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ORIGINAL RESEARCH ARTICLE

The dynamics of dietary supplementation of probiotic and synbiotic on blood profile in turkey

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ABSTRACT

An experiment was conducted to evaluate the effect of dietary probiotic and synbiotic supplementation on serum metabolites and haematological parameters of turkey poults. One hundred and twenty-eight (128) seven-day-old poults were used and the study lasted for 7 weeks. Birds were randomly allotted to 4 dietary treatments sorted by body weights consisting of 4 replicates of 8 birds each. The basal diet was a corn-soyabean diet formulated according to the recommendations of NRC for starter and grower phases. Diet 1 was the negative control without additive, diets 2, 3 and 4 contained antibiotic, probiotic, and synbiotic respectively. Blood samples were collected from the jugular vein of 2 poults per replicate for serum and haematological parameters. Results showed that there were significant (P<0.05) differences in the red blood cell (RBC), haemoglobin (Hb), packed cell volume (PCV), monocytes and eosinophils of the turkey poults. Highest values of RBC (4.42 x 10^6/µl), Hb (13.00g/100ml) and PCV (39%) were recorded for birds on synbiotic diet which was comparable to those on antibiotic diet. No effect of supplemental feed additive was observed in most of the serum indices of the birds. Cholesterol, triglycerides, very low density lipoprotein, low density lipoprotein, aspartate amino transferase and alanine amino transferase of turkey poults were significantly (P< 0.05) influenced by the dietary treatments. Meanwhile, least values of cholesterol (97.15mg/dl) and low density lipoprotein (47.40mg/dl) were recorded for birds fed synbiotic and probiotic supplemented diets respectively which were similar to that of birds on antibiotic supplemented diet. The results suggest that probiotic and synbiotic supplementation could be effectively used as alternative to antibiotics to boost the immune response of turkey poults with reduced serum cholesterol. These feed additives could therefore be introduced as a safe and natural alternative to antibiotic growth promoters in turkey diets.

Keywords: feed additives, turkey poults, serum biochemical indices, haematological parameters

INTRODUCTION

Antibiotics have been used at sub-therapeutic doses in animal feed, including poultry diets, for over five decades to prevent diseases, promote growth and improve feed conversion efficiency (Engberg *et al.*, 2000). Antibiotics exerted their effect by stabilising the intestinal microbial flora thereby preventing proliferation of specific intestinal pathogens (Shane, 2005; Aroniyo, 2014). However, there has been a serious concern about the indiscriminate use of antibiotics as feed supplement in poultry. This has resulted in residue deposition of the antibiotics in animal products, which invariably pose health hazards to humans because of the potential development of antimicrobial resistance and about transference of antibiotic resistance genes from animal to human microbiota (Mathur and Singh, 2005). As a result, antibiotics used as growth promoters in poultry feeds are banned by the European Union (EU, 2003; 2006). Such legistration is yet to take effect in some other countries including Nigeria, however, viable alternatives that could enhance the natural defence mechanisms of animals and reduce the massive use of antibiotics should be looked into. Among such potential alternatives are prebiotics, probiotics, organic enzymes, yeast culture, extracts and essential oils of some herbs and spices (Hooge, 2006). Apparently, probiotic and prebiotic have been shown to reduce serum cholesterol and abdominal fat in broiler chickens (Gaggia *et al*., 2010), increase performance, improve resistance to pathogenic bacteria colonisation and enhance host mucosa immunity thus resulting in a reduced pathogen load, and improved health status of the animals (Yalcinkaya *et al*., 2008). Also, their anti-atherogenic and hepatoprotective effect has also being emphasised (Ashayerizadeh *et al*., 2011). However, there is limited information on the influence of these feed additives on blood metabolites of turkey poults. It was therefore the objective of this study to evaluate the effect of dietary supplementation of probiotic and synbiotic (combinations of prebiotic and probiotic) on serum

biochemical indices and haematological parameters of turkey poults.

MATERIALS AND METHODS

Experimental site

This experiment was carried out at the Poultry Unit of the Teaching and Research Farm, University of Ibadan, Oyo State in the South West zone of Nigeria.

Experimental diets and management of the turkey poults

The basal diet was a corn-soyabean meal diet formulated to meet the nutrient requirements (NRC, 1994) for starter (8 to 28 days) and grower (29 to 56 days) turkeys. Diet 1 was the negative control (basal without antibiotic); Diet 2 was the positive control (basal with oxytetracycline hydrochloride added at the rate 200 g/tonne feed). In Diets 3 and 4, 500 g/tonne probiotic (*Lactobacillus sporogenes* + *Saccharomyces cerevisiae)* and 500 g/tonne synbiotic (prebiotic + probiotic), respectively replaced the antibiotic. The prebiotic used was mannanoligosaccharide. The gross compositions of the basal diets (starter and grower) are as shown in Tables 1 and 2. The analysed proximate compositions of the diets are shown in Table 3.

One hundred and twenty eight (128) one-day-old unsexed turkey poults (Nicholas strain) used for this experiment were obtained from a reputable commercial hatchery. The poults were fed on the control diet to stabilise for one week after which they were weighed, tagged and randomly allotted to 4 dietary treatments sorted by body weight in a randomised complete block design. Each dietary treatment had 4 replicates of 8 turkey poults per replicate. Experimental diets were given *ad libitum* and birds had free access to clean water.

Blood collection

At day 56, blood sample was collected from the jugular veins of 2 birds per replicate into two vaccutainer tubes for each poult, one containing Ethylene Diamine Tetra acetic Acid (EDTA) for haematological analysis and the other sterile vaccutainer tubes without EDTA. The second set of tubes were covered and centrifuged, serum separated out, decanted, deep – frozen for serum biochemical analyses.

Packed cell volume estimation

The blood samples collected in bottles containing EDTA were gently mixed and drawn up in a micro haematocrit capillary tube to ¾ of its length. One end of the tube was sealed with plasticine. The capillary tube was placed in micro –haematocrit centrifuge ensuring that the plasticine end is outward. After closing, these were then centrifuged at 12,000 rpm for 4 minutes. The tubes were then read in the haematocrit reader. The reading expressed the packed red blood cells as a percentage (%) of the total volume of blood (Mitruka and Rawnsley, 1981).

Table 1: Gross composition (g/100g DM) of experimental diets (Starter Phase)

Ingredient	Control	Antibiotic	Probiotic	Synbiotic
Maize	42.00	41.98	41.95	41.95
Soyabean meal	52.00	52.00	52.00	52.00
Fish meal	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.50	1.50	1.50	1.50
Limestone	1.40	1.40	1.40	1.40
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.50	0.50	0.50	0.50
Premix*	0.25	0.25	0.25	0.25
Additives	_	0.02	0.05	0.05
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated nutrients (%)				
ME (Kcal/kg)	2902.64	2902.64	2902.64	2902.64
Crude Protein	27.90	27.90	27.90	27.90
Crude Fibre	4.24	4.24	4.24	4.24
Methionine	0.52	0.52	0.52	0.52
Lysine	1.67	1.67	1.67	1.67

ME= Metabolisable energy; *Composition of Premix per Kg of diet: vitamin A, 12,500 I.U; vitamin D_3, 2,500 I.U; vitamin E, 40mg; vitamin K_3, 2mg; vitamin B_1, 3mg; vitamin B_2, 5.5mg; niacin, 55mg; calcium pantothenate, 11.5mg; vitamin B_6, 5mg; vitamin B_{12}, 0.025mg; choline chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg; selenium, 0.12mg; Anti-oxidant, 120mg.

Table 2: Gross composition (g/100gDM) of experimental diets (Grower Phase)

Ingredient	Control	Antibiotic	Probiotic	Synbiotic
Maize	44.50	44.48	44.45	44.45
Soyabean meal	49.00	49.00	49.00	49.00
Fish meal	2.00	2.00	2.00	2.00
Dicalcium phosphate	1.50	1.50	1.50	1.50
Limestone	1.40	1.40	1.40	1.40
Salt	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10
Methionine	0.50	0.50	0.50	0.50
*Premix	0.25	0.25	0.25	0.25
Additives	_	0.02	0.05	0.05
Titanium dioxide	0.50	0.50	0.50	0.50
Total	**100.00**	**100.00**	**100.00**	**100.00**
Calculated Nutrients (%)				
ME (Kcal/kg)	2908.33	2908.33	2908.33	2908.33
Crude Protein	26.02	26.02	26.02	26.02
Crude Fibre	4.10	4.10	4.10	4.10
Methionine	0.49	0.49	0.49	0.49
Lysine	1.59	1.59	1.59	1.59

ME= Metabolisable energy; *Composition of Premix per Kg of diet: vitamin A, 12,500 I.U; vitamin D_3, 2,500 I.U; vitamin E, 40mg; vitamin K_3, 2mg; vitamin B_1, 3mg; vitamin B_2, 5.5mg; niacin, 55mg; calcium pantothenate, 11.5mg; vitamin B_6, 5mg; vitamin B_{12}, 0.025mg; choline chloride, 500mg; folic acid, 1mg; biotin, 0.08mg; manganese, 120mg; iron, 100mg; zinc, 80mg; copper, 8.5mg; iodine, 1.5mg; cobalt, 0.3mg; selenium, 0.12mg; Anti-oxidant, 120mg.

Haemoglobin and corpuscular constants concentrations determination

Haemoglobin concentration was determined by a cyanmethaemoglobin method using Drabkin's solution as diluent. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) were determined using appropriate formula.

$$MCV\ (\mu^3) = \frac{\text{Haematocrit} \times 10}{\text{RBC in millions/mm}^3}$$

$$MCH\ (\mu\mu g) = \frac{\text{Hb in g/100ml blood} \times 10}{\text{RBC in millions/mm}^3}$$

$$MCHC\ (\%) = \frac{\text{Hb in g/100ml blood} \times 100}{\text{Haematocrit}}$$

Table 3: Proximate composition (g/100gDM) of experimental diets

Parameter	Starter diet	Grower diet
Dry matter	91.50	92.63
Crude protein	28.05	26.92
Crude fibre	4.43	4.68
Ether extract	6.05	6.00
Ash	3.50	4.60
Nitrogen Free Extract	57.97	57.80

Red Blood Cell (RBC) and platelets counts

Properly mixed blood sample from bottle containing EDTA was drawn up to 0.5 mark of a red blood cell pipette. The tip of the pipette was immersed into normal saline and carefully drawn up to exactly 101 marks after which the dilute blood was mixed by shaking for about half a minute. About a quarter of the content was expelled before filling the haematocytometer counting chamber and was allowed to stand for about a minute to settle after filling. All the red cells were then counted using the x 40 objective lens and x8 eye piece of the microscope, with the aid of a counter.

RBC Total count= RBC counts x 10 x dilution factor

= RBC counts x 10,000

Platelets were determined by phase microscopy method of Brecher and Cronkite (1950).

White Blood Cell (WBC) and differential leukocytes counts

The total leukocyte counts were determined using Neubauer haemocytometer after appropriate dilution, and differential leukocyte counts performed using the oil immersion objective examination of blood films stained with the modified Romanovsky's Giemsa stain.

Serum metabolites

Total serum cholesterol, triglycerides, and high density lipoprotein (HDL) were assayed by the method of

Roschlan *et al*. (1974).Very low density lipoproteins (VLDL) were estimated as (triglycerides/5) (Friedewald *et al*., 1972), while low density lipoproteins (LDL) were estimated using Friedewald equation [LDL= Total cholesterol – (HDL-Tryglycerides/5)]. The biuret method was utilized in the determination of the total protein fraction while the serum was subjected to the direct colorimetric method for albumin with Bromocresol Green (BCG) as the dye as described by Peters *et al*. (1982). The globulin concentration was obtained by subtracting albumin from the total protein. Albumin/globulin ratio was obtained by dividing the albumin value by the calculated globulin value as described by Peters *et al*. (1982).

Aspartate and Alanine aminotransferase determinations

Aspartate amino transferase (AST) and Alanine aminotransferase (ALT) activities were determined using spectrophotometric methods as described by Rej and Hoder (1983).

Chemical and Statistical Analyses

The proximate composition of diets was determined by the methods of AOAC (2000). Data obtained were analysed using ANOVA of SAS (SAS, 2008) and significant level of P = 0.05 was used. The treatment means were compared using Duncan Multiple Range Test.

RESULTS

Haematological indices of birds fed experimental diets

The results of haematological indices of turkey poults on are as shown in Table 4. The haematological variables showed that blood parameters of birds were significantly (P< 0.05) influenced by the dietary treatment. There were significant (P<0.05) differences observed in the Red Blood Cell (RBC), Haemoglobin (Hb), Packed Cell Volume (PCV), monocytes and eosinophils of turkey poults on experimental diets. Birds on synbiotic supplementation had highest values of RBC (4.42 $x10^6$/µl), Hb (13.00g/100ml) and PCV (39.00%) which were similar to what was obtained in birds on antibiotic diet. There were no significant differences observed in the platelets, White Blood Cell (WBC), heterophils, lymphocytes, basophils, Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Cell Haemoglobin (MCH) and Mean Cell Volume (MCV) of turkey poults on the experimental diets. There was no basophil count for poults on antibiotic diet, but similar MCHC value (33.30%) was recorded for birds across the dietary treatments.

Serum metabolites of birds fed experimental diets

The results of serum metabolites and liver function enzymes of turkey poults are shown in Table 5. There were no significant (P>0.05) differences observed in total protein, albumin, globulin, albumin/globulin ratio, urea, creatinine, high density lipoprotein and alkaline phosphatase of poults on experimental diets. The cholesterol, triglycerides, Very Low Density Lipoprotein (VLDL), Low Density Lipoprotein (LDL) and some liver enzymes; Aspartate amino transferase (AST) and Alanine Amino Transferase (ALT) of turkey poults were significantly (P< 0.05) influenced by the dietary treatments.

Table 4: Haematological indices of turkey poults on experimental diets

Parameter	Control	Antibiotic	Probiotic	Synbiotic	SEM
Red blood cells ($x10^6$/µl)	3.85^b	4.22^{ab}	3.96^b	4.42^a	0.13
Haemoglobin (g/100ml)	11.58^b	12.42^{ab}	11.67^b	13.00^a	0.46
Packed cell volume (%)	34.75^b	37.25^{ab}	35.00^b	39.00^a	1.40
Platelets (/µL)	194,500	213,750	208,750	225,500	16405.98
White blood cells ($x10^3$/µl)	18.84	18.69	17.44	20.13	1.13
Heterophils ($x10^3$µl)	28.00	28.50	26.25	25.00	2.44
Lymphocytes ($x10^3$µl)	66.50	65.50	70.00	70.50	2.30
Monocytes ($x10^3$µl)	3.00^a	3.50^a	3.00^a	1.75^b	0.45
Eosinophils ($x10^3$µl)	2.25^b	3.00^a	0.75^c	2.50^{ab}	0.37
Basophils ($x10^3$µl)	0.25	0.00	0.25	0.25	0.23
MCHC (%)	33.30	33.30	33.30	33.30	0
MCH (µµg)	30.05	29.70	29.53	29.53	1.57
MCV (μ^3)	90.20	89.05	88.56	88.55	4.71

Means on the same row with different superscripts are significantly (P<0.05) different, MCHC-mean corpuscular haemoglobin concentration, MCH-mean cell haemoglobin, MCV-mean cell volume SEM-standard error of mean

Elevated levels of cholesterol (132.58mg/dl) and LDL (85.70mg/dl) were recorded in poults on the basal diets (negative control) while least values of cholesterol (97.15mg/dl) and LDL (47.40mg/dl) were recorded for birds fed synbiotic and probiotic supplemented diets respectively, although the values compared favourably with those on antibiotic diet (positive control). Triglycerides and VLDL of poults on probiotic diet were significantly (P< 0.05) higher than birds on other diets, though not different from those on the basal diet (negative control). Highest AST value (279.30IU/L) was recorded in turkey poults on basal diet while least value (246.00 IU/L) was recorded in birds on synbiotic supplementation; though not significantly different from birds on antibiotic diet. Similarly, highest value of ALT (16.87 IU/L) was observed in poults on probiotic diet while lowest value (7.52 IU/L) was recorded in birds fed antibiotic diet.

DISCUSSION

The haematological variables are important indices that reflect the physiological state of the individual animal. The ability to interpret the state of blood profile in normal and diseased condition is among many primary objectives of haematological studies (Khan and Zafar, 2005). The blood contains myriad of metabolites and other constituents, which provide a valuable medium for clinical investigation and nutritional status of animals. Hence, WHO (2003) recommended the use of blood and biochemical parameters in medical nutritional assessment (Olorode *et al*., 1995). Heamatological parameters most commonly used for assessment in nutritional studies include PCV, RBC, HBC, MCHC, MCV and clotting time (Adeyemi *et al*., 2000). Highest values of RBC, Hb and PCV observed in birds on synbiotic diet were similar to the findings of Cetin *et al*. (2005) who reported a significant increase in the erythrocyte count, haemoglobin concentration and haematocrit values when turkey diet was supplemented with probiotics and synbiotics.

In a similar work carried out by Amber *et al*. (2010), there was an increase in the total RBCs counts in the birds fed effective microorganism and zinc bactracin as an alternative growth promoter as compared to those fed control diets. However, RBC values observed across the treatments were higher than the normal physiological range of 1.74 - 3.70 x 10^6/mm^3 reported by Nirmalan and Robinson (1971) for turkeys and this could possibly suggest polychytemic condition. Meanwhile, RBC of poults on probiotic and synbiotic supplemented diets were similar to those on the basal (negative control) and antibiotic (positive control) diets. This could imply that the increase in RBC may not necessarily be attributed to the supplementation of probiotic or synbiotic to the diets. Although PCV and Hb concentration were higher in synbiotic supplemented diet, values still fall within the normal physiological range reported by Nirmalan and Robinson (1971). This suggests a normal physiological functioning and better circulatory gaseous exchange since haematocrit and Hb measure the concentration of red blood cells and transportation of oxygen and carbon dioxide respectively. However, lowest monocyte count was observed in birds on synbiotic supplemented diet.

Table 5: Serum metabolites of turkey poults on experimental diets

Parameter	Control	Antibiotic	Probiotic	Synbiotic	SEM
Total protein (g/dl)	3.68	3.59	3.67	3.37	0.25
Albumin (g/dl)	2.12	1.99	2.06	1.92	0.17
Globulin (g/dl)	1.56	1.60	1.61	1.45	0.26
Alb/Glo	1.36	1.24	1.28	1.32	0.46
Urea (mg/dl)	11.02	7.74	7.41	6.78	2.61
Creatinine (mg/dl)	0.60	0.54	0.59	0.60	0.02
Cholesterol (mg/dl)	132.58^{a}	98.18^{b}	100.5^{b}	97.15^{b}	14.99
Triglycerides (mg/dl)	107.3^{ab}	89.73^{b}	132.4^{a}	93.13^{b}	18.72
HDL (mg/dl)	25.43	27.28	26.57	24.88	1.58
VLDL (mg/dl)	21.46^{ab}	17.95^{b}	26.49^{a}	18.63^{b}	3.74
LDL (mg/dl)	85.70^{a}	52.96^{b}	47.40^{b}	53.65^{b}	11.95
AST (IU/L)	279.30^{a}	256.90^{ab}	276.90^{a}	246.00^{b}	12.47
ALT (IU/L)	10.32^{bc}	7.52^{c}	16.87^{a}	13.20^{ab}	2.13
ALP (IU/L)	175.9	140.9	374.0	218.1	130.47

Means on the same row with different superscripts are significantly (P<0.05) different, HDL- high density lipoprotein, VLDL- very low density lipoprotein, LDL- low density lipoprotein AST- aspartate amino transferase; ALT- alanine amino transferase; ALP- alkaline phosphatase ; SEM-standard error of mean

Similarly, very low eosinophil count was recorded in birds on diet supplemented with probiotic. Eosinophils are mobilised at the site of antigens-antibody reactions, and this mobilisation is accompanied by an increase in the number of eosinophil in the blood stream (Deldar, 1994).

A very low value of eosinophils recorded for birds on probiotic diet could mean that the immune response of birds on this diet was enhanced. Circulatory monocytes are tissues macrophages, known as mononuclear phagocyte system (MPS), play an important role in phagocytising and destroying intra cellular organisms (fungi, protozoa and viruses) and transformed cells (Deldar, 1994) while eosinophils play a primary role of detoxification (Coles, 1986). In this present study, monocyte and eosinophil counts recorded were within the normal physiological range reported by Nirmalan and Robinson (1971), this suggests that there is no presence of intra cellular organism to elicit the activities of MPS which could abnormally increase the monocyte count and parasitic infestation to raise eosinophils count than normal. However, low monocyte value observed in birds on synbiotic supplementation diet probably suggests presence of condition known as monocytopenia. The platelets, White Blood Cell (WBC), heterophils, lymphocytes, basophils, Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Cell Haemoglobin (MCH) and Mean Cell Volume (MCV) of turkey poults were not influenced by the dietary treatments.

However, the recorded values were within the normal physiological range reported by Nirmalan and Robinson (1971) except MCH and MCV which had lower values than the reported values; this probably suggests microcytic anemic condition. However, Capcarova *et al*. (2008) observed no differences in WBC, RBC and PCV in turkeys after an experimental probiotic, *Enterococcus faecium* M-74 strain administration.

The chemistry of serum is routinely used for detection of organ disease in domestic animal and the amount of available protein in the diets (Iyayi and Tewe, 1998). It has been reported that serum biochemical constituents are positively correlated with the quality of the diet (Adeyemi *et al*., 2000). There were no appreciable differences observed in total protein, albumin, globulin and albumin/globulin ratio of birds which was also similar to the findings of Konca *et al*. (2009). The present study suggests that the dietary treatments did not precipitate any severe effects on the health status of the birds. However, it opposed the findings of Ewuola *et al*. (2011) who observed hyperglobulinemia condition in rabbits fed probiotic and synbiotic supplemented diets.

The serum urea nitrogen test measures the amount of nitrogen. High serum urea level can indicate kidney dysfunction, because blood urea nitrogen is also affected by protein intake and liver function, the test is usually done in conjunction with a blood creatinine, a better indicator of kidney function. The dietary treatments did not affect the blood urea and creatinine of the birds. This indicates there is no kidney dysfunction condition and also a better utilisation of protein since blood urea can also be associated with the protein break down. This is in line with the findings of Konca *et al*. (2009) that dietary mannan oligosaccharides and *Saccharomyces cerevisiae* did not affect blood urea of a growing turkey tom.

Cholesterol is widely distributed in the body and it plays an important role in the synthesis of steroid hormones, bile salts and vitamin D. The cholesterol, triglycerides, VLDL and LDL in the present study were significantly influenced by dietary treatments as opposed to the findings of Stanley *et al*. (1997). Birds on synbiotic and probiotic supplementation had the least values of cholesterol and LDL respectively, though similar to those on antibiotic diet. This is probably a normocholesterolemic condition which could be attributed to probiotic effect and its ability to bind cholesterol in the small intestines. Usman (1999) reported that strains of *Lactobacillus gasseri* could remove cholesterol from laboratory media via binding onto cellular surfaces. Pereira and Gibson (2002) also reported that, probiotic bacteria ferment food-derived indigestible carbohydrates to produce short-chain fatty acids in the gut, which can then cause a decrease in the systemic levels of blood lipids by inhibiting hepatic cholesterol synthesis and/or redistributing cholesterol from plasma to the liver. Possible conversion of cholesterol into coprostanol by bacteria has been evaluated by Chiang *et al*. (2008). The present study also agrees with this fact, as least value of cholesterol (97.15 mg/dl) was observed in birds on synbiotic diet. The authors found that cholesterol dehydrogenase/isomerase produced by bacteria such as *Sterolibacterium denitrificans* was responsible for catalysing the transformation of cholesterol to cholest-4-en-3-one, an intermediate cofactor in the conversion of cholesterol to coprostanol. Similarly, low value of LDL observed in birds on probiotic though similar to antibiotic and synbiotic diets is highly beneficial as LDL is known for the transportation of cholesterol from the liver to the peripheral tissues which is harmful to the animal. Meanwhile, triglyceride and VLDL were significantly

higher in birds fed probiotic supplemented diet compared to birds on other treatments. Yalcinkaya *et al*. (2008) reported that there was no reduction in the triglyceride of birds fed probiotics supplemented diet compared to control group which also corresponds to the present finding. Lower triglyceride observed in birds fed synbiotics supplemented diet may be attributed to the presence of non-digestible carbohydrate components in synbiotic which aids the proliferation of probiotics thus better assimilation of fat.

In serum enzymology, the concentration of the enzymes used in diagnosis of heart, liver and kidney damage give information as regards their status and state of damage (Harpers *et al*., 1979). According to Voss *et al*. (1993) increases in serum Alanine Amino Transferase (ALT), Aspartate Amino Transferase (AST) and Alkaline Phosphatase (ALP) levels serve as an indication of damage caused to the liver, kidney and/or heart due to cellular destruction caused by toxins or infections.

The AST and ALT of turkey poults in this study were significantly influenced by the dietary treatments. The value of AST in birds fed probiotic diet was similar to those on antibiotic supplemented diet, this may probably be associated with hepatoprotective effects of the probiotics as reported by Umeki *et al*. (2004). The values of AST and ALT in turkey poults were also within the normal physiological range reported by Bounous and Stedman (2000) which indicates normal functioning of the liver and kidney, because any abnormal increase in serum levels of AST, ALT and ALP may imply liver damage. Meanwhile, Aluwong *et al*. (2012) reported decrease in activities of serum ALT and ALP of broiler chickens fed probiotic supplemented diet, when compared with the control. In another study, Macha *et al*. (2004) showed that the addition of probiotic strain *Enterococcus faecium* caused significant increase in serum ALT and ALP activities in piglets and sows but effect of dietary supplementation was not observed in the ALP in turkey poults in the present study.

CONCLUSION

The haematological and serum biochemical indices observed showed that addition of probiotic and synbiotic to turkey diets proved beneficial and served as worthy alternative growth promoters without adverse effects on the blood metabolites.

CONFLICT OF INTEREST

Authors have declared that no conflict of interest exists.

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