Journal of Agriculture and Agricultural Technology

(JAAT)

Journal of Agriculture and Agricultural Technology 14 (1), 2025

GROWTH PERFORMANCE, HAEMATOLOGICAL PARAMETERS AND SERUM BIOCHEMISTRY OF INDIGENOUS TURKEY (*MELEAGRIS GALLOPAVO*) ADMINISTERED AQUEOUS LEAF EXTRACTS OF *MORINGA OLEIFERA* AT STARTER PHASE

ABDULLAHI, B.M., MALIK, A.A., ALABI, O.J., AND OTU, B.O.

Department of Animal Production, Federal University of Technology, Minna, Nigeria.

bilalajos@gmail.com 08053018686

ABSTRACT

The experiment evaluated the growth performance, haematological parameters, and serum biochemistry of indigenous turkey (Meleagris gallopavo) and administered Aqueous Leaf Extracts of Moringa Oleifera (ALEMO) at the starter phase. In a completely randomised design, one hundred and twenty poults were randomly allocated to five treatments of four replicates. The treatments were tagged as negative control, positive control, 5, 10, and 15 mls/l of ALEMO from treatments one to five, respectively. The ALEMO extracts were administered orally via water to the turkey for 28 days. Basal diets and water were given ad libitum. Data generated were subjected to a One-Way Analysis of Variance using a Statistical Package for Social Science, and mean differences were separated using the Duncan multiple range test at $P<0.05$. The results of growth traits revealed all parameters measured were not significantly ($P>0.05$) affected by ALEMO administration. The nutrient digestibility results indicated that dry matter (69.17) and crude protein (72.43) were significantly ($P<0.05$) better in birds on ALEMO 15 mls/l when compared to those on plain water (negative control). The administration of ALEMO improved the productive performance without any detrimental effect on the Turkeys.

Key words: Antibiotics, Growth performance, Haematology, Indigenous turkey, Moringa, Serum Biochemistry.

INTRODUCTION

Research into the nutritional aspects of turkey production in Nigeria is beginning to receive attention (Ojewola *et al*., 2002). The production of these birds has been improved through the use of synthetic antibiotics (Tanko and Ojewola, 2003). Studies have shown that the feed efficiency of poultry birds has improved by about 1-10 % through the use of antibiotics as growth promoters, as reported by the Food and Agricultural Organization (FAO, 2007). Food Animal Concerns Trust (FACT, 2015) recognizes that animals may need to be treated with antibiotics when they become sick with a bacterial infection. However, antibiotics are often used in the absence of disease to promote growth or prevent disease. This practice is known to lead to the spread of superbugs, which is of urgent public health significance (FACT, 2015). Antibiotics cause animals to put on weight more quickly with less feed. When used for disease prevention, antibiotics provide animal insurance for a disease that might happen but for which signs of illnesses are not currently shown. When used this way, antibiotics are often given to all the animals in low doses and for long duration in all conditions. This practice has, however, led to the spread of superbugs (Shahidi *et al.,* 2004).

The spread of antibiotic-resistant superbugs is an urgent public health significance that has already led to over two million illnesses and 23,000 deaths (FACT, 2015) in the United States each year. Although such results have not been documented in developing countries, there are indications of antibiotic resistance and residues in poultry meat. The major driver of resistance is the overuse of antibiotics in human medicine and animal agriculture. Antibiotic use on farms can spread superbugs by consuming animal products from farm workers and contaminating air and water. These resistant superbugs cause difficulty in treating illnesses in people and animal species. The negative impact on consumers of poultry products due to residual effects has led to the European Union's ban on antibiotics as growth promoters (Figen *et al.,* 2011). Hence, animal scientists and veterinarians now focus on safe and natural alternatives such as phytogenic and phytobiotic extracts to replace synthetic antibiotics. Figen *et al.* (2011) proposed that these herbs and spices could be used as feed additives in animal nutrition. These additives may improve feed intake, flavour enhancement and anti-oxidative activities. These plant extracts are reported to contain

some anti-microbial phytochemicals like phenolics and polyphenols (simple phenols, phenolic acids, quinines, flavones, tannins and coumarins), essential oils, alkaloids, lectins and polypeptides (Moyo *et al.,* 2012a). Several alternatives to growth promoters have been proposed (Ali *et al.,* 2012). Organic acids and medicinal plants as natural feed additives are now variously used in poultry diets to enhance the performance of the immune response of birds (Sarwatt *et al.,* 2002). One such plant is *Moringa oleifera*, the drumstick tree (Agbede and Aletor, 2003).

Moringa Oleifera Leaf Extracts (MOLE) have potential as growth promoters and can be equivalent to synthetic antibiotics in commercial poultry and livestock production in the tropics (Morton, 1991). *Moringa oleifera* leaves are readily available and cheap worldwide (Elkhalifa *et al.,* 2007). They also contain substantial amounts of crude protein, metabolizable energy, essential amino acids, vitamins and minerals. As such, MOLE is projected to be a promising and sustainable resource for commercial poultry production in the tropics (Kakengi *et al.*, 2007; Atawodi *et al.,* 2008). *Moringa* has been reported to be a valuable component in human and animal feed due to its adequate amino acid profile and crude protein content. It is high in vitamins A and E and has low levels of anti-nutritional compounds (Yang *et al.,* 2006). According to Fahey (2005), all parts of the *Moringa* tree are edible and have long been consumed by man.

A lot of studies have been carried out on the importance of *Moringa oleifera* leaf meals and extracts to improve the performance of various farm animals like dairy cows (Reyes-Sánchez *et al.,* 2006), beef cattle (Foidl *et al*., 2001; Reyes-Sánchez *et al*., 2006), goats (Moyo *et al*., 2012b), fish and pigs (Richter *et al*., 2003; Kakengi *et al*., 2007; Olugbemi *et al*., 2010; Nkukwana *et al*., 2014, a, b, c), broiler chickens (Gadzirayi *et al*. 2012), layer chickens (Abou-Elezz *et al*. 2011) and quails (Portugaliza and Fernandez, (2011). However, studies on the importance of *Moringa oleifera* leaf extracts in Turkey are limited. The optimal dosage levels of the bioactive ingredients responsible as growth promoters in *Moringa oleifera* leaf extracts and how they affect the performance of turkeys (*Meleagris gallopavo*) and their haematological and serum biochemistry parameters are unknown. This research aimed to determine the effect of ALEMO at varying dosages in the drinking water of indigenous turkeys (*Meleagris gallopavo*) as a substitute for synthetic antibiotics as a growth promoter and its impact on their growth performance, haematological and serum biochemistry parameters.

MATERIALS AND METHODS

Experimental Location

The experiment was carried out at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna, Niger State, Nigeria. The town is situated between latitude 9°28' and 9°37' North, longitude 6° 23' and 6°33' East. It has an annual rainfall of 1000 – 1500 mm and an average temperature of 32 ^{o}C. It is located in Nigeria's Southern Guinea Savannah Vegetation Zone (Minna Meteorological Station, 2020).

Experimental Design and Treatments

A completely randomized design was used for this study. The birds were randomly allocated to three ALEMO treatments. Treatment 1 was without antibiotics and was labelled plain water (negative control). Treatment 2 was administered a synthetic antibiotic (Gendox®) as the positive control. Treatments 3, 4, and 5 contained ALEMO quantities at 5, 10, and 15 mls/l, respectively. Each of the treatments was replicated four times. One hundred and twenty-day-old local poults were randomly assigned to five treatments consisting of four replicates with six poults per replicate.

Sources of Experimental Materials and Turkey Management

120-day-old indigenous poults were purchased from Olams Hatchery and Breeder Farms, Kaduna, Kaduna State, Nigeria. The poults were acclimatized for 4 weeks and randomly allotted to five treatments. All necessary management practices were strictly observed. Feed and water were given *ad libitum* throughout the study. Feed ingredients were purchased from Step-by-Step Integrated Services, Minna. The diet contained crude protein of 26 % and energy of 2900 kcal/kg as recommended by the National Research Council (NRC, 1994) for turkey (Table 1).

Preparation and Administration of *Moringa* Leaf Extract

Moringa oleifera leaf was collected from the olericulture garden of the Federal University of Technology, Bosso campus. Moringa oleifera leaves were air-dried (94.25 dry matter) and ground to powder using mortar and pestle. The infusion technique was applied to extract bioactive

substances in the leaves according to the procedures of Portugaliza and Fernandez (2011). The leaves were soaked in distilled water for 24 hours using a 1:2 ratios (weight/volume). The solution was filtered using Whatman paper no 1 to separate the debris from the aqueous extract. The filtrate was processed in a Rotary Evaporator (600 ^{0}C) until 20 ml concentration was attained. The plant extract was kept in a freezer (40 ^{0}C) until needed. The concentrated extract was diluted using tap water (volume/volume) into 5, 10 and 15 ml/1000 ml water for Treatments 3, 4 and 5. The ALEMO was administered *ad libitum* throughout the study period.

Data Collection

Body Weight

At the beginning of the experiment, birds in each replicate were weighed using an electron digital weighing scale 275 (Ace Inc., Jaipur, India) and then weighed at weekly intervals throughout the experimental period. The mean body weight was obtained by dividing the total weight obtained from each set of birds by the number of birds weighed.

Body Weight Gain

The body weight gain was determined by calculating the differences between the body weight for the previous week and the present week's body weight. Mean body weight was obtained by dividing the weight gain by the number of days a week.

Feed Intake

Feed was weighed daily for the birds in each replicate, and the quantity consumed for the day was obtained by subtracting the leftover from the quantity supplied over a period of 24 hours. Average feed consumption per bird was taken weekly from each replicate by dividing the total feed consumed by the number of birds in each replicate.

Feed Conversion Ratio

The amount of feed required to produce 1 g of body weight was calculated weekly by dividing the quantity of feed consumed by the weight gain of the birds in each replicate using the following expression given by Malik *et al.* (2010).

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Average daily feed intake (g)}}{\text{Average daily weight gain(g)}}$$

Hematological and Serum Biochemical Indices Determination

The blood samples were taken very early in the morning via the wing vein with the aid of a 5 ml syringe and needle into two sets of sterilized 7 ml plastic bijou bottles, with the first set of bottles containing Ethylene Diamine-Tetra Acetate (EDTA) as an anticoagulant. They were used for hematological analysis, and the second set of bottles not containing any anticoagulant was used for serum biochemistry. The samples were then taken immediately to the State Veterinary Clinic Laboratory at Bosso, Minna, where a three parts differential Abacus Junior haemo-analyzing machine was used to determine the hemoglobin concentration, Packed Cell Volume (PCV), Red Blood Cells (RBC) count, White Blood Cell (WBC) count and their differentials (granulocytes, neutrophils, lymphocytes, monocytes, eosinophils and basophils).

The second set of bijou sterilized bottles containing the blood samples with no anticoagulant was used to test for serum electrolytes and liver and kidney function. Total plasma protein was determined using the Biuret method described by AOAC (2000) using a commercial preparation (Sigma Chemical Co.) as a protein standard. Albumin was determined by a dye-binding reaction with Bromocresol green (Doumas, 1975). Creatinine was determined by a Jaffe reaction according to the method described by Willard *et al.* (1989). Urea was determined by diacetyl monoxime method (Henry *et al.,* 1974).

Data Analysis

Data collected on growth performance, hematological parameters, and serum biochemistry were subjected to One-Way analysis of variance using the General Linear Model (GLM) Procedure of Statistical Package for Social Science (SPSS version 16.0). Significant mean variations were separated using Duncan's Multiple Range Test using the same package.

RESULTS AND DISCUSSION

Growth Performance of Turkey (*Meleagris gallopavo*) Administered ALEMO at Starter

The results of the growth performance of turkey-administered aqueous leaf extracts of *Moringa oleifera* at the starter phase are presented in Table 2. All the parameters evaluated were not significantly ($P>0.05$) influenced by the ALEMO treatments. This might imply that the ALEMO dosage administered in the present study is insufficient for increasing turkey performance growth.

The current result is contrary to the observation of (Akhouri *et al.,* 2013), who asserted that administering aqueous extracts of *Moringa oleifera* significantly ($P<0.05$) increased the feed conversion ratio and overall growth performance of broiler chickens.

Table 1 Experimental Diets and Calculated Nutrient Composition for Turkeys at the Starter Phase

Ingredients	Brooding phase (%)
Maize (yellow)	23.00
Full fat soya	57.00
Soybean cake (CP)	11.00
Maize offal	4.00
Vitamin and Mineral premix*	0.25
Limestone	1.50
Bone meal	2.50
Salt	0.50
Methionine	0.15
Lysine	0.10
Total	100.00
Calculated nutrient composition	
Crude protein (%)	28.20
Metabolizable energy (kcal/kg)	2937.81
Ether extract (%)	11.90
Crude fibre (%)	4.60
Calcium (%)	1.41
Available phosphorus (%)	0.48
Lysine	1.74
Methionine	0.97

The non-significant effect of ALEMO treatment on the growth parameters of Indigenous turkey at the starter phase might imply that the dose level of *Moringa oleifera* extract administration in this study is not optimal for indigenous turkey production in the tropic. The present findings agreed with the report of Kashyap *et al.* (2022) that dietary addition of *Moringa oleifera* leaf meal had no significant influence on the growth performance of broiler chickens. Similarly, Kashyap *et al*. (2022) observed no significant effect on the growth response of broiler chickens administered *Moringa oleifera* leaf extracts. Furthermore, Zanu *et al*. (2012) observed that final body weight gain and daily body weight gain increase with an increment in the dosage level of Moringa leaf extract.

Apparent Nutrient Digestibility of Turkey (*Meleagris gallopavo*) Administered ALEMO at Starter Phase.

Table 3 presents the apparent nutrient digestibility parameters of turkey-administered aqueous leaf extracts of *Moringa oleifera* (ALEMO) at the starter phase. The results showed that all the apparent nutrient digestibility parameters measured were not significantly ($P>0.05$) influenced by dietary treatments at the starter phase except for dry matter and crude protein. Dry matter (%) ranged from 64.53 (T_4) to 72.69 (T_2). Birds on oxytetracycline (positive control) had the highest mean value, and their values were significantly higher ($P<0.05$) than all the other treatments. Birds on $AMOLE_5$ (15 mls) had similar ($P>0.05$) mean values to the birds on $AMOLE_3$ (5 mls). Birds on $AMOLE_3$ (5 mls) and birds on plain water also had similar ($P>0.05$) mean values. The mean dry matter value of birds on plain water was similar ($P>0.05$) to the mean value recorded for birds on $AMOLE_4$. $AMOLE_4$ (10 mls) had the least mean value. Crude protein (%) ranged from 66.43 (T_2) – 72.43 (T_5). Birds on $AMOLE_5$ (15 mls) had the highest ($P<0.05$) mean crude protein digestibility value but similar ($P>0.05$) to the mean values of birds on $AMOLE_3$ (5 mls) and $AMOLE_4$ (10 mls) treatments.

The increased dry matter and crude protein digestibility obtained in the present study during the starter phase might be attributed to the bioactive properties of *Moringa oleifera* leaf extract. This suggests that *Moringa oleifera* leaf extract has the potency to promote nutrient breakdown, bioavailability, and utilization in the gastrointestinal tract of indigenous turkey. The present study, which shows no significant difference in the growth performance of local turkey, contradicts the

observation of Oso *et al.* (2019), who reported that incorporation of *Moringa oleifera* leaf meal at 1 and 25 g per kg of feed during the starter period enhanced apparent nutrient digestibility in the indigenous turkeys. Similarly, the findings of the current study conform with the report of Elnesr *et al.* (2020), who studied the dietary effect of *Moringa oleifera* Leaf Meal (MOLM) on growth performance and nutrient digestibility of broiler chicken and found increased crude protein with increase in MOLM inclusion with no influence on the other nutrient digestibility parameters.

Table 2: Growth Performance of Indigenous Turkey (*Meleagris gallopavo*) Administered ALEMO at Starter Phase

Treatments	Initial body weight (g)	Final body weight (g)	Body weight gain (g)	Total feed intake (g)	FCR
T_1	86.00	699.45	613.45	743.083	1.33
T_2	86.25	568.81	482.56	661.86	1.37
T_3	83.65	637.01	553.36	669.47	1.24
T_4	88.50	621.60	533.10	685.04	1.24
T_5	90.30	659.46	569.16	671.89	1.19
SEM	1.60	23.13	23.35	14.23	0.04
P-value	0.77	0.52	0.54	0.40	0.69

Plain water (T_1), Oxytetracycline (T_2), ALEMO 5 mls (T_3), ALEMO 10 mls (T_4), ALEMO 15 mls (T_5), ALEMO: Aqueous Leaf Extracts of *Moringa oleifera,* FCR: Feed conversion ratio P-value: Probability value, SEM: Standard error of the means, Mls: milli litres

Haematological Parameters of Turkey Administered ALEMO at Starter Phase

The results of hematological parameters of turkey administered aqueous leaf extracts of *Moringa oleifera* (ALEMO) at the starter phase are presented in Table 4. The results showed that only eosinophil and basophil were significantly ($p< 0.05$) influenced by dietary treatments at the starter phase.

Eosinophil ranged from 0.25 (T_5) – 1.00 (T_1, T_2 and T_3). Birds administered plain water (negative control), oxytetracycline (positive control), $ALEMO_3$ (5 mls), and $ALEMO_4$ (10 mls) had the highest ($P<0.05$) mean values, while birds on $AMOLE_5$ recorded the lowest ($P<0.05$) mean value. For basophil, the range is between 0.00 (T_3) and 1.00 (T_2 and T_5). Birds administered oxytetracycline (positive control), and those on $ALEMO_4$ (10 mls) and $ALEMO_5$ (15 mls) had higher ($P<0.05$) mean basophil values than the birds on plain water (negative control) and $ALEMO_3$ (5 mls). The values of hematological parameters obtained for indigenous turkey poults administered with aqueous extracts of *Moringa oleifera* fell within the normal reference values for healthy birds reported by Nkukwana *et al.* (2014b). The values recorded from this study are contrary to the findings of Gakuya *et al.* (2014), who reported that dietary supplementation of *Moringa oleifera* leaf meal increased packed cell volumes (PCV), Red Blood Cells (RBC) count, and White Blood Cells (WBC) count in broiler chickens. The present findings confirmed the reports of Nanbol *et al.* (2016), who noted that most hematological parameters of indigenous chickens increase as the birds grow; males generally had higher values than females. Similarly, this study disagrees with the observations of Addass *et al.* (2012), who conducted a study on indigenous chickens administered with varying levels of *Moringa oleifera* extracts and found PCV, RBC, WBC, Mean Corpuscular Volume (MCV) and Mean Corpuscular Haemoglobin Concentration (MCHC) of the birds were significantly enhanced. However, the result of the present study is in line with the observation of Nathaniel *et al.* (2020), who indicated that the dietary addition of *Moringa oleifera* leaf meal had no significant effect on broiler chickens' PCV, RBC, and WBC. The differences observed in the results of the current study, when compared with those of other authors, might be attributed to the variations in the livestock species and environments. In the same vein, dissimilarity observed in the eosinophils and basophils in the present study may be associated with stress and the health status of animals.

Table 3 Apparent Nutrient Digestibility of Turkey (*Meleagris gallopavo*) Administered Aqueous Leaf Extracts of *Moringa oleifera* (ALEMO) at Starter Phase

	Parameters						
Treatments	**DM**	**CP**	**CF**	**EE**	**ASH**	**NFE**	**TDN**
T_1	66.38^{cd}	66.51^{b}	58.86	71.27	71.85	87.13	73.70
T_2	72.69^{a}	66.43^{b}	61.44	73.41	70.37	88.43	70.13
T_3	67.88^{bc}	69.26^{ab}	58.35	67.66	71.46	83.47	75.56
T_4	64.53^{d}	70.66^{ab}	61.67	67.88	74.49	88.80	70.30
T_5	69.17^{b}	72.43^{a}	60.63	65.90	70.61	88.00	74.97
SEM	0.77	0.80	0.71	1.04	0.74	0.87	0.87
P-value	0.01	0.04	0.52	0.12	0.47	0.32	1.9

abcd = means in the column with different superscript differs significantly when ($P<0.05$)
Plain water (T_1), Oxytetracycline (T_2), ALEMO 5 mls (T_3), ALEMO 10 mls (T_4), ALEMO 15 mls (T_5) ALEMO: Aqueous Leaf Extracts of *Moringa oleifera,* DM: Dry matter, CP: Crude protein, CF: Crude fibre, EE: Ether extract, NFE: Nitrogen free extract P-value: Probability value, SEM: Standard error of mean, ml: Mili-liter, k.g: Kilogram

Serum Biochemistry Parameters of Turkey Administered ALEMO at Starter Phase

The results of serum biochemistry parameters of turkey administered aqueous leaf extracts of *Moringa oleifera* (ALEMO) at the starter phase are presented in Table 5. The results showed that all the serum biochemistry parameters measured were not significantly ($P > 0.05$) influenced by dietary treatment at the starter phase except for the urea (mmol/l), sodium (mmol/l), and nitrogen (mmol/l). Urea (mmol/l) ranged from 3.45 $ALEMO_4$ – 3.70 ($ALEMO_1$). Birds administered plain water (negative control) had the highest ($P<0.05$) mean value, while birds on oxytetracycline (positive control), $ALEMO_3$ (5 mls), $ALEMO_4$ (10 mls), and $AMOLE_5$ recorded the lowest ($P<0.05$) mean values. Sodium (mmol/l) ranged from 64.50 (T_4) – 69.00 (T_1). A similar ($P<0.05$) result was accurate, as observed in the mean values of urea. Birds administered plain water

(negative control) had the highest (P>0.05) mean value, while birds on oxytetracycline (positive control), $ALEMO_3$ (5 mls), $ALEMO_4$ (10 mls) and $AMOLE_5$ recorded the lowest (P<0.05) mean values.

The study of blood serum biochemistry in birds identifies metabolic alterations due to many endogenous and exogenous factors such as genetics, husbandry conditions, season, sex, and age (Isaac *et al.,* 2013). The serum parameters are good indicators of the physiological conditions of the animal body, and any deviation in the serum indices is important in assessing the response of such animals to various physiological situations and health (Juráni *et al.,* 2004). The administration of aqueous leaf extracts of *Moringa oleifera* to indigenous turkey only influenced blood glucose, creatinine, and cholesterol. The blood biochemical parameters obtained in the present study fell within the normal reference values for healthy turkeys, as Rajman *et al.* (2006) reported. This implies that the dosage of aqueous leaf extracts of *Moringa oleifera* administered in this study is safe and tolerable to the birds without any detrimental effects on their welfare/health. The present study agreed with the observation of Ashour *et al.* (2020), who conducted a study on Indigenous chickens administered with varying levels of *Moringa oleifera* leaf extracts and found that the PCV, RBC, WBC, MCV and MCHC of the birds were significantly enhanced. In the same vein, a study conducted by Nanbol *et al.* (2016) investigated the effect of supplementing *Moringa oleifera* leaf powder on serum biochemistry of broiler chickens' blood; their findings revealed a significant influence in uric acid and creatinine amongst the experimental groups. However, the present results disagreed with a report by Durai *et al.* (2012), who found insignificant differences in the serum profile of broiler chickens fed graded levels of *Moringa oleifera* leaf meals. The reason for the variation between the results of this study and those other findings might be attributed to the level of management, species of animal, and types and forms of Moringa used for the experiment

Table 4 Haematological Parameters of Turkey (*Meleagris gallopavo*) Administered ALEMO at Starter Phase

Treatments	Hb (g/dl)	PCV (%)	RBC ($x10^9$/l)	WBC ($x10^9$/l)	Neutrophil (%)	Lymph (%)	Monocyte (%)	Eosinophil (%)	Basophil (%)	MCV (fl)	MCH (pl)	MCHC (%)
T_1	10.20	30.7	5.10	5.13	37.75	33.25	2.50	1.00[a]	0.25[b]	60.25	20.00	33.15
T_2	11.15	33.50	5.55	5.60	38.25	34.00	2.75	1.00[a]	1.00[a]	60.35	20.05	33.25
T_3	9.78	29.50	4.88	5.01	36.75	32.00	1.83	1.00[a]	0.00[b]	60.45	20.03	33.10
T_4	10.48	31.50	5.23	5.28	37.00	31.50	1.58	0.75[a]	0.75[a]	60.25	20.03	33.23
T_5	10.05	30.25	5.00	5.10	37.25	33.00	2.75	0.25[b]	1.00[a]	60.45	20.05	33.16
SEM	0.19	0.55	0.09	0.09	0.21	0.39	0.19	0.092	0.11	0.06	0.01	0.02
P-value	0.17	0.19	0.17	0.24	0.09	0.27	0.13	0.02	0.00	0.77	0.57	0.23
NR	9.5-16.6	28-50	4-6	3.5-10	30-70	30-70	0-3	0-1	0-1	40-70	11-20	30-36

ab: Means in the same column with different superscripts differ significantly when (P<0.05)

ALEMO: Aqueous Leaf Extracts of *Moringa oleifera*

Hb: Haemoglobin. PCV: Packed cell volume. RBC: Red blood count. WBC: White blood cell. Lymph: Lymphocyte. MCV: Mean corpuscular volume. MCH: Mean corpuscular heamoglobin. MCHC: Mean corpuscular heamoglobin concentration

P-value: Probability value SEM: Standard error of the means Mls: milli litres, l = litre

Table 5 Serum Biochemical Parameters of Turkey (*Meleagris gallopavo*) Administered ALEMO at Starter Phase

	Parameters												
Treatments	**B.G** (mmol/l)	**Urea** (mmol/l)	**Na** (mmol/l)	**K** (mmol/l)	**Cl** (mmol/l)	**Creatine** (µ/l)	**Cholest.** (mg/dl)	**T. Protein** (g/dl)	**Albumin** (g/dl)	**N** (mmol/l)	**AST** (µ/l)	**ALT** (µ/l)	**ALP** (µ/l)
T_1	3.33	3.70[a]	69.00[a]	4.40	53.50	2.38	0.40	5.08	1.58	2.75	4.00	20.25	12.00
T_2	3.43	3.48[b]	66.75[b]	4.40	52.50	2.53	0.43	5.38	1.53	2.63	4.50	21.25	11.25
T_3	3.40	3.55[b]	66.25[b]	4.35	52.75	2.53	0.38	5.33	1.80	2.60	4.25	21.00	11.25
T_4	3.30	3.45[b]	64.50[a]	4.35	52.25	2.55	0.38	5.20	1.78	2.55	4.50	22.00	12.50
T_5	3.48	3.53[b]	65.50[a]	4.35	52.25	2.20	0.38	5.20	1.78	2.50	4.25	21.75	12.25
SEM	0.03	0.03	0.45	0.02	0.41	0.10	0.01	0.05	0.82	0.03	0.11	0.35	0.26
P-value	0.36	0.00	0.01	0.87	0.88	0.79	0.67	0.34	0.42	0.06	0.57	0.60	0.47
NR	2.8-8.9	3.3-14.9	65-145	4.3-5.8	42-102	0.11	0.1-2.1	5.4-7.3	1.3-6.4	2.5-7.1	4-20	10-120	10-45

abcd = Means in the same column with different superscripts differs significantly when ($P<0.05$), Plain water (T_1), Oxytetracycline (T_2), ALEMO 5 mls (T_3), ALEMO 10 mls (T_4), ALEMO 15 mls (T_5). ALEMO: Aqueous Leaf Extracts of *Moringa oleifera.* P-value: Probability value. SEM: Standard error of the means. Mls: milli litres. NR: Normal range, B.G: Blood glucose (mmol/l). Na: Sodium (mmol/l). K: Potassium (mmol/l). Cl: hloride (mmol/l). Cholest.: Cholesterol (mg/dl). T. Proten: Total Protein (g/dl). N: Nitrogen (mg/dl). AST: Aspartane amino transferase (µ/l). ALT: Amino alanine transferase (µ/l). ALP: Alkaline Phosphatase(µ/l).

CONCLUSION

Based on the results, using oxytetracycline in Turkey has no advantage over plain water and ALEMO because there were no significant differences in the growth performance and most of the measured hematological and serum biochemical parameters. As for crude protein, digestibility increased progressively with an increase in ALEMO, which implies that a higher dosage of ALEMO might improve the productive performance. Thus, it is recommended that a higher dosage of ALEMO be used to determine the optimal dosage for maximum performance.

REFERENCES

Abou-Elezz, F. M. K., Sarmiento-Franco, L., Santos-Ricalde, R. and Solorio-Sanchez, F. (2011). Nutritional effects of dietary inclusion of *Leucaena leucocephala* and *Moringa oleifera* leaf meal on Rhode Island Red hens' performance, *Cuban Journal of Agricultural Science*, 45, 163-169.

Addass, P. A., David, D. L., Edward, A., Zira, K. E., and Midau, A. (2012). Effect of Age, Sex and Management System on Some Haematological Parameters of Intensively and Semi-Intensively Kept Chicken in Mubi, Adamawa State, Nigeria. *Iranian Journal of Applied Animal Science, 2*(3), 277-282.

Agbede, J. O., and Aletor, V. A. (2003). Evaluation of fish meal replaced with leaf protein concentrate from *Glyricidia* in diets for broiler-chicks: Effect on performance, muscle growth, haematology and serum metabolites. *International Journal of Poultry Science*, 1:45-55.

Akhouri, S., Prasad, A., and Ganguly, S. (2013). *Moringa oleifera* Leaf Extract Imposes Better Feed Utilization in Broiler Chicks. *Journal of Biological and Chemical Research*, 447-450.

Ali, A. S., Reza, N. H., Enayat, R., and Jalal, S. (2012). Herbal additives and organic acids as antibiotic alternatives in broiler chickens' diet for organic production. *African Journal of Biotechnology*, 11:2139-2145.

AOAC, (2000). Official Methods of Analysis. 15th edition. Association of Official Analytical Chemists. Arlington, VA

Ashour, E. A., EL-Kholy, M. S., Alagawany, M., EL-Hack, A., Mohammed, E., Mohammed, L. A., Taha, A. E., EL Sheikh, A. I., Laudadio, V., and Tufarelli, V. (2020). Effect of dietary

supplementation with *Moringa oleifera* leaves and/or seeds powder on production, egg characteristics, hatchability and blood chemistry of laying Japanese quails. *Sustainability,* 12**,** 2463.

Atawodi, S. E., Atawodi, J. C., Idakwo, G. A., Fundstein, B. P., Haubner, R., Wurtele, G., Bartsch, H., and Owen, R. W. (2008). Evaluation of the Polyphenol contents and antioxidants properties of methanol extracts of leaves, stem and root barks of *Moringa oleifera* Lam. *Journal of Medicinal Food,* 13: 710-716

Doumas, B. (1975). *Veterinary Clinical Chemistry.* 7:175.

Durai, P. C., Maruthai, T. P. T., Arumugam, S. S., and Venugopal, O. A. (2012). Haematological Profile and Erythrocyte Indices in Different Breeds of Poultry. *International Journal of Livestock Research,* 2(3), 89-92.

Elkhalifa, A. E. O., Ahmed, S. A., and Sara, A. (2007). Nutritional evaluation of *Moringa Oleifera* leaves and extract. Report. Ahfad *Journal,* 01-DEC-07.

Elnesr, S. S., Alagawany, M., Elwan, H. A., Fathi, M. A., Farag, M. R. (2020). Effect of sodium butyrate on intestinal health of poultry— A review. *Animal Science*, 20, 29–41.

Fahey, J. W. (2005). *Moringa oleifera*: A review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. *Trees for Life Journal,* pages 1, 5.

FACT (2015). Food Animal Concerns Trust, Insurance. `

Figen, K., Bora, U. H., and Guven, O. (2011). Effects of oregano and garlic essential oils on performance, carcass, organ and blood characteristics and intestinal microflora of broilers. *Livestock. Science,* 137:219-225.

Foidl, N., Makkar, H. P. S and Becker, K. (2001). The Multiple Attribute of *Moringa* Food and Diet 2nd edition, Wageningen and W.S, Dakar, pp: 77-81.

FAO (2007). Food and Agricultural Organization. Eradicating world hunger- taking stock ten years after the world summit. Food and Agriculture Organization of the United Nations, Rome.

Gadzirayi, C. T**.,** Masamha, B., Mupangwa, J. F. and Washaya. S. (2012). Performance of broiler chickens fed on matured *Moringa oleifera* leaf meal as a protein supplement to Soybean meal. *International Journal of Poultry Science,* 11, 5-10.

Gakuya, D. W., Mbugua, P. N., Kavoi, B., Kiama, S. G. (2014). Effect of supplementation of *Moringa oleifera* leaf meal in broiler chicken feed. *International Journal of Poultry Science*, 13 (4): 208-213.

Henry, R. J., Cannon, D. C., and Winkelman, J. W. (1974). Clinical Chemistry: principles and techniques 2nd ed, New York, Harper and Row; pp. 422-424.

Isaac, L. J., Abah, G., Akpan, B., and Ekaette, I. U. (2013). Haematological properties of different breeds and sexes of rabbits (p.24-27). Proceedings of the 18th Annual Conference of Animal Science Association of Nigeria.

Juráni, M., Výboh, P., Zeman, M., Lamo.Ová, D., Ko, T., Ál, L., and Bla.Ièek, P. (2004). Post-hatching dynamics of plasma biochemistry in free-living European starlings (*Sturnus vulgaris*). *Complete Biochemistry Physiology*. 138, 89-95.

Kakengi, A. V., Kaijage, J. T., Sarwa, H., S. V., Mutayoba, S. K., Shem, M. N. and Fujihara, T. (2007) Effect of *Moringa oleifera* leaf meal as a substitute to sunflower seed meal on performance of laying hens in Tanzania. *Livestock Research for Rural Development*, 19(8).

Kashyap, P., Kumar, S., Riar, C. S., Jindal, N., Baniwal, P., Guiné, R. P. and Kumar, H. (2022). Recent advances in Drumstick (*Moringa oleifera*) leaves bioactive compounds: Composition, health benefits, bio-accessibility, and dietary applications. *Antioxidants*, *11*(2), 402.

Malik, V. S., Popkin, B. M., Bray, G. A., Despre´s, J. P., Hu, F. B. (2010). Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. *Circulation*, 121:1356–1364

Minna Meteorological Station (2020). Climate and average weather around Minna, Nigeria.

Morton, J. F. (1991). The Horseradish Tree, *Moringa Ptervgospermia. Economic Botany*, 45(3): 318-333.

Moyo, B., Oyedemi, S., Masika, P. J., Muchenje, V. (2012a). Polyphenolic content and antioxidant properties of *Moringa oleifera* leaf extracts and enzymatic activity of liver from goats supplemented with *Moringa oleifera* leaves/sunflower seed cake. *Meat Science* 91: 441-447.

Moyo, B., Masika, P.J., and Muchenje, V. (2012b). Antimicrobial activities of *Moringa oleifera* Lam leaf extracts. *African Journal of Biotechnology* 11(11): 2797-2802.

Nanbol, D.L., Duru, B. N., Nanbol, H. D., Abiliu, C. A., Anueyegu, D. M., Peterside Rinle Kumbish, P. R. and Solomon, M. (2016). Establishment of Reference values for some biochemical and haematological parameters for broilers and layers in Plateau State Nigeria, *Vom Journal of Veterinary Science*, 11, 30 – 35.

Nathaniel, E. U., Onyancha, J. M., Mugambi, M., Ncene, W. and Moriasi, G. A. (2020). Chemical composition of *Moringa oleifera* Lam. and *Moringa stenopetala* Bac. leaves from Kenya. *International Journal of Plant Research*, 10**,** 1-10.

NRC (1994). National Research Council. Nutrient Requirement of Domestic Animal. Nutrient Requirements of Poultry, 4th edition. National Academic Press. Washington D.C. 100-120.

Nkukwana, T., Muchenje, V., Pieterse, E., Masika, P., Mabusela, T., Hoffman, L. and Dzama, K. (2014a). Effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *Livestock Science,* 161**,** 139-146.

Nkukwana, T. T., Muchenje, V., Masika, P., Hoffman, L. and Dzama, K. (2014b). The effect of *Moringa oleifera* leaf meal supplementation on tibia strength, morphology and inorganic content of broiler chickens. *South African Journal of Animal Science,* 44**,** 228-239.

Nkukwana, T. T., Muchenje, V., Masika, P., Hoffman, L. C., Dzama, K. and Descalzo, A. M. (2014c). Fatty acid composition and oxidative stability of breast meat from broiler chickens supplemented with *Moringa oleifera* leaf meal over a period of refrigeration. *Journal of Food Chemistry,* 142**,** 255-261.

Ojewola, G. S., Udokainyang, A. D., and Obasi, V. (2002). Growth, carcass and economic response of indigenous turkey poults to various levels of dietary energy. In: V.A. Aletor and G. E. Onibi (eds.). Increasing household protein consumption through livestock products. Proceeding of the 27th Annual Conf. of Nigeria Society for Animal Production, Akure, Nigeria. Pp:167-169.

Olugbemi, T. S., Mutayoba, S. K., and Lekule, F. P. (2010). Evaluation of *Moringa oleifera* meal inclusion in cassava chip-based diets fed to Laying birds. Livestock *Research and Rural Dev*elopment, 22, 6.

Oso, A. O., Williams, G. A., Oluwatosin, O. O., Bamgbose, A. O., Adebayo, A. O., Olowofeso, V., Pirgozliev, V., Adegbenjo, A. A., Osho, S. O., Alabi, J. O., Li, F., Liu, H., Yao, K. and Xin, W. (2019). Growth performance, nutrient digestibility, metabolizable energy, and

intestinal morphology of growing turkeys fed diet supplemented with arginine. *Core uk* 12, 234-239.

Portugaliza, P., and Fernandez, T. J. (2011). "Growth performance of Cobb broilers given varying concentrations of Malunggay (*Moringa oleifera* Lam.) aqueous leaf extract". Online *Journal of Animal and Feed Research*, Volume 2, Issue 6: 465-469 (2012).

Rajman, M., Juráni, M., Lamoová, D., Máèajová, M., Sedlaèková, M., Ko. T. Ál, L., Je.Ová, D., and Výboh, P. (2006). The effects of feed restriction on plasma biochemistry.

Reyes-Sánchez, N., Spörndly, E. and Ledin, I. (2006). Effects of feeding different levels of foliage from *Moringa oleifera* to creole dairy cows on intake, digestibility, milk production and composition. *Livestock Science,* 101, 24-31.

Richter, R. P., and Brisson. A. (2003). Characterization of lipid bilayers and protein assemblies supported on rough surfaces by atomic force microscopy. *Langmuir*, 19:1632–1640.

Sarwatt, S. V., Kapange, S. S., Kakengi, A. M. V. (2002). Substituting sunflower seed-cake with *Moringa oleifera* leaves as a supplemental goat feed in Tanzania Agro-forestry Systems., 56, 3, 241-247.

Shahidi, F., Janitha, P.K., and Wanasundara, P. (2004). Phenolic antioxidants. Critical reviews in Food Science and Nutrition. 32:67-102.

Tanko, L. and Ojewola, G.S. (2003). Allocative efficiency of brewers dried grain and palm kernel meal in the supplement of male turkey diets with Roxazyme G-enzyme. Proceedings of the 28th Annual Conf. of Nigeria Society for Animal Production, 16-20 March, Ibadan, Nigeria. 28: 201-203.

Willard, H. F., Wevrick, R., Warbinton, P. E. (1989). Human centromere structure organization and potential role of alpha satellite DNA. *Program Clinical Bio Ressearch*, 318:9-18.

Yang, R. Y., Tsou, S. C. S., Lee, T. C., Chang, L. C., Kuo, G., and Lai, P. Y. (2006). *Moringa*, a novel plant rich in antioxidants, bio-available iron, and nutrients. Pp 224-239. In: C. T. Ho (ed) Challenges in chemistry and biology of herbs. American chemical society, Washington, D.C.

Zanu, H. K., Asiedu, P., Tampuori, M., Abada, M. and Asante, I. (2012) Possibilities of using Moringa (Moringa oleifera) leaf meal as a partial substitute fish meal in broiler chickens. *Journal of Animal Feed Research*, 2:70- 75.