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Research Paper

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Haematology and Serum Chemistry of Local Grower Turkeys Fed Diets Containing Samsorg17 and ICSV400 Varieties of Sorghum

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ABSTRACT

Turkeys are of considerable economic and social significance to the traditional life of Nigerians but its production has been hampered by high cost of feedstuff. This study was carried out to determine the haematological parameters and serum chemistry of local grower turkeys fed Samsorg 17 and ICSV 400 sorghum varieties as replacement for higher cost maize in their diet. One hundred six weeks old grower turkeys were divided into nine groups of three replicates each on sex and weight equalization basis. The groups were randomly assigned to nine experimental turkey grower diets containing 0, 25, 50, 75 and 100% replacement level of maize with each of samsorg17 and ICSV400 varieties of sorghum. The feeding trial lasted 42 days. Six turkeys were randomly selected on trial day 38, blood samples were collected for haematological and serum biochemical analysis. RBC, HB, WBC and PCV were determined while MCHC, MCH AND MCV were calculated using appropriate formulae. Serum protein (albumin and globulin), sugar, cholesterol, urea, minerals and enzymes were also determined. The result indicated that only WBC count was higher and the serum sugar and creatinine was lower than normal range. The ALP level declined while SGPT increased with increasing dietary sorghum but SGOT followed no pattern. There was no observed adverse effect on the blood parameters of experimental grower turkeys fed these sorghum varieties and is therefore recommended as replacement for maize in their diets.

Key words: Blood Chemistry, Haematology, Maize, Sorghum, Turkey

INTRODUCTION

Due to high cost, only the rich minority consumed turkey meat in Nigeria compared to developed countries (Abeke et al., 2004). However, importation of cheaper frozen turkey meat aroused interest in turkey meat consumption among Nigerians before their eventual ban by Government in 2003 (Okoli et al., 2006). These circumstances seem to have awakened local poultry farmers' interest in turkey production. Even with this, turkey production in Nigeria has remained at smallholder level due largely to high cost of feed, inconsistency in feeding programme, lack of knowledge of the adequate levels of nutrient requirements, unavailability of poults and longer rearing period (Ojewola et al., 2002). Adene and Oguntade (2006) reported that about 63,735 households in Nigeria keep turkeys at subsistence level with 43 birds as the highest flock size. This is the case even when turkey production has advantage over other classes of poultry in terms of meatiness, appealing organoleptic properties, faster growth rate and command of premium price in relation to other poultry products (Peter et al., 1997).

Considering the awakened interest of local farmers and the advantages inherent in turkey production, there is the need to intensify research into various aspects of tropical turkey nutrition management, especially in Nigeria where a growing market has been identified (Ojewola et al., 2002; Tanko and Ojewola, 2003; Ojo et al., 2005; Etuk, 2008), to provide cheaper feedstuff. Although turkeys have been of considerable economic and social significance in the traditional life of Nigerians, only two breeds, pure local breed (51.6%) and cross-breeds (48.4%) have been identified (Peters et al., 1997). For optimal growth of these breeds 24% (Oluyemi and Roberts, 2000) and 23% (Olomu, 1995 and Ogundipe and Dafwang, 1986) crude protein for grower turkey diet were recommended.

Sorghum [Sorghum bicolour (L) Moench] is widely grown in the semi-arid and savannah regions of Nigeria. Nigeria was ranked the third largest producer of sorghum in the world with about six million tonnes of grains produced from 5.7 million hectares of land (ICRISAT, 2000). Feeding turkeys with sorghum as a replacement for maize which is more costly in Nigeria has been recommended (Etuk et al., 2012), since there is no significant difference in the body weight gain and feed efficiency when compared to other grains (Dosay, 1993). Abubakar et al. (2006) earlier reported similarly that sorghum is cheaper than maize in the northern part

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of Nigeria. Sorghum grains contain about 92.50% dry matter, 3270 kcal/kg metabolizable energy for poultry, 9.5% crude protein, 2.55% ether extract, 2.70% crude fibre, 1.25% ash and 76.6% Nitrogen-Free Eextract. Some varieties of sorghum have been reported to contain tannin, an antinutritional factor that binds protein and impairs digestion (Aduku, 1993; Olomu, 1995; Aletor, 1999; Etuk and ukaejiofor, 2007). Some improved varieties of sorghum have been developed by the International Crop Research Institute for the Semi Arid tropics (ICRISAT), Kano centre and the Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU), Zaria, Nigeria. These are the yellow coloured Samsorg 17 and the cream coloured ICSV 400 varieties. The utilization of these improved varieties will improve the feed supply system at affordable cost. However, it is important to investigate the health and physiological implication of these varieties of sorghum on the birds particularly when it has been established that feed and feed components affect body constituents (Harper et al., 1979).

This study was carried out to determine the dietary effect of Samsorg 17 and ICSV 400 varieties of sorghum on the blood chemistry and haematological parameters of grower turkeys.

MATERIALS AND METHODS

Experimental Sites

The study was carried out at the Poultry Unit of the School of Agriculture and Agricultural Technology (SAAT) Teaching and Research Farm, Federal University of Technology, Owerri (FUTO), Imo State, Nigeria. The haematological and serum biochemical analysis were conducted at the Federal Medical Centre, Owerri. Imo state is located in the South – eastern agro-ecological zone of Nigeria Owerri, the capital of Imo State lies between latitude 404’ and 603’ N and longitude 6015’ and 8015’ E.. Owerri is about 91m above sea level with annual rainfall, temperature and humidity ranging from 2300 – 2700, 26.5 – 27.5 and 80– 90%, respectively.

Annual evapotranspiration is 1450 mm and soil pH ranges from 4.9 to 5.5. Owerri has a three-month dry season duration (i.e. months with less than 65 mm rainfall) and this is the period from December – February (MLS Atlas, 1984; Ibeawuchi et al., 2005; Ibeawuchi et al., 2007).

Experimental Materials

Day old White (90%) and mixed (10%) coloured plumage local turkeys were sourced from a local hatchery in Owerri, Imo State. The test materials, yellow coloured Samsorg 17 and the cream coloured ICSV 400 sorghum varieties were sourced from the Institute for Agricultural Research, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Other feed ingredients, yellow maize, soybean meal, palm kernel cake, wheat offal, fish meal, blood meal, bone meal, oyster shell, vitamins/mineral premix, methionine, lysine and common salt were sourced locally from Ceekings Farm and Feed Mills Ltd., Egbu, Owerri, Nigeria.

Chemical Analysis of Experimental test materials

The Samsorg 17 and ICSV 400 varieties of sorghum were analysed for proximate composition, gross energy value and tannin contents.

Proximate Analysis

Samsorg 17 and ICSV 400 varieties of sorghum were hammer milled (2 mm sieve size) and samples analysed for proximate composition (crude protein, crude fibre, ether extract, ash and dry matter) according to standard procedures (AOAC, 1995). Nitrogen– free extracts were obtained by difference. The nitrogen content was determined by the Micro-kjedahl method using the Foss Tecator Kjeltec distilling system 2006 digester and crude protein taken as %N × 6.25 (Pearson, 1976).

Energy Value Determination

Gross energy of the test materials was determined using the Gallenkamp® Ballistic bomb calorimeter. The metabolisable energy values of sorghum were determined by the equation outlined by Janssen (1989) viz:ME (kcal/kg) = 38.55 × DM – 394.59 tannic acid.

Tannin Determination: The tannin content was determined by the method of Markkar and Goodchild (1996).

Experimental diets and analysis

Nine experimental turkey grower diets were formulated such that Samsorg 17 (G) and ICSV 400 (V) varieties of sorghum respectively replaced 0% (G0), 25% (GG25, GV25), 50% (GG50, GV50), 75% (GG75, GV75) and 100% (GG100, GV100) of maize in the diets (Table 1). The chemical composition of the diets were calculated from standard values (Aduku, 2004) and thereafter analysed for proximate composition (AOAC, 1995).

Experimental Design and Management of Experimental birds

A 2 × 5 factorial arrangement in a completely randomized design (CRD) was employed in this study. One hundred and eight (108) 42 day old (six weeks) local turkeys were selected and divided into 9 groups of twelve birds each. Each of the nine groups was subdivided into 3 replicates of 4 turkeys (2 males and 2 females) each on weight equalization basis (Zdunczyk et al., 2002). Each replicate was housed in a compartment measuring 3.3m × 1.7m in an open-sided poultry house. The nine experimental turkey groups were randomly assigned to the nine experimental turkey grower diets. Feed and water were offered ad-libitum. Routine vaccinatiions and multivitamins were administered.

Determination of Haematological and Serum Biochemical Characteristics of the Experimental Turkeys: On the 38th day of the study (birds were 80 days old), between 7 AM and 9 AM. 3 male and 3 female grower turkeys were randomly selected from each dietary treatment group, giving 6 turkeys per

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treatment group. Three ml of blood was collected from the sub-clavical vein of each bird using a scalp vein needle set after swabbing with methylated spirit and quickly transferred into EDTA vial bottles. The blood was mixed with the EDTA by gently inverting the bottle repeatedly after which it was subjected to haematological analysis. A second set of birds (one each per replicate) were selected and about six ml of blood was similarly collected from each bird. One ml of the blood was put into fluoride treated vial bottle for determination of blood sugar while five ml of blood were put into vial bottles with no anticoagulant for determination of serum biochemical parameters. Samples were immediately taken to the laboratory for analysis.

Haematological Assay

RBC count was determined using the improved Neubauer ruled chamber after previously diluting 0.02ml of blood mixed with anticoagulant with 4.0ml of formaldehyde citrate solution; while the sahli method was used in estimating haemoglobin (WHO, 1980). White blood count was determined using charged improved Neubauer counting chamber (Baker and Silvertan, 1985). PCV was determined by the microhaematocrit method (Schalm, 1965). MCHC, MCH and MCV were computed using appropriate formulae (Jain, 1986).

Blood Chemistry Assay

The total serum protein was determined using the photometric method (Biuret method) based on the violet-blue complex formed by copper ions with serum protein in the presence of an alkaline solution. The bromocresol green (BCG) method was employed to determine the serum albumin (Henry, 1974b). This Serum Globulin was determined by difference (Serum globulin = Total serum protein– serum albumin). Serum sugar was determined by the Trinder method (Trinder, 1959) using the glucose oxidase reagent Q-kit (phenol free). Serum Cholesterol was determined by the Ferric chloride-sulphuric acid reaction (modified Leffler method) (Elletson and Caraway, 1970). Serum Creatinine was determined quantitatively by the modified endpoint method (Heinegard and Tiderstrom, 1973).

Serum urea was determined by the modified Berthelot method (Tietz, 1976). The colorimetric method was employed to determine the amount of Sodium in the serum (Tietz, 1976). The modified colorimetric method of Skeggs and Hochestrasser (1964) was used to determine chloride content of serum. Serum potassium was determined by the colorimetric method (Tietz, 1976) while Bicarbonate concentration in serum was measured by the spectrophotometric procedures (Natelson, 1951). Serum Glutamate Oxaloacetate Transferase (SGOT) was determined by the modified colorimetric method (Henry, 1974b). ALP reagent set was used to determine the Alkaline Phosphatase value of serum by the colorimetric endpoint method (Kochmar and Moss, 1976). Serum Glutamate Pyruvate Transferase (SGPT) was determined by the colorimetric method based on dinitrophyenylhydrazine formation (Henry, 1974a).

Data Analysis

Data collected were subjected to factorial analysis of variance (ANOVA) with sorghum varieties and dietary levels as factors (Little and Hills, 1978) and where significant differences were detected, means were compared using the Duncan's New Multiple Range Test (DNMRT) at 5% confidence interval using the Statistical Analysis System (SAS Inc, 1999).

Table 1. Composition of the experimental turkey grower diets

Ingredients	Replacement level (s) of sorghum for maize (%)								
	Control	Samsorg 17				ICSV 400			
	G_0	GG_{25}	GG_{50}	GG_{75}	GG_{100}	GV_{25}	GV_{50}	GV_{75}	GV_{100}
Maize	52.00	39.00	26.00	13.00	0.00	39.00	26.00	13.00	0.00
Sorghum	0.00	13.00	26.00	39.00	52.00	13.00	26.00	39.00	52.00
Soybean meal	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
Palm kernel cake	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Wheat offal	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Blood meal	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit/min premix*	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Common salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
L – Methionin	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
L – Lysin	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
****Calculated chemical composition of the experimental diets**									
ME (kcal/kg)	2874.98	2856.41	2832.86	2811.80	2790.74	2856.41	2832.86	2811.80	2790.74
Crude protein	24.06	24.14	24.22	24.29	24.37	24.14	24.22	24.29	24.37
Ether extract	4.00	3.85	3.69	3.54	3.38	3.85	3.69	3.54	3.38
Crude fibre	4.16	4.06	3.97	3.88	3.79	4.06	3.97	3.88	3.79
Calcium	1.08	1.09	1.09	1.09	1.09	1.09	1.09	1.09	1.09
Phosphorus	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Lysine	1.56	1.54	1.52	1.51	1.48	1.54	1.52	1.51	1.48
Methionine	0.76	0.77	0.78	0.80	0.82	0.77	0.78	0.80	0.82

** Computed from standard values (Aduku, 2004); *Vital® grower premix (Grand Cereals and Oil Mills Ltd.). Each 2.5 kg per 1000 kg feed contains: Vit A, 8,000,000 IU; Vit D3, 2,400,000 IU; Vit. E , 8,000 IU; Vit K , 2,400 mg; Thiamine (B1) , 2,400 mg; Riboflavin (B2), 4,800 mg; Pyridoxine (B6), 3,300 mg; Niacin, 24,000 mg; Vit B12, 16 mg; Pantothenic acid , 10,000 mg; Folic acid, 640 mg; Biotin, 40 mg; Choline chloride, 160 mg; Antioxidant, 20,000 mg; Manganese, 80,000 mg; Zinc, 80,000mg; Iron, 60,000mg; Copper, 20,000mg; Iodine, 500mg; Selenium, 300mg; Cobalt, 150mg; Magnesium, 80,000mg.

RESULTS AND DISCUSSION

Chemical Composition of Experimental Turkey Grower Diets

Calculated crude protein values increased with increasing dietary sorghum (24.06– 24.37%) (Table 2) and were within the recommended levels (ARC, 1975; Aduku, 1993; NRC, 1994). Determined crude protein values of the diets also followed the same trend and ranged from 23.43– 24.97%) (Table 2). Diets containing ICSV 400 sorghum contained higher crude protein values than those containing samsorg 17. This reflected the crude protein content of the two varieties of sorghum. Only the control diet (G0) and diet GG25 recorded a determined crude protein of less than 24% possibly due the higher dietary level of maize which is known to possess a lower crude protein that sorghum.

Haematological Characteristics of the Grower Turkeys

The effects of dietary levels of samsorg 17 and ICSV 400 on the haematological characteristics of the grower turkeys are presented in Table 3 while the effects of varieties are presented in Tables 4. Mean RBC count ranged from 3.60 to 3.95 x 106/µl Turkeys on diet GG75 recorded the lowest RBC count (3.60 x 106/µl) while those on diet GV100 recorded the highest value (3.95 x 106/µl). The differences between these values were the only ones that differed significantly (p < 0.05) (Table 3). Turkeys on samsorg 17 recorded a slightly lower RBC count (3.75 x 106/µl) than those on ICSV 400 (3.80 x 106/µl) (Table 4). A definite pattern among dietary levels of sorghum was not apparent but the values were similar to 3.8 x 106/µl reported by Bamgbose et al. (2007). These values were indicated the health conditions of the birds. Mean Hb ranged from 11.15 to 11.80g/dl. These values were similar to the 11.0– 11.4g /dl reported for turkeys (Aiello and Mays, 1998; Bamgbose et al., 2007). Hb values increased from diet GV25 to GV75 and declined (p > 0.05) at GV100 (Table 3). Samsorg 17 recorded a slightly lower Hb value than ICSV 400 (Table 4). This shows that the turkeys were well fed (Aiello and Mays, 1998), with iron sufficiently supplemented (Graifier et al., 1981; Kerr et al., 1982). Mean WBC count ranged from 160 – 193 x 103/µl (Table 3). These values were much higher than 10 – 46 x 103/µl reported for pen-reared wild turkeys (Bounous et al, 2000). Turkeys on samsorg 17 recorded higher mean WBC counts than those on ICSV 400 (Table 4).

Table 2. Determined proximate composition of experimental turkey grower diets (%DM)

Nutrient	Control	Samsorg 17				ICSV 400			
	G_0	GG_{25}	GG_{50}	GG_{75}	GG_{100}	GV_{25}	GV_{50}	GV_{75}	GV_{100}
Dry matter	91.51	91.56	91.45	91.45	90.82	91.41	91.13	91.21	91.00
Crude protein	23.43	23.80	24.07	24.46	24.76	24.00	24.36	24.90	24.97
Ether extract	4.22	4.00	4.00	3.96	3.92	4.35	4.31	4.31	4.28
Crude fibre	4.32	4.36	4.44	4.53	4.57	4.58	4.66	4.74	4.75
Ash	8.32	8.43	8.64	8.86	8.90	8.67	8.76	8.81	9.00
NFE	59.71	59.40	58.95	58.19	57.85	58.40	57.87	57.25	57.00

G0 = 0% sorghum, GG25 = 25% samsorg 17, GG50 = 50% samsorg 17, GG75 = 75% samsorg 17, GG100 = 100% samsorg 17 sorghum replacements of maize in turkey grower diets; GV25 = 25% ICSV 400, GV50 = 50% ICSV 400, GV75 = 75% ICSV 400, GV100 = 100% ICSV 400 sorghum replacements of maize in turkey grower diets

Table 3. Effects of dietary levels of Samsorg 17 and ICSV 400 varieties of sorghum on haematological characteristics of grower turkeys

Parameters	Control	Samsorg 17				ICSV 400				SEM
	G_0	GG_{25}	GG_{50}	GG_{75}	GG_{100}	GV_{25}	GV_{50}	GV_{75}	GV_{100}	
RBC (x 10^6/µl)	3.77^{ab}	3.72^{ab}	3.85^{ab}	3.60^{b}	3.82^{ab}	3.90^{ab}	3.70^{ab}	3.65^{ab}	3.95^{a}	0.116
Haemoglobin (g/dl)	11.35^{ab}	11.15^{a}	11.20^{ab}	11.15^{a}	11.15^{a}	11.35^{ab}	11.50^{ab}	11.80^{b}	11.35^{ab}	0.213
WBC (× 10^3/µl)	163.50^{ab}	155.00^{a}	155.00^{a}	179.00^{b}	162.00^{ab}	161.50^{ab}	158.50^{a}	177.50^{bc}	159.00^{ac}	6.300
MCHC (g/dl)	31.95^{a}	30.97^{ab}	30.65^{b}	30.06^{b}	30.13^{b}	30.24^{b}	31.01^{ab}	30.61^{b}	30.64^{b}	0.411
MCH (Pg)	30.25^{ab}	29.82^{ab}	29.04^{ab}	31.00^{ab}	29.53^{ab}	29.75^{ab}	31.09^{ab}	32.52^{a}	28.74^{b}	1.177
MCV (fL)	95.09^{a}	99.00^{ab}	94.89^{a}	103.75^{ab}	99.84^{ab}	99.11^{ab}	100.88^{ab}	107.13^{b}	93.88^{a}	3.076
PCV (%)	36.50	36.00	36.50	37.00	37.00	37.50	37.00	38.50	37.00	0.707^{ns}

a,b,c Means within a row with different superscripts are significantly different ($p < 0.05$); ns = not significantly different ($p > 0.05$)
G_0 = 0% sorghum (control); GG_{25} = 25% samsorg 17, GG_{50} = 50% samsorg 17, GG_{75} = 75% samsorg 17, GG_{100} = 100% samsorg 17 sorghum replacements of maize, respectively; GV_{25} = 25% ICSV 400, GV_{50} = 50% ICSV 400, GV_{75} = 75% ICSV 400, GV_{100} = 100% ICSV 400 sorghum replacements of maize, respectively

Table 4. Effects of sorghum varieties based diets on hematological characteristics of grower turkeys

Parameters	Samsorg 17	ICSV 400	SEM
RBC (× 10^6/µl)	3.75	3.80	0.035^{ns}
Haemoglobin (g/dl)	11.16	11.50	0.170^{ns}
WBC (× 10^3/µl)	162.70	160.60	0.074^{ns}
MCHC (g/dl)	30.47	30.62	0.053^{ns}
MCH (Pg)	30.24	30.52	0.114^{ns}
MCV (fl)	99.37^{a}	100.29^{b}	0.265
PCV (%)	36.62^{a}	37.50^{b}	0.254

a,b Means within a row with different superscripts are significantly different ($p < 0.05$) ns = not significantly different ($p > 0.05$)

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Talebi et al. (2005) suggested that the low leucogram of exotic strains could be a reason behind their high susceptibility to avian pathogenic agents when compared with indigenous chickens which are relatively resistant to poultry diseases. It is also probable that the turkeys might have been reacting to a chronic pathogenic invasion or stress or vaccine administered since elevated WBC including lymphocytosis is associated with these factors (Shapiro and Schechtma, 1949; Beisel, 1977). Mean MCHC, MCH and MCV values ranged from 30.06– 31.95g/dl, 28.74– 32.52Pg and 93.88– 103.75fl respectively (Table 3). The MCHC and MCH values were close to the normal values of 29% and 30.0 Pg respectively and MCV values were within the normal range of 89– 203fl (Aiello and Mays, 1998; Bamgbose et al., 2007). MCHC value was highest with diet G0 which was similar ($p > 0.05$) to the values of those on diets GG25 and GV50. Significantly ($p < 0.05$) higher MCV values were recorded among turkeys fed ICSV 400 than those on samsorg 17 (Table 4). MCHC values obtained did not conform to the report of Edozien and Swtizer (1977) that increase in MCHC is synonymous with low energy and high protein diet. The PCV values ranged from 36.0– 38.50% (Table 3). These values were within the 31– 42% reported for juvenile wild turkeys (Bounous et al., 2000) and slightly below the 39% reported for domestic turkeys (Aiello and Mays, 1998), however, it is probably that the slightly higher crude protein value of ICSV 400 sorghum might have elicited the higher PCV values.

Serum Biochemical Characteristics of Experimental Grower Turkey

Table 5 show the effects of dietary levels of Samsorg 17 and ICSV 400 on serum biochemical characteristics of the grower turkeys. Effects of sorghum varieties are presented in tables 6. Mean total serum protein values ranged from 3.9– 4.40 g/dl. These values were similar to values reported in wild juvenile turkeys (Bounous et al., 2000), adult white England turkeys (Makinde and Fatunmbi, 1985) and 14 week old BUT stag 9 turkeys (Ojo et al., 2005). However, the values were lower than 4.7g/dl reported for 12 weeks old Nigerian local turkeys (Nneji, 2006). Albumin and globulin values were 1.2– 2.0 g/dl and 2.4– 2.7 g/dl, respectively. Total serum protein and globulin did not reflect dietary trends. Since serum protein and albumin depend on availability of protein (Hoffenberg et al., 1966), it is possible that protein metabolism was a problem in the sorghum diets. Elevation of serum protein with dietary sorghum was not observed in this study which differed from the observations of Bamgbose et al. (2007) in young turkeys fed whole wheat in replacement for maize. Serum sugar values were 129.00– 133.00 mg/dl (Table 3), lying below the 215– 500 mg/dl reported for 16 week old juvenile wild turkeys (Bounous et al, 2000) and 227.83g/dl for native chickens (Rampori and Igbel, 2007). Turkeys on samsorg 17 recorded significantly ($p < 0.05$) higher serum sugar value than those on ICSV 400 diets. The narrow range of blood sugar values though lower than reported values indicated the ability of grower turkeys to maintain a relatively stable blood sugar level (Liukkonen – Anttila, 2001). Serum urea values of 7.20– 7.50 mg/dl were observed (Table 5). These values were within 3– 17 mg/dl reported for 16 week old wild turkey (Bounous et al., 2000) and higher than 4.10 mg/dl reported for 16 week domesticated turkeys (Bamgbose et al., 2007). Blood urea is reported to be influenced by dietary protein quantity, quality and bleeding time (Eggum, 1970, Karasawa, 1989). It would appear that the increased dietary protein with sorghum had a positive influence on serum urea (Yokozawa et al., 1991). Higher dietary tannin and poor dietary protein utilisation have however been implicated in depressed blood urea (Eggum, 1970; Wildeus et al., 2004). Cholesterol values of 119– 121.00 mg/dl were observed in this study (Table 5). This falls within the 60– 220mg/dl reported for turkeys (Bounous et al, 2000) and below 150 mg/dl, 155.29 mg/dl and 156 mg/dl reported for 6, 12 and 16 weeks old turkeys, respectively (Iwuchukwu, 2006; Bamgbose et al., 2007). Turkeys on samsorg 17 recorded a significantly ($p < 0.05$) higher cholesterol value (121.0mg/l) than those on ICSV 400 (120.0g/dl) (Table 6). The generally lower cholesterol values recorded in this study might be due to seasonal variations (Lisano and Kennamer, 1977). Creatinine values were observed to range from 0.80– 1.30 mg/dl. These values were low but close to 1.25 and 1.40 mg/dl reported, respectively for 14 week old and 16 week old turkeys (Ojo et al, 2005a; Bamgbose et al, 2007). This disparity in serum creatinine values might have been induced by age since the values were still within the reported range for older turkeys. A major source of excess creatinine in blood of animals is from the muscle when wasting occurs and creatine phosphate is catabolised (Bell et al., 1972). Quantity and quality of protein also affect serum creatinine content (Iyayi and Tewe, 1998).

Calcium, Phosphorus Sodium, potassium, chloride and bicarbonate values were 4.7– 5.8 mg/dl, 2.10– 3.20 mg/dl, 113– 121 mmol/l 1.2– 1.7 mmol/l, 56– 63 mmol/l and 18– 21 mmol/l respectively (Table 5). Turkeys on samsorg 17 diets recorded significantly ($p < 0.05$) lower calcium and phosphorus values than those groups on ICSV 400 (Table 5). Dietary influences were not distinctively apparent in all mineral parameters recorded in this study. Alkaline phosphatase (ALP), serum glutamate pyruvate transferase (SGPT) and serum glutamate oxaloacetae transferase (SGOT) values were 13.59– 20.90 IU/l, 12– 16 IU/l and 50– 61 IU/l, respectively (Table 5). These values were slightly below the values reported for 12 week old local turkeys (Iwuchukwu, 2006). There was a consistent decline in ALP value with dietary level of sorghum while SGOT followed a reverse trend increasing with dietary level of sorghum. SGPT however did not show a definite pattern. The increasing SGOT with increasing dietary sorghum agrees with the findings of Ojo et al (2005a). Olayemi et al. (2002) reported significant increases in SGOT and ALP in young chickens than adult birds. Only SGOT values reflected these findings probably because of the closeness of the age of the turkeys. There is a correlation between levels of SGPT and growth performance characteristics.

Table 5. Effects of dietary levels of Samsorg 17 and ICSV 400 varieties of sorghum on serum biochemical parameters of grower turkeys

Parameters	G_0	Samsorg 17				ICSV 400				SEM
		GG_{25}	GG_{50}	GG_{75}	GG_{100}	GV_{25}	GV_{50}	GV_{75}	GV_{100}	
Total serum protein (g/dl)	4.40^{a}	4.30^{a}	4.20^{ab}	4.30^{a}	4.20^{ab}	4.10^{ab}	4.30^{a}	4.20^{ab}	3.90^{b}	0.103
Serum Albumin (g/dl)	2.00^{a}	1.90^{a}	1.70^{a}	1.80^{a}	1.60^{ab}	1.70^{a}	1.60^{ab}	1.60^{ab}	1.20^{b}	0.162
Serum Globulin (g/dl)	2.40^{a}	2.40^{a}	2.50^{ab}	2.40^{a}	2.60^{ab}	2.40^{a}	2.70^{b}	2.60^{ab}	2.70^{b}	0.092
Sugar (mg/dl)	130.00^{ab}	132.00^{ab}	131.00^{ab}	130.00^{ab}	130.00^{ab}	133.00^{b}	130.00^{ab}	129.00^{a}	129.00^{a}	1.257
Urea (mg/dl)	7.20	7.40	7.30	7.50	7.50	7.40	7.50	7.30	7.50	0.125^{ns}
Cholesterol (mg/dl)	121.00^{ab}	121.00^{ab}	122.0^{b}	120.00^{ab}	121.00^{ab}	121.00^{ab}	120.00^{ab}	120.00^{ab}	119.00^{a}	0.881
Creatinine (mg/dl)	1.10^{ab}	1.30^{a}	1.20^{ab}	0.90^{ab}	0.80^{b}	1.30^{a}	1.00^{ab}	0.90^{ab}	0.80^{b}	0.142
Calcium (mg/dl)	5.20^{ab}	5.10^{ab}	4.90^{ac}	5.30^{ab}	5.10^{ab}	5.80^{b}	5.70^{bc}	5.80^{b}	4.70^{a}	0.282
Phosphorus (mg/dl)	2.50^{ab}	2.30^{ab}	3.10^{a}	2.40^{ab}	2.70^{ab}	2.50^{ab}	2.10^{b}	3.00^{a}	3.20^{a}	0.270
Sodium (mmol/L)	120.00^{a}	112.00^{b}	113.00^{b}	116.00^{ab}	115.00^{ab}	118.00^{ab}	117.00^{ab}	115.00^{ab}	121.00^{a}	2.005
Potassium (mmol/l)	1.20^{a}	1.70^{b}	1.50^{ab}	1.50^{ab}	1.40^{ab}	1.40^{ab}	1.30^{ab}	1.20^{a}	1.60^{ab}	0.161
Chloride (mmol/l)	65.00^{a}	62.00^{ab}	63.00^{ac}	58.00^{bc}	61.00^{ab}	58.00^{bc}	60.00^{ab}	56.00^{b}	58.00^{bc}	2.051
Bicarbonate (mmol/l)	20.00^{ab}	19.00^{ab}	21.00^{a}	20.00^{ab}	21.00^{a}	21.00^{a}	18.00^{b}	20.00^{ab}	19.00^{ab}	0.745
Alkaline phosphatase (ALP) (IU/l)	20.90^{a}	17.45^{ab}	16.23^{b}	14.81^{b}	13.59^{b}	15.42^{b}	15.87^{b}	16.65^{b}	15.01^{b}	1.477
SGPT (IU/l)	16.00	15.00	14.00	14.00	15.00	12.00	14.00	15.00	16.00	1.547^{ns}
SGOT (IU/l)	50.00^{a}	50.00^{a}	51.00^{a}	53.00^{ab}	58.00^{ab}	55.00^{ab}	59.00^{ab}	61.00^{b}	61.00^{b}	3.230

[a,b,c] Means within a row with different superscripts are significantly different ($p < 0.05$)ns = not significantly different ($p > 0.05$)
G_0 = 0% sorghum (control); GG_{25} = 25% samsorg 17, GG_{50} = 50% samsorg 17, GG_{75} = 75% samsorg 17, GG_{100} = 100% samsorg 17 sorghum replacements of maize, respectively; GV_{25} = 25% ICSV 400, GV_{50} = 50% ICSV 400, GV_{75} = 75% ICSV 400, GV_{100} = 100% ICSV 400 sorghum replacements of maize, respectively

Table 6. Effects of sorghum varieties based diets on serum biochemical parameters of grower turkeys

Parameters	Samsorg 17	ICSV 400	SEM
Total serum protein (g/dl)	4.25	4.12	0.065^{ns}
Serum Albumin (g/dl)	1.75^{a}	1.52^{b}	0.073
Serum Globulin (g/dl)	2.46^{a}	2.60^{b}	0.044
Sugar (mg/dl)	130.60^{a}	129.50^{b}	0.317
Urea (mg/dl)	7.42	7.42	0.000^{ns}
Cholesterol (mg/dl)	121.00^{a}	120.00^{b}	0.289
Creatinine (mg/dl)	1.06	1.00	0.021^{ns}
Calcium (mg/dl)	5.10^{a}	5.50^{b}	0.115
Phosphorus (mg/dl)	2.65^{a}	2.70^{b}	0.014
Sodium (mmol/l)	115.20	117.75	1.042^{ns}
Potassium (mmol/l)	1.52	1.37	0.061^{ns}
Chloride (mmol/l)	61.00	58.00	1.226^{ns}
Bicarbonate (mmol/l)	20.25	19.50	0.306^{ns}
Alkaline phosphatase (ALP) (IU/l)	15.52	14.25	0.085^{ns}
SGPT (IU/l)	14.50	14.75	0.102^{ns}
SGOT (IU/l)	53.00^{a}	59.00^{b}	1.560

[a,b] Means within a row with different superscripts are significantly different ($p < 0.05$); ns = not significantly different ($p > 0.05$)

However, low energy diet could also elicit increased SGPT and SGOT values (Bassey et al., 1946). Higher levels of SGPT and SGOT not beyond the threshold may be an indication of a better quality protein (Babatunde et al., 1987; Oluwole-Banjo et al, 2001), beyond the threshold, liver damage and bone marrow demineralisation might be implicated (Ekpenyong and Biobaku, 1986). The enzymes values recorded in this study did not, however, fall beyond the threshold. Therefore any variation might be attributed substantially to the turkey's ability to utilise the higher crude protein in the diet which was reflected somewhat in the growth performances.

CONCLUSION

In conclusion, the two varieties of sorghum appear to have been well tolerated by the experimental grower turkeys since much variation were not observed on their haematological and serum biochemical parameters from the normal ranges. It is therefore recommended that these varieties of sorghum could be used to replace maize in the diet of grower turkeys in Nigeria.

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