Original Research Article

EVALUATION OF BREAD WASTE FORTIFIED WITH MORINGA LEAF MEAL ON PERFORMANCE AND HEALTH STATUS OF BROILER CHICKENS

Abstract

Aim: This study is to evaluate the effects of using bread waste fortified with moringa leaf meal on broiler chickens.

Methodology: Bread wastes were sun-dried and moringa leaves air-dried. The two dried products were milled separately. Thereafter, the meals were mixed in ratio 9:1 (9kg Bread Waste + 1kg Moringa Leaf) to produced fortified bread wastes. Four broiler starter diets and four finisher diets were formulated using fortified bread waste at graded levels of 0, 5, 10 and 15% and designated diets I, II, III and IV, respectively. Two hundred chicks were assigned to four dietary treatments of five replicates and ten chicks per replicate in a Completely Randomized Design. Diets and water were fed to the broilers *ad libitum* from 0 - 28 days as starter phase and 29 - 56 days as finisher phase.

Results: Highest final weight gain and total weight gain (2.12kg/bird and 2.07kg/bird) and least feed conversion ratio (2.32) were observed in bird fed Diet I. The dressed weight, eviscerated weight, head, chest, drumstick, wing, thigh, back and shank were influenced significantly (P<0.05) by the dietary treatments. Highest dressed weight (92.64%), eviscerated weight (79.52%), head (25.34g/kg body weight), chest (206.53g/kg body weight) and wing (83.10g/kg body weight) were recorded in bird fed Diet I. Only lymphocyte was influenced (P<0.05) by the dietary treatments. Erythrocyte sedimentation rate varies: 2.33 - 3.33mm/hour, packed cell volume: 26.67 - 28.67%, haemoglobin concentration: 9.23 - 9.88g/100ml and mean cell haemoglobin concentration: 34.41 - 34.61%. Cholesterol and alkaline phosphatase were influenced (P<0.05) by the dietary treatments. The cholesterol: 22.57 - 32.78mg/dl and alkaline phosphatase: 144.17-150.98IU/l.

Conclusion: From the results obtained in this study, it can be concluded that increasing levels of fortified bread wastes in broiler chicken diets up till 5% inclusion level can be practiced.

Keywords: Bread waste, Moringa leaf, performance, carcass, relative organs and blood

Introduction

Feeding constitutes an important part of poultry production. Ukachukwu (2015) observed that developing countries have feed deficits. He reported that feed is the highest single cost input in production of poultry. In poultry, feed cost is put at about 70 - 80% of total cost of production under intensive system, while in other livestock it is about 45 – 64% (Ologhobo *et al*., 1993; Ukachukwu, 2015). This, according to Ukachukwu (2015) is made to be complicated by competition among human, the industry and farm animals for the same food items as either food for man, feed for animals and raw materials for the industry. Since feed is a major factor in poultry production, reducing feed cost is a priority for every poultry farmer and animal nutritionist. Currently, feed ingredients for poultry, especially those for which there is competition with humans, are scarce and expensive (Ologhobo *et al.,* 1993). Among the feed ingredients, protein and energy sources are most expensive. For instance, soya bean meal, the most widely used plant protein source and maize, the most widely used energy source, are very expensive in Nigeria, due to the fact that the demand for them out weighs their supply.

One of the ways of solving this problem of high feed cost is by looking for alternative feedstuffs, which have little or no dietary value for man and industry. However, the use of agricultural or industrial wastes as feed sources that have the capacity to yield the same output as conventional feedstuff and perhaps at a cheaper cost. One agro-industrial wastes that has received little research attention is bread waste. Large numbers of bread factories are operated in the urban and peri-urban areas, and they produce a sizable amount of wastes during processing and marketing of the bread which in most cases contribute to environmental menace. Bread waste had been used as an alternative energy source for maize in poultry diets (Nworgu *et al*., 1999). However, it is envisaged that the nutritive potential of bread waste could be enhanced with addition of moringa leaf. Moringa is rich in protein, vitamins and minerals (Ladeji *et al*., 1995 and Adegbenro, 2015). Moringa is also rich in iron and have been reported to be useful in the treatment of anaemia (Alada, 2000). Yameogo *et al.* (2011) reported that on a dry matter basis, Moringa leaves contained 27.2% protein, 5.9% moisture, 17.1% fat, and 38.6% carbohydrates. Its leaves and green pods are rich in carotene and ascorbic acids with good profile of essential amino acid contents of the leaves and sulfur containing amino acids of the kernel were higher than the amino acid pattern of the FAO reference protein amino acids (Makkar and Becker, 1996). It is therefore conceivable that a rational blend of bread wastes with moringa leaf meal could help to increase the nutrient density vis-à-vis availability of bread wastes in broiler chicken diet. Thus, this study is designed to evaluate the nutritive potential of bread waste-moringa leaf meal in broiler chicken diets using growth indices and health status as response criteria.

Methodology

Experimental site: The experiment was carried out at the Poultry Unit of the Teaching and Research Farm, The Federal University of Technology, Akure, Nigeria, (Latitude $7^0$18''N and Longitude 5^0 10''E) which falls within the rainforest zone of the humid tropics which is characterized by hot and humid climate.

Collection of test ingredients: Bread wastes were collected from different bakeries in Akure, Nigeria and were sun-dried to prevent staling. Moringa leaves were sourced for in large quantities in Akure and air-dried between 14 - 21days. The dried bread wastes and moringa leaves were milled separately using hammer mill and stored in plastic containers at 4^0C prior to use.

Fortified bread waste production: The bread waste meal was mixed with moringa leaf meal in ratio 9:1 (9kg bread waste meal + 1kg moringa leaf meal) to produced fortified bread wastes. However, other feed ingredients were sourced from feed-millers locally in Akure, Nigeria.

Experimental diets: Four (4) diets were formulated for both phases (starter and finisher) to meet NRC (1994) minimum requirement for each of the phases. The four (4) broiler starter diets were formulated using fortified bread waste as one of the feed ingredients at the graded levels of 0, 5, 10 and 15% (0kg, 5kg, 10kg and 15kg) and designated diets I, II, III and IV, respectively. The same procedure was followed for the finisher phase. Each diet was thoroughly mixed. The gross composition (%) of the experimental diets for the starter and finisherwere presented in Tables 1 and 2.

Experimental layout and feeding trials: A total number of two hundred and fifty (250) day-old Arbor-acre broiler chicks were purchased from a reputable hatchery in Ibadan, Nigeria. Out of which two hundred (200) chicks were assigned to four (4) dietary treatments of five (5) replicates and ten (10) chicks per replicate. The chicks were electrically brooded. The design of the trial was Completely Randomized Design. The respective formulated diets and water were fed to the broiler chicks *ad libitum* from 0 - 28 days as starter phase and 29 - 56 days as finisher phase. Vaccination and medication were also carried out as at when due as prescribed by the Teaching and Research Farm, Federal University of Technology, Akure, Nigeria. During the trial, data on initial body weights, weekly weight changes and weekly feed intake were recorded. The feed conversion ratio (FCR) was estimated as a ratio of feed intake to weight gain.

Slaughtering and blood collection: At the end of the trial, four (4) birds were randomly selected per replicate, stunned and slaughtered by severing the jugular vein, for blood collection for the haematological and serum indices studies. For haematology, blood samples were collected into sterilized bottles containing Ethylene Diamine Tetra-acetic Acid (EDTA). Blood samples for serum biochemical studies were collected into test tubes (without anticoagulant) and placed in test tube racks in the microscopy laboratory of Animal production and health Department, FUTA. After some hours, the serum was obtained by centrifugation and serum samples were stored in a deep freezer prior further study.

Carcass and organs measures and blood sample collection: The slaughtered birds were defeathered and weighed. The eviscerated weight was obtained by removal of the offal and internal organs. Carcass parts and organs were weighed and their weights expressed as percent of live body weight.

Chemical and Statistical Analyses: The proximate composition of the diets was determined according to the method of AOAC (2006). Data collected were subjected to one-way analysis of variance using SPSS version 13 package and where significant differences are found; the means were compared using Duncan Multiple Range Test of the same package.

Results

Performance characteristics: Table 3 shows the influence of fortified bread waste on the performance of broiler chickens. From the table, the final weight gain and total weight gain were significantly influenced (P<0.05) by the dietary treatments. Highest final weight gain (2.12±13.16kg/bird), highest total weight gain (2.07±13.14kg/bird) and least feed conversion ratio (2.32±0.02) were observed in bird fed Diet I. Lowest final weight gain (1.66±10.26kg/bird), lowest total weight gain (1.62±9.58kg/bird) and highest feed conversion ratio (2.54±0.12) were observed in bird fed Diet IV. Meanwhile, highest total feed intake (4.82±25.60kg/bird) was observed in bird fed Diet I.

Carcass characteristics: Results of carcass characteristics are presented in Table 4. Among all the parameters measured; dressed weight, eviscerated weight, head, chest, drumstick, wing, thigh, back and shank were significantly (P<0.05) influenced by the dietary treatments. Highest values for dressed weight (92.64±8.30%), eviscerated weight (79.52±6.50%), chest (206.53±14.50g/kg body weight), thigh (112.95±10.60g/kg body weight) and wing (83.10±4.80g/kg body weight) were recorded in bird fed Diet I.

Organ weight: The results of organ weights are shown in Table 5. For all the parameters measured, only the pancreas was significantly (P<0.05) influenced by the dietary treatments. The relative weights of gizzard (ranged: 11.99 – 13.59g/kg body weight). Highest values for gizzard (13.59±1.92g/kg body weight) were observed in bird fed Diet IV and heart (4.06±0.14g/kg body weight) were observed in bird fed Diet II while lowest values for gizzard and heart were recorded in bird fed Diet III (11.99±1.38g/kg and 3.36±0.03g/kg body weight, respectively). Highest value for liver (17.16±2.19g/kg body weight) was recorded in bird fed Diet II while lowest value (15.98±2.08g/kg body weight) was recorded in bird fed Diet III.

Haematological indices: The results of haematological indices are presented in Table 6. The Erythrocyte sedimentation rates (ESR) of bird fed Diet III (3.33±0.19mm/hr) had the highest value while lowest ESR was recorded in bird fed Diet II (2.33±0.15mm/hr). Highest Packed cell volume (PVC) was observed in bird fed Diet II (28.67±0.22%) while the bird fed Diet III had the lowest PVC (26.67±0.27%). Highest red blood cell (RBC) was recorded in bird fed Diet II (2.35±0.11×10^6mm^{-3}) while lowest RBC was recorded in bird fed Diet III (1.82±0.05×10^6mm^{-3}). Highest haemoglobin concentration was recorded in bird fed Diet II (9.88±1.90g/100ml) while lowest Hb was recorded in bird fed Diet III (9.23±1.20g/100ml). The mean cell haemoglobin concentration values ranges from 34.41±0.02% in bird fed on Diet I to 34.61±0.12% in bird fed Diet III. Also, for mean cell haemoglobin (MCH), the highest value (50.71±0.64pg) was recorded in bird fed Diet III while lowest value (42.04±0.50pg) was recorded in bird fed Diet II. Mean cell volume (μ^3) values also varied from 122.00±8.10μ^3in bird fed Diet II to 146.54±8.35μ^3 in bird fed Diet III.

Serum metabolites: Table 7 shows that among all parameters measured for biochemical indices, only cholesterol and alkaline phosphatase were significantly ($P<0.05$) influenced by the dietary treatments. Bird fed Diet I had highest total protein (3.03±0.17g/dl) and lowest value was observed in bird fed Diet IV (2.56±0.11g/dl). Highest aspartate transamine and alanine aminotransferase values were observed in bird fed Diet II (32.08±2.89IU/l, 11.53±1.41IU/l, respectively) while lowest values for aspartate transamine (18.75±2.03IU/l) and alanine aminotransferase (6.20±1.11IU/l) were observed in birds fed Diet I and Diet III, respectively. Lowest cholesterol was recorded in bird fed Diet IV (22.57±3.21mg/dl) while highest cholesterol level was observed in bird fed Diet I (32.78±3.78mg/dl).

Discussion

The result obtained from this study showed that the growth in terms of body weight of the birds fed at varying level of bread waste fortified with moringa leaf meals were significantly for final weight and total weight gain of the birds. The results obtained from total weight gain of this study was in agreement with the report of Leeson *et al*., (1996), that the increased growth rate of broiler chicken is achieved by increase in feed intake. Total feed consumed by all the experimental birds were not significantly. The depression in growth rate, which is as a result of high feed conversion ratio in bird fed Diet IV and inconsistency in feed intake for the treatment suggested poor utilization of this diet. Olabode (2008) and Onyimonyi *et al*., 2009 both worked with neem leaf meal and they also observed low level of feed intake in broiler birds as the level of neem leaf meal increased in the diet of the birds. These authors suggested that the low palatability, nutrient imbalance and bitterness of the diets as imparted by the neem leaf meal could be responsible for the low feed intake. According to Brown *et al*., (2001) who reported that comparison of feed conversion ratio among different species may be of little significance unless the feed involve are of similar quality and suitability. The result obtained in this study shows that the birds on the test diets have ability to turn feed to body mass. Diet I had more ability to turn feed to body mass due to their low feed conversion ratio value and followed by Diet II and Diet IV. This result agrees with the findings of Al-Ruqaie *et al*., (2011) who reported that bread waste product could replace 100% of the corn in broiler diets without any adverse effect on the performance. Carcass has been known to be an important parameter for determining the relationship for the "whole sale" or "further process" base of birds (Warren and Emmert, 2000). The output quality for the system is fixed by a predetermined amount of kilogram carcass of final product of broilers (Warren and Emmert, 2000). In this study, the dressed weight, eviscerated weight, head, breast, drumstick, wing, back and shank of the birds decreased progressively as the levels of inclusion of the fortified bread wastes increased in the diets. This implies that the decreased in these carcass weights at increased inclusion levels of the fortified bread wastes could be as a result of effect of fibre which increased in the diets. Preston and William (1973) who reported that heavier birds at slaughter would have greater dressing percentage and higher eviscerated yield than lighter birds. The weight of organs in broilers according to Atteh, 2004 reflects the anatomical response of birds to the type of diet consumed.Liver, heart, gizzard, spleen, proventriculus and belly fat weights were generally similar (P>0.05) for all the experimental birds showing that the fortified bread wastes were not detrimental to the birds. This was in agreement with (Ani *et al*., 2013), who reported that dressing percentage, liver, heart, spleen, gizzard, small and large intestine weights were generally similar for treated and control groups showing that *Gongronem alatifolium* inclusion in the diets was not detrimental to the birds.

Blood is a means of assessing both clinical and nutritional health status of animals in feeding trials (Aderemi, 2004). Haematological profiles such as Red blood cell, Packed cell volume, White blood cell and Haemoglobin concentration have all been found useful for disease prognosis, for therapeutic and feed stress monitoring Olafedehan *et al.* (2010).The results of the haematological profiles showed that the Mean cell haemoglobin, Neutrophils, Eosinophils, Monocyte, Erythrocyte sedimentation rate, Basophils, Packed cell volume, Red blood cell, Mean cell volume, Mean cell haemoglobin concentration and Haemoglobin of all the birds in the treatments were not influenced by the varied inclusion level of the fortified bread wastes. The values for all the haematological profiles determined in this experiment all fell within the range presented by Maton *et al.,* (2004). The result obtained in this study also buttress the point that the fortified bread waste could be used as an alternative feed ingredient without any adverse effect on the health status of the birds.

It has been established that high value of serum total protein is a good indicator of quality protein in experimental diets (Tewe, 1985; Aletor *et al*., 1998). The results of biochemical indices obtained from this present study shows that the total protein, albumin, globulin, creatinine, aspartate transamine and alanine aminotransferase were not influenced at varying inclusion levels of the fortified bread wastes in the diets.In this study, the serum total protein values were not significantly affected by the dietary treatments which suggest the adequacy and utilization of the dietary protein by the birds irrespective of the varying inclusion in the fortified bread wastes. The function of albumin in the blood have been reported to include the facilitation of blood clotting ability in farm animals, the higher the albumin the higher the clotting abilityand hence it ability of preventing haemorrhage (Azeez *et al.,* 2002). However, the value of albumin obtained in this study was in line with the normal range of 2-3g/dl reported by Mitruka and Rawnsley (1977). Globulin prevents infection in animal by providing antibodies which fights infection (Awojobi and Opiah, 2000). Adegbenro *et al*. (2016) reported that low globulin levels could lead to high mortality. A normal range of 3-3.5g/dl was reported by Mitruka and Rawnsley (1977). Alkaline phosphatase (ALP), Alanine aminotransferase (ALT) and Aspartate Transamine (AST) are major indicators used for assessing the liver condition of animals (Agbede *et al*., 2011). Alanine aminotransferase (ALT) and Aspartate Transamine (AST) were not affected at varying level of the fortified bread wastes in the diets and this is a good indicator that the fortified bread wastes might not pose any serious health challenges to the birds, especially the liver, as increased activities of these enzymes are well known diagnostic indicator of liver injuiry (Agbede *et al*., 2011).

Conclusion

From the results obtained in this study, it can be concluded that increasing levels of fortified bread wastes in broiler chicken diets can be practiced. It can be therefore recommended that 5% fortified bread waste inclusion level will perform well considering the performance, carcass and organ results. Also the results obtained from the haematological and biochemical indices suggested that the fortified bread wastes had no negative effect on all the experimental birds.

Competing interest: The authors declare that they have no competing interests.

Ethics approval: The right to conduct the research granted by the Research committee of the Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria. The birds were managed following the recommendation and guidelines of the committee.

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Table 1: Gross Composition of the Basal Starter Diets (%)

Ingredients	Diet I	Diet II	Diet III	Diet IV
Maize	53.05	50.05	46.55	43.05
Soybean	17.00	15.00	13.50	12.00
Groundnut cake	20.00	20.00	20.00	20.00
Fish meal	3.00	3.00	3.00	3.00
Fortified bread waste	0.00	5.00	10.00	15.00
Lysine	0.10	0.10	0.10	0.10
Methionine	0.10	0.10	0.10	0.10
Di-calcium phosphate	1.00	1.00	1.00	1.00
Limestone	2.00	2.00	2.00	2.00

Starter premix	0.25	0.25	0.25	0.25
Vegetable oil	3.00	3.00	3.00	3.00
Salt	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis				
Energy (kcal/kg)	3109.18	3148.84	3185.26	3221.68
Crude protein (%)	22.93	22.93	23.07	23.21
Calcium (%)	1.18	1.18	1.17	1.17
Phosphorus (%)	0.47	0.45	0.44	0.43

Table 2: Gross Composition of the Finisher Diets (%)

Ingredients	**Diet I**	**Diet II**	**Diet III**	**Diet IV**
Maize	59.00	56.00	53.00	50.00
Soybean	11.00	9.00	7.00	5.00
Groundnut cake	20.00	20.00	20.00	20.00
Fish meal	3.00	3.00	3.00	3.00
Fortified bread waste	0.00	5.00	10.00	15.00
Lysine	0.12	0.12	0.12	0.12
Methionine	0.12	0.12	0.12	0.12
Di-Calcium Phosphate	1.21	1.21	1.21	1.21

Limestone	2.00	2.00	2.00	2.00
Premix	0.25	0.25	0.25	0.25
Vegetable oil	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis				
Energy (kcal/kg)	3146.50	3186.17	3225.83	3265.50
Crude protein (%)	21.19	21.16	21.14	21.11
Calcium (%)	1.22	1.21	1.21	1.20
Phosphorus (%)	0.48	0.46	0.45	0.43

Table 3: Performance characteristics of broiler chickens fed fortified bread waste meals

Parameters	Diet I	Diet II	Diet III	Diet IV
Initial Weight(g/bird)	40.92±0.34	40.99±0.66	40.96±0.58	40.94±0.56
Final Weight(kg/bird)	2.12±13.16[a]	1.91±12.67[ab]	1.89±11.27[b]	1.66±10.26[b]
Total Weight gain (kg/bird)	2.07±13.14[a]	1.86±12.51[ab]	1.85±11.17[b]	1.62±9.58[b]
Total Feed Consumed(kg/bird)	4.82±25.60	4.39±24.50	4.34±24.26	4.11±22.15
Feed Conversion Ratio	2.32±0.02	2.36±0.06	2.34±0.04	2.54±0.12

[a, b, c]- Mean within rows having different superscripts are significantly different (P<0.05)

Table 4: Carcass Traits of broiler chickens fed fortified bread waste meals

Parameters	Diet I	Diet II	Diet III	Diet IV
Dressed Weight (%)	92.64±8.30^{a}	91.85±7.50^{ab}	88.26±6.60^{b}	88.18±6.40^{bc}
Eviscerated Weight (%)	79.52±6.50^{a}	78.54±6.45^{b}	73.48±6.70^{bc}	71.82±7.10^{c}
Head (g/kg body weight)	25.34±2.30^{a}	26.35±2.50^{a}	23.07±2.12^{ab}	22.83±2.08^{b}
Chest (g/kg body weight)	206.53±14.50^{a}	187.05±14.30^{b}	184.34±14.22^{bc}	163.81±14.11^{bc}
Drumstick (g/kg body weight)	106.42±12.30^{a}	110.84±12.67^{a}	103.19±12.10^{b}	95.34±11.67^{c}
	b			
Wing (g/kg body weight)	83.10±4.80^{a}	80.65±4.50^{ab}	79.52±4.30^{b}	77.56±4.20^{bc}
Thigh (g/kg body weight)	112.95±10.60^{a}	107.51±10.48^{a}	101.65±10.13^{bc}	104.85±10.30^{b}
		b		
Neck (g/kg body weight)	38.48±3.60	40.95±3.80	32.53±3.22	37.86±3.48
Back (g/kg body weight)	158.83±13.40^{a}	159.47±13.45^{a}	145.47±13.32^{b}	138.86±13.11^{c}
	b			
Shank (g/kg body weight)	42.03±4.15^{ab}	45.24±4.30^{a}	41.54±3.89^{b}	40.71±3.50^{bc}

[a, b, c]- Mean within rows having different superscripts are significantly different (P<0.05

Table 5: Relative Organ Weight of broiler chickens fed fortified bread waste meals

Parameters	Diet I	Diet II	Diet III	Diet IV
Liver(g/kg body weight)	16.08±2.11	17.16±2.19	15.98±2.08	16.61±2.15
Heart(g/kg body weight)	3.55±0.04	4.06±0.14	3.36±0.03	3.88±0.11
Lung(g/kg body weight)	4.10±0.21	4.39±0.30	4.79±0.55	4.41±0.33
Gizzard(g/kg body weight)	12.54±1.44	12.97±1.62	11.99±1.38	13.59±1.92
Spleen(g/kg body weight)	1.82±0.13	1.92±0.15	1.58±0.07	1.67±0.08
Pancreas(g/kg body weight)	2.41±0.18^{a}	2.41±0.18^{a}	2.27±0.15^{ab}	1.80±0.11^{c}
Proventriculus(g/kg body weight)	3.41±0.19	3.64±0.21	3.30±0.17	3.67±0.24

Belly Fat(g/kg body weight)	10.12±1.20	11.13±1.27	12.60±1.38	17.22±1.95

[a, b, c]- Mean within rows having different superscripts are significantly different ($P<0.05$)

Table 6: Haematological parameters of broiler chickens fed fortified bread waste meals

Parameters	Diet I	Diet II	Diet III	Diet IV
Erythrocyte Sedimentation Rate (mm/hr)	2.83±0.14	2.33±0.15	3.33±0.19	3.17±0.17
Packed Cell Volume (%)	27.55±0.23	28.67±0.22	26.67±0.27	27.50±0.23
Red Blood Cell ($\times10^6$/mm^3)	2.10±0.07	2.35±0.11	1.82±0.05	2.04±0.06
Haemoglobin (g/100ml)	9.48±1.40	9.88±1.90	9.23±1.20	9.50±1.50
Mean Cell Volume (μ^3)	131.19±8.27	122.00±8.10	146.54±8.35	134.80±8.29
Mean Cell Haemoglobin (pg of Hb)	45.14±0.57	42.04±0.50	50.71±0.64	46.57±0.60
Mean Cell Haemoglobin Concentration (%)	34.41±0.02	34.46±0.03	34.61±0.12	34.55±0.08
Lymphocytes (%)	59.00±0.23^{bc}	59.67±0.25^{a}	58.50±0.13^{c}	59.17±0.19^{b}
Neutrophils (%)	25.00±0.43	24.00±0.24	24.50±0.37	24.67±0.40
Monocytes (%)	12.33±0.18	12.33±0.18	13.00±0.25	12.00±0.16
Basophils (%)	2.17±0.05	2.00±0.03	2.17±0.05	2.33±0.08
Eosinophils (%)	1.00±0.05	1.00±0.05	0.83±0.03	0.83±0.03

$^{a, b, c}$- Mean within rows having different superscripts are significantly different ($P<0.05$)

Table 7: Serum indices of broiler chickens fed fortified bread waste meals

Parameters	Diet I	Diet II	Diet III	Diet IV
Total Protein (g/dl)	3.03±0.17	3.02±0.15	2.96±0.14	2.56±0.11
Albumin (g/dl)	2.82±0.16	2.68±0.13	2.42±0.07	2.35±0.05
Globulin (g/dl)	1.22±0.02	1.35±0.03	1.54±0.07	1.22±0.02
Creatinine (mg/dl)	0.14±0.03	0.19±0.03	0.51±0.07	0.35±0.04
Alkaline Phosphatase (IU/l)	150.98±9.80^{a}	144.17±9.29^{b}	146.91±9.50^{b}	148.41±9.68^{ab}
Cholesterol (mg/dl)	32.78±3.78^{a}	28.28±3.65^{ab}	25.51±3.42^{b}	22.57±3.21^{bc}
Alanine Aminotransferase (IU/l)	8.70±1.18	11.53±1.41	6.00±1.11	10.00±1.21
Aspartate Transamine (IU/l)	18.75±2.03	32.08±2.89	25.25±2.63	25.17±2.52

$^{a, b, c}$- Mean within rows having different superscripts are significantly different (P<0.05)