	153.20	159.75	3.48
MCH (pg)	47.10	47.43	46.25	48.30	47.35	0.41
MCHC (%)	31.75	31.28	30.75	31.555	29.70	0.64
PLT ($\times 10^3/\mu\text{L}$)	156.50	187.00	135.00	202.50	212.75	33.68 ^{NS}

NS= Not significant, SEM= Standard error of mean, PCV= Packed Cell Volume, RBC= Red Blood Cell, WBC= White Blood Cell, Hb= Haemoglobin Concentration

Table 4: Serum biochemical values of broiler chickens fed sorghumSK-5912 based diets

Parameters	Diets					SEM
	1	2	3	4	5	
Total Protein (g/L)	45.00	48.00	39.50	41.50	36.00	2.81
Albumin (g/L)	14.00	12.50	12.00	10.50	11.00	2.34
Globulin (g/L)	31.00	35.50	27.50	31.00	25.00	2.71
Creatinine ($\mu\text{mol/L}$)	7.10	2.58	2.35	2.60	5.90	1.64
Cholesterol (mmol/L)	5.65	5.18	5.65	7.15	2.83	0.97
HDL (mmol/L)	2.70	2.40	1.45	1.55	1.18	0.22
LDL (mmol/L)	1.50	1.88	2.05	2.25	1.48	0.23
Triglyceride(mmol/L)	1.90	0.95	1.00	1.10	0.50	0.40
ASAT ($\mu\text{mol/L}$)	121.50	204.00	95.50	122.00	58.75	15.54
ALAT ($\mu\text{mol/L}$)	49.50	31.00	68.00	68.00	14.50	9.85
T. Bilirubin ($\mu\text{mol/L}$)	112.55	46.32	68.50	51.90	66.10	18.52
C. Bilirubin ($\mu\text{mol/L}$)	17.55	23.40	34.20	24.00	28.38	3.16

NS= Not significant, SEM= Standard error of mean, ASAT= Aspartate Amino Transferase, ALP= Alkaline Amino Transferase

Discussion

The blood constituents are the biochemical medium of transportation in all animals and thus its profile shows the health status of the birds. The haematological and serum biochemical indices showed non-significant effect among the treatment groups in all the parameters measured. Kwari *et al.* (2014) obtained similar results for packed cell volume (PCV), red blood cells (RBC) counts, white blood cells (WBC) counts and haemoglobin (Hb) concentration with broiler chickens fed maize, sorghum and millet and their

combinations. This observation showed that sorghum SK-5912 was not toxic or detrimental to broiler chickens. Although, the values obtained on MCV was higher, while those on MCH and platelet were lower compared to the normal values reported by Merck (2012). The values obtained for some haematological parameters were within the normal ranges of 25.00-45.00% for PCV and 7.00-13.00g/dL for Hb concentration in chickens as reported by Ayo *et al.* (1996) and Olodele *et al.* (2000) cited by Opoola *et al.* (2013) and by Swenson (1977) and Anon (1980)

indicating that the birds were adequately nourished and thus not anaemic or showing any sign of disease infection or parasite infestation. The serum biochemical indices also showed no significant differences among the treatment groups. Although, the total serum protein values were higher than the range of 16.00-34.00g/dL reported by Kwari *et al.* (2011) for broiler chickens, and since total protein is usually a reflection of the protein quality of feed (Eggum, 1970) and thus higher values obtained indicated that the protein levels were sufficient to sustain the normal protein level in the blood of the birds. The AST and ALT enzymes were also similar across the dietary treatments and not beyond the threshold which may be an indication of a better quality protein in the test diet (Babatunde *et al.* 1987). This observation indicates that Sorghum SK-5912 did not have any adverse effect on blood parameters measured in this study.

Conclusion

The results of haematological and serum biochemical indices obtained in this study revealed that Sorghum SK-5912 variety can be used as source of dietary energy in broiler chickens without adverse effect on the health of the birds. Its production should be encouraged, thus its utilization in poultry diets will improve the feed supply system at affordable cost.

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