Paper ISSN 0189-0514
Online ISSN 1427-4410
J. Anim. Prod. Res. (2022) 34(2):19-31

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EFFECT OF ADMINISTRATION OF EGG-LIME-MOLASSES MIXTURE ON HAEMATOLOGY, SERUM BIOCHEMICAL AND VISCERAL ORGAN PARAMETERS OF JAPANESE QUAILS

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ABSTRACT

This study was conducted to investigate the effect of the administration of aqueous solution of egg-lime-molasses mixture (ELM) on blood profile and visceral organs parameters of Japanese quails. The experiment was conducted in the poultry section of Babcock University Farmhouse, Ilishan-Remo, Ogun State, Nigeria. ELM was prepared by placing fresh chicken eggs in a bowl containing 1 liter of lime juice and 500g of molasses and tightly covered and left for 10 days at temperature of 27^{o}C and relative humidity of 61%. The entire solution was blended together. Two hundred day old birds were assigned to five treatments with forty birds in a completely randomized design (CRD). The birds were subdivided into 4 replicates of 10 birds each. The control (T1) having no administration of ELM, T2, T3, T4 and T5 had inclusion levels of 10ml, 20ml, 30ml and 40ml in 500ml of water, respectively. Feed and water were offered *ad libitum*. Data were collected on blood profile and visceral organs parameters and subjected to one-way analysis of variance ($p<0.05$). Result showed no significant difference ($p>0.05$) in haematology but significant difference ($p<0.05$) in cholesterol and alanine transaminase (ALT) with birds with the highest administration of ELM (30ml and 40ml ELM/500ml water) having significantly least values. The administration of ELM significantly influenced ($P<0.05$) the relative weights of spleen, small intestine and gizzard. It can be concluded that ELM can be administered to Japanese quails up to 40ml per 500ml of water without compromising the health status of the birds.

Keywords: Blood, Health, Phytogenics, Status

INTRODUCTION

Chickens used to be the most recognized and acceptable poultry bird reared by farmers; however, other birds have come into limelight among which there is the Japanese quail (*Coturnix coturnix japonica*) (Shim, 2005). This specie of poultry was introduced in Nigeria to expand the poultry subsector through meat and egg production (Ani *et al.*, 2009). Quails being a fast growing specie are very economical to maintain as they require less floor space (Haruna *et al.*, 1997), and less feed requirement of 20 – 25 g per day. They have short generation interval, fairly disease resistance, and produce meat and eggs of high quality protein with low body fat and cholesterol content. Chimezie *et al.* (2022) reported that the female Japanese quails had higher weights than their male counterparts.

In a study on the nutritional and ethno-medicinal potentials of egg-lime-molasses mixture (ELM) in livestock production by Akintunde *et al.* (2023a), the results of proximate analysis of ELM showed the

presence of moisture content (19.60%), crude protein (15.20%), lipids (5.50%), ash (14.60%), crude fibre (9.60%), carbohydrates (35.20%), fatty acid (4.40%) and energy (1060.30 Kcal/100 kg). Phytochemical screening of ELM according to Akintunde *et al.* (2023a) revealed that it contained alkaloids, flavonoids, glycosides, saponin, steroids, phenols, terpenoides, tannin and antraquinones. They further reported the quantitative evaluation of the phytochemicals that it contained alkaloids (8.46 mg/100 g), flavonoids (2.30 mg/100 g), glycosides (0.08 mg/100 g), Saponin (5.25 mg/100 g), steroids (0.22 mg/l00 g), phenols (0.09 mg/100 g), terpenoides (0.56 mg/100 g), tannin (8.34 mg/100 g), and antraquinones (1.60 mg/100 g) and the vitamin constituents are Vitamin A (3.20 mg/100 g), Vitamin B1 (280 mg/100 g), Vitamin B2 (880 mg/100 g), Vitamin B3 (340 mg/100 g), Vitamin C (15.40 mg/100 g) and Vitamin E (0.015 mg/100g). Mineral analysis showed that it contained calcium (29.95%), magnesium (4.08%), potassium (23.20%), sodium (0.38%), phosphorus (6.90%), chlorine (0.30%), manganese (1.44 ppm), iron (3.60 ppm), aluminum (5.35%), titanium (2.10 ppm) and silicon (22.70 ppm) (Akintunde *et al.*, 2023a). Akintunde *et al.* (2023a) however concluded that ELM is rich in various nutrients and phytochemicals conferring it the ability to perform multiple biological activities and as a natural alternative to antibiotics especially in monogastric animal production.

Also, in a study by Akintunde *et al.* (2023b) on the growth pattern and physiological response of Japanese quails to administered aqueous solution of egg lime molasses mixture, significant difference was observed in feed conversion ratio at the starter phase and birds administered 20 ml ELM/500 ml of water had the best FCR. The administration of ELM also significantly influenced live weight and weight gain at the finisher phase. They also reported that the administration of ELM had significant effect on rectal temperature and respiratory rate at the starter phase and rectal temperature at the finisher phase.

Also, in a study on Spermiogramic parameters of Japanese quails (*Coturnix coturnix japonica*) to aqueous administration of egg lime molasses mixture by Akintunde *et al.* (2023c), it was observed that testosterone values significantly increased with increased ELM inclusion. They however, concluded that the administration of ELM did not alter growth parameters while birds that received 20 mL per 500 mL of water had the best reproductive parameters.

Studies have shown that the administration of phytogenics significantly influenced haematological, serum biochemical and the relative weights of visceral organs in birds (Ajibade *et al.*, 2023; Akintunde *et al.*, 2023d; Olumide *et al.*, 2022; Tayo *et al.*, 2022; Akintunde *et al.*, 2021a.b; Akintunde *et al.*, 2019; Akintunde and Toye, 2014). Blood parameters can also be used to monitor the quality of feeds (Akintunde *et al.*, 2021a, 2019). Hematological components are also valuable in monitoring feed toxicity especially with feed constituents that affect formation of blood (Oyawoye and Ogunkunle, 1998; Akintunde *et al.*, 2017, 2019). This implies that haematological and serum biochemical analyses are essential to monitor the health status of poultry in general and Japanese quails in particular for effective performance and quality products considering the use of phytogenics as Japanese quails have the potentials of being massively produced to bridge the protein shortage among households in the developing country. This trial however aimed at determining the effect of aqueous administration of egg-lime-molasses mixture on haematology, serum biochemical and visceral organs parameters of Japanese quails.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the poultry unit of Babcock University Farm House, Ilishan-

Remo, Ogun State, Nigeria. Ilishan-Remo is in the rain forest zone of Nigeria with an annual rainfall of about 1500mm, having a mean temperature of 27^{o}C.

Preparation of Egg-Lime-Molasses Mixture

First, it was ensured that the eggs were very fresh by placing the eggs inside water. The fresh eggs were then placed in a bowl after which 1 liter of lime and 500g of molasses were added into the same bowl and tightly covered tightly for 10 days. At the end of 10 days, the egg shells had dissolved into the solution. The entire solution was then blended together.

Experimental Treatments

Five (5) dietary treatments were formulated. T_1 which was the control had no administration of egg lime molasses solution. T_2, T_3, T_4, T_5 had 10ml, 20ml, 30ml, and 40ml per 500ml of water, respectively.

Management of Experimental Birds and Design

A total of 200 day-old Japanese quails were purchased from a local farmer in Lagos State, Nigeria. Prior to the arrival of the quails, the pens where the birds stayed during the experiment was washed, disinfected alongside drinkers, feeders and other equipment; and left to air-dry for two weeks. One hundred (100) watt electric bulbs were installed in the cages to provide heat and illumination at night for continuous feed intake. Feed and water were supplied to the birds *ad-libitum* throughout the duration of the experiment. The experiment lasted for 49 days. Table 1 showed the gross composition of the experimental diets at the starter (0 – 21 days) and finisher phases (22 – 49 days).

Data Collection

Blood Collection, Haematology and Serum Biochemical Analysis

Blood was collected from the birds using 3ml syringe needle via the jugular vein. The birds were placed on a table, setting it on its side, the wing were lifted up and the needle was placed at a slight angle level up against the vein underside of the wing. The level end is the side of the needle with the angle and hole. The needle was then inserted into the vein and slowly withdraw blood. After collection, the needle was then removed and pressure was applied on the vein for a few seconds. The sample blood was put into labelled blood sample bottles containing anti-coagulant (Ethyl Diamine-Tetra-Acetate powder (EDTA)) to determine hematological parameters.

Parameters that were analyzed include; white blood cell count (WBC), red blood cell count (RBC), platelet count, packed cell volume (PCV), mean corpuscular volume, mean corpuscular hemoglobin concentration, mean corpuscular hemoglobin, basophil level, neutrophil level and eosinophil level using the procedure of Jain (1986).

For serum biochemical analysis, the following parameters were analyzed: Glucose (mg/dl), Total Protein (g/dl), Albumin (g/dl), Globulin (g/dl), Cholesterol (mg/dl), Alanine transaminase (IU/L), Aspartate transaminase (IU/L) and Creatinine (mg/dl).

Carcass and Visceral Organ Evaluation

Eight birds were randomly selected from each treatment two (2) per replicates for the carcass characteristics. The selected birds were starved overnight and their live weight were recorded. The birds were then be eviscerated and the eviscerated weights were recorded. The birds were de-feathered after scalding and their plucked weights were taken. The relative weights of the following were recorded: gizzard, liver, heart, crop, proventriculus, spleen, pancreas, small intestine, large intestine and caecum weights and lengths for small intestine, large intestine and caecum.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) according to the procedure of SAS (2002). Significant differences between

the treatment's means were separated using Duncan multiple range test (Duncan, 1955).

Table 1: Gross Composition for Experimental Starter and Finisher Diets (g/100kg)

Ingredient	Starter	Finisher
Maize	48.00	59.00
Soybean meal	33.00	30.00
Wheat offal	6.00	5.64
Fishmeal	4.00	-
Palm oil	-	3.00
Vegetable oil	4.00	-
Meat – bone meal	2.50	-
Limestone	1.00	-
Dicalcium phosphate	0.50	1.56
Oyster shell	-	1.00
Salt	0.40	0.25
Methionine	0.20	0.25
Lysine	0.10	0.05
Avatec	-	0.06
%CP	**15.20**	**20.00**

RESULTS

Table 2 showed the results of hematological parameters obtained from Japanese quails administered egg-lime-molasses mixture and the results showed that there was no significant difference ($p>0.05$) from all parameters obtained from the analysis.

Table 3 showed the serum biochemical analysis of Japanese quails obtained administered varying level of Egg lime molasses solution. The table indicated that there were significant differences ($p<0.05$) in ALT and cholesterol only. Birds administered with the highest levels of ELM had significantly lowest ($p<0.005$) lowest values for ALT (10.33 U/l) and cholesterol (140.00 mg/dl).

Table 2: Hematological parametersofJapanese quail administered Egg Lime Molasses Mixture

	T1	T2	T3	T4	T5
PCV (%)	39.00± 3.21	40.00 ± 2.00	39.33 ± 4.67	34.00 ± 7.21	36.33 ± 6.33
HB(g/d)	13.57± 1.78	12.43 ± 0.81	13.13 ± 1.54	11.33 ± 2.40	12.10 ± 2.11
TWBC (mm^3)	9400.00±1307.67	10000.00±2000.00	8166.67±1201.85	9166.67±440.96	9333.33±1201.85
Heterophils (%)	43.67 ± 7.80	37.67 ± 5.67	49.67 ± 2.63	39.67 ± 2.63	35.33 ± 2.91
Neutrophils (%)	47.67 ± 6.69	50.67 ± 4.67	38.67 ± 2.73	49.33 ± 4.05	52.67 ± 4.67
Monocytes (%)	6.67 ± 2.40	6.67 ± 3.33	6.33 ± 1.67	7.00 ± 3.00	8.00 ± 2.31
Eosinophils (%)	0.67 ± 0.07	1.33 ± 0.08	1.67 ± 0.07	1.667 ± 0.03	1.000± 0.01
Basophils (%)	1.33 ± 0.33	3.67 ± 2.33	3.67 ± 0.67	2.33 ± 0.33	3.00 ± 1.00
Lymphocytes (%)	47.67 ± 6.69	50.67 ± 4.67	38.67 ± 2.73	49.33 ± 4.05	52.67 ± 4.67
RBC Count(μ)	4.40 ± 0.29	4.30 ± 0.21	4.50 ± 0.61	4.00 ± 0.68	4.67 ± 0.79
Platelet	188000.00±26102.36	172333.33±36190.85	133333.33±15898.99	124000.00±11372.48	211666.67±4409.59
MCH (μ/g)	3.06 ± 0.21	2.89 ± 0.05	2.93 ± 0.06	2.96 ± 0.72	2.59 ± 0.05
MCV (fl)	8.85 ± 0.17	9.34 ± 0.59	8.78 ± 0.18	8.88 ± 2.16	7.77 ± 0.14
MCHC (%)	34.52 ± 1.66	31.19 ± 2.14	33.40 ± 0.03	33.33 ± 0.00	33.31 ± 0.03

($p>0.05$) = No significant difference

Legend: Packed Cell Volume (PCV), Hemoglobin (HB), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin Concentration (MCHC), Mean Corpuscular Hemoglobin (MCH), Red Blood Cell Count (RBC Count) and Total White Blood Cell (TWBC).

Table3: Serum Biochemical Analysis of Japanese Quails Administered Egg-Lime-Molasses Mixture

	T1	T2	T3	T4	T5
Total protein (mg/dl)	9.70± 0.74	8.93 ± 0.57	9.97 ± 0.49	9.83 ± 0.73	8.93 ± 0.52
Albumin (mg/dl)	5.80± 0.47	5.37 ± 0.33	5.87 ± 0.44	5.77 ± 0.44	5.07 ± 0.43
Globulin (mg/dl)	3.90± 0.26	3.57 ± 0.23	4.10 ± 0.06	4.07 ± 0.33	3.87 ± 0.38
Glucose(mg/dl)	137.33±3.93	129.33±5.36	129.00 ± 7.02	141.00 ± 5.57	132.00 ± 7.57
Cholesterol (mg/dl)	153.33±21.86^{ab}	168.33±6.01^{b}	143.33±6.01^{ab}	130.00±5.77^{a}	140.00±5.77^{ab}
ALT(U/I)	17.33± 4.70^{ab}	13.67± 4.91^{ab}	23.00 ± 1.15^{b}	15.33±2.03^{ab}	10.33 ± 1.20^{a}
AST(U/I)	10.67 ± 2.03	10.67 ± 1.20	10.33 ± 2.85	12.33 ± 0.33	10.67 ± 0.33
Creatinine (mg/dl)	2.10 ± 0.87	1.97 ± 0.91	2.00 ± 0.58	3.20 ± 0.70	2.25 ± 1.06

*ab = Mean within the same row with different superscripts are significantly different.
Group mean and Standard error of sample (x±sem) shown ($p<0.05$)
Legend: Aspartate transaminase (AST) and Alanine Transaminase (ALT)

Tables 4, 5 and 6 showed the carcass evaluation and visceral organ characteristics of Japanese quail. Table 4 signified that there was no significant difference ($p>0.05$) in all parameters obtained while there were significant differences ($p<0.05$) in the proventriculus weight, spleen weight, large intestine weight, relative spleen weight and relative small intestine weight as presented in Table 5. Birds administered with the highest concentrations of ELM had significantly least ($p<0.05$) values for all these parameters. There was no significant difference ($p>0.05$) in all the parameters presented in Table 6.

Table 4: Carcass Evaluation of Japanese Quail Administered Egg Lime Molasses Solution

	T1	T2	T3	T4	T5
Live weight (g)	149.75± 8.05	156.00±15.15	169.00±19.16	140.67±11.67	146.00 ± 8.21
Bled Weight (g)	146.00 ± 8.16	152.25±15.07	166.25±19.08	138.67±11.68	142.50 ± 8.26
Defeathered Weight (g)	131.97 ± 3.42	129.88±11.34	151.48±16.48	133.13±13.01	130.86 ± 5.83
Eviscerated Weight (g)	115.72 ± 2.08	115.07±10.86	133.00±12.36	117.00±12.10	116.50 ± 4.09
Visceral Organs Weight (g)	16.25 ± 2.73	14.81 ± 2.86	18.958 ± 4.54	16.13 ± 2.04	14.36 ± 2.53
Dressed Weight (g)	101.99 ± 2.79	103.08±10.61	123.50±10.82	106.00±12.34	106.00 ± 3.03
Dressing Percent (%)	68.79 ± 4.39	66.60 ± 5.26	73.81 ± 3.62	75.00 ± 3.09	73.25 ± 4.37

($p>0.05$) = No significant difference

Table 5: Visceral OrgansCharacteristics ofJapanese Quail Administered Egg Lime Molasses Solution

	T1	T2	T3	T4	T5
Gizzard Weight (g)	4.15 ± 0.68	3.95 ± 0.54	4.78 ± 0.88	4.21 ± 0.77	3.38 ± 0.24
Liver Weight (g)	3.50 ± 0.71	2.50 ± 0.38	3.73 ± 1.04	2.91 ± 0.27	2.60 ± 0.66
Heart Weight (g)	1.32 ± 0.22	0.98 ± 0.12	1.60 ± 0.21	0.91 ± 0.19	1.23 ± 0.30
Crop Weight (g)	0.58 ± 0.18	0.40 ± 0.09	0.59 ± 0.16	0.47 ± 0.17	0.35 ± 0.08
Proventriculus Weight (g)	0.84 ± 0.22^{ab}	0.54 ± 0.12^{ab}	1.03 ± 0.29^{ab}	0.64 ± 0.15^{ab}	0.39 ± 0.03^{a}
Spleen Weight (g)	0.41 ± 0.17^{ab}	0.65 ± 0.12^{b}	0.52 ± 0.18^{ab}	0.27 ± 0.06^{ab}	0.17 ± 0.01^{a}
Pancreas Weight (g)	0.44 ± 0.15	0.47 ± 0.14	0.42 ± 0.18	0.40 ± 0.12	0.38 ± 0.10
Small Intestine Weight (g)	2.64 ± 0.40	2.60 ± 0.77	3.12 ± 0.60	2.06 ± 0.67	2.05 ± 0.32
Large Intestine Weight (g)	2.49 ± 0.43^{ab}	1.59 ± 0.59^{b}	2.61 ± 0.67^{b}	1.83 ± 0.11^{ab}	0.62 ± 0.18^{a}
Dressed Gizzard Weight (g)	3.39 ± 0.56	2.56 ± 0.33	3.15± 0.49	2.97 ± 0.17	2.35 ± 0.36
Relative Gizzard Weight (%)	2.73 ± 0.32	2.51 ± 0.15	2.79 ± 0.34	2.98 ± 0.47	2.32 ± 0.13
Relative Liver Weight (%)	2.30 ± 0.36	1.60 ± 0.18	2.11 ± 0.38	2.08 ± 0.18	1.72 ± 0.34
Relative Heart Weight (%)	0.91 ± 0.19	0.66 ± 0.12	0.96 ± 0.12	0.63 ± 0.07	0.83 ± 0.17
Relative Crop Weight (%)	0.41 ± 0.14	0.26 ± 0.05	0.34 ± 0.07	0.34 ± 0.13	0.24 ± 0.06
Relative Proventriculus Weight (%)	0.59 ± 0.17	0.34 ± 0.05	0.59 ± 0.15	0.45 ± 0.11	0.27 ± 0.02
Relative Spleen Weight (%)	0.28 ± 0.12^{ab}	0.42 ± 0.07^{b}	0.31 ± 0.11^{ab}	0.19 ± 0.05^{ab}	0.12 ± 0.00^{a}
Relative Pancreas Weight (%)	0.31 ± 0.12	0.29 ± 0.07	0.27 ± 0.13	0.28 ± 0.08	0.25 ± 0.06
Relative S/I Weight (%)	1.74 ± 0.19^{b}	1.59 ± 0.37^{ab}	1.81 ± 0.19^{b}	1.44 ± 0.44^{b}	1.40 ± 0.20^{a}
Relative L/I Weight (%)	1.64 ± 0.21	0.98 ± 0.31	1.52 ± 0.35	1.33 ± 0.17	0.43 ± 0.13^{a}
Relative Dressed Gizzard Weight (%)	2.23 ± 0.27^{b}	1.62 ± 0.09^{ab}	1.86 ± 0.21^{ab}	2.12 ± 0.12^{ab}	1.58 ± 0.15^{a}

ab = Mean within the same row with different superscripts are significantly different.
Group mean and Standard error of sample (x±sem) shown ($p<0.05$)
Legend: S/I - Small intestine and L/I – Large intestine, Rel. - Relative

Table 6: Visceral Organs length (cm) parameters ofJapanese quail administered Egg-Lime-Molasses Mixture

	T1	T2	T3	T4	T5
Small intestine	19.55 ± 2.97	20.87 ± 3.38	17.60 ± 3.64	19.17 ± 1.43	13.60 ± 1.80
Large intestine	30.65 ± 3.02	28.37 ± 1.46	31.80± 3.37	30.10 ± 2.50	29.77 ± 3.56
Caecum	9.65 ± 1.24	12.35 ± 3.17	8.97 ± 1.91	13.00 ± 3.63	13.50± 2.89

($p>0.05$) = No significant difference

DISCUSSION

Hematological test are tools that can be used to determine the physiological and pathological statuses of organisms (Oloruntola *et al.*, 2016). Hematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which includes feed and feeding (Esonu *et al.*, 2001). Hematological components which consist of red blood cells, white blood cells, Mean Corpuscular Hemoglobin and Mean Corpuscular Hemoglobin Concentration are valuable in monitoring feed toxicity, especially with feed constituents that affect the blood as well as the health status of farm animals (Isaac et al, 2013).

Etim *et al.* (2014) and Akintunde *et al.*(2019) reported that hematological traits especially Packed Cell Volume (PCV) and Hemoglobin (Hb) were correlated with the nutritional status of the animal. Other blood parameters like blood viscosity are often neglected in routine clinical and physiological investigations. Blood viscosities are however, also affected by nutrition, especially, when phytogenics are used as feed additives. The use of phytogenics as feed additives, for instance may ultimately affect other blood values like hematocrit and erythrocyte sedimentation rate (Rosencranz and Bogen, 2006; Aro *et al.*, 2013). Blood viscosity can also help to unravel clinical case of blood abnormalities like polycythemia and reduced plasma volume (Jain, 1993; Aro and Akinmoegun, 2012).

Hematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu *et al.*, 2001).

Adamu *et al.* (2006) observed that nutrition had significant effect on hematological value like PCV, Hb and RBC. Togun *et al.* (2007) reported that increase in PCV coupled with the marginal increase in RBC is indicative of more efficient erythropoiesis in experimental rabbits.

Table 2 signified no significant differences across all parameters taken for hematological test. The values obtained for Hb were also within the recommended hemoglobin concentration (7 – 18.6 g/dl) for healthy birds (Maxwell *et al.*, 1990). The aim of estimating the haemoglobin content was to determine the oxygen carrying capacity of the bird's circulatory system (Mmereole,

1996).Compared to reports by Habibu*et al.* (2014), a significant influence of molasses on erythrocyte indices (MCV and MCHC), differential leucocyte counts and platelet was established. The variation might be due to the addition of eggs and lime juice to the molasses used in the present study.

In agreement with the findings of Njidda *et al.* (2006) and Fayemi *et al.* (2007), no significant difference in PCV and RBC between control and molasses treated chickens was observed. In contrast, Fayomi *et al.* (2007) reported an increase in all other hematologic parameters besides PCV and RBC in control chickens. This difference may be because the latter study was conducted in cockerels and the molasses was not administered continuously to the cockerels.According to Isaac *et al.*, (2013), Pack Cell Volume is involved in the transport of oxygen and absorbed nutrient. Increased packed cell volume shows a better transportation and thus, prevents anemia (Coles, 1986).

There were no significant differences in aspartate transaminase (AST), total protein (TP) creatinine, albumin, glucose and globulin. Significant difference ($p<0.05$) was observed in alanine transaminase (ALT) and cholesterol. Total protein and creatinine contents have been shown to depend on the quantity and quality of dietary protein (Iyayi and Tewe, 1998; Esonu et al, 2001).The non-significant effect of experimental diets on the total protein and albumin of the birds indicates the ability of the diet to support production of these blood components.The values obtained for total serum protein of birds were within the normal range recommended for healthy birds as most normal birds have serum total protein values between 3 and 9 mg/dl (Altman and Katz., 1979; Maxwell *et al.*, 1990). Values less than 2.5 mg/dl indicates a grave prognosis and birds with severe hypoproteinemia rarely survive (Altman and Katz., 1979). However, the non-significant difference in the total serum protein observed among birds on ELM based administration also suggests nutritional adequacy of the diets and safety of the test ingredient.

Creatinine had a value range from 1.967-3.200mg/dl. Birds which were administered with 30ml of ELM had the highest Creatinine value of 3.200mg/dl, while the least value was obtained from birds in T2 (1.967mg/dl). Creatinine is also linked with muscle wasting as a result of excess creatinine in the blood of the animal due to catabolism (Patel *et al.*, 2013). The creatinine values observed in this study may suggest that the diets were of good protein quality and there was no muscular stress caused by anti-nutritional factors in birds.

Cholesterol levels of birds were significantly different ($p<0.05$). However, the cholesterol content (4.19 and 5.82 g/dl) of birds in this study were within the normal range reported by Mitruka and Rawnsley (1977) and Akinola and Abiola (1999). The non-significant difference in albumin values observed in birds across the treatments may suggest nutritional adequacy of the diets and safety of the test ingredients.AST value for the controlled group compared well ($P>0.05$) with T2 and T5 but lower in T3 and higher in T4.The numerical difference in organ weight of quails may probably be due to their differences in live weight since the surface area and the live weight determine the amount of feather and visceral organs required hence, the need to compare the weights of visceral organs in relative to their live weights (Akintunde *et al.*, 2021a). Similar to this current report, administration of molasses through drinking water did not affect feed consumption, but significantly increase percentage weight gain in broiler chickens (Habibu *et al.*, 2014). This finding agrees with the study of Hildalgo *et al.* (2009) in vinasse (a molasses fermentation byproduct).Contrary to the result of the current study, administration of molasses has been reported to decrease feed intake, but increase live weight gain in chickens (Rahim *et al.*, 1999; Ndelekwute *et al.*, 2010).

Parameters obtained from relative visceral organs as seen in Table 5 shows there were significant differences ($p<0.05$) in the Spleen, Proventriculus, Large intestine, Relative. Spleen, Relative. Small Intestine and Relative dressed gizzard. The increase in gizzard and intestinal weight can also increase the metabolic activities such as digestion, which led to increase demand for oxygen and blood circulation and thus, contributes to increase in heart weight as seen in Table 5. In terms of relative organ length such as Small intestine, Large intestine and Caecum, there were no significant differences ($p>0.05$). This however showed that PNLE could effectively be used without any deleterious effects for Japanese quails.

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