Blood chemistry and carcass characteristics of finisher broiler chickens fed Malted Sorghum sprout (MSP) or Wheat-offal based diets supplemented with yeast culture and enzyme

[1]*Oke, F. O., Oluwatosin, O. O.,[2] Obadire, S. O.,[3], Jegede, V. A.,[2] Fafiolu, A. O.,[2] Oso, A. O.,[2] Adeyemi, A. O.,[2] Olorunisola, R. A.,[4] Adeoye, S. A[2].

[1]Department of Animal Science Federal University Dutse, Jigawa State.

[2]Department of Animal Nutrition Federal University of Agriculture, Abeokuta, Ogun state.

[3]Laboratory Department Federal Medical Centre Birnikudu Jigawa State.

[4]Faculty of Science, Ondo State University of Science and Technology, Ondo, Nigeria.

Corresponding author: florenceobadire@gmail.com

Abstract

This experiment was conducted to determine the blood chemistry and carcass characteristics of broilers fed malted sorghum sprouts (MSP) or wheat offal (W/O)-based diets supplemented with yeast culture and enzyme. A total of two hundred and forty 28-day old, Marshal Broiler chickens used for the experiment were randomly allotted to 8 dietary treatment groups of 30 birds each. Each treatment group was replicated thrice with 10 birds per replicate. Data on selected blood indices and carcass traits of the birds were collected during the course of the feeding trial that lasted for 4 weeks. The experiment was a 2X4 factorial consisting of two (2) test ingredients (MSP and wheat offal) at 4 inclusion levels of enzyme or yeast (0g kg^{-1}, +0.01gkg^{-1} yeast and Roxazyme $G2^{(G)}$ enzyme, +0.01gkg^{-1} yeast , + Roxazyme $G2^{(G)}$ enzyme. At the end of the trial, the effect of MSP and wheat offal inclusion showed a significant effect ($P<0.05$) for uric acid, WBC, Total protein, albumin and globulin. However, uric acid, total protein, Albumin and Globulin were highest for wheat offal diet. Furthermore, the results show that values obtained for white blood cell, uric acid, total protein, albumin, globulin, creatinine, ALT & AST were significantly ($P<0.05$) affected by the enzyme, yeast and their combination. The carcass results show that none of the parameters measured differed significantly. In conclusion, supplementation with yeast + enzyme improves total protein, albumin and globulin. Meanwhile, it reduced concentrations of uric acid, ALT and AST by broiler chickens. Therefore MSP diet should be supplemented with yeast+ enzyme or enzyme singly to improve Livestock ration for better utilisation.

Keywords: Blood parameters, carcass, starter broiler, malted sorghum sprout, wheat offal

Introduction

The increase in cost of conventional feedstuffs for basal energy and protein in poultry feeding have encouraged inadequate concentrate feeding and low productivity in poultry production. However, it has also resulted in competition between man and livestock of the limited resources. This high competitive rate of demand for grains especially maize has made it imperative to augment with other non- conventional feed ingredients. There has been an increase in the awareness of the usefulness of agro-industrial by –products as replacements for grains especially maize in livestock diets (Ukachukwu *et al*., 2003). One of such by- products is malted Sorghum Sprouts (MSP). MSP a by – product of sorghum malting has been reported by Oduguwa *et al*. (2007) to have a

low nutritive value for monogastric animals and cannot be used as a main protein source, the low nutritive value may be due to the non- starch polysaccharide content and fibre as well as tannin in MSP. Therefore, there is the need for protein supplements in which yeast and the use of exogenous enzyme are considered appropriate to improve the nutritive value of cereal by-products. Friesen *et al.* (1992) reported that enzyme had been used to improve fibre digestion and reduced viscosity of digesta (Bedford *et al*., 1991; Atteh, 2001). Enzyme treatments also improve performance of broiler chicks, increase weight gain, feed conversion efficiency, dry matter digestibility, nutrient digestibility, nutrient digestibility and decrease jejunal content viscosity respectively and (Sundu *et al*., 2006; Oke *et al*., 2014). This study therefore seeks to evaluate Blood chemistry and carcass characteristics of finishing broilers fed Malted Sorghum sprout (MSP) or Wheat-offal (W/O) based diets supplemented with yeast culture and enzyme.

Materials and methods

Experimental site

The research work was carried out at the poultry unit of the Teaching and Research Farms, Federal University of Agriculture, Abeokuta, Ogun State Nigeria (Latitude 7113 ′49.46 ″N and Longitude 3126 ′11.98 ″ E).

Test ingredients (Enzyme and yeast, Malted Sorghum Sprout and Wheatoffal)

The commercial enzyme (Roxazyme G®) used in this study is a blend of multi-enzymes consisting of endo – 1, 4 – β – xylanase (EC 3.2.1.8), endo – 1, 3 (4) – β – glucanase (EC 3.2.1.6) and endo – 1, 4 – β – glucanase (EC 3.2.1.4) produced by *Trichoderma reesei.* Bakers' yeast was purchased commercially and used in this study. The Dried MSP used in this study was obtained from a commercial brewery industry located in Sango, Ogun State, and wheatoffal from the Federal University of Agriculture Abeokuta, Nigeria Agro-Allied Feedmill. Two hundred and forty (240) 28 day (Marshal Broiler chickens) were reared intensively on deep litter housing system. The birds were fed the experimental diets *ad-libitum* until mature weight. The commercial enzyme used was added at the rate of 10g/100kg diet and yeast also at 10g/100kg diet. Eight experimental diets were formulated for finisher (29-56days) phase. Such that (150g/kg) MSP and wheat offal (WF) were supplemented with yeast (+Y), enzyme (+E) or a combination of yeast and enzyme (+Y+E) while unsupplemented diet (_Y_E) stands for control in broiler diet formulated.

Experimental birds, design and Dietary treatment

The experiment was a 2 by 4 factorial design made of 2 factors (MSP and WO and 4 levels (–Y-E, +Y, +E and +Y+E). The eight experimental diets were formulated such that (150g/kg) Malted Sorghum Sprout (MSP) and wheat offal (WO) were supplemented with yeast (+Y), enzyme (+E) or a combination of yeast and enzyme (+Y+E) while unsupplemented diet (_-Y_-E) stands for control in broiler finisher diet formulated. Two hundred and forty (240) 28 day (Marshal Broiler chickens) were randomly allotted into 8 groups of 10 birds replicated 3 times and were allocated to 8 experimental diets. The feed were fed without restriction and managed on deep litter intensively.

Table 1: The composition of basal experimental diet of finisher Broiler (g/kg^{-1})

Levels	**MSP**				**W/O**			
	1	2	3	4	1	2	3	4
Ingredient	-Y –E Control	Y	E	Y + E	-Y –E Control	Y	E	Y + E
Maize	562	562	562	562	562	562	562	562
Wheat offal	-	-	-	-	150	150	150	150
Fish Meal	10	10	10	10	10	10	10	10
MSP	150	150	150	150	-	-	-	-
Soybean meal	120	120	120	120	120	120	120	120
Groundnut cake	130	130	130	130	130	130	130	130
Bone Meal	15	15	15	15	15	15	15	15
Oyster shell	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Premix	3	3	3	3	3	3	3	3
Salt	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Lysine	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Methionine	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Total	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**	**1000**
Calculated Analysis								
ME (MJ/kg)	11.43	11.43	11.43	11.43	11.25	11.25	11.25	11.25
CP (%)	20.89	20.89	20.89	20.89	19.80	19.80	19.80	19.80
EE (%)	3.56	3.56	3.56	3.56	3.93	3.93	3.93	3.93
CF (%)	2.79	2.79	2.79	2.79	3.62	3.62	3.62	3.62
Calcium (%)	1.18	1.18	1.18	1.18	1.41	1.18	1.18	1.18
Av. Phosphorus (%)	0.12	0.12	0.12	0.12	0.33	0.33	0.33	0.33
Lysine (%)	0.72	0.72	0.72	0.72	0.99	0.99	0.99	0.99
Methionine (%)	0.19	0.19	0.19	0.19	0.54	0.54	0.54	0.54
Determined Analysis								
CP (%)	18.93	20.06	19.68	19.49	19.93	19.86	19.56	19.52
EE (%)	3.92	3.69	3.72	3.67	3.89	3.51	3.59	3.81
CF (%)	3.96	3.56	3.59	3.63	4.83	3.68	3.72	3.61
NDF(%)	38.59	38.14	38.73	38.91	40.12	37.36	38.59	38.62
ADF (%)	21.28	20.13	20.63	20.89	21.74	19.46	19.81	21.01
NFE(%)	58.19	59.18	58.76	58.47	57.55	59.39	59.10	58.01
Ash (%)	6.92	5.24	5.87	6.03	6.76	5.63	6.10	5.92

†Vitamin/mineral premix provided the following per kg diet (pre -starter and starter diet): 210 g Ca; 85.7 g P; 828 mg F; 75 mg retinol; 1.25 mg cholecalciferol; 375 mg dl -tocopheryl acetate; 42.5 mg menadione; 45 mg thiamin; 150 mg ribo?avin; 62.5 mg pyrid oxine; 300 µg cyanocobalamin; 100 mg niacin; 27 mg folic acid; 400 mg pantothenic acid; 12.5 g choline; 2 mg biotin; 45 g methionine; 2500 mg Mn; 1500 mg Zn; 1250 mg Fe; 250 mg Cu; 15 mg I; 8.2 mg Se.

†Vitamin/mineral premix provided the following per kg d iet (grower diet): 200 g Ca; 77 g P; 710 mg F; 42 mg retinol; 1 mg cholecalciferol; 325 mg dl -tocopheryl acetate; 35 mg menadione; 45 mg thiamin; 125 mg ribo?avin; 75 mg pyridoxine; 300 µg cyanocobalamin; 875 mg niacin; 19 mg folic acid; 300 mg pantothenic acid; 7.5 g choline; 31 g methionine; 2500 mg Mn; 1500 mg Zn; 1250 mg Fe; 250 mg Cu; 15 mg I; 8.2 mg Se.

Data collection and analysis

Serum chemistry

At 56 d of the study blood samples were collected from 4 randomly selected broilers per treatment to determine the blood serum chemistry. Blood collection was done through brachial vein puncture (Frandson, 1986) using needles and syringes. Each blood sample was emptied into 2 sets of well labelled sample bottles; one containing

ethylene diamine tetra-acetate (EDTA) as anti- coagulant while the other contained no anti-coagulant. The sample containing anti-coagulant was used to analysis for the haematological traits while the other sample that did not contain anti-coagulant was used to analyse the serum bio-chemical traits of the birds per treatment. Samples were analysed for haematological traits (packed Cell Volume (PCV), Haemoglobin (Hb), Red Blood Cell (RBC) and White Blood Cell (WBC) and biochemical traits (Blood glucose, the total serum protein, albumin and globulin were determined using bromocresol purple method (Varley *et al.,* 1980). Serum creatinine (Bousnes and Taussky, 1945) and serum uric acid concentration (Wootton, 1964) was determined according to standard procedures. Serum enzymes (alanine transaminase (ALT) and aspartate serum transaminase (AST) were analysed using the commercial kits (Qualigens India. Pvt. Ltd., Catalogue number 72201-04).

Carcass Measurements

At the end of 56 days, two birds whose weights were nearest to the average weight of birds in each replicate were selected; the birds were starved of feed for 12hours and thereafter slaughtered by severing their jugular veins with sharp knife. The slaughtered birds were scalded in hot water, defeathered and eviscerated. The live weights of the birds were taken prior to slaughtering and the dressed weights were also recorded. The head, neck, breast, back, thigh, drumstick, and shank were weighed and recorded, the spleen, kidney, lungs, gizzard liver, heart, abdominal fat, proventriculus were also weighed using a sensitive digital electronic pocket scale. The weights were expressed as percentages of respective live weights.

Statistical Analyses

The proximate composition of the diet was determined by the AOAC (1995). The data generated were subjected to ANOVA in a completely randomized design using statistical Analysis System (SAS, 2001). Significant means at 5% level of probability were separated using Duncan's Multiple Range Test (Duncan, 1955)

Results

The proximate composition of Malted Sorghum Sprout and wheat offal are presented in table 2. MSP contained more ether extract, Ash, NDF, ADF and less crude protein, crude fibre than wheatoffal.The dry matter values of 916.7 g kg-^{1}and 914.6g kg $^{-1}$were recorded for MSP and W/O respectively. The NFE values recorded in this study were 560.7 g kg-1and 538.6g kg^{-1} for MSP and W/O respectively. The calcium, Phosphorus and HCN recorded of MSP were these 9.2 g kg^{-1}, 11.1 g kg^{-1}, 2.5mg/kg respectively.

Effects of malted sorghum sprout (MSP) and wheat offal (W/O) with or without yeast or enzyme on blood parameters of finisher broiler chickens as shown in Table 3. Values obtained for PCV, RBC, and WBC were not significantly (P>0.05) different among treatments. However, birds on wheat offal diet with yeast supplement recorded a significantly (P<0.05) higher value of uric acid, followed by birds on MSP diet with yeast alone. Birds on wheat offal diet with enzyme and those without additive recorded statistically similar (P>0.05) uric acid values, these values were significantly (P<0.05) higher than birds fed MSP diet with enzyme alone. Birds on MSP diet with yeast + enzyme had the least value of uric acid. Total protein value ranged between 18.27/g/L for birds on MSP diet with yeast + enzyme to 43.57g/L for birds on MSP diet without additive. Highest (P<0.05) albumin value was recorded for birds on wheat offal diet without additive

while the least albumin value was recorded for birds on MSP diet with yeast + enzyme. Birds on MSP diet without additive recorded the highest (P<0.05) value of globulin while birds on MSP diet with yeast + enzyme recorded the least (P<0.05) value.

Table 2: Chemical composition of test ingredient

Test ingredients	MSP	W/O
Component	g kg-1	g kg^{-1}
Dry matter	916.7	914.6
Crude protein	227.3	229.6
Crude fibre	36.9	39.7
Ash content	53.2	52.6
Ether extract	38.6	35.9
Nitrogen free extract	631.3	538.6
Ca	9.2	8.05
P	11.1	10.2
HCN (mg/kg)	2.5	
NDF	372.1	368.2
ADF	171.2	165.3

Table 3: Effect of MSP and W/O with yeast (+y) and enzyme (+e) on blood parameters of finisher broiler chickens

	Finisher								
	MSP				W/O				
Measurements	**-Y-E**	**+Y+E**	**+Y**	**+E**	**-Y-E**	**+Y+E**	**+Y**	**+E**	**SEM**
Packed cell volume (%)	24.00	25.33	25.00	27.33	27.33	23.00	27.67	26.33	0.94
Red blood cell (10^6/l)	6.33	5.40	6.67	5.53	6.17	5.90	5.46	5.33	0.15
White blood cell (10^9/l)	7.90	7.33	8.60	10.43	8.93	7.87	8.87	10.07	0.23
Uric acid (umol/l)	35.17^{e}	15.80^{f}	70.20^{b}	39.57^{d}	49.40^{c}	35.80^{e}	117.00^{a}	50.80^{c}	6.02
Total protein (g/l)	43.57^{a}	18.27^{f}	31.40^{b}	25.53^{e}	27.90^{d}	30.00^{c}	30.00^{c}	24.87^{e}	1.44
Albumin (g/l)	11.77^{c}	8.23^{e}	13.20^{b}	12.13^{c}	15.20^{a}	12.43^{bc}	12.63^{bc}	10.37^{d}	0.47
Globulin (g/l)	31.80^{a}	10.03^{e}	18.20^{b}	13.40^{cd}	12.63^{d}	17.57^{b}	17.37^{b}	14.50^{c}	1.37
Creatinine (Mmol/l)	60.67^{c}	79.33^{a}	61.33^{c}	52.67^{d}	60.67^{c}	54.67^{d}	67.67^{b}	66.00^{b}	1.83
ALT (u/L)	14.00^{cd}	22.33^{a}	13.00^{d}	14.00^{cd}	14.67^{cd}	15.33^{bc}	16.67^{b}	15.33^{bc}	0.74
AST u/L)	15.33^{c}	19.00^{a}	15.33^{c}	12.67^{d}	15.33^{c}	15.33^{c}	17.67^{b}	15.33^{c}	0.49

^{abc} Means on the same row having different superscripts are significantly different (p<0.05).

Creatinine of birds fed MSP diet with yeast + enzyme were significantly (P<0.05) higher followed by the birds on wheat offal diet with yeast alone and enzyme alone while those on MSP diets with yeast alone, without additive and those on wheat offal diet without additive were statistically similar but higher (P<0.05) than birds fed MSP diet with enzyme alone and wheat offal diet with yeast + enzyme. Birds on MSP diet with yeast + enzyme supplemented had the highest ALT. This was closely followed by birds on wheat offal diet with Yeast + enzyme, yeast alone and enzyme alone which were statistically similar, while the rest recorded the least statistically similar value. AST was highest for birds on MSP diet with yeast + enzyme while the least value was recorded for birds on MSP diet with enzyme alone.

Table 4: Effect of yeast (+y) and enzyme (+e) on carcass characteristics, cut parts and relative organ weights of broiler chickens

	Additives				
Measurements	**-Y-E**	**+Y+E**	**+Y**	**+E**	**SEM**
Live weight (g)	1250.00	1241.67	1125.00	1316.67	39.82
Dressing (%)	74.03[a]	67.72[b]	69.69[ab]	72.85[a]	1.64
Cut parts					
Dressing (%)	74.03[a]	67.72[b]	69.69[ab]	72.85[a]	1.64
Head (%)	2.97	2.88	2.89	2.88	0.02
Neck (%)	3.28	2.75	3.46	2.86	0.17
Breast (%)	13.81	12.59	12.37	13.27	0.33
Back (%)	12.26	11.36	11.33	12.36	0.28
Thigh (%)	8.68	8.56	8.72	9.28	0.16
Drum stick (%)	8.66[a]	7.61[b]	8.06[ab]	8.56[a]	0.24
Wing (%)	8.00[a]	6.97[b]	7.61[a]	794[a]	0.24
Shank (%)	4.63	4.09	4.37	4.53	0.12
Relative Organs					
Spleen (%)	0.09	0.12	0.10	0.10	0.01
Kidney (%)	0.53	0.45	0.54	0.58	0.03
Gizzard (%)	4.69	4.27	4.58	4.54	0.09
Liver (%)	2.61	2.66	2.65	2.83	0.05
Heart (%)	0.36	0.37	0.35	0.35	0.01
Abdominal fat (%)	0.20	0.34	0.22	0.22	0.03
Preventriculus (%)	0.64	0.65	0.78	0.72	0.03

[abc] Means on the same row having different superscripts are significantly different (P<0.05)

Table 4 shows the effects of yeast and enzyme supplementation on carcass characteristics of broiler chickens. The result shows a significantly higher (P<0.05) dressed weight in birds fed diets without additives and diets supplemented with enzyme alone. The least dressed weight value was recorded for birds fed enzyme and yeast mixture. The same trend was observed for drumstick and wing. Birds fed diets without additive and those with enzyme recorded the highest (P0<0.05) value of drumstick and wing meanwhile, birds fed diets with yeast and enzyme recorded the least (P>0.05) values of these parameters. Other parameters measured were not significantly influenced by the various additive used.

Discussion

The high crude protein of wheat offal suggested it as high protein potential source for poultry birds. This add credence to the fact that wheatoffal have more tendency in supporting growth than MSP. Crude protein (CP) value (227.3 g kg^{-1}) recorded for MSP in this finding agrees with earlier reports of Aning *et al.* (1998), Fafiolu *et al.* (2006) and Akinola (2002), who reported CP values of 226 g kg-1 . The crude fibre (CF) of 36.9 g kg-1 reported is at variance with the findings of Oduguwa *et al.* (2001) who reported 83.0 g kg-1. The low crude fibre recorded of MSP could be due to improper hardening or lignification of the rootlets and shoots has not taken place before harvesting. However, the high neutral detergent fibre reported here is relatively higher compared to Oduguwa *et al.* (2007) who reported a relatively high (224 g/ kg) in MSP. This add credence to the fact that non-starch polysaccharides (NSP) limiting the utilization of this by-product. Also the high NDF, ADF and crude fibre contained in MSP confirm its content of non-starch polysaccharides. Report had shown that MSP has a lot of prospects as

livestock feed but its usefulness is limited by its tannin content and non-starch polysaccharides Elkine *et al*. (1995). In addition, the ether extract recorded agrees with earlier reports of Akinola (2002) who recorded 39.8 g kg-1 for alkaline-treated MSP and Aning *et al.* (1998) who reported 33.0 g kg-1. The ash content of 53.2 g kg-1 obtained agrees with the findings of Fafiolu *et al.* (2016) who reported 63.0gkg^{-1} and Akinola (2002) who reported 70.0 g kg-1 for untreated fermented treated for ash content in MSP. The calcium (Ca) and Phosphorus (P) contents of msp in this result is at variance with Oduguwa *et al.* (2007) who reported the calcium (Ca) content of MSP was 1.78 g kg-1 and 3.5g kg^{-1} respectively.

The higher value of uric acid in birds fed wheat offal and MSP in this study suggests that protein in these diets were poorly utilized by the birds. However, the increased uric acid with inclusion of yeast is an indication that the birds did not utilize the protein properly which accounted for the poor performance of the final live weight of the birds. Kumpta and Harper (1961) and Eggum (1970) explained that an amino acid imbalance will result in an increase in blood urea concentrations. Urea is known to be a function of protein quality as high level is an indication of low protein quality. Ranjhan (2001) explained that in a diet, the amino acid present will be deaminated and hence result in an increase in excretion of urea. Previous studies confirmed increased uric acid of turkeys and pullet chicks following MSP inclusion (Oke *et al.,* 2014; Fafiolu *et al.,* 2016).

The activity of serum glutamate pyruvate transaminase enzyme was higher in birds fed MSP based diets. The activity of this enzyme is normally very low except in cases when the nutritional plane is very low or the presence of a toxic factor which may affect the liver. The higher activity of this enzyme recorded for birds fed MSP diet add credence to the fact that MSP contain some toxic factors. It has been reported to contain tannin (Aning *et al.,* 1998; Oduguwa *et al*., 2001) and hydro cyanide (Ikediobi, 1989). The white blood cell, total protein, albumin, globulin, SGPT & SGOT were significantly ($P<0.05$) influenced by additives supplementation. The increased WBC value recorded in this experiment is an indication that, the birds were reacting to one or more factors in the feed (Oduguwa *et al.*, 2006). This observation is in line with the report of Wilson and Brig Stoke (1981). White blood cells (WBC) play prominent role in disease resistance especially with respect to the generation of antibodies and the process of plygocytes (Wintrobe, 1983). The values recorded for ALT & AST in this research were considerably higher in comparism with Fafiolu (2003). This could be as a result of poor utilization of nutrient in the feed. Fafiolu *et al*. (2006) reported that an increase in activities of the transaminase indicates poor utilization of nutrients in the feed.

The higher creatinine of birds fed MSP diet with yeast + enzyme and birds on wheat offal diets supplemented with yeast or enzyme is an indication that the birds were unable to incorporate the protein in the feed into their tissues. (Eggum, 1970 and Adewusi 1993 reported that high level of creatinine in the blood is an indication of impair protein utilisation. This report agrees with Fafiolu *et al.* (2016)who reported high creatinine when pullet chicks were fed MSP based diet. The slightly higher live weight before slaughter, dressed percentage and neck weight of birds fed wheat offal over birds fed MSP diet could be attributed to the fact that wheat offal diets were able to support a level of muscle accretion. Wheat is considered to be highly

nutritious in poultry nutrition except for the apparent metabolisable energy AME which is extremely variable due to the constituent non starch polysaccharides (Wiseman and Inborr, 1990). The effect of additives on carcass characteristics of broiler chickens significantly ($P<0.05$) influenced dress percentage drum stick and wing. This agreed with previous studies which indicated that inclusion of enzymes, synthetic amino acids and other feed additives significantly influenced the cut parts of poultry birds (Crouch *et al.,* 2000). Birds fed control diet and those supplemented with enzyme recorded the highest value for dressed percentage over those containing yeast and both yeast& enzyme. The increment noticed in dressed percentage of birds fed enzyme supplemented diets could be traced to proper use of nutrients in the diet. Similar result was reported by Ezennabike (2007). Conclusively, dietary inclusion of MSP resulted in increased uric acid and serum enzymes (AST) irrespective of additives supplementation meanwhile Supplementation with enzyme+ yeast improved total protein, albumin and globulin for better utilization of diets irrespective of the birds' physiological stage. Therefore, it can be concluded that Malted Sorghum Sprouts cannot replaced wheat offal without appropriate supplementation with additives or their combinations for better performance. Further study should be carried out on the appropriate dosage of these additives when MSP is included in broiler's diet. However, nutritionist should intensify their research on appropriate methods to reduce drastically the NSP and tannin content contained in MSP.

References

Adewusi, S. R. A. and Bradbury, J. H. 1993. Carotenoids in cassava: Comparison of open-column and HPLC methods of analysis. *Journal of Science Food Agriculture*, *62*(4), 375-383.

A.O. A. C. 1995. Official methods of analysis (18th Ed.) Association of Official Analytical Chemist, Washington D.C.B

Akinola, O. A. 2002. Effect of alkaline treated MSP and untreated MSP on broilers. A Master of Agric. Dissertation submitted to Animal Nutrition Department., University of Agriculture Abeokuta pg33

Aning, K. G., Onifade, A. G., Awkan, J. A., Adekola, A. L. and Letor, V. A. 1998. Effect of replacing dried brewers dried grain with sorghum rootlets on growing nutrient utilization and some blood constituent in rats. *Animal Feed Science Technology* 71: 185-190.

Atteh, J. O. 2001. Versatility of nutrase xyla as a feed additive for monogastric animals. A paper presented at a two day seminar on starting the millennium with an array of tailor-made biotechnology improvement of flour milling and baking industry at Sheraton hotel, Lagos.

Bedford, M. R., Classen, H. L. and Campbell, G. L. 1991. The effect of pentosans on the viscosity of the intestinal content and the performance of broilers fed rye. *Poultry Science* 70: 1571-1577.

Bousnes, R. and Taussky, H. H. 1945. Colorimetric determination of creatinine by Jaffe reaction. Journal of Biochemistry,158, 581-591

Brij, M. A., Horward, M. R. and Bhuran, V. V. 1977. *Clinical biochemical and haematological value in normal*

experimental animals. Massan Publishing Co. U.S.A. F r Geflugelkunde, 54: 34-37.

Crouch, A. N., Lerner, S. P. and Karunakaran, D. 2000. Influence of feed quality in the brooding period of commercial turkeys and its subsequent effect on market performance. *Poultry Science* 79: 67 – 68.

Duncan, D. B. 1955. Multiple Range and Multiple F-test Biometric. 11: 1-24.

Eggum, B. O. 1970. Protein quality of cassava leaf. *British Journal of Nutr*. 24: 761-768.

Ezennabike, C. C. N. 2007. The response of broiler Chickens to maize- wheat offal based diets supplemented with Allzymessf®.M.Agric project report. Department of Animal Nutrition ,University of Agriculture, Abeokuta.

Fafiolu, A. O. 2003. The effect of malted sorghum sprouts on laying birds. A.M. Agric dissertation submitted to Animal Nutr. Dept. University of Abeokuta

Fafiolu, A. O., Oduguwa, O. O., Ikeobi, C. O. N. and Onwuka, C. F. I. 2006. Utilization of malted sorghum sprouts in the diet of rearing pullets and laying hens. *Archivos Zootechina*. 55: 361-371

Oke, F. O., Onasanya, G. O., Adedire, A. O., Oduguwa, O. O., Obadire, S. O. and Osofowora, A. O. *2014.* Effects of feed probiotics on serum biochemistry and carcass characteristics of tropically bred exotic turkey.*IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) Volume 7, Issue 11 Ver. I PP 53 - 59 www.iosrjournals.orgDol:10.13140 12.1.1901.4084*

Frandson, R. D. 1986. Blood and other fluids. In: Anatomy and physiology of farm animals.Lea and febiger, Philadelphia. 4th edition. Pp233-254

Friesen, O. D., Guenter, W., Marguardt, R. R. and Rotter, B. A. 1992. Effect of enzyme supplementation on the apparent metabolizable and nutrient digestibilities of wheat, barley, oats and rye in broiler chicks. *Poultry Science* 71(10):171-176.

Ikediobi, O. 1989. Industrial malting of sorghum in Nigeria. Paper presented to the ICRISAT-WASIP-IAR Workshop on Industrial Utilization of Sorghum, held in Kano, 4 – 6 December, 1990 pp 56.

Kumta, U. S. and Harper, A. E. 1961. Amino acid balance and imbalance. VII. Effects of dietary additions of amino acids on food intake and blood urea concentration of rats fed low-protein diets containing fibrin. *Journal of Nutrition* 74, 139-147.

Oduguwa, O. O., Fafiolu, A. O. Jegede, A. V. and Akinwale, P. B. 2007. The effect of diets containing malted sorghum sprout supplemented with yeast and amyloglucosidase enzyme on blood composition of broiler chickens. *Proceedings of the spring meeting of the World's Poultry Science Association, UK Branch held at Southport U.K 3rd -4th April, 2007, 40 - 41*

Oduguwa, O. O., Fanimo, A. O., Oduguwa, B. O., Iyayi, E. A. and Opadotun, A. I. 2001. Effects of enzyme supplementation on the nutritive value of MSP in the rat. *Tropical Journal of Animal Science* 4(1): 189-195

Oduguwa, O. O., Pirgozliev, V. and Acamovic, T. 2006. Effects of glucanases and proteases on the

utilization of malted sorghum sprouts by broiler chickens. *Proceedings of the Spring meeting of the World's Poultry Science Association, UK Branch held at The University of York, York, UK, 28 – 29th March 2006. 37 – 38*

Oduguwa, O. O., Pirgozliev, V. and Acamovic, T. 2007. Energy metabolisability and digestibility of amino acids by broilers fed on malted sorghum sprouts supplemented with polyethylene glycol, charcoal, phytase and xylanase. *British Poultry Science.* 48 (1): 55-63

Pellet, P. Z. and Young, N. P., 1980. Nutritional evaluation of protein feeds. United Nation Universal World Hunger Programme. *Food and Nutrition bulletin*. pp 154.

SAS Institute 2001. SAS/ STAT. guide for personal computer, version 8 edition (Cary, North Carolina SAS Institute).

Sundu, B., Kumar, A. and Dingle, J. 2006. Response of broiler chicks fed increasing levels of Copra meal and enzymes. *International Journal of Poultry Science* 5(1): 13-18

Udo, H. 1987. Effect of cassava peels supplementation in swine ration on performance, haematology and serum metabolites in growing pigs. M.Sc. Thesis submitted to the Department of Animal Science, University of Ibadan. Pp 112.

Ukachukwu, S. N., Ojewola, G. S. Abasiekong, S. F. and Uzuegbu, C. P. 2003. Biologic and Economic effects of different Agro-industrial by- products in turkey poult diets. Nig. Agric. J.34:138-142.

Varley, H., Van, E. and Kass I., 1980. Practical clinical chemistry, New York, Inter Science Publishers Inc.,197- 240

Wintrobe, N. M. 1983. The size of haemoglobin content of erythrocytes. Method of determination and clinical application. *Journal of laboratory and Clinical Medicine* 17:87

Received: 15th November, 2016
Accepted: 23rd February, 2017