DF-504
[1-7]

RESEARCH ARTICLE Agricultural Science Digest

Growth Pattern and Physiological Response of Japanese Quails to Administered Aqueous Solution of Egg Lime Molasses Mixture

A.O. Akintunde[1], L.C. Ndubuisi-Ogbonna[1], O.A. Olorunfemi[1], M.M. Ladele[1], O.A. Ojo[2], A. Adewumi[3], O.E. Akinboye[1],

10.18805/ag.DF-504

ABSTRACT

Background: Japanese quails have the potentials of being cheap source of animal protein. This study was conducted to determine the growth pattern and physiological response of Japanese quails to administration of aqueous solution of egg lime molasses mixture (ELM).

Methods: ELM was prepared by placing fresh eggs in a bowl after which 1 liter of lime juice and 500 g of molasses were added and left for 10 days at temperature of 27°C and relative humidity of 61%. The entire solution was then blended together. Two hundred day old Japanese quails were assigned to five treatments (4 replicates/treatment) with forty birds in a completely randomized design (CRD). The control (T1) having no administration of ELM, T2 had an inclusion level of 10 ml, T3: 20 ml, T4: 30 ml and T5: 40 ml ELM all into 500 ml of water. Feed and water were offered *ad libitum.* The study was carried out for 49 days. Data were collected on growth, morphometrics and key physiology parameters. Data were subjected to descriptive statistics and Analysis of Variance using SPSS Version 22.

Result: Significant difference ($p<0.05$) was observed only for feed conversion ratio at the starter phase, however, birds administered 20 ml ELM/500 ml of water had the best FCR. Significant differences ($p<0.05$) were observed for live weight and weight gain at the finisher phase. Significant differences ($p<0.05$) were observed in body morphometrics with birds administered 20 ml/500 ml of water having the highest values. There were significant differences ($p<0.05$) in rectal temperature and respiratory rate at the starter phase while at the finisher phase, significant difference ($p<0.05$) was only observed in rectal temperature. It can be concluded from this study that aqueous administration of egg lime molasses solution in the diet of Japanese quails has no detrimental effect on the growth pattern and physiological response.

Key words: Cardiovascular, Growth, Morphometrics, Performance.

INTRODUCTION

Coturnix coturnix Japonica, or the Japanese quail, has seen a surge in popularity as a livestock in Nigeria and many other countries. This species of avian, the smallest among farmed birds, is bred for both meat and egg production (Panda and Singh, 1990). Asides from the fact that it can be started with very little capital, it also has a high rate of return on investment. Quails which are fast growing poultry species are very economical to maintain as they require less floor space (Haruna *et al.*, 1997). They are small sized, early maturing, hardy and prolific (Robbins, 1981; Robbins *et al.*, 1991). They come to sexual maturity and egg production early between 5-6 weeks of age and attain market weight of 150-180 g at almost the same age. The meat and eggs are high quality protein with low body fat and cholesterol content making it a choice product for individuals prone to cardiovascular diseases (Haruna *et al.*, 1997; Olubamiwa *et al.*, 1999). It was found by Chimezie *et al.* (2022) that female Japanese quail had greater body weight and morphometric traits than males.

Eggs are a source of vital amino acids and a complete protein. Additionally, nine non-essential amino acids, antioxidants, vitamins, minerals, saturated, monounsaturated and polyunsaturated fatty acids, cephalin, lecithin and cholesterol are all present in eggs (King, 2009). Eggs are one of the few foods that are regarded as a complete protein because they contain all of the essential amino acids that are needed, as well as oleic acid, a monounsaturated fatty

[1]Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria.
[2]Department of Animal Production Fisheries and Aquaculture, Kwara State University, Malete, Kwara State, Nigeria.
[3]Department of Basic Sciences, Babcock University, Ilishan-Remo, Ogun State, Nigeria.

Corresponding Author: A.O. Akintunde, Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria. Email: adeyinka.akintunde@gmail.com

How to cite this article: Akintunde, A.O., Ndubuisi-Ogbonna, L.C., Olorunfemi, O.A., Ladele, M.M., Ojo, O.A., Adewumi, A. and Akinboye, O.E. (2023). Growth Pattern and Physiological Response of Japanese Quails to Administered Aqueous Solution of Egg Lime Molasses Mixture. Agricultural Science Digest. DOI: 10.18805/ag.DF-504.

Submitted: 16-08-2022 **Accepted:** 01-09-2023 **Online:** 28-09-2023

acid and important sources of essential unsaturated fatty acids (Linoleic) (Vinayananda *et al.*, 2019).

Lime juice is a good source of organic acids such as citric and ascorbic acids (Holden *et al.*, 2005) and could serve this purpose. There was a claim that lime juice included additional biomolecules, including flavonoids and carotenoids (Holden *et al.*, 2005). Due to the presence of organic acids, this could be an additional benefit to lime juice's anticipated bioactive properties.

A study conducted by Çetingül *et al.* (2019) found that pomegranate molasses, due to its palatability, can be a beneficial binder and energy source for livestock feed. However, there is limited research regarding the use of molasses for quail production.

In a study on nutritional and ethno-medicinal potentials of egg-lime molasses mixture (ELM) in livestock production by Akintunde *et al.* (2022), quantitative evaluation of the phytochemicals showed that ELM 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/100 g) (Akintunde *et al.*, 2022). However, Akintunde *et al.* (2022) came to the conclusion that ELM could be a viable natural antibiotic alternative, particularly in monogastric animal production, because of its abundance in numerous nutrients and phytochemicals that give it the capacity to perform many biological activities.

This study is necessitated by the fact that there is dearth of information in relation to administration of aqueous solution of egg lime molasses mixture in drinking water in addition to regular diet especially as it relates to poultry production and especially quail production. Therefore, the objective of this work was to determine the growth pattern and physiological response of Japanese quails to administration of aqueous solution of egg lime molasses mixture in drinking water.

MATERIALS AND METHODS

Experimental site

The investigation was carried out in Ogun State, Nigeria at the farm house of Babcock University, in Ilishan Remo. Ilishan Remo, which has a mean temperature of 27°C and is located in Nigeria's rain forest region with about 1500 mm of rain annually.

Preparation of egg lime molasses solution

The fresh eggs were placed in a bowl after which 1 liter of lime juice and 500 g of molasses were added into the same bowl, then it was covered tightly and left for 10 days at temperature of 27°C and relative humidity of 61%. At the end of 10 days, the egg shells had dissolved into solution. The entire solution was then blended together.

Experimental treatments

Five 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 10 ml, 20 ml, 30 ml and 40 ml per 500 ml 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. The quail cages were cleaned, disinfected and given two weeks to air dry before the quails arrived. Throughout the duration of the trial, the birds were given unlimited access to food and water. Table 1 showed the starter and finisher phases' nutritional makeup for the experimental diets. Between days 1 and 21, the starting phase took place and between days 22 and 49, the finisher phase.

Data collection

Data was obtained regarding the performance parameters of feed intake, weight gain and feed conversion ratio (FCR) and livability), morphometrics and physiological response.

Performance parameters

Feed intake was calculated weekly. The daily feed intake was determined by subtracting the remaining feed in the feeder from the initial amount of feed provided the previous day.

$$\text{Average feed intake/animal} = \frac{\text{Feed offered in (g) - Feed leftover (g)}}{\text{Total number of birds in the group}}$$

Weight gain

At the start of each weighing week, the weight of all the birds in each replicate was measured using a digital scale. Throughout the experiment, the weight gain of the birds was measured at the conclusion of each week.

Table 1: Gross composition for experimental starter and finisher diets (g/100 kg).

Ingredient	Starter	Finisher
Maize	48	59
Soybean meal	33	30
Wheat offal	6	5.64
Fishmeal	4	-
Palm oil	-	3
Vegetable oil	4	-
Meat - bone meal	2.5	-
Limestone	1	-
Dicalcium phosphate	0.5	1.56
Oyster shell	-	1
Salt	0.4	0.25
Methionine	0.2	0.25
Lysine	0.1	0.05
Avatec	-	0.06

Feed conversion ratio

This was determined by dividing the total amount of feed consumed by the overall amount of weight gained.

Morphometrics/Linear body measurements

The measurements of shank length (SL), thigh length (TL), body girth (BG), wing length (WL) and body length (BL) were established following the method outlined by Egena *et al.* (2014), Ikpeme *et al.* (2016) and Akintunde *et al.* (2019).

Physiological response

Respiratory rate

This is calculated by the counting of panting breaths of the birds for 30 seconds and the value (X) is then multiplied by 2.

Oxygen concentration

Pulse oximeter was used to measure how much oxygen the hemoglobin in the blood is carrying. This is called the oxygen saturation and is expressed in percentage.

Body mass index

The Body Mass Index (BMI) was calculated by taking the bodyweight (in grams) and dividing it by the square of the body length (in centimeters), with the result expressed in g/ cm^2, as Akintunde *et al*. (2021a) described.

RESULTS AND DISCUSSION

Table 2 showed the growth performance of Japanese quails administered with varying levels of Egg Lime Molasses solution at the starter phase. Significant difference ($p<0.05$) was observed only for feed conversion ratio at the starter phase, however, birds that received 20 ml ELM/500 ml of water had the best FCR but the results from the birds administered ELM compared well with the control.

Table 3 showed the growth performance of Japanese quails administered with varying levels of Egg Lime Molasses solution at the finisher phase. Significant difference ($p<0.05$) was observed only for live weight and weight gain at the finisher phase from all the parameters recorded, however, birds that received 10 ml ELM /500 ml of water had the best final live weight while birds that received 20 ml ELM /500 ml of water had the best weight gain but the results from the birds administered ELM were similar ($p>0.05$) to the control for both parameters.

Tables 4 and 5 showed the morphometric parameters of Japanese quails administered ELM solution at starter phase and finisher phase respectively. At the starter phase, significant differences were ($p<0.05$) observed among the different treatments on shank length, thigh length, body girth and body mass index. At the finisher phase, significant differences were ($p<0.05$) were observed among the different treatments on shank length, thigh length, wing length, body girth and body mass index. Birds administered 20 ml/500 ml of water having the highest values for shank length and thigh length while birds administered 30 ml/ 500 ml of water had the highest values for body girth and body mass index.

Table 2: Growth performance characteristics of japanese quails at starter phase administered egg lime molasses solution.

	T1	T2	T3	T4	T5
Initial live weight (g)	7.075±0.118	6.875±0.189	6.800±0.178	6.900±0.147	6.875±0.063
Final live weight- starter (g)	111.600±2.353	111.225±1.903	117.350±0.699	111.200±3.560	110.375±1.344
Weight gained (g)	104.525±2.435	104.35±2.070	110.55±0.801	104.3±3.702	103.5±1.392
Feed intake (Starter) (g)	55.700	55.200	54.960	55.200	55.420
FCR- Starter	$1.814±0.079^{ab}$	$1.858±0.213^{ab}$	$1.565±0.076^{a}$	$1.822±0.133^{ab}$	$2.038±0.076^{b}$
Mortality (%)	1.250±0.25	1.250±0.946	1.750±0.479	1.250±0.479	0.500±0.289
Average temperature (°C)	29.175±0.139	29.359±0.071	29.263±0.144	29.103±0.271	29.250±0.152
Average humidity (%)	79.813±0.313	79.813±0.325	80.469±0.286	80.188±0.325	80.406±0.434

*ab= Mean within the same row with different superscripts are significantly different.

Group mean and standard error of sample (x±sem) shown ($p<0.05$), FCR- Feed conversion ratio.

Table 3: Growth performance characteristics of Japanese quails at finisher phase administered egg lime molasses solution.

	T1	T2	T3	T4	T5
Live weight (starter)	$110.725±3.138^{ab}$	$113.2±2.466^{ab}$	$107.775±1.017^{a}$	$116.8±1.249^{b}$	$113.45±1.330^{ab}$
Final live weight (g) (Finisher) (g)	164.625±1.648	162.275±5.959	175.575±5.934	165.467±3.438	166.025±5.541
Feed intake- finisher (g)	520.229±89.894	405.764±53.986	537.181±173.855	403.284±81.11	526.431±36.803
Mortality (%)	0±0	0±0	0±0	0±0	0±0
Weight gain- finisher (g)	$53.900±4.716^{ab}$	$49.075±5.258^{a}$	$67.800±6.072^{b}$	$48.667±3.915^{ab}$	$52.575±6.860^{ab}$
FCR finisher	7.295±1.334	5.192±0.436	5.67±1.653	5.122±1.104	6.897±1.137

*ab= Mean within the same row with different superscripts are significantly different.

Group mean and standard error of sample (x±sem) shown ($p<0.05$).

FCR- Feed conversion ratio.

Table 6 and 7 showed the physiological parameters obtained at both the starter and finisher phase respectively. The table indicates that there were significant differences ($p<0.05$) in rectal temperature and respiratory rate at the starter phase while at the finisher phase, significant difference ($p<0.05$) was only observed in rectal temperature. However, birds administered 20-30 ml of ELM/ 500 ml of drinking water recorded the least values for respiratory rates.

According to the results from this study, all the parameters for growth were not significantly influenced ($p>0.05$) by the administration of egg lime molasses solution with the exception of feed conversion ratio at the starter phase and this was in agreement with the report of Habibu *et al.* (2014) where quails were administered molasses. It should however be noted that the best FCR and weight gained was recorded in the birds administered with 20 ml ELM which was T3 while the treatment groups that received higher levels of ELM did not show significant differences compared to the control group.

Administration of egg lime molasses solution through drinking water did not alter feed consumption, but had a significant effect on percentage weight gain in Japanese quail. This result is similar to previous studies on the effect of molasses administration on broiler chickens, where Habibu *et al.* (2014) found that drinking water with molasses increased percentage weight gain in broiler chickens, particularly in those who received lower doses. However, there have been reports of molasses decreasing feed intake but increasing live weight gain in chickens (Rahim *et al*., 1999; Ndelekwute *et al.*, 2010). The current study's results are in agreement with the findings of Gilchrist *et al*. (2020), who observed that a molasses enriched cassava fibre-based diet supplemented with enzymes improved growth performances in broiler chickens without having any effect on feed intake or feed conversion ratio. It is worth noting that the current study did not use enzymes, however the lime may have acted as a source of organic acids. The results also agreed partly with the reports demonstrating

Table 4: Morphometric parameters of japanese quail administered egg lime molasses solution at starter phase.

	T1	T2	T3	T4	T5
SL (cm)	3.00 ± 0^{a}	3.00 ± 0^{a}	3.25 ± 0.06^{b}	3.03 ± 0.02^{a}	3.03 ± 0.02^{a}
TL (cm)	6.81 ± 0.32^{c}	6.33 ± 0.07^{bc}	6.79 ± 0.05^{c}	6.11 ± 0.22^{ab}	5.54 ± 0.25^{a}
WL (cm)	8.44±0.09	8.61±0.14	8.33±0.26	8.24±0.19	8.14±0.17
BL (cm)	16.91±0.37	16.58±0.19	16.16±0.13	16.38±0.2	16.60±0.23
BG (cm)	14.51 ± 0.39^{a}	15.68 ± 0.22^{b}	15.83 ± 0.22^{b}	17.20 ± 0.33^{c}	16.36 ± 0.18^{b}
BMI (g/cm^2)	0.39 ± 0.01^{a}	0.40 ± 0.01^{ab}	0.42 ± 0.01^{ab}	0.43 ± 0.01^{b}	0.42 ± 0.01^{ab}

*abc= Mean within the same row with different superscripts are significantly different.

Group mean and Standard error of sample (x±sem) shown ($p<0.05$)

SL- Shank length, TL- Thigh length, WL- Wing length, BL- Body length, BG- Body girth, BMI- Body mass index, BW- Body weight.

Table 5: Morphometric parameters of Japanese quail administered egg lime molasses solution at finisher phase.

	T1	T2	T3	T4	T5
SL (cm)	3.04 ± 0.02^{a}	3.04 ± 0.02^{a}	3.15 ± 0.05^{b}	3.05 ± 0.02^{a}	3.08 ± 0.03^{ab}
TL (cm)	6.75 ± 0.19^{bc}	6.71 ± 0.15^{bc}	6.95 ± 0.1^{c}	6.38 ± 0.13^{b}	5.84 ± 0.16^{a}
WL (cm)	8.6 ± 0.11^{ab}	8.76 ± 0.08^{b}	8.43 ± 0.23^{ab}	8.33 ± 0.18^{ab}	8.2 ± 0.23^{a}
BL (cm)	17.13±0.36	17.24±0.35	16.69±0.2	16.61±0.19	16.79±0.22
BG (cm)	15.49 ± 0.37^{a}	16.31 ± 0.46^{ab}	16.48 ± 0.2^{b}	17.18 ± 0.16^{b}	16.51 ± 0.12^{b}
BMI (g/cm^2)	0.55 ± 0.02^{ab}	0.50 ± 0.02^{a}	0.54 ± 0.02^{ab}	0.56 ± 0.01^{b}	0.58 ± 0.02^{b}

*abc = 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: (SL)- Shank length, (TL)- Thigh length, (WL)- Wing length, (BL)- Body length, (BG)- Body girth, (BMI)- Body Mass Index, (BW)- Body weight.

Table 6: Physiological parameters of Japanese quail administered egg lime molasses solution at starter phase.

	T1	T2	T3	T4	T5
Rectal temp. (°C)	38.25 ± 0.31^{ab}	38.06 ± 0.24^{ab}	37.75 ± 0.23^{a}	38.63 ± 0.25^{b}	38.13 ± 0.23^{ab}
RR	31.13 ± 0.69^{bc}	32.38 ± 2.14^{c}	27.00 ± 1.76^{a}	24.75 ± 1.06^{a}	29.50 ± 0.82^{bc}
Oxygen conc. (%)	97±0.27	97±0.27	97.13±0.30	97.13±0.30	97.00±0.33

*abc= 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: RR- Respiratory rate.

Table 7: Physiological parameters of Japanese quail administered egg lime molasses solution- finisher phase.

	T1	T2	T3	T4	T5
Rectal temp. (°C)	38.25±0.27^{ab}	38.06±0.22^{ab}	38.25±0.21^{ab}	37.63±0.26^{a}	38.81±0.25^{b}
RR	33.00±1.58	32.88±1.78	32.38±1.24	31.00±2.24	35.25±1.6
Oxygen conc. (%)	96.88±0.3	97.38±0.26	97.25±0.25	97.13±0.35	97.25±0.25

*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: RR- Respiratory rate.

that the consideration of molasses in broiler diets had no critical impact on feed effectiveness (Khalid *et al.*, 2007).

The inclusion of ELM significantly influenced the feed conversion ratio of Japanese quails at the starter phase in the present study and this was in agreement with the reports of Rahman *et al.* (2019) that feed efficiency improved ($p<0.05$) at 2nd, 3rd and 4th weeks as the fundamental impact of molasses supplementation in broiler production.

Body weight and body measurements are significant considerations for both poultry breeders and meat processors (Adeniji and Ayorinde, 1990; Akintunde *et al.*, 2019; Akintunde *et al.*, 2021a). These factors are used to calculate a variety of economic characteristics of farm animals. Furthermore, they are indispensable factors when it comes to assessing growth, feed efficiency and making economic and marketing decisions (Momoh and Kershima, 2008).

The results of the current study showed that there were significant ($p<0.05$) differences for some parameters measured (shank length (SL), thigh length (TL), body girth (BG)). There was, however, no significant difference ($p>0.05$) in wing length (WL), body length (BL) and body mass index (BMI). The body weight and linear measurements obtained in this study were lower compared to the values reported by other authors, such as Reddish *et al.* (2003) and Ojo *et al.* (2014), which ranged from 35.23 g to 143.78 g. Alabi *et al.* (2012) anticipated a correlation between morphometric traits and body weight in birds from multiple populations and environments. Ibe and Nwakalor (1987) observed a strong positive correlation between linear measurements and body weight in Nigerian local chickens. Akintunde *et al.* (2020) also found a low positive connection between morphometrics and body weight in Yoruba Ecotype Chickens that were given graded levels of *Moringa oleifera* seed meal. Raji *et al*. (2009) conducted a zoometric study on Nigerian local duck, which demonstrated a highly significant positive correlation between body weight (BW) and linear body measurements. It was found that body girth had the highest correlation to body weight, followed by body length. This strong relationship between body girth and body weight may be due to the presence of important bones, muscles and viscera in the body girth. These results are in agreement with the findings of Akintunde *et al.* (2020) that diets affect the association between body weights and morphometric measurements.

The results obtained signified an improvement in the performance parameters of quail receiving an inclusion level of 20ml of ELM into 500 ml of water as seen in T3 which had a better body weight gain, shank lengths and thigh lengths while T4 (30 ml of ELM in 500 ml of water) had the best body girth which is a good pointer to higher body weight.

The body mass index was significantly influenced by the inclusion of ELM and this was in agreement with the reports of Akintunde *et al.* (2021b) who observed that the inclusion of *Moringa oleifera* seed meal significantly influenced BMI in Yoruba Ecotype chickens and Marshall broiler chickens. Similar observations in the BMIs of broiler and pullets chickens fed cabbage were also made by Adesina and Toye (2014). However, the values obtained for BMIs in the study at starter (0.39-0.43 g/cm^2) and finisher (0.50-0.58 g/cm^2) were in proximity to the ranges reported for pullets chickens at week 4 (0.31- 0.36 g/cm^2) and week 7 (0.48-0.56 g/cm^2) reported by Oludoyi and Toye (2012) and the range of 0.47-0.61 g/cm^2 reported by Akintunde *et al.* (2021b) for Yoruba Ecotype Chickens.

It was observed from the present study that there was significant difference ($p<0.05$) in rectal temperature and respiratory rate (RR) having an average of 38.48°C and 97.10% respectively. The results showed that the inclusion of the ELM did not negatively affect the physiological response of the birds. The respiratory rate was normal and also within the range reported for broiler chickens by Nurmeiliasari *et al.* (2020). The values obtained for rectal temperature (37.63-38.81°C) was however lower than the values of 41.07-41.64°C and 41.00-43.60°C for quails reported by Alkan *et al.* (2012) and Khalil *et al.* (2012) respectively.

CONCLUSION

It can be concluded from this study that the administration of aqueous solution of egg lime molasses mixture in drinking water of Japanese quails did not alter the growth parameters of Japanese quails however birds that received 20 ml per 500ml of water had the best feed conversion ratio and weight gain. Also, in terms of their growth patterns, birds administered 20 ml/500 ml of water had the best thigh and shank length, hence they have the potentials of growing taller while birds administered 30 ml of ELM/500 ml of water had the highest body girth and body mass index which might be an indication of cardiovascular problem. However, birds administered 20 ml ELM per 500 ml of drinking water had the least values for respiratory rates at the starter phase which is suggestive that the administration of 20 ml of ELM per 500 ml of drinking water will be most effective for better

feed conversion ratio, weight gain and for optimum cardiovascular physiological responses of Japanese quails.

Coflict of interest: None.

REFERENCES

Adeniji, F.O. and Ayorinde, K.L. (1990). Prediction of body weight from body measurements of chicken. Nigerian Journal of Animal Production.17: 42-47.

Adesina, O.O. and Toye, A.A. (2014). Nutritive effect of cabbage (*Brassica oleracea*) on growth, obesity, lipidaemia and haematology in broiler and pullet chickens. Global Journal of Agricultural Sciences.13:11-25. DOI: http://dx.doi.org/10.4314/gjass.v13i1.3.

Akintunde, A.O., Toye, A.A. and Ogundere, A.A. (2019). Genetic differences in the body weight and haematological traits of Local and Exotic chickens fed graded levels of *Moringa oleifera* seed meal. Wayamba Journal of Animal Science. 11: 1836-1849.

Akintunde, A.O., Toye, A.A., Ademola, A.A. and Jubril, A.E. (2020). Correlation between body weight and morphometric traits in local and exotic chickens to dietary levels of *Moringa oleifera* (Lamarck) seed meal. Nigerian Journal of Animal Production. 47(3): 1-6.

Akintunde, A.O., Toye, A.A. and Ademola, A.A. (2021a). Principal component analysis of body measurements in two genotypes of chickens fed graded levels of *Moringa oleifera* seed meal. Journal Animal Production Research. 33(1): 1-13.

Akintunde, A.O., Toye, A.A. and Ademola, A.A. (2021b). Effects of dietary *Moringa Oleifera* seed meal on obesity, liver and kidney functional parameters of local and exotic chickens. Aceh Journal of Animal Science. 6(3): 97-103.

Akintunde, A.O., Ndubuisi-Ogbonna, L.C., Olorunfemi, O.A., Ladele, M.M., Shobo, B.A., Adewole, S.A. and Akinboye, O.E. (2022). Nutritional and ethno-medicinal potentials of egg-lime-molasses mixture in livestock production. Asian Journal of Dairy and Food Research. doi: 10.18805/ajdfr.DRF-285.

Alabi, O.J., Ngambi, J.W., Norris, D. and Egena, S.A. (2012). Comparative study of three indigenous chicken breeds of South Africa: Body weight and linear body measurements. Agricultural Journal. 7(3): 220-225. DOI: 10.3923/aj.2012.220.225.

Alkan, S., Karsli, T., Karabağ, K., Galiç, A. and Balcioğlu, M.S. (2012). The effects of thermal manipulations during early and late embryogenesis on body temperatures of Japanese quails (*Coturnix coturnix japonica*). Journal of Applied Animal Research. 40(1): 13-16. DOI: 10.1080/09712119.2011.607940.

Brzóska, F., Iiwiñski, B. and Michalik-Rutkowska, O. (2013). Effect of dietary acidifier on growth, mortality, post-slaughter parameters and meat composition of broiler chickens. Annals of Animal Science. 13: 85-96.

Çetingül, İ.S., Iqbal, A., Bayram, İ., Gültepe, E.E., Uyarlar, C. and Özçýnar, Ü. (2019). Effect of pomegranate molasses on egg quality traits during different storage time in laying hens. Kocatepe Veterinary Journal. 12(2): 193-199.

Chimezie, V.O., Akintunde, A.O., Ademola, A.A. and Aina, F.A. (2022). Principal component analysis of bodyweight and morphometric traits in Japanese Quail *Coturnix coturnix japonica*. Aceh Journal of Animal Science. 7 (2): 47-52. DOI: 10.13170/ajas.7.2.24533.

Egena, S.S.A., Ijaiya, A.T., Ogah, D.M. and Aya, V.E. (2014). Principal component analysis of body measurements in a population of indigenous Nigerian chickens raised under extensive management system. Slovak Journal of Animal Science, 47(2): 77-82.

Gilchrist, T.D., Ruben, N.T., Raphaël, K.J., Agwah, E.D., Sévérin, T., Josiane, K.N.G., Guilaine, N.T., Boris, N.T., Kodel, T.T.R. and Aghanie, A. (2020). Growth performances of broiler chickens fed on molasses enriched cassava fibre based-diet supplemented with enzymes. Journal of Animal and Plant Sciences. 46(1): 8100-8112. https://doi.org/10.35759/JAnmPlSci.v46-1.4.

Habibu, B., Ikira, N.M., Buhari, H.U., Aluwong, Y., Kawu, M.U., Yaqub, L.S., Tauheed, M. and Isa, H.I. (2014). Effect of molasses supplementation on live weight gain, haematologic parameters and erythrocyte osmotic fragility of broiler chickens in the hot-dry season. International Journal of Veterinary Science. 3: 181-188.

Haruna, E.S., Musa, U., Okewole, P.A., Shemaki, D., Lombin, L.H., Molokwu, J.U., Edache, J.A. and Karsin, P.D. (1997). Protein requirement of quail chicks in Plateau State, Nigeria. Nigerian Veterinary Journal. 18: 108-113.

Holden, J.M., Bhagwat, S.A., Haytowitz, D.B., Gebhardt, S.E., Dwyer, J.T., *et al.* (2005). Development of a database of critically evaluated flavonoids data: Application of USDA's data quality evaluation system. Journal of Food Composition Analysis. 18: 829-844.

Ibe, S.N. and Nwakalor, C.N. (1987). Growth pattern performance in broilers influence of genotype and management on isometry of growth. Poultry Science. 66: 1274-1284.

Ikpeme, E.V., Kooffreh, M.E., Udensi, O.U., Ekerette, E.E., Ashishie, L.A. and Ozoje, M.O. (2016). Multivariate-based genetic diversity analysis of three genotypes of Nigerian local chickens (*Gallus domestica*). International Journal of Science and Research Methodology. 5 (2): 1-12.

Khalid, Seham, Khadiga and Omer, M.I. (2007). The response of broiler chicks to different dietary molasses levels. AL buhuth. Khartoum. 11: 1.

Khalil, H.A., Gerken, M., Hassanein, A.M. and Mady, M.E. (2012). Behavioural responses of two Japanese quail lines differing in body weight to heat stress. Egyptian Journal of Animal Production. 49 (Suppl. Issue): 151-158.

King, A.J. (2009). Multidisciplinary Uses of the Chicken Egg. Avian Biology Research. 2(3): 107-119. doi:10.3184/175815508X402455.

Momoh, O.M. and Kershima, D.E. (2008). Linear body measurements as predictors of body weight in Nigerian local chickens. Asset series. A8(2): 206-212.

Ndelekwute, E.K., Uzegbu, H.O., Igwe, I.R., Nosike, R.J., Odoemelam, V.U. and Inyan, U.O. (2010). Effects of administration of molasses through drinking water on growth and conformation parameters of meat-type chicken. Animal Production Research Advances. 6: 30-34.

Nurmeiliasari, Fenita, Y., Zitriyani, E. and Firdaus, F. (2020). Physiological responses and blood profile of broiler chicken supplemented with red dragon fruit peel (*Hylocereus polyrhizus*) subjected to transportation stress. Advances in Biological Sciences Research. 13: 182-189.

Ojo, V., Fayeye, T.R., Ayorinde, K.L. and Olojede H. (2014). Relationship between body weight and linear body measurement of Japanese quail. Journal of Scientific Research. 6(1): 175-183.

Olubamiwa, O., Haruna, E.S., Musa, U., Akinwale, T.O., Combin, L.H. and Longe, G.O. (1999). Effects of different energy levels of cocoa based diets on the productive performance of Japanese quail. Nigerian Journal of Animal Production. 26: 88-92.

Oludoyi, I.A. and Toye, A.A. (2012). The effects of early feeding of *Moringa oleifera* leaf meal on performance of broiler and pullet chicks. Agrosearch. 12(2):160-172. DOI**:** 10.4314/agrosh.v12i2.4.

Panda, B. and Singh, R. (1990). Development in processing Quail. World Poultry Science Journal. 46: 219-234.

Rahman, S., Yasin, M., Hoque, M.A., Akter, N., Islam, S. and Hossain, M.E. (2019). Effects of supplementing lemon juice and molasses onthe performance of broiler chickens. Indian Journal of Poultry Science. 54(3): 205-211.

Rahim, A.G.A., Eiman, A.T.E., El-Bagir, N.M. and Haseeba, S.A. (1999). Effects of feeding different levels of sugar cane molasses to broiler chicks: feed intake, body weight gain, efficiency of feed utilization and dressing percentage. Sudan Journal of Veterinary Science and Animal Husbandry. 38: 93-101.

Raji, A.O., Igwebuike, J.U. and Usman, M.T. (2009). Zoometric body measurements and their relation with live weight in matured local Muscovy ducks in Borno state Nigeria. ARPN Journal of Agricultural and Biological Science. 4: 52-58.

Reddish, J.M., Nestor, K.E. and Lilburn, M.S. (2003). Effect of selection for growth on onset of sexual maturity in random -bred and growth selected lines of Japanese quail. Poultry Science. 82: 187.

Robbins, G.E.S. (1981). Quail, their breeding and management. Publisher-World Pheasant Association (WPA). 1(9): 10.

Robbins, M.P., Hartnoll, J. and Morris, P. (1991). *Phenylpropanoid defence* responses in transgenic Lotus corniculatus 1. Glutathione elicitation of isoflavanphytoalexins in transformed root cultures. Plant Cell Reports. 10(2): 59-62.

Vinayananda, C.O, Sudheer, K. and Rongsensusang. (2019). Nutritional Value of Poultry Egg: An Overview. Poultry Punch Magazine. https://thepoultrypunch.com/2019/09/.