INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

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HEMATOLOGY AND SEROLOGY OF BROILER CHICKENS FED MAIZE, SORGHUM AND MILLET AND, THEIR COMBINATIONS IN THE SEMI ARID ZONE OF NIGERIA

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ABSTRACT
The effects of feeding maize, low tannin sorghum, millet and their combinations on hematological and serum biochemical indices of broiler chickens was investigated in the semi- arid zone of Nigeria. Two hundred and seventy (270), 14 days old broiler chicks were randomly allotted to six experimental diets in which 100% maize (T1), 100% low tannin sorghum (T2), 100% millet (T3), 50% maize and 50% sorghum (T4), 50% maize and 50% millet (T5) and 50% sorghum and 50% millet (T6) served as the main energy sources in a feeding experiment that lasted forty two (42) days. Results from blood analysis indicated that there were no treatment effects on Red Blood Cell (RBC) count, haemoglobin concentration (Hb), Packed Cell Volume (PCV), Monocytes and basophils. Similarly, except for total protein (TP), Aspartate Amino Transferase (ASAT) and hydrogen bicarbonate (HCO_3), there were no significant treatment effects among all the treatment groups for serum biochemical indices. This study therefore revealed that maize, sorghum, millet and their combinations can be used interchangeably as energy sources in broiler chicken diets without adverse effects on the haematological and serum biochemical parameters of the birds.

KEY WORDS: Hematology, Serology, Broiler, Chickens, Maize, Sorghum, Millet.

INTRODUCTION

Maize which forms the major energy source for poultry in Nigeria is becoming scarce and expensive because of the decline in its production due to unfavorable climate (Kwari *et al*., 2011). This calls for an urgent search for alternative energy sources which are readily available. Parthasarathy *et al*. (2005) and Issa *et al*. (2007) reported that sorghum grains could play an important role in poultry feeds in West Africa. Similarly, Dowling *et al*. (2002) and Travis *et al*. (2006) have shown that sorghum could be a suitable feedstuff in the poultry industry. Cromwell and Coffely (1993) exonerated millet from the anti nutritional properties (phytate and tannins) which were found in sorghum. Millet has no tannins but contains 5-7% oil and higher protein and minerals than maize (NRC, 1996). Medugu *et al*. (2010) replaced maize with sorghum and millet grains in broiler chickens diets and reported no difference in performance. This study was conducted to compare the hematology and serology of broiler chickens fed maize, sorghum and millet and, their combinations in the semi arid zone of Nigeria.

MATERIALS & METHODS

Study site

The study was conducted at the Poultry unit of the University of Maiduguri Livestock Teaching and Research Farm Maiduguri, Nigeria during the months of March-April, 2013. The area falls within the semi arid zone with an annual rainfall of 500-700 mm and the ambient temperature reaches 40 ^{0}C and above during the months of April and June (Piller, 1986).

Sources of maize, sorghum and millet

White maize, white sorghum (low tannin) and millet grains were purchased from a grain market in Maiduguri metropolis ground to the same particle size (2.0 mm) and used for the formulation.

Experimental diets

Six experimental diets were formulated using maize, sorghum and millet as the main energy source at the inclusion levels of 100% maize (T1), 100% sorghum (T2), 100% millet (T3), 50% maize and 50% sorghum (T4), 50% maize and 50% millet (T5) and 50% sorghum and 50% millet (T6). The protein sources were fish meal and full fat soybean meal. The diets were formulated at the starter and finisher phases containing about 24 and 21% crude protein respectively (Table 1 and 2).

Experimental birds and management

Two hundred and seventy (270) broiler chickens were used for the experiment which lasted for seven (7) weeks. The birds were brooded together for the first 14 days during which they were fed a commercial starter diet from livestock feeds, Kaduna, Nigeria. At the end of the 14th day, the birds were weighed and divided into 18 groups of similar weight, housed in deep litter pens the birds were vaccinated against Gumboro (2 and 4 weeks of age) and Newcastle (3 and 5 weeks of age) diseases. Each of the diets in Table 1 and 2 were given ad libitum to 3 randomly selected pens of 15 birds per pen in a Completely Randomized Design. Clean drinking water was equally supplied ad libitum throughout the experimental period.

TABLE 1. Ingredients and Chemical Composition of Broiler Starter Diets

	Treatment/Diets					
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet
Maize	45.80	-	-	22.90	22.90	-
Sorghum	-	45.80	-	22.90	-	22.90
Millet	-	-	45.80	-	22.90	22.90
Wheat offal	12	12	12	12	12	12
Soybeans	32.0	32.0	32.0	32.0	32.0	32.0
Fish meal	7	7	7	7	7	7
Bone meal	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Total (kg)	100	100	100	100	100	100
Proximate Analysis						
Crude protein (%)	23.3004	23.621	24.766	23.4149	24.0332	24.1935
Crude fibre (%)	4.09	4.09	5.83	4.29	4.28	5.56
EE (%)	4.50	4.50	5.10	4.61	4.72	4.81
NFE (%)	58.30	58.21	56.51	59.11	57.83	57.81
Calcium (%)	0.925	1.46232	1.4669	1.45545	1.45774	1.46461
Phosphorus (%)	0.85422	0.956	0.956	0.90689	0.9068	0.85422
ME (kcal/kg)	2791	2731.52	2390.31	2761.17	2591.14	2560.90

Metabolizable energy calculated according to the formula of Pauzenga (1985) as ME= 37x% CP+81x %EE+35.5x %NFE
*Premix :- Vitamin A 12,000mg, Vitamin E 15,000mg, Folic acid 1000mg, Panthotenic acid 15,000 mg, Vitamin B_{12} 15,000 mg, manganese 100 mg, Vitamin D3 2500, 000 iU, Nicotinic acid 40, 000 mg, Vitamin B1 2000 mg, Biotin 60, 000 mg, Vitamin C 30,000 mg, Copper 1500 mg, Cobalt 250 mg and Selenium 100 mg.

TABLE 2. Ingredients and Chemical Composition of Broiler Finisher Diets

	Treatment/Diets					
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet
Maize	51.60	-	-	25.80	25.80	-
Sorghum	-	52.60	-	25.80	-	25.80
Millet	-	-	51.60	-	25.80	25.80
Wheat offal	16.00	16.00	16.00	16.00	16.00	16.00
Soybeans	23.20	23.20	23.20	23.20	23.20	23.20
Fish meal	6.00	6.00	6.00	6.00	6.00	6.00
Bone meal	2.5	2.5	2.5	2.5	2.5	2.5
Premix*	0.20	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Total (kg)	100	100	100	100	100	100
Proximate Analysis						
Crude protein (%)	20.31	20.67	21.90	20.49	21.14	
Crude fibre (%)	4.36	4.48	5.90	4.50	4.80	5.61
EE (%)	4.60	4.70	4.90	4.65	4.76	4.80
NFE (%)	60.13	61.01	59.11	60.62	60.00	59.61
Calcium (%)	1.37	1.39	1.39	1.38	1.38	1.39
Phosphorus (%)	0.79	0.91	0.91	1.06	0.84	0.91
ME (kcal/kg)	2817.52	2759.838	2749.838	2783.53	2591.669	2557.70

Metabolizable energy calculated according to the formula of Pauzenga (1985) as ME= 37x %CP+81x %EE+35.5x %NFE
*Premix :- Vitamin A 12,000mg, Vitamin E 15,000mg, Folic acid 1000mg, Panthotenic acid 15,000 mg, Vitamin B_{12} 15,000 mg, manganese 100 mg, Vitamin D3 2500, 000 iU, Nicotinic acid 40, 000 mg, Vitamin B1 2000 mg, Biotin 60, 000 mg, Vitamin C 30,000 mg, Copper 1500 mg, Cobalt 250 mg and Selenium 100 mg.

Data collection

At the end of the experiment, three (3) birds were randomly selected per pen, fasted over night from which blood was collected and used for hematological and serological measurements. Hematological samples were collected into sample tubes containing Ethylene Diamine Tetra-acetic Acid (EDTA) as an anticoagulant while serological samples were collected into anticoagulant free tubes. Hematological parameters analyzed were Packed Cell Volume (PCV), Red Blood Cells (RBC) count, White Blood Cells (WBC) count, Hemoglobin (Hb)

concentration and differential Leucocyte count. They were measured according to the methods outlined by 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 (rpm) for 10 minutes to separate the cells from the serum. Total Protein (TP), Albumin, Total Bilirubin (TB), Alkaline Amino Transferase (ALAT), Aspartate Amino Transferase (ASAT), Creatinine, Urea, Potassium, Chloride, Sodium, Globulin, Cholesterol, Conjugate Bilirubin (CB), Alkaline Phosphate and Hydrogen bicarbonate formed the serological indices.

Statistical analysis

Data collected on both the hematological and serological parameters were subjected to Analysis of Variance (ANOVA) in a completely Randomized Design (Steel and Torrie, 1980) using Statistix 8.0 software. Where significant differences were observed, means were separated using the Duncan's Multiple Range Test (Duncan, 1955).

RESULTS & DISCUSSION

The results of hematological and serum biochemical indices are presented in Table 3 and 4. Packed Cell Volume (PCV), Red Blood Cells (RBC) count, Hemoglobin (Hb) concentration, Monocytes and Basophils did not differ among all the treatment groups.

TABLE 3. Hematological values of Broiler chickens fed maize, sorghum, millet and their combinations

	Treatment/Diets						
Parameters	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum	T5 (50% maize & 50% millet	T6 (50% sorghum & 50% millet	SEM
PCV (%)	26.67	29.00	29.00	31.33	31.60	28.80	1.99 ^{ns}
RBC (10^6/mm^3)	3.10	3.05	2.70	3.07	3.27	2.67	0.37 ^{ns}
Hb (g/dl)	9.57	955	9.33	10.07	10.20	9.13	0.60 ^{ns}
WBC (10^6/mm^3)	22.00^{bc}	28.00 ^{a}	26.40 ^{ab}	21.13 ^{c}	25.50 ^{ab}	25.17 ^{ab}	2.32*
RDLC							
Neutrophil (%)	25.33 ^{b}	29.50 ^{ab}	45.33 ^{a}	37.67 ^{ab}	30.33 ^{ab}	31.67 ^{ab}	8.08*
Eosiniphil (%)	7.00 ^{a}	6.50 ^{ab}	3.67 ^{bc}	3.33 ^{c}	4.00 ^{abc}	5.33 ^{ab}	1.30*
Lymphocyte (%)	64.00 ^{a}	24.00 ^{b}	48.67 ^{ab}	56.33 ^{a}	63.33 ^{a}	60.33 ^{a}	13.14*
Monocyte (%)	0.33	0.00	0.00	0.00	0.00	0.00	0.19 ^{ns}
Basophil (%)	3.33	3.50	2.33	2.67	2.33	2.67	0.57^{ns}

a,b, c: = means within the same row bearing different superscripts differ significantly (P<0.05),Ns =not significant (P<0.05)
* = Significant (P<0.05), SEM = Standard Error of Mean, PCV = Packed Cell Volume, RBC = Red Blood Cell, Hb = Hemoglobin Concentration, WBC= White Blood Cell, RDLC = Relative Differential Leucocyte Count

TABLE 4. Serum biochemical values of Broiler chickens fed maize, sorghum, millet and their combinations

	Treatment/Diets						
	T1 (100% maize)	T2 (100% sorghum)	T3 (100% millet)	T4 (50% maize & 50% sorghum)	T5 (50% maize & 50% millet)	T6 (50% sorghum & 50% millet)	SEM
Total Protein (g/dl)	43.00 ^{b}	51.50 ^{a}	50.50 ^{ab}	50.50 ^{ab}	45.50 ^{ab}	48.50 ^{ab}	2.40*
Albumin (g/dl)	26.00	29.50	28.50	26.00	23.50	28.50	3.24 ^{ns}
TB (ummol/l)	4.20	4.60	3.10	3.90	3.60	2.90	0.53 ^{ns}
ALAT (IU/L)	111.00	123.00	110.00	119.00	108.00	115.00	11.86 ^{ns}
ASAT (IU/L)	105.00 ^{d}	142.00 ^{ab}	131.00^{abc}	143.50 ^{a}	119.00 ^{cd}	120.00 ^{bcd}	6.36*
Creatinine (ummol/l)	36.00	37.50	28.50	33.50	35.00	29.50	6.50 ^{ns}
Urea (ummol/l)	2.50	3.50	3.80	2.90	3.55	3.65	0.47 ^{ns}
Potassium (mmol/l)	4.80	4.50	4.30	4.30	4.40	4.30	0.45 ^{ns}
Chloride (mmol/l)	113.50	113.00	113.50	112.00	115.00	116.50	4.17 ^{ns}
Sodium (mmol/l)	142.50	143.00	145.00	142.50	149.50	140.00	3.06 ^{ns}
Globulin (mmol/l)	17.00	22.00	21.50	24.00	22.00	20.00	2.09 ^{ns}
Cholesterol (mmol/l)	3.25	2.95	3.70	3.20	3.65	3.20	0.26 ^{ns}
CB (ummol/l)	2.60	2.90	2.20	2.90	2.00	1.90	0.29 ^{ns}
AlPhos (IU/L)	196.50	174.00	214.50	231.50	215.00	232.50	21.78 ^{ns}
HCO3 (mmol/l)	25.00 ^{ab}	21.00 ^{b}	27.50 ^{a}	23.00 ^{ab}	24.50 ^{ab}	25.50 ^{ab}	1.85*

a,b, c: = means within the same row bearing different superscripts differ significantly (P<0.05), Ns =not significant (P<0.05)
* = Significant (P<0.05), SEM = Standard Error of Mean, TB = Total Bilirubin, CB = Conjugate Bilirubin, ALAT = Alkaline Amino Transferase, ASAT = Aspartate Amino Transferase, AlPhos = Alkaline Phosphate, HCO_3 = Hydrogen bicarbonate

However, White Blood Cells (WBC) count, Neutrophils, Eosinophils and Lymphocyte counts showed significant (P<0.05) differences among the six treatments. WBC showed superiority in 100% sorghum over 100% maize and, 50% maize and 50% sorghum but did not differ from 100% millet, 50% maize and 50% millet and, 50% sorghum and 50% millet based diets. All the values of hematological indices obtained in this were within the

normal ranges reported by Swenson (1977) and Anon (1980) indicating that the birds were adequately nourished and thus not anemic nor showing any sign of disease infection or parasitic problems. For serum biochemical indices, except for TP, ASAT and Hydrogen bicarbonate, there were no significant (P>0.05) differences among all the treatment groups. The TP value was significantly higher in the 100% sorghum than the 100% maize treated group. All the values for TP obtained in this study were however higher than the range of serum protein (16 -34 g/dl) reported by Kwari et al. (2011) for broiler chickens in a similar experiment. Total Protein is usually a reflection of the protein quality fed (Eggum, 1970) and thus higher values obtained here indicated that the protein levels in the diets fed were sufficient to sustain the normal protein level in the blood of the birds. The higher serum protein observed in the 100% sorghum based diet has vindicated the protein level in this diet (Tables 1 and 2). For the differences in ASAT values, Armand (1986) has asserted that fluctuations in the serum levels of ASAT values are usually very difficult to interpret because of the wide distribution of this enzyme in avian tissues. The ASAT values obtained in this study however fall within the range of 105 to 143.5 IU/ L reported by Anon (1980). The reduced value of bicarbonate in the 100% sorghum treated group could be due to the effect of tannin content of the sorghum grain which might have depressed the bicarbonate value in the blood of the birds fed this diet.

CONCLUSION

The results of hematological and serum biochemical indices obtained in this study showed that maize, sorghum and millet or their combinations can be used as energy sources in broiler chickens diets without adverse effects on the health of the birds.

REFERENCES

Anon (1980) Guide to the Care and Use of Experimental Animals. Vol. 1. Canadian Council of Animal Care, Ottawa, Ontario, Canada. Pp. 85-90.

Armand, W.B. (1986) Avian Clinical Haematology and Blood Chemistry. 2nd Edition. Philedelphia, W.B. Saunders. Pp. 264-276.

Cromwell, G.I. and Coffey, R.D. (1993) An assessment of the availability of phosphorus in feed ingredients for non-ruminants. Proceedings of the Maryland Nutrition Conference for Feed Manufacturers Maryland U.S.A. pp. 146-158.

Dowling, I.F., Amdt, C. and Hamaker, B.R. (2002) Economic viability of high digestibility sorghum as feed for market broilers. Agronomy Journal 94:1050-1058.

Duncan, D.B. (1955) Multiple Range and Multiple F.Test. Biometrics 11: 1-42.

Eggum, O. (1970) The Nutritional Value of Feedstuffs. British J. Nutri. 24:983-988.

Issa, S., Hancock, J.D., Tuinstr, M.R., Kapran, I. and Kaka, S. (2007) Effects of sorghum variety on growth and carcass characteristics in broiler chicks reared in West Africa. J. Poult. Sci.86:69.

Kwari, I.D., Diarra, S.S., Saleh, B., Bovoa, P.R., Ramat, O.A. and Tochukwu, D. (2011) Growth, Haematology and Serology of Broiler chickens fed different cultivars of sorghum as replacement for maize in the semi arid zone of Nigeria. Int. J. Poult. Sci. 10: 608-612.

Medugu, C.I., Kwari, I.D., Igwebuike, J.U., Nkama, I., Mohammed, I.D., and Hamaker, B.R. (2010) Carcass and blood components of broiler chickens fed Sorghum or millet as replacement for maize in the semi arid zone of Nigeria. Agric. Biol. J. North America 1:326-329.

NRC (1996) Nutrient Requirements of Poultry. 9th revised edition. National Research Council. National Academy Press, Washington, DC, U.S.A. pp. 146-158.

Parthasarathy, P. R., Gurava, K.R., Reddy, V.S. and Gowda, C.K. (2005) Linking producers and processors of sorghum for poultry feed. Acase study from India. International crops Research Institute for the Semi-Arid Tropics (ICRISAT), New Delhi, India. Pp 12.

Piller, T.B. (1986) The effect of growth variation during growing period of Broilers. J. Poult. Sci. 65:1074-1079.

Steel, R. G. D. and Torrie. J. A. (1980) Principles and Procedures of Statistics. A Biometrical Approach, 2nd Ed. McGraw Hill Book Co. NewYork, U.S.A.

Swenson, M.T. (1977) Dukes physiology of domestic animals. 9th Edition, Comstock Publishing Associates. A Dividion of Cornell University Press, Ithaca and London.

Travis, D.K., Tuinstra, M.R. and Hancock, J.D. (2006) Variation in nutritional value of sorghum hybrids with contrasting seed weight characteristics and comparison with maize in broiler chicks. Crop Science 46:695-699.