Reproductive Potentials of Female Japanese Quails to Administration of Egg-Lime-Molasses Mixture

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Abstract

Japanese quails are hardy with huge potentials to bridge protein deficiency, hence the need for an assessment of their reproductive potentials. The egg-lime-molasses mixture (ELM) was prepared by placing 10 fresh chicken eggs (average weight of 58 g per egg) in a bowl, after which 1 liter of lime juice and 500 g of molasses were added, then it was covered and left for 10 days. The solution was then blended. Two hundred day-old Japanese quails were assigned to 5 treatments with 40 birds in a completely randomized design (CRD) and 4 replicates of 10 birds each. The control (T1) had no ELM, while treatments 2, 3, 4 and 5 (T2, T3, T4, and T5) had inclusions of 2%, 4%, 6%, and 8% ELM in water, respectively. Data were collected on the morphometrics, egg characteristics, follicle stimulating, and leutenizing hormone concentrations. The findings revealed that at the early stage of laying, the administration of ELM did not have a significant effect ($p > 0.05$) on egg parameters. However, at the latter phase of egg laying, there was a significant effect ($p < 0.05$) on shell weight and albumen percentage. ELM did not have a significant effect ($p > 0.05$) on the production performance. There was no significant effect ($p < 0.05$) on follicular characteristics, while birds administered 30ml ELM/500ml of water had the significantly highest ($p < 0.05$) weights of oviduct (1.01 ± 0.01 g) and ovary (3.995 ± 0.005 g). Birds administered higher levels of ELM had significantly higher concentrations ($p < 0.05$) of leutenizing and follicle stimulating hormones. The inclusion of aqueous administration of ELM in drinking water has no detrimental effect on the reproductive potentials of female Japanese quails.

Keywords: Fertilizing, Hormones, Ovary, Oviduct

Introduction

Raising poultry primarily serves the functions of producing meat, eggs, and feathers, as well as occasionally for religious rituals (Scanes et al., 2004). Poultry are effective food-to-feed converters. The highest nutritional benefits are provided by foods of poultry origin, with eggs being particularly high in all essential nutrients and both palatable and nutrient-dense (Scanes et al., 2004).

Japanese quails are noted for their early maturity. By the time they are 50 days old, they are fully developed and have been seen to lay their first eggs. Its production cycle takes between 300 and 320 days to complete. Hens could lay 200 eggs in their first year of laying. Only two to two and half years are considered to be the average lifespan. The typical egg weighs about 10g or 8% of the quail's overall weight. The fact that quail eggs are a source of protein, vitamins, and lipids such as phospholipids and polyunsaturated fatty acids makes them a functional food (Meluzzi et al., 2000). Quail eggs have a significantly better nutritional value than other eggs since they are rich in antioxidants, minerals, and vitamins and provide a lot more nutrients than other foods (Lalwani 2011).

Due to the health, nutritional, and economic advantages of quail, the market for quail birds and its products is rising, albeit very slowly, particularly in emerging nations like Nigeria. As a result, efforts to increase the level of quail production in the developing nations must be stepped up in order to keep up with this rising demand. One of the most promising methods for bridging the animal protein shortfall is quail farming. Due to modern applications like consumption of its goods and frequently its numerous by-products, the manufacturing of quail products is distinctive and has attracted particular attention. However, the potential of raising poultry has not been completely realized since most farmers have focused only on raising chickens, despite the fact that other birds have similar economic, social, and nutritional advantages. It is significant to note that numerous initiatives have been made to increase Nigeria's overall poultry production. However, it has been shown that a number of variables, including nutrition and genetics, affect egg production (Akintunde and Toye 2021, 2022).

According to Akintunde et al. (2023), the aqueous mixture of eggs, lime, and molasses had the following compositions: moisture content (19.60%), crude protein (15.20%), lipids (5.50%), ash (14.60%), crude fiber (9.60%), carbs (35.20%), fatty acid (4.40%), and energy (1060.30 Kcal/100 kg). Alkaloids, flavonoids, glycosides, saponin, steroids, phenols, terpenoides, tannin, and antraquinones were all found in ELM after phytochemical analysis. According to quantitative analysis of the phytochemicals, ELM contains 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). The components of the vitamins are as follows: 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). According to the mineral analysis, it contains silicon (22.70 ppm), 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 magnesium (4.08%) (Akintunde et al., 2023). The study was aimed at determining the reproductive potentials of female Japanese quails to oral administration of egg-lime-molasses mixture.

Materials and Methods

Experimental Site

This experiment was performed at a standard poultry unit (approved for research by the Department of Agriculture and Industrial Technology, Babcock University) at the farm house of Babcock University, Ilishan-Remo Ogun State, Nigeria. Babcock university is located at latitude 6.8920 °N and longitude 3.7181 ° E. It is covered predominantly by rain forest and has wooden savanna in the northwest. with an annual rainfall of about 1500 mm, with a mean temperature range of 27 - 31 degree census and a very high relative humidity (above 87%).

Preparation of Egg Lime Molasses Solution

The eggs of chickens were first checked to make sure they were incredibly fresh; this was done by submerging them in water. Following the placement of 10 fresh eggs in a bowl, 1 liter of lime juice and 500 g of molasses from sugarcane were then added. The bowl was then carefully covered and left for 10 days at a temperature of 27 °C and a relative humidity of 61%. The egg shells had broken down into solution after 10 days. The entire mixture was then blended together.

Experimental Birds

The day-old of the Japanese quail were obtained from a local farmer in Lagos State, Nigeria. The pen was cleaned, disinfected, and given time to air dry two weeks prior to the arrival of the 200 Japanese Quails. Also thoroughly cleaned and disinfected were the drinkers and feeders. To provide heat and illumination at night for continuous feed intake, 100 watt electric lamps were fitted in the cages. A completely randomized design (CRD) was utilized to randomly assign the birds to five treatments, each of which had four replicates and ten birds per replication.

Experimental Treatments

The development of five oral medications was done. The control (T1), which had no egg lime molasses solution in the water while the treatment groups 2, 3, 4 and 5 (T2, T3, T4, and T5) had 2%, 4%, 6% and 8% ELM/ drinking water respectively. In the first week, the third week, the fifth week, and the seventh week, the birds were administered the egg-lime-molasses solution five days each. The starter phase of the experiment was from day one to day 28 while the finisher phase was from day 28 to day 49.

Data Collection

Data were collected on egg production parameters, egg quality (internal and external qualities) and morphometrics of the female reproductive tracts.

Egg Production Parameters

At day 28, sexing was performed and 28 female birds were used per treatment (7 birds per replicate) for the study. The following data were then taken:

i. Age at first lay: The number of days from point of lay to the day the first egg is laid.

ii. Body weight of hen at first lay: This was measure as weight of each live pullet average over the number of pullets' weight per group at first lay.

iii. Weight of first egg: weight of each first egg average over the weight of first eggs laid per group using a balance sensitivity of 0.01 g.

iv. Hen day production: Number of eggs collected divided by number of birds alive as at that day multiplied by 100%.

Egg Quality Evaluation

Two eggs per replicate were sampled for egg quality evaluation at first lay, and then weekly till day 49.

Internal Egg Qualities

The following measurements were determined:

i. Albumen height: The eggs were softly cracked, and a tripod spherometer was used to measure the maximum albumen height (Doyon et al., 1986).

ii. % Albumen weight: This was calculated as the percentage of the albumen weight to the egg weight.

iii. Yolk weight: This was measured using Mettler top-loading weighing balance.

iv. Haugh Unit (HU): This was calculated using the values obtained for the egg weight and albumen height as expressed by Haugh (1937) and enunciated by Asuquo et al. (1992) in the formula shown below:

HU = 100log (H+7.5-1.7W0.37)

Where, H = Albumen height in mm

W = Egg weight in gram

Table 1. Composition for experimental starter and finisher diets (Kg/100 kg).

Ingredients	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 (Coccidiostat)	-	0.06
%CP	15.20	20.00

External Egg Qualities

i. Egg weight: This was measured using Mettler® top-loading sensitive scale (manufactured by Mettler Toledo, Canada).

ii. Egg length and width: The length and width of each egg were measured using vernier calipers. The width was measured as the distance between two ends of the egg at the widest cross-sectional region using vernier calipers. The length was measured as the distance between the broad and narrow ends of the eggs.

iii. Egg shape Index (ESI): This was calculated as the percentage of the egg breadth (width) to the egg length (Panda 1996). This formula is as follows:

$$\text{Egg Shape Index} = \frac{\text{Width of egg (mm)} \times 100}{\text{Length of egg (mm)} \times 1}$$

iv. Shell thickness: The thickness of individual air-dry shells was measured to the nearest 0.01mm using micrometer screw gauge (Chowdury 1987).

v. Shell weight: Egg shells were air-dried in the crates. The relative shell weight was calculated by relating the shell weight to the weight of the egg.

Determination of Leutenizing Hormone and Follicle Stimulating Hormone Levels

Blood samples were collected from 8 birds per treatment at day 42. Blood collected was harvested into heparinized plastic tubes and the tubes were labeled accordingly. Hormones assay was done for luteinizing hormone (LH) and follicle stimulating hormone (FSH). These were determined by enzyme immunoassay method, using commercial kits Stratus (DADE International Incorporation in immune fluorescence apparatus BAXTER STRATUS II).

Morphometrics of Female Reproductive Organs

After the birds had been slaughtered (12 birds per treatment), the reproductive tract was removed, trimmed free of fat and adhering connective tissue, the body weight, the female reproductive tract, each ovary that had been taken out of the ovarian bursa, the infundibulum, and the oviduct were measured, and morphometric evaluations were carried out using a highly sensitive digital balance. A thread was used to measure the oviduct and infundibulum, which were then promptly remeasured on a ruler and noted.

The relative ovary weight was calculated as ovary weight (wet weight, mg)/BW (g) x 100% where, BW is body weight.

Statistical Analysis

Data collected were presented as mean±standard error, the comparison was done using one-way analysis of variance using statistical package for social science version 22.0 and the treatment means were separated using Duncan Multiple Range Test (Steel and Torries, 1990) at 95% confidence limit.

Results

Table 2 showed that there was no significant difference ($p > 0.05$) in the production performance of the Japanese quails to aqueous administration of egg-lime-molasses mixture (ELM). The administration of ELM did not significantly influence ($p > 0.05$) day at first lay, weight of first egg, total number of eggs laid and hen day production.

Table 3 showed the means of external and internal egg parameters measured of Japanese quails to different concentrations of the egg-lime-mollases solution from day 35 to day 42. There was no significant difference ($p > 0.05$)

among all the parameters across the treatments. Different concentrations of ELM solution did not affect ($p > 0.05$) the internal and external characteristics of the Japanese quail eggs.

Table 4 showed the egg parametes of Japanese quails to administration of ELM from day 42 to day 49. Significant difference ($p < 0.05$) was observed in shell weight, shell percentage and albumen percentage of the Japanese quails where the control had the highest shell weight (1.35 ± 0.07 g) and birds administered 0.40 ml/500 ml of water had the least shell weight (1.09 ± 0.03 g). however, birds administered the highest concentration of ELM had the least significant ($p < 0.05$) value for albumen percentage.

Table 5 showed the reproductive morphometrics and hormonal responses of Japanese quails to the administration of ELM. The administration of ELM significantly influenced ($p < 0.05$) the weight of oviduct, weight of infundibulum, ovary weight and relative ovary weight with birds with the administration of 30 ml (T_4) having the significantly highest ($p < 0.05$) weight of oviduct (1.01 ± 0.01 g) and relative ovary weight (3.995 ± 0.005%) while the birds in the control (0ml ELM) had the significantly highest ($p < 0.05$) weight for infundibulum (4.19 ± 0.49 g). Also, the administration of ELM significantly influenced the reproductive hormones (LH and FSH) where birds with the highest concentration of ELM (40 ml per 500 ml of water) had significantly highest ($p < 0.05$) concentrations for leutenizing hormones and follicle imulating hormones.

Table 2. Egg production parameters of Japanese quails to aqueous administration of egg-lime-molasses mixture.

	T1	T2	T3	T4	T5
Day at First Lay	37.25 ± 1.03	39.25 ± 1.60	36.25 ± 1.11	36.75 ± 0.95	36.75 ± 1.49
Weight of First Egg (g)	6.74 ± 0.64	8.23 ± 0.51	7.69 ± 0.76	6.41 ± 0.64	7.31 ± 0.55
Eggs Laid Till Day Day 49	21.25 ± 4.96	16.25 ± 8.68	22.50 ± 5.95	29.25 ± 3.90	24.50 ± 7.10
Hen Day Production (%)	54.25 ± 5.75	55.00 ± 18.48	72.08 ± 4.62	56.69 ± 2.55	62.33 ± 13.95

No significant difference was found between the treatment groups ($p > 0.05$). T1 - 0% ELM; T2 - 2% ELM; T3 - 4% ELM; T4 - 6% ELM; T5 - 8% ELM.

Table 3. Egg properties and qualities of Japanese quails to aqueous administration of egg-lime-molasses mixture (Day 35-42).

	T1	T2	T3	T4	T5
Egg Weight (g)	8.08 ± 0.36	8.33 ± 0.45	8.71 ± 0.24	8.85 ± 0.22	8.81 ± 0.18
Egg Length (mm)	12.95 ± 0.51	12.66 ± 0.81	13.61 ± 0.39	13.35 ± 0.32	13.74 ± 0.29
Egg Width (mm)	7.21 ± 0.3	6.96 ± 0.53	7.74 ± 0.35	8.1 ± 0.33	7.56 ± 0.32
Shell Thickness (mm)	0.18 ± 0.01	0.17 ± 0.01	0.21 ± 0.02	0.16 ± 0.01	0.19 ± 0.02
Shell Weight (g)	1.14 ± 0.04	1.1 ± 0.07	1.16 ± 0.11	1.13 ± 0.03	1.17 ± 0.07
Albumen Height (mm)	2.21 ± 0.08	2.28 ± 0.08	2.3 ± 0.04	2.35 ± 0.05	2.39 ± 0.04
Yolk Height (mm)	8.61 ± 0.12	8.56 ± 0.17	8.64 ± 0.08	8.65 ± 0.08	8.71 ± 0.1
Albumen Weight (g)	4.88 ± 0.25	5.06 ± 0.31	5.26 ± 0.2	5.48 ± 0.17	5.48 ± 0.2
Yolk Weight (g)	2.07 ± 0.09	2.17 ± 0.13	2.3 ± 0.1	2.23 ± 0.08	2.17 ± 0.16
Shell Percentage (%)	14.1 ± 0.23	13.33 ± 0.83	13.33 ± 1.3	12.81 ± 0.21	13.29 ± 0.64
Albumen Percentage (%)	60.23 ± 0.53	60.64 ± 1.16	60.28 ± 1.11	61.92 ± 0.99	62.08 ± 1.62
Yolk Percentage (%)	25.67 ± 0.49	26.03 ± 0.85	26.38 ± 0.93	25.27 ± 0.82	24.64 ± 1.8
Haugh Unit	78.57 ± 0.29	78.73 ± 0.34	78.42 ± 0.22	78.62 ± 0.14	78.92 ± 0.15
Egg Shape Index	0.56 ± 0.01	0.55 ± 0.02	0.57 ± 0.02	0.61 ± 0.03	0.55 ± 0.02

No significant difference was found between the treatment groups ($p > 0.05$). T1 - 0% ELM; T2 - 2% ELM; T3 - 4% ELM; T4 - 6% ELM; T5 - 8% ELM.

Table 4. Egg properties and qualities of Japanese quails to aqueous administration of egg-lime-molasses mixture (Day 42-49).

	T1	T2	T3	T4	T5
Egg Weight (g)	9.41 ± 0.41	9.73 ± 0.39	9.43 ± 0.33	9.59 ± 0.3	9.43 ± 0.33
Egg Length (mm)	13.99 ± 0.61	14.83 ± 0.49	14.09 ± 0.45	14.28 ± 0.42	14.33 ± 0.54
Egg Width (mm)	8.2 ± 0.43	8.48 ± 0.32	8.24 ± 0.3	8.26 ± 0.26	8.4 ± 0.31
Shell Thickness (mm)	0.23 ± 0.01	0.24 ± 0.01	0.22 ± 0.01	0.24 ± 0.01	0.24 ± 0.01
Shell Weight (g)	1.35 ± 0.07^{b}	1.15 ± 0.05^{a}	1.09 ± 0.03^{a}	1.15 ± 0.05^{a}	1.24 ± 0.05^{ab}
Albumen Height (mm)	2.63 ± 0.11	2.89 ± 0.13	2.94 ± 0.08	2.28 ± 0.44	2.29 ± 0.29
Yolk Height (mm)	9.9 ± 0.21	9.34 ± 0.16	9.36 ± 0.18	9.68 ± 0.22	9.81 ± 0.22
Albumen Weight (g)	5.52 ± 0.27	5.85 ± 0.22	5.76 ± 0.22	5.87 ± 0.17	5.46 ± 0.24
Yolk Weight (g)	2.54 ± 0.11	2.73 ± 0.17	2.59 ± 0.18	2.57 ± 0.16	2.74 ± 0.09
Shell Percentage (%)	14.38 ± 0.55^{c}	11.94 ± 0.59^{ab}	11.67 ± 0.54^{a}	11.96 ± 0.27^{ab}	13.17 ± 0.24^{bc}
Albumen Percentage (%)	58.61 ± 0.7^{ab}	60.2 ± 0.83^{ab}	61.06 ± 1.26^{b}	61.31 ± 1.2^{b}	57.76 ± 0.85^{a}
Yolk Percentage (%)	27.02 ± 0.67	27.86 ± 1.01	27.27 ± 1.3	26.74 ± 1.09	29.07 ± 0.75
Haugh Unit	79.9 ± 0.89	81.34 ± 0.98	82 ± 0.58	76.3 ± 3.61	77.04 ± 2.61
Egg Shape Index	0.59 ± 0.02	0.57 ± 0.01	0.59 ± 0.02	0.58 ± 0.01	0.59 ± 0.01

^{a,b,c} means within a row with difference superscripts are significantly different ($p < 0.05$). T1 - 0% ELM; T2 - 2% ELM; T3 - 4% ELM; T4 - 6% ELM; T5 - 8% ELM.

Table 5. Morphometrics of reproductive organs and reproductive hormomal responses of Japanese quails to aqueous administration of egg-lime-molasses mixture.

	T1	T2	T3	T4	T5
Liveweight (g)	163.50 ± 1.50	178.00 ± 7.00	191.00 ± 35.00	146.50 ± 17.50	157.00 ± 9.00
Weight of Oviduct (g)	0.87 ± 0.07^{ab}	0.63 ± 0.11^{a}	0.81 ± 0.09^{ab}	1.01 ± 0.01^{b}	0.68 ± 0.06^{a}
Length of Oviduct (mm)	6.25 ± 0.15	7.40 ± 0.40	6.15 ± 1.35	5.90 ± 0.10	5.95 ± 0.95
Weight of Infudibulum (g)	4.19 ± 0.49^{b}	3.04 ± 0.28^{ab}	3.83 ± 0.60^{ab}	3.15 ± 0.15^{ab}	2.40 ± 0.04^{a}
Length of Infudibulum (mm)	19.05 ± 4.55	17.05 ± 2.75	16.75 ± 0.35	18.40 ± 0.40	13.85 ± 3.35
Ovary Weight (g)	1.87 ± 0.23^{a}	2.66 ± 0.20^{a}	3.59 ± 0.36^{b}	3.99 ± 0.00^{b}	2.64 ± 0.12^{a}
Follicle Number	33.00 ± 3.00	33.00 ± 6.00	29.50 ± 7.50	46.00 ± 3.00	49.50 ± 9.50
Relative ovary weight (%)	1.143 ± 0.13^{a}	1.50 ± 0.17^{a}	1.98 ± 0.55^{ab}	2.77 ± 0.33^{b}	1.68 ± 0.02^{ab}
LH (mIU/ml)	4.65 ± 0.05^{c}	4.10 ± 0.10^{b}	3.75 ± 0.05^{a}	5.00 ± 0.00^{d}	5.40 ± 0.10^{e}
FSH (mIU/ml)	2.15 ± 0.05^{a}	2.10 ± 0.10^{a}	1.85 ± 0.05^{a}	2.75 ± 0.25^{b}	3.10 ± 0.10^{b}

^{a,b,c} means within a row with difference superscripts are significantly different ($p < 0.05$). LH ñ Luteinizing hormone; FSH ñ Follicle-stimulating hormone. T1 - 0% ELM; T2 - 2% ELM; T3 - 4% ELM; T4 - 6% ELM; T5 - 8% ELM.

Discussion

The results showed that the administration of ELM did not have significant effect on age at first lay, weight of first egg, total number of eggs laid till day 49 and hen day production. It is well established that nutrition has a significant impact on reproductive processes in the majority of domestic animals (Attia 2018; Akintunde et al., 2020). From an economic perspective, sexual maturity age is a very important characteristic. The initial oviposition age is important since it affects the production in the first year, and the earlier a pullet begins to lay eggs, the sooner money is made. The outcomes concurred with Bolukbasi et al. (2009), who found no increase in laying hen performance with supplementation of black cumin seed oil (1, 2 or 3 ml/kg diet). In a study similar to this one, Cabuk et al. (2006) found that the essential oil mixture made of fennel seed oil and oregano oil did not significantly affect feed intake, egg production, or egg mass. Additionally, laying rate and weight of settable eggs did not change in response to an essential oil mixture supplementation at 24, 36, or 48 mg/kg that included essential oil from oregano, laurel, sage, myrtle, fennel, and citrus (Bozkurt et al., 2009). Similar to this, when diets were supplemented with 200 mg/kg of thyme, sage, or rosemary over a period of 12 weeks, Bolukbasi et al. (2008) reported no effect on laying rate but an increase in egg weight. Additionally, dietary garlic and thyme in laying hens did not affect egg production, egg mass, or FCR, according to Ghasemi et al. (2010). This outcome is consistent with prior findings published by Chowdhury et al. (2012), who found that the addition of 10% garlic paste had no appreciable positive impact on egg production rate. The outcomes concurred with the findings of Akintunde and Toye (2022), who found no discernible difference between Isa Brown chickens and Yoruba Ecotype Nigerian Local Chickens in response to the addition of *Moringa oleifera* seed meal.

The morphological characteristics of quail eggs have a significant impact on embryo growth and hatchability. These factors may be able to provide the nutrition, physical safety, and subsequent smooth hatching process that fast-growing quail embryos require to develop into viable chicks (Bai et al., 2016).

The phrase çegg qualityé refers generally to a number of standards that describe both internal and exterior quality. In contrast to internal quality, which refers to egg white (albumen) clarity and viscosity, air cell size, yolk shape, and yolk membrane strength, external egg quality is concerned with the cleanliness, texture, and shape of the eggshell. These characteristics are frequently used to assess egg quality from a number of perspectives, including egg nutritional content, egg integrity for commercialization, storage and incubation, as well as preservation during storage, in addition to their functional significance. The egg's main organic components are the albumen and yolk, which provide 16 and 11% of the protein and 32 and 1% of the fat, respectively (Willems et al., 2014).

Egg weight in the current experiment was not affected by the various treatments. The results of Bozkurt et al. (2012) and Manafi et al. (2016) are in agreement with these findings. In contrast, Bolükbasi et al. (2008) observed that adding essential oils boosted the egg weight of layer chickens. The findings of this study were also consistent with Manafi et al. (2018)'s observation that dietary treatments had no effect on egg shell thickness. However, in contrast to their findings regarding egg shell weight, which was increased by the addition of phytogenic feed additives (PFA), and albumen and Haugh unit scores, which were significantly decreased by the addition of PFA, the present study found that the addition of ELM had no significant impact on these parameters. According to a study, adding essential oils to the daily diet of laying quails did not significantly affect their Haugh unit scores, shell thickness, eggshell weight, yolk color, yolk weight, or albumen and yolk indices (Bozkurt et al., 2012). The results of Kaya et al. (2013), who reported that plant extract of Origanum vulgare, Thymus vulgaris, thyme oil, origanum oil, garlic oil, anise oil, and fennel oil boosted eggshell strength and eggshell thickness. However, Bozkurt et al. (2012) found that supplementing with essential oils had no impact on laying hens' eggshell strength and thickness. Due to the high energy value of ELM present in molasses and chicken egg shells, there may have been a considerable impact on egg shell weight, shell percentage, and albumen percent. In contrast to Ding et al. (2017), who found that adding the commercial supplement enviva essential oil significantly increased the thickness of the eggshell but had no effect on the shell's resistance when compared to the control group. Considering the fact that ELM was employed in the current study, the contrasting results could be due to variations in the test ingredients. This study also contradicted Nasiroleslami and Torki (2010), who claimed that adding a herbal supplement to the diet of laying birds increased egg weight, shell weight, and shell thickness. The discrepancy could be due to various test substances.

The ovary was significantly affected by the administration of ELM. The ovary weights in this study were between 1.87 and 3.99 g, which was greater than the 0.381 g reported by Akinloye et al. (2014) but lower than the 5.02 g reported by Kashmiri and Oreta (2011) for Japanese quails. The production of sex hormones and the growth of germ cells are the two primary purposes of the ovary in birds (Berg 2000). Leutenizing hormone and follicle stimulating hormone concentrations were significantly higher in the birds administered 6% of

ELM; this result may have been impacted by ovary weight because it was also true for the birds with the smallest ovary weights. Additionally, the number of follicles was largest in birds with substantial highest ovary weights and highest levels of LH and FSH. Thus, it is inferred that the administration of ELM may have a considerable impact on female Japanese quails' capacity for reproduction.

Similar to other bird species, the egg is fertilized in the oviduct by sperm that have been squeezed out by the passage of an egg after being stored in the lower end of the tract. Then, as the next egg approaches, they swim up the tract to meet it. The egg is propelled along by movements of the body and muscular oviduct contractions (Ogwuegbu and Aire 1990; Aughey and Frye 2001). During ovulation, the first order ovocyte travels into the oviduct where it undergoes further maturation, fertilization, the creation of egg shells, and the early phases of embryonic development (Subedi et al., 2008). The oviduct weights of the birds given 30ml of ELM were much higher, and this suggests that giving ELM at this dosage could have effect on female Japanese quail's capacity to reproduce.

According to research by Johnston and Gous (2003), the addition of follicle stimulating hormone (FSH) raised oestrogen levels in laying hens, leading to an increase in the quantity of tiny follicles and the stimulation of their rapid development phase. The high oviduct weight of female Japanese quails in T4 may be correlated with elevated FSH levels. These findings support a study by Musa-Azara et al. (2014) that suggested that oestrogenic compounds from Moringa oleifera inhibited the release of leutinizing hormone and FSH, which in turn decreased levels of endogenous oestrogen and progesterone. The limited number of follicles and low weight of the ovary and oviduct in birds may be related to the lowering of these sexual hormone levels. According to this study, administering larger concentrations of ELM has a follicle-stimulating effect, increasing the number of follicles in the ovaries of birds and resulting in noticeably higher weights for the ovary and oviducts.

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 egg production parameters of Japanese quails however birds that received 6% ELM had the best reproductive parameters hence administration of 6% is recommended for optimum reproductive performance of Japanese quails.

Competing interest

There is no conflict of interests of any sort between authors or elsewhere.

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