

Original Research Article

Performance and Carcass Characteristics of Broiler Chicken Fed Soybean and Sesame/Soybean Based Diets Supplemented With or Without Microbial Phytase

ABSTRACT

Aims: The experiment was conducted to investigate the performance and carcass characteristics of meat-type chicken fed Soybean Meal (SBM) and Sesame/Soybean Meal (SSBM) supplemented with microbial phytase.

Study design: The experiment employed a complete randomized design; all data generated were subjected to analysis of variance, $P=0.05$.

Place and duration of study: The study was carried out at the Teaching and Research Farm of the University of Ibadan, Nigeria, between October and December, 2011.

Methodology: One hundred and sixty-eight unsexed two weeks old Abor Acre strain chickens were used in a 35-day feeding trial. Two feeding regimes of soybean meal and Sesame/soybean meal based diets were formulated. Each feeding regime comprised of control diet and two levels of phytase units (300 and 600 FTU/kg) of 500 unit /g activity making a total of six dietary treatments. The birds were fed the experimental diets for a 35-day period during which data were obtained on Feed Intake (FI), Body Weight Gain (BWG) and Feed Conversion Ratio (FCR). At the end of the feeding trial, three birds were sacrificed per replicate to evaluate carcass and meat characteristics.

Results: The addition of phytase enzyme to diet had a positive effect on birds' performance, FI and FCR. Significant ($P<0.05$) increase was obtained for apparent retention of nitrogen (67.22%), ash (74.85%), ether extract (65.43%), crude fibre (76.22%) and Phosphorus (45.58%). Cooking loss values increased while the Water Holding Capacity (WHC) reduced with microbial phytase supplementation.

Conclusion: Sesame/soybean diet supplemented with 300 FTU/Kg microbial phytase gave optimum performance and should probably be adopted as the feeding regime of choice since it also resulted into better nutrient utilization by the birds.

Keywords: Microbial phytase, soybean meal, sesame, broiler chicken, performance

1. INTRODUCTION

Plant materials are the major constituents of poultry diets. Unfortunately, about two-third of the phosphorus (P) in cereal grains, oilseed meals and plant by-products is present in the form of P bound to phytic acid (phytate P), which is not available to poultry. Corn-soybean diets are rich in phytic acid which is not available for non-ruminant animals. Most of phytate phosphorus is discharged along with excrement. In this case, it not only leads to waste of resource, but also increases the environmental pollution.

Soybean is a major plant protein source used in poultry ration formulation essentially for its high lysine content. Sesame seed (*Sesamum indicum*) is another plant protein source produced locally and it has appreciable amount of methionine. Aduku [1]. When used in the right proportions together with soybean meal which has a higher content of lysine; a balanced diet with respect to lysine and methionine will result. Olomu [2]. Incidentally, both plants are high in phytic phosphorus which reduces phosphorus and calcium availability however, this adverse effect could possibly be overcome by dietary supplementation with exogenous phytase. Naher [3].

Enzymes such as microbial phytase has been used as commercial feed additive in broiler feed production to improve nutritive values of plant based diets. Addition of microbial phytase to broiler diet leads to hydrolysis of phytate, which bind phosphorus of the plant based diet. Biehl *et al.*, and Kies *et al.*, [4, 5]. Moreover, interest in the use of phytase as feed additive has now increased due to problems posed by phosphates in animal wastes. Phytic acid is generally regarded as being resistant to hydrolysis in the avian gut due to lack of endogenous phytase. Inclusion of exogenous enzymes in animal's diet has been shown to improve broilers performance. Wang *et al.*, [6] but the effect on meat quality attributes has to be determined as certain feed additives have been found to affect meat qualities. Hence this study was initiated to ascertain the effects of feeding soybean and sesame/soybean based diets supplemented with phytase on performance and meat characteristics of broiler chicken and also to investigate the utilization and excretion of N and P by poultry and develop dietary strategies for improving their utilisation and reduce their contribution to environmental pollution.

2. MATERIALS AND METHODS

A total of one hundred and sixty eight unsexed 1-day old Abor Acre plus strain of broiler chicks were purchased from a commercial hatchery. The chicks were brooded for two weeks and were randomly allotted to six dietary treatments with 4 replicates and 7 broilers per replication in a completely randomized design. Two isocaloric and isonitrogenous basal diets based on corn-soybean meal and corn-

76 sesame/soybean meal were formulated. Microbioal phytase concentrations of 0, 300 and 600 phytase
77 units (FTU/ kg) were added to the basal diet resulting in the following six treatments:
78

79 Soybean +0 FTU/kg

80 Soybean + 300 FTU/kg

81 Soybean + 600 FTU/kg

82 Sesame / Soybean + 0 FTU/kg

83 Sesame /Soybean + 300 FTU/kg

84 Sesame /Soybean + 600 FTU/kg

85 The microbial phytase (E.C.3.1.3.8) used was Natuphos® 5000, a commercial preparation with a
86 Phytase activity of 5000 Unit/g.
87

88 Table 1. Gross composition of the starter diet (%)

Ingredients	Treatments					
	T1	T2	T3	T4	T5	T6
Maize	53.10	53.10	53.10	48.00	48.00	48.00
Soybean	34.60	34.60	34.60	28.60	28.60	28.60
Sesame	-	-	-	13.10	13.10	13.10
Wheat offal	5.00	5.00	5.00	4.00	4.00	4.00
Fish meal (72%)	2.50	2.50	2.50	2.50	2.50	2.50
Palm oil	2.00	2.00	2.00	1.00	1.00	1.00
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
Di calcium phosphate	2.05	2.05	2.05	2.05	2.05	2.05
Salt	0.25	0.25	0.25	0.25	0.25	0.25
**Phytase	-	0.06	0.12	-	0.06	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients						
M KCal/Kg	2972	2972	2972	3300	3300	3300
Crude protein	23.26	23.26	23.26	23.10	23.10	23.10
Total Phosphorus	0.85	0.85	0.85	0.87	0.87	0.87
Calcium	1.67	1.67	1.67	1.72	1.72	1.72

89 ** Not included as part of the formulation but added as supplement to the basal diet

90 *2.5 kg Premix used supplied vitamin A, 12,500000iv; vitamin D, 2500000iv; vitamin E,40,000mg;
91 vitamin K3,2000mg;vitamin B1, 3000mg; vitamin B2 5500mg Niacin, 55000mg;calcium pantothenate,
92 11500mg vitamin B6, 5000mg; vitamin B12, 25mg; Folic acid,1000mg;biotin,80mg;choline chloride
93 500000mg;manganese, 120000mg; Iron100,000mg;zinc,80000mg;copper 8500mg;iodine 1500mg

cobalt 3000mg;selenium 120mg and anti-oxidant 120,000mg.

T₁ and T₄ = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T₂ and T₃ = Treatments for soybean meal diets with 300 and 600 units of phytase

T₅ and T₆ = Treatments for sesame/soybean with 300 and 600 units of phytase

Table 2. Gross composition of finisher's diet (%)

Ingredients	Treatments					
	T1	T2	T3	T4	T5	T6
Maize	59.30	59.30	59.30	54.20	54.20	54.20
Soybean	28.40	28.40	28.40	22.40	22.40	22.40
Sesame	-	-	-	13.10	13.10	13.10
Wheat offal	4.00	4.00	4.00	4.00	4.00	4.00
Fish meal	2.50	2.50	2.50	2.50	2.50	2.50
Palm oil	3.00	3.00	3.00	1.00	1.00	1.00
*Premix	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.15	0.15	0.15	0.15	0.15	0.15
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
DCP	2.05	2.05	2.05	2.05	2.05	2.05
Salt	0.25	0.25	0.25	0.25	0.25	0.25
**Phytase	-	0.06	0.12	-	0.06	0.12
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Nutrients						
M Kcal/Kg	3061	3061	3061	3363	3363	3363
Crude Protein	21.02	21.02	21.02	21.09	21.09	21.09
Phosphorus	0.75	0.75	0.75	0.77	0.77	0.77
Calcium	1.52	1.52	1.52	1.57	1.57	1.57

* *Not included as part of the formulation but added as supplement to the basal diet

*2.5 kg Premix used supplied vitamin A, 12,500,000iu; vitamin D, 2500,000iu; vitamin E,40,000mg; vitamin K3,2000mg;vitamin B1, 3000mg; vitamin B2 5500mg Niacin, 55000mg;calcium pantothenate, 11500mg vitamin B6, 5000mg; vitamin B12, 25mg; Folic acid,1000mg;biotin,80mg;choline chloride 500000mg;manganese, 120000mg; Iron100,000mg;zinc,80000mg;copper 8500mg;iodine 1500mg cobalt 3000mg;selenium 120mg and anti-oxidant 120,000mg.

T₁ and T₄ = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T₂ and T₃ = Treatments for soybean meal diets with 300 and 600 units of phytase

T₅ and T₆ = Treatments for sesame/soybean with 300 and 600 units of phytase

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120 2.1 Feed intake and Weight gain

121 The chicks were given a free choice access to diets and fresh cool water throughout the experimental period
 122 which comprised of two phases, 3-4 and 5-7 weeks representing the starter and finisher phase respectively.
 123 The feed intake and weight gain were taken on weekly basis. Weight gain was determined as difference
 124 between initial weight and final weight. Feed conversion ratio (FCR) was determined based on the average
 125 feed intake and average body weight gain.

126 $FCR = \frac{\text{Average feed Consumed (g)}}{\text{Average body weight gain (g)}}$

127

128 The gross compositions of the experimental diets are shown in Tables 1 and 2.

129 2.2 Nutrient Retention

130 At the end of the feeding trial, nutrient retention was determined in a 7 day trial using twelve birds per
 131 treatment (three birds per replicate). A nutrient retention trial was conducted during 7th week of the
 132 experiment. Three birds per replicate were selected at random and housed individually in metabolic
 133 cages. After four days of an adjustment period, a measured amount of feed was offered and daily feed
 134 consumption by the birds was recorded on cage basis. Excreta voided were collected in 24 h from each
 135 pen in a separate wide mouth plastic containers. At the end of collection period, excreta of each pen
 136 were thoroughly mixed and weighed. Representative samples of the excreta were dried in an oven at
 137 60°C and ground to pass through 1 mm sieve. These ground excreta samples were analyzed for total
 138 nitrogen (N), crude fiber, fat, ash and phosphorus contents AOAC [7]. All calculations were expressed
 139 on dry matter (DM) basis. The difference in the nutrient content of the feed consumed and of the feces
 140 voided was used to calculate the retention of nutrients.

141 2.3 Carcass cut up

142 At the end of the feeding trials, 3 birds in each of the replicate groups whose weight corresponded to the
 143 average of the group were purposively selected, fasted for twelve hours and sacrificed to evaluate
 144 carcass and meat characteristics. The birds were weighed and slaughtered in batches of six according to
 145 the method described by Omojola *et al.*, [8]. The slaughtered birds were properly bled, defeathered and
 146 eviscerated. The eviscerated birds were dissected and all internal and external offal carefully removed.
 147 The hot carcasses were weighed to obtain the dressed weight; the carcasses were later chilled before
 148 they were dissected into primal cuts and weights taken.

149 2.4 Meat quality study

150 2.4.1 Percentage cooking loss

151 Meat samples (20g) were taken from the breast muscle, thigh and drumstick of each carcass and cooked
 152 to an internal temperature of 72°C in a moist-heat cookery method. The water released after cooking and
 153 cooling was manually separated and the weight of the cooked meat taken to obtain the cooking loss.

154 Percentage cooking loss was calculated as:

155 $\frac{(\text{Weight of sample before cooking} - \text{Weight after cooking})}{\text{Weight of sample before cooking}} \times 100$

156 Weight of sample before cooking

157 2.4.2 Water Holding Capacity

158 This was determined in triplicate by the press method of Tsai and Ockerman [9]. Approximately 5.0g
 159 samples from breast muscle, drumstick and thigh were weighed individually into a 9cm Whatman No 1
 160 filter paper and pressed between two 10.2x10.2 cm plexi glasses and pressed at approximately
 161 35.2kg/cm³ for a minute. The area of free water was measured using a compensatory planimeter (Planix
 162 5000, Tamaya Technics, Inc., Tokyo, Japan) and percentage free water was calculated based on sample
 163 weight and moisture content Tsai and Ockerman [9] while percentage bound water or water holding
 164 capacity was calculated as 100% minus free water %.

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167 2.4.3 Chilling loss

168 A known weight of meat was chilled at 4°C for 24 hours, after which the meat was thawed and weighed.
 169 Chilling loss was calculated as follows:

170 Chilling loss (%) = $\frac{\text{Initial weight (before chilling)} - \text{Final weight (after chilling)}}{\text{Initial weight (before chilling)}} \times 100$

171 Initial weight (before chilling)

172 2.4.4 Shear force

173 Shear force was determined using the modified Warner Braztler shear force procedure. Meat samples
 174 from the breast, drum stick and thigh muscles were cooked to an internal temperature of 72°C. The
 175 cooked samples were allowed to equilibrate to room temperature (27°C). Three cores of 1.0 cm diameter
 176 were removed from each cooked meat sample. Each core was sheared at three locations parallel to the
 177 orientation of the muscle fibre. The average of the three muscle types were taken and recorded as the
 178 shear force value for each treatment.

179 2.5 Statistical analysis

180 All data obtained were subjected to statistical analysis of variance. The analysis was conducted using the
 181 general linear modeling procedure SAS [10] and the means were separated using Duncan Multiple
 182 Range Test of the same software.

183

184 3. RESULTS AND DISCUSSION

185 The effects of different dietary treatment on performance characteristics of broiler chicks are
 186 summarized in Table 3. There was no significant difference ($P > 0.05$) among the treatments in terms of
 187 initial weight. Final weight obtained showed that birds on diets supplemented with microbial phytase in
 188 each of the feeding regime were significantly higher ($P < 0.05$) compared with those on the respective
 189 control diets. The results of the present experiment showed that broiler chickens fed phytase
 190 supplemented diets had better performance in terms of weight gain and feed conversion ratio. Earlier
 191 studies by Lan *et al.*, Moshad, Aksakal and Bilal, and Scott *et al.*, [11, 12, 13 and 14] demonstrated that
 192 broiler chickens fed diets supplemented with microbial phytase has improved feed conversion ratio due
 193 to better feed utilization. In a similar way, results of this experiment agreed with those of Huff, *et al.*

Namkung and Leeson, Zyla, *et al.*, and Bozkurt, *et al.*, [15, 16, 17 and 18] which reported that the growth rate and feed conversion ratio of broilers fed low P diets containing phytase were comparable or even better than those obtained for broilers fed the standard P diets. Although, Farrell *et al.*, [19] reported that phytase addition to duck diets improved growth and increased feed intake, but not FCR. The inability of poultry birds to utilize dietary phytate was clearly shown in this study by the significant increase in the final weight, feed intake and body weight gain of broiler chicks fed phytase supplemented diets.

Table 3. Effect of phytase supplementation on performance of broilers fed soybean and sesame/soybean based diets

	Treatments							
	Soybean			Sesame/Soybean				
Parameters	T1	T2	T3	T4	T5	T6	SEM	P-Val
Initial weight (g)	162.00	161.00	160.15	160.00	162.80	162.50	1.95	0.685
Final weight (g)	1557.50 ^e	1670.00 ^{de}	1767.50 ^{cd}	1862.50 ^{bc}	2212.50 ^a	2020.00 ^b	56.06	0.000
Weight gain g/day	33.50 ^d	37.13 ^{cd}	38.33 ^c	40.83 ^{bc}	48.60 ^a	44.23 ^b	1.30	0.000
Feed intake/day	92.65 ^b	93.23 ^b	96.95 ^{ab}	96.95 ^{ab}	101.98 ^a	97.53 ^{ab}	1.77	0.019
*FCR	2.79 ^a	2.52 ^b	2.50 ^b	2.38 ^{bc}	2.08 ^d	2.21 ^{cd}	0.07	0.000

Means with different superscripts in the same row differ significantly (P<0.05)

*Feed Conversion Ratio

T₁ and T₄ = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T₂ and T₃ = Treatments for soybean meal diets with 300 and 600 units of phytase

T₅ and T₆ = Treatments for sesame/soybean with 300 and 600 units of phytase

These results agreed with those reported by El-Tazi *et al.*, Arabi and El Medany *et al.*, [20,21,22] which indicated that the body weight gain and feed intake were significantly increased by addition of microbial phytase to broiler diet. On the other hand, the results contradicted the findings of Wilson *et al.*, [23], who reported that feed consumption decreased due to addition of enzymes since birds fulfilled their nutrient requirement by taking less amount of feed. The improvement in growth performance of broilers fed phytase supplemented diets could be attributed to the improvement in essential amino acids

(including lysine) and metabolizable energy as reported by Orban *et al.*, Attia *et al.*, Ravindran *et al.*, and Cowan [24,25,26,27] or due to overall increased utilization of nutrients Miles and Nelson [28].

The results for percentage retentions of Nitrogen, Ash, Ether extract, Crude fibre and Phosphorus are shown in Table 4. In soybean meal and sesame unsupplemented diets, percentage nitrogen retentions were 59.55 and 63.13% respectively. The addition of phytase to soybean meal and sesame/soybean diets significantly increased ($P<0.05$) nitrogen retention. Phytase addition significantly increased ($P<0.05$) percentage ash retention while ether extract (Fat) retention were not affected ($P>0.05$) by phytase supplementation. An increased level of crude fiber retention was obtained in diets with supplemented phytase over the control. Similar improvements in nutrient retention obtained in this study as a result of phytase supplementation have been reported in other studies with broiler for apparent nitrogen and phosphorus retention Kornegay [29]. The addition of microbial phytase to broiler diets often increases apparent digestibility of protein and amino acids as well as enhanced the utilization of phytate phosphorus Sebastian *et al.*, [30]. These results can be explained that phytase enzyme has a positive influence on gastrointestinal tract digestive enzymes that leads to the increase in digestibility observed in birds fed with P-deficient diets. These results are in agreement with previous findings on broiler Ravindran, *et al.*, Rutherford, *et al.*, Onyange, Mondal, *et al.*, [31, 32, 33 and 34]. The improvement in nutrient retention was expected because phytase liberates nutrients and minerals from phytate bound mineral complexes.

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Table 4: Effect of phytase supplementation on nutrient utilization by broilers fed soybean and sesame/soybean based diets

Parameters	Treatments						SEM	P-Val
	Soybean			Sesame/Soybean				
	T1	T2	T3	T4	T5	T6		
Nitrogen	59.55 ^c	62.98 ^b	63.64 ^b	63.13 ^b	65.32 ^a	67.22 ^a	2.42	0.038
Ash	68.21 ^b	68.48 ^b	72.48 ^{ab}	70.36 ^{ab}	73.65 ^a	74.85 ^a	1.90	0.024
Fat	57.12	60.70	62.90	63.99	65.43	64.75	3.84	0.661
Crude Fiber	64.72 ^c	69.55 ^b	71.76 ^b	68.65 ^b	75.53 ^a	76.22 ^a	2.23	0.044
Phosphorus	28.12 ^d	34.33 ^c	37.12 ^b	29.03 ^d	32.51 ^c	45.58 ^a	4.08	0.042

Means with different superscripts in the same row differ significantly ($P<0.05$)

T₁ and T₄ = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T₂ and T₃ = Treatments for soybean meal diets with 300 and 600 units of phytase

T₅ and T₆ = Treatments for sesame/soybean with 300 and 600 units of phytase

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Phosphorus retention improved as dietary phytase level in the diet increased and the highest P retention was obtained in sesame/soybean based diet (45.58%) with 600FTU/g phytase activity (T₆). Phytase treatments of diet have been reported to increase minerals (Ca, P) retention and its concentration in serum and tibia ash of broilers by various workers (Sebastian *et al.*, Ahmad *et al.*, and Lim *et al.*, [30, 35 and 36]. Phytate being a strong acid can form various salts with essential minerals, thus reducing their solubility and ultimately their absorption. However, when phytate is hydrolyzed by microbial phytase, it

may release all constituent minerals, myo-inositol and inorganic phosphate Wodzinski and Ullah [37]. Increase in P retention will probably lead to the reduction of the excretion of the mineral into the environment thereby reducing the pollution rate.

The carcass yield characteristics of different diets with and without enzymes are presented in Table 5. The breast muscle of birds fed sesame/soybean meal diet supplemented with 300FTU/Kg phytase was significantly heavier than the others (Table 5). Phytase supplementation increased breast muscle accretion. Data obtained from this experiment revealed that chicks fed diets containing Sesame/soybean diet supplemented with phytase has higher breast weight ($P<0.05$) than those on soybean meal supplemented diets. This is probably due to the balance of methionine and lysine in sesame/soybean diet rather than the effect of microbial phytase alone. The result was in line with those of Mukhtar et al [38] who reported that the breast meat yield was affected positively ($P<0.05$) with the increase in synthetic lysine and methionine in the diet. Soybean is reported to be high in lysine Olomu [2] while Sesame is noted for its high methionine content Aduku [1]. The findings in this study are not in isolation as they agreed with the report of Rezaei et al and Schutle et al., [39, 40] who reported that the addition of DL-methionine at 0.05% to the basal diet caused higher ($P<0.05$) percentage of breast meat yield in broiler. However, the findings of this present study contradicted that of Brandao et al [41] who verified that phytase had no effect breast yield of broilers.

Table 5. Primal cuts of broiler fed phytase supplemented diets (% live weight)

	Treatments						SEM	P-Val
	Soybean		Sesame/Soybean					
Parameters	T1	T2	T3	T4	T5	T6		
Breast	24.18 ^c	24.42 ^c	26.41 ^{bc}	26.89 ^{bc}	29.89 ^a	27.74 ^b	1.05	0.038
Thigh	16.77	15.33	16.57	16.25	17.44	15.37	0.77	1.154
Drum stick	15.46	14.75	15.79	14.26	15.12	13.74	0.44	2.981
Back	21.74	22.87	21.13	20.99	20.46	22.89	1.18	0.754
Wing	11.25	12.26	12.40	11.29	11.41	11.64	0.35	2.023

Means along the same row with similar superscripts are not significantly different ($P > 0.05$).

T₁ and T₄ = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T₂ and T₃ = Treatments for soybean meal diets with 300 and 600 units of phytase

T₅ and T₆ = Treatments for sesame/soybean with 300 and 600 units of phytase

Similar yields for the carcass and its different parts such as thighs, drumsticks and wings were noted between the control and the different enzyme concentration groups (Table 5) and are in agreement with (Mohamad and Hamza, Vranjes and Wenk, Saleh *et al.*, Café *et al.*, [42,43,44,45 and 46] who reported no apparent effects on carcass yields when enzymes were added. This probably implied that muscle accretion reached a plateau in response to available nutrient at the levels of crude protein and energy in the diets.

The meat characteristics of broiler chickens fed on diets supplemented with or without phytase are presented in Table 6. There was no significant ($P>0.05$) effect of phytase supplementation on the chilling loss and shear force values. These findings agreed with that of Hana *et al.*, [47] who reported no significant effect of enzyme supplementation on different meat quality attributes such as shear force among others. However, the result was not in consonance with the findings of the above authors on their

assertion that enzyme supplementation resulted in no effect on different meat quality traits such as cooking loss and water holding capacity.

Table 6. Meat attributes of broilers fed phytase supplemented diets

Parameters **	Treatments						SEM	P-Val
	Soybean			Sesame/Soybean				
	T1	T2	T3	T4	T5	T6		
Chilling loss (%)	2.38	3.10	2.16	1.95	3.24	2.45	0.84	0.612
Shear	3.22	3.18	3.50	3.96	3.71	3.84	0.36	0.686
Force (Kg/Cm ³)								
Cooking loss (%)	28.61 ^b	31.11 ^{ab}	32.29 ^{ab}	25.27 ^c	32.49 ^{ab}	35.56 ^a	2.02	0.038
Water	65.16 ^a	60.89 ^b	58.31 ^{bc}	62.26 ^{ab}	58.38 ^{bc}	57.48 ^c	4.58	0.042
Holding Capacity (%)								

Means along the same row with similar superscripts are not significantly different ($P > 0.05$).

** Measurement was the average values for thigh, drumstick and the breast muscles.

T1 and T4 = Control diets for soybean and sesame/soybean diets with 0 unit of phytase

T2 and T3 = Treatments for soybean meal diets with 300 and 600 units of phytase

T5 and T6 = Treatments for sesame/soybean with 300 and 600 units of phytase

Water holding capacity is defined as the ability of meat to retain its water upon the application of an external force Hedrick *et al.*, [48] and it is a primary indicator of degree of meat juiciness. Enzyme supplementation negatively affected the WHC as it reduced as the phytase inclusion increased in both feeding regime. Cooking yield of meat is dependent on cooking loss while cooking loss is a function of the WHC. The cooking loss percent obtained in this experiment increased as the enzyme inclusion increased indicating a lower yield for enzyme supplemented group.

4. CONCLUSION

It can therefore be concluded that sesame/soybean diet supplemented with 300 FTU/Kg microbial phytase should be adopted as the feeding regime of choice over the soybean enzyme supplemented diet since this feeding regime resulted in; optimum weight gain and better FCR. Also, the synergistic effect of the

combination became pronounced in nutrient utilization especially at level of 600 FTU/Kg. Nitrogen and Phosphorus utilization increased with the implication that less of these nutrients will be excreted to the environment. The effect of phytase supplementation on cooking loss and WHC bears an important implication on poultry processing industry.

ETHICAL APPROVAL

All authors hereby declare that principle of laboratory animal care (nih publication no. 85-23. Revised1985) were followed, as well as specific national laws where applicable. The experiment was examined and approved by the appropriate ethics committee.

COMPETING INTERESTS

Authors hereby declare that no competing interest exists.

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