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Growth Pattern and Cardiovascular Response of Japanese Quails to the Administration of *Parquetina nigrescens* Leaf Extracts

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ABSTRACT

Japanese quails are hardy with huge potentials to bridge protein deficiency and, *Parquetina nigrescens* is a medicinal plant with diverse pharmacological properties but there is dearth of information on its utilization. The study was conducted to determine the responses of Japanese quails to administration of *Parquetina nigrescens* leaf extracts (PNLE). Two hundred day old Japanese quails were assigned to five treatments with forty birds in four replicates in a Completely Randomized Design. The control (T1) had no administration of PNLE, T2, T3, T4, and T5 had an inclusion of 0.2, 0.4, 0.6, and 0.8ml per bird in 500ml of water respectively. The extract was obtained by harvesting and blending the leaves, using 50g of leaves in 1000ml of water. Data were collected on growth, cardiovascular response and organ morphometrics. Data were subjected to one-way Analysis of Variance using SAS (2010) package ($\rho<0.05$). For performance characteristics, birds administered PNLE showed no significant ($\rho>0.05$) difference with the exception of wing and thigh lengths ($p<0.05$). There was significant difference ($p<0.05$) in rectal temperature at the starter phase while significant difference ($p<0.05$) was observed in respiratory rate at the finisher phase. Administration of PNLE had no significant effect ($p>0.05$) on visceral organ morphometrics. Administration of 0.4ml had significantly highest ($p<0.05$) values for Packed Cell Volume (46.00 ±0.00%) and haemoglobin concentration (15.30 ±0.00) and significantly least values for lymphocytes (47.00 ±2.00). Significant differences ($p<0.05$) were observed for antioxidant parameters. The administration of PNLE had no detrimental effect on growth and cardiovascular response of the birds.

Keywords*:* Cardiovascular, Growth Pattern, Japanese Quails, *Parquetina nigrescens* leaf extract, Response.

Introduction

The Japanese quail was initially domesticated in Japan in 1595 after emerging from the wild. This bird stands out for its quick growth and prolific egg production. It makes a superior laboratory bird and a cheap supply of protein (egg and meat) [1]. The Japanese quail (*Coturnix coturnix japonica*) represents a huge genetic resource that has not yet been fully utilized. The Japanese quail may still be the best source of high-quality, low-cost protein (meat and eggs) and an ideal research bird for improvement due to its rapid growth, early sexual maturity, short generation interval, high rate of egg production, short incubation period, and high resistance to many poultry diseases. [2, 3] *Parquetina nigrescens* is from the family *Apocynaceae*. The English name is African Parquetina, it is known by different names here in Nigeria. In the Yoruba language it is called "Ewe ogbo". The leaves have been used to treat helminthiasis (intestinal worm) in Nigeria, while the roots are used to treat rheumatism.[4]

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Parquetina nigrescens leaf extract has been shown to have analgesic, anti-inflammatory, and antipyretic properties.[5] *Parquetina nigrescens* leaf extract has been shown to ameliorate hemorrhagic anemia.[6] According to studies [7, 8, 9, 10, 11], the plants have hematinic, antidiabetic, cardiotonic, anti-ulcerative, and antioxidant characteristics. Some nutrients are abundant in the leaf extract of Parquetina nigrescens. They may function as preventative measures and treatments for a variety of illnesses, including cardiovascular conditions, anemia, and immune system boosters.[12] *Parquetina nigrescens* leaf extract was evaluated and found to contain high levels of alkaloids (8.27 mg/100g), flavonoids (2.25 mg/100g), glycosides (0.06 mg/100g), saponin (5.20 mg/100g), steroids (0.20 mg/100g), phenols (0.86 mg/100g), terpenoids (0.52 mg/100g), tannin (6.30 mg/100g) and anthraquinones (1.55 mg/100g). [12] However, there is dearth of information as it relates to the cardiovascular system of Japanese quails in response to administration of plant extracts. Cardiovascular response is of utmost importance as there should be much concern on the health status of the birds even while focusing on the rapid growth response and improvement of Japanese quails. The study is therefore aimed to evaluate the growth pattern and cardiovascular response of Japanese quail to the administration of *Parquetina nigrescens* leaf extract.

Materials and Methods

Fresh *Parquetina nigrescens* leaves were obtained from Ibadan, Oyo State, Nigeria, and identified by an agronomist at Babcock University, Ilishan-Remo, Ogun State, Nigeria. 1000 ml of water and 50 g of the freshly collected leaves were mashed together in a blender. Using common filter papers (Whatman paper No. 1), the combined samples

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were thoroughly filtered. Following that, the filtrates were divided up into treatment groups and given to each bird via drinking water. The study was conducted at the poultry unit of Babcock University farmhouse, Ilishan-Remo, Ogun State, Nigeria. Ilishan Remo is in the rain forest zone of Nigeria with an annual rainfall of about 1500mm, a mean temperature of 27˚Celsius. Isonitrogenous and isocaloric combinations were formulated for all the birds in the treatments. T_1 which is the control were not administered with *Parquetina nigrescens* in drinking water, T2, T_3, T_4, T_5 had 0.2, 0.4, 0.6 and 0.8 mil of *Parquetina nigrescens* extract in 500 ml of drinking water per bird respectively administered all through the starter (1- 21 days) and finisher phases (22 - 42 days). Table 1 showed the gross composition of experimental diet.

Experimental Birds, Management and Design

A total of 200 day old Japanese quails were purchased from a commercial quail farmer in Ibadan, Nigeria. Prior to the arrival of the quails, the pens were washed, disinfected alongside with the drinkers, feeders and other equipment and left to air-dry for two weeks. The bird's initial weights were taken before they were randomly assigned to one of five treatments (T1, T2, T3, T4 and T5) with four (4) replicates of 10 birds each in a completely randomized design. 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 experimental period.

Data collection

Feed intake and water intake were calculated weekly. Feed intake was done by subtracting the amount of feed left in the feeder from the initial amount of feed given in the previous day as feed intake for the day while water intake was calculated by subtracting the volume of water left in the drinker from the volume of water offered.

Feed intake (g) = Feed offered (g) – Feed leftover (g)

Water intake= Volume of water given (ml) – Volume of water left (ml)

The weights of all the birds in each replicate were taken. This was done on the day of arrival and was subsequently done weekly until the end of the experiment.

Feed Conversion Ratio - This was calculated by dividing the total feed intake by the total body weight gained.

$$\text{Feed Conversion Ratio (FCR)} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

According to the descriptions provided by [13, 14, 15], the morphometrics/linear body measurements (shank length (SL), thigh length (TL), body girth (BG), wing length (WL), and body length (BL)) were determined.

Body Length (BL): This measurement was made from the nostril to the pygostyle in centimeters (cm). The bird has a tape stretched across its back, stretched neck, and nasal aperture to the tip of its pygostyle.

Body Girth (BG): The distance covered when a tape is looped around the breast area was measured in centimeters (cm). The tape was carefully placed such that it went under the wing rather than over it.

Shank Length (SL): This measurement, in centimeters (cm), represents the separation between the foot pad and the hock joint.

Thigh Length (TL): The measurement was made between the ball joint and the tarsal tip with the aid of a tape measure, this was measured in centimeters (cm).

Wing Length (WL): This was calculated using a tape measure and measured in centimeters (cm) as the distance from the humerus-coracoid junction to the distal point of the phalange digits.

Cardiovascular Response

Body Mass Index was calculated by dividing body weight, stated in grams, by the square of body length, expressed in centimeters.[16]

Respiratory Rate was determined by counting the birds' panting breaths for 30 seconds, and the result then multiplied by two. [17]

Respiratory rate = Number of panting breaths (X) for 30 seconds X 2

Oxygen Concentration - The amount of oxygen carried by hemoglobin in the blood was measured using a pulse oximeter. This is known as the oxygen saturation and is represented as a percentage.

Rectal Temperature – This was measured using a digital rectal thermometer that was inserted into the cloaca and held there for one minute to a depth of between one and two centimeters before the reading was taken. 2.0 ml of blood was drawn on the 42nd day of the experiment from the brachial vein of three birds per replicate into sterile universal vials that were labeled and included EDTA as an anticoagulant. Haematological parameters (Red blood cells counts, white blood cells' counts, platelet, mean corpuscular volume, mean corpuscular haemoglobin concentration, mean corpuscular haemoglobin, basophil, neutrophil, eosinophil, haemoglobin concentration, packed cell volume, monocytes, lymphocytes, and heterophils were determined. [18]

Antioxidants Parameters

The 42-day-old birds were chosen at random, and blood samples were taken in heparinized tubes from the veins in their wings. Using commercial enzymatic kits (Biosis LTD, Athens, Greece), blood plasma cholesterol, protein, and triglycerides were measured. Enzymatic method was used to estimate cholesterol concentration of samples. [19]The plasma protein levels were also determined. [20]. Triglycerides were determined according to the enzymatic colorimetric method. [21] The oxygen radical absorbance (ORAC) assay was used to measure the blood plasma's total antioxidant capacity (TAC) and assess the hydrophilic antioxidants. It was also possible to measure superoxide dismutase, catalase, malondialdehyde, glutathione peroxidase, and creatinine.

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

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
Total	100.00	100.00

Total antioxidant capacity was determined using a Fenton-type reaction method and appropriate formula as described by [22, 23, 24]. Peroxidative activity method was used to determine the Catalase with appropriate

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formula [25] and time duration was modified to 0 and 5minutes reading. [26] Superoxide dismutase activity was determined using an inhibition method and appropriate formula as described [27] and modified [28] while the time duration was modified to 0 and 3 minutes reading. [26] Glutathione Peroxidase activity was estimated with appropriate formula. [29] The levels of malondialdehyde (MDA) as indices of lipid peroxidation were measured in a thiobarbituric acid reactive substance (TBARS) [30] while creatinine was determined by Folin-Wu filtrate methods.[31]

Visceral Organ Evaluation
From each treatment, eight birds were chosen at random for visceral organ examination. After starving the chosen birds for an entire night, their live weights were noted. To avoid organ denaturation, the birds' feathers were removed with cold water, and their weights after being plucked were recorded. The weights of the birds were then recorded after they were eviscerated. Heart, spleen, and liver were measured.

Statistical Analysis
Data collected were subjected to analysis of variance (ANOVA) according to standard procedure. [32] Significant differences between the treatments' means were separated using Duncan multiple range test. [33]

Results and Discussion

Table 2 showed the performance characteristics of Japanese quails after administration of *Parquetina nigrescens* leaf extracts at the starter phase. The study showed that the administration of *Parquetina nigrescens* leaf extract in drinking water did not significantly influence (p>0.05) all the performance parameters (final body weight, total feed intake, weight gain and feed conversion ratio) at the end of the starter phase while maintaining non-significance (p>0.05) for temperature and relative humidity in all times of the day. The process of digesting and absorbing nutrients is crucial for enhancing growth. The results showed that the administration of the extracts of *Parquetina nigrescens* did not significant influence performance parameters of Japanese quails at starter phase. The findings of this investigation were consistent with the previous observations that reported that there was no significant difference in body weight, feed intake and weight gain at the starter phase in Japanese quails to the administration of aqueous egg-lime-molasses mixture. [17] The results obtained from this study was however in contrast with the observations which studied the effects of mulberry leaves on growth performance, carcass characteristics, and meat quality of Japanese quail.[34] They reported that the inclusion of the leaves significantly influenced all the growth parameters (body weight gain, feed intake and feed conversion ratio) at the starter phase. The variation might be due to the differences in the test ingredients. The results were also in contrast with the findings [35] which studied the performance and immunological response of broiler chickens to *Parquetina nigrescens* leaf extracts and reported that the administration of *Parquetina nigrescens* significantly influence body weight, weight gain and feed conversion ratio at the end of the starter phase.

Table 3 showed the performance characteristics of Japanese quails to administration of *Parquetina nigrescens* leaf extracts at finisher phase. The results showed that the administration of *Parquetina nigrescens* did not significantly influence (p>0.05) body weight, water intake, feed intake, weight gain and feed conversion ratio at the finisher phase despite the fact that the environmental temperature and humidity were similar (p>0.05) The findings of this study corroborated the observations[17] which noted that the administration of an aqueous egg-lime-molasses mixture to Japanese quails during the finisher phase did not significantly affect body weight, feed intake, or feed conversion ratio. The results obtained from this study were in contrast with the study[36] which conducted a study on turmeric (*Curcuma longa Linn.*) as a phytogenic growth promoter alternative for antibiotic and comparable to mannan oligosaccharides for broiler chicks. They observed that the group of chickens fed with a diet containing turmeric had the better body weight gain and feed intake compared to the control group. Similarly, a study [37, 38] which investigated the effect of dietary supplementation with *Moringa oleifera* leaf meal on the growth performance and haematology of broiler chickens. The authors found that the group of chickens fed with a diet containing *Moringa oleifera* leaf meal had significantly lower body weight gain, feed intake, and feed conversion ratio compared to the control group.

Table 2: Performance Characteristics of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Starter Phase

	T1	**T2**	**T3**	**T4**	**T5**
Initial Weight (g)	7.00 ± 0.00	7.20 ± 0.00	7.10 ± 0.02	7.00 ± 0.00	7.15 ± 0.00
BW (g)	74.13 ± 3.35	83.13 ± 4.77	75.63 ± 3.30	81.75 ± 3.29	73.88 ± 2.50
TFI/Bird-Starter (g)	195.95 ± 11.69	166.35 ± 5.88	190.33 ± 13.41	175.70 ± 7.00	191.20 ± 11.82
TWI/Bird-Starter (ml)	542.13 ± 23.51	579.98 ± 118.86	549.70 ± 32.68	500.45 ± 5.98	522.28 ± 12.36
Weight Gain-Starter (g)	67.13 ± 3.35	75.93 ± 4.77	68.53 ± 3.31	74.75 ± 3.29	66.73 ± 2.50
FCR -Starter	3.10 ± 0.39	2.45 ± 0.27	3.05 ± 0.05	2.51 ± 0.34	2.77 ± 0.22
Temp- Morning (ºC)	27.77 ± 0.12	27.61 ± 0.14	27.67 ± 0.11	28.13 ± 0.10	27.61 ± 0.11
Temp- Afternoon (ºC)	32.91 ± 0.07	33.24 ± 0.09	32.76 ± 0.19	32.15 ± 0.08	32.42 ± 0.09
Temp-Evening (ºC)	32.30 ± 0.06	32.20 ± 0.04	31.93 ± 0.09	31.97 ± 0.03	32.02 ± 0.03
RH-Morning (%)	51.09 ± 0.29	49.18 ± 0.20	50.15 ± 0.43	49.85 ± 0.15	49.79 ± 0.12
RH-Afternoon (%)	28.48 ± 0.04	27.69 ± 0.04	28.49 ± 0.21	28.37 ± 0.00	28.40 ± 0.00
RH-Evening (%)	31.83 ± 0.04	31.03 ± 0.05	31.82 ± 0.17	31.88 ± 0.08	31.83 ± 0.04

Note: ^{a,b}; Means with different superscripts along the same row are significantly (P<0.05), Body weight (BW), Total Feed Intake (TFI), Total Water Intake (TWI), Feed Conversion Ratio (FCR), Temperature (Temp.), Relative Humidity (RH)

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Table 3: Performance Characteristics of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Finisher Phase

	T1	T2	T3	T4	T5
Initial Weight (g)	74.13 ± 3.35	83.13 ± 4.77	75.63 ± 3.30	81.75 ± 3.29	73.88 ± 2.50
BW (g)	132.00 ± 4.90	149.25 ± 4.62	148.38 ± 4.03	153.25 ± 3.72	142.00 ± 13.34
TFI/Bird – Finisher (g)	373.13 ± 49.31	313.35 ± 14.49	394.23 ± 51.61	304.00 ± 7.52	374.83 ± 53.47
TWI-Finisher (ml)	1391.55 ± 56.24	1311.00 ± 27.44	1453.23 ± 112.42	1303.85 ± 66.36	1387.60 ± 68.92
Weight Gain –Finisher (g)	57.88 ± 4.72	66.13 ± 7.43	72.75 ± 5.49	71.50 ± 5.49	68.13 ± 13.64
FCR-Finisher	7.62 ± 0.94	4.22 ± 0.21	5.90 ± 1.18	3.99 ± 0.40	9.02 ± 3.11
Temp - Morning (ºC)	24.22 ± 0.12	24.20 ± 0.13	24.19 ± 0.13	24.20 ± 0.11	24.17 ± 0.13
Temp- Afternoon (ºC)	33.23 ± 0.43	33.36 ± 0.39	33.48 ± 0.32	33.27 ± 0.43	33.21 ± 0.32
Temp-Evening (ºC)	31.03 ± 0.23	30.91 ± 0.19	30.86 ± 0.20	30.74 ± 0.19	30.62 ± 0.25
RH-Morning (%)	54.01 ± 0.66	54.15 ± 0.37	54.34 ± 0.43	54.43 ± 0.30	54.23 ± 0.24
RH-Afternoon (%)	37.10 ± 0.34	37.48 ± 0.07	37.45 ± 0.13	37.56 ± 0.07	37.35 ± 0.12
RH-Evening (%)	44.03 ± 0.81	44.91 ± 0.62	45.39 ± 0.69	45.46 ± 0.68	45.29 ± 0.58

Note: [a,b]; Means with different superscripts along the same row are significantly (P<0.05), Body weight (BW), Total Feed Intake (TFI), Total Water Intake (TWI), Feed Conversion Ratio (FCR), Temperature (Temp.), Relative Humidity (RH)

Table 4 present the morphometric measurements of Japanese quails that were administered with *Parquetina nigrescens* Leaf Extracts (PNLE) at the starter phase. The results revealed that the administration of the extracts of *Parquetina nigrescens* significantly influenced (p<0.05) shank length and wing length while no significant difference was observed in thigh length, body girth, body length and body weight at the starter phase. The results showed that the birds administered with the highest dose of *Parquetina nigrescens* leaf extract (0.80 ml per 500 ml of drinking water) had the significantly least (p<0.05) values (2.125 cm) for shank length while the other treatments compared well with the control. However, birds administered with 0.6 ml per 500 ml of drinking water had significantly highest (p<0.05) values (8.625 cm) for wing length while the significantly least (p<0.05) values (7.938 cm) were observed among the birds that did not receive PNLE.

Both chicken breeders and meat processors consider parameters related to growth, such as body weight and body measurements as of utmost importance. [39, 40, 41] Numerous farm animals' economic features can be determined in part by body weight. It is a crucial characteristic because it serves as the foundation for evaluating the growth and feed efficiency of farm animals as well as for economic and market decisions. [41, 42]
The administration of PNLE at the starter phase significantly influenced (p<0.05) only shank length and wing length. The results from this study however agreed with the reports [43] that diets influenced the levels of association between body weights and morphometric measurements. The results obtained in the present study agreed with the findings[40] that the shank length of Yoruba Ecotype Nigerian Local Chickens at the end of the end of 4 weeks was significantly minimal at higher levels of inclusion of *Moringa oleifera* seed meal but contrary observation was recorded for wing length and this could be as a result of variations in the test ingredients and species of animals used. Also, according to reports [44, 45, 46] shank length is positively correlated with chick weight and length and significantly influences how well they grow. [47] added that there are a number of traits, including day-old chick weight, hatchling length, and shank length that are frequently used for early growth prediction in broilers. These findings further clarified why other morphometric characteristics were not significant, as shank length is a marker of increasing bird height and wing length may indicate the flightiness of Japanese quails. These findings further demonstrate that treatment of PNLE may increase vigor and strength that may be required for natural mating and flightiness of Japanese quails. Table 5 showed that the administration of PNLE did not have significant effect (p>0.05) on all the body morphometric parameters of Japanese quails at the finisher phase.
Body parameters such as body weight and morphometric features, which are significant criteria for chicken breeders and meat processors, can be used to measure body growth in animals. Animal body sizes and shapes can be compared using the knowledge of the variance in morphometric features.[48] According to reports [45, 46, 49] chick weight and morphometric features like chick length and shank length have a significant impact on broiler growth performances since these parameters strongly affect slaughter yield at market age. The results of this study were in contrast to those of the report[40], which found that at the end of week 8 of the study, Yoruba Ecotype Nigerian Local Chickens and Marshall broiler chickens fed graded levels of *Moringa oleifera* seed meal had significant differences in their body morphometrics. The results also ran counter to reports[17], which noted notable variations among Japanese quails given different dosages of an egg-lime-molasses mixture during the finishers' phase. The changes seen can be brought on by the variables in the test ingredients.

Table 6 present the effect of the administration of PNLE to Japanese quails on rectal temperature and body mass index at the starter phase There was significant difference (p<0.05) in rectal temperature while the administration had no significant effect (p>0.05) on body mass index. The birds administered 0.2 ml had the least significant (p<0.05) value (34.10±1.37ºC) for rectal temperature while the significant highest (p<0.05) values (37.61±0.62ºC) were observed among birds administered with 0.4 ml of PNLE while the values then increased significantly (p<0.05) across the group from 0.6 ml to 0.8 ml of PNLE. The results obtained in this study was in agreement with the findings[19] which observed significance to administration of egg-lime-molasses mixture in rectal temperature at the starter phase but the rectal temperature had an average of 38.48ºC while the rectal temperature in the present study was from the range of 34.10±1.37ºC to 37.61±0.62ºC. Also, the values obtained for rectal temperature was lower than the values of 41.07 – 41.64ºC and 41.00 – 43.60ºC for quails reported by [50, 51] respectively.

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Table 4: Morphometrics of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Starter Phase

	T1	T2	T3	T4	T5
SL (cm)	2.34 ± 0.11^{b}	2.40 ± 0.11^{b}	2.24 ± 0.07^{ab}	2.45 ± 0.08^{b}	2.13 ± 0.05^{a}
TL (cm)	6.30 ± 0.31	6.78 ± 0.29	6.71 ± 0.25	6.33 ± 0.27	6.31 ± 0.41
BG (cm)	13.73 ± 0.39	14.31 ± 0.19	14.00 ± 0.15	14.53 ± 0.27	14.13 ± 0.20
WL (cm)	7.94 ± 0.27^{a}	8.39 ± 0.14^{ab}	8.46 ± 0.13^{ab}	8.63 ± 0.27^{b}	8.39 ± 0.20^{ab}
BL (cm)	17.23 ± 0.45	17.95 ± 0.44	17.63 ± 0.35	17.36 ± 0.66	17.34 ± 0.25
BW (g)	74.13 ± 3.35	83.13 ± 4.77	75.63 ± 3.30	81.75 ± 3.29	73.88 ± 2.50

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05), Body weight (BW), Body length (BL), Body girth (BG), Shank length (SL), Thigh Length (TL), Wing length (WL), Keel length (KL).

Table 5: Morphometrics of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Finisher Phase

	T1	**T2**	**T3**	**T4**	**T5**
SL (cm)	3.36 ± 0.14	3.31 ± 0.10	3.39 ± 0.10	3.16 ± 0.09	3.13 ± 0.05
TL (cm)	6.84 ± 0.31	7.03 ± 0.29	7.08± 0.29	7.06 ± 0.20	7.16 ± 0.27
BG (cm)	18.11 ± 0.50	19.00 ± 0.27	18.99 ± 0.32	18.75 ± 0.39	18.56 ± 0.46
WL (cm)	8.24 ± 0.23	8.28 ± 0.31	8.29 ± 0.17	8.25 ± 0.36	7.85 ± 0.22
BL (cm)	22.11 ± 1.05	21.81 ± 0.44	21.65 ± 0.50	22.43 ± 0.46	21.46 ± 0.47
BW (g)	132.00 ± 4.90	149.25 ± 4.62	148.38 ± 4.03	153.25 ± 3.72	142.00 ± 13.34

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05), Body weight (BW), Body length (BL), Body girth (BG), Shank length (SL), Thigh Length (TL), Wing length (WL), Keel length (KL).

Table 6: Rectal Temperature and Body Mass Index of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Starter Phase

	T1	**T2**	**T3**	**T4**	**T5**
RT (°C)	35.68 ± 1.08^{ab}	34.10 ± 1.37^{a}	37.61 ± 0.62^{b}	35.94 ± 1.23^{ab}	36.78 ± 0.79^{ab}
BMI (g/cm^2)	0.25 ± 0.01	0.26 ± 0.01	0.24 ± 0.00	0.28 ± 0.03	0.25 ± 0.01

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05), Rectal Temperature (RT), Body Mass Index (BMI)

The variations could be as a result of variation in the geographical locations where the study were carried out while the test ingredient in the present study was different from the ELM used by [17]. There are substantial associations between BMI values in infancy and in adulthood, and larger BMI values are linked to higher morbidity and death in adulthood.[52] This may imply that birds with high BMIs in week one may have steeper slopes as a result of quicker growth, or that birds with smaller hatchlings may mature more quickly. In livestock, there is a positive relationship between birth weight and subsequent weights [53, 54, 55]; likewise, [56] found a positive relationship between hatchling weight and chick growth.

BMI values in the first week may be a good predictor of the carcass quality and subsequent growth. [57]. The non-significance of BMI at the starter phase in this study was in contrast with the observations of [16] that the inclusion of *Moringa oleifera* seed meal significantly affected BMI at starter phase in Yoruba Ecotype Nigeria Local Chickens and Marshall broilers, [58] with the inclusion of cabbage for broiler and pullets chickens and [59] to inclusion of *Moringa oleifera* leaf for pullets. Also, in contrast with the findings of [17] who administered aqueous extracts of egg-lime-molasses mixture.

The presented data in Table 7 showed the effect of administering *Parquetina nigrescens* leaf extracts on cardiovascular vital tests. The administration of PNLE did not have significant effect (p>0.05) on oxygen concentration, pulse rate, pulse index, rectal temperature and body mass index while significant difference (p<0.05) was observed in respiratory rates. Birds administered 0.4 ml and 0.4ml of PNLE had significantly least (p<0.05) values for respiratory rates. The values obtained were within the normal ranges of 48 to 60 breaths per minutes reported for Avian and Cobbs strains of broiler chickens under comfort condition as reported by [60, 61] reported that the range of 12-37 breaths per minute and [62] stated that 15-30 breaths per minute are appropriate for chickens. The higher values obtained in this study might be due to the flightiness of Japanese quails when compared to chickens especially broiler chickens. The results were in line with the observation of [63], who showed that broilers' average respiration rates ranged from 51.73 to 58.67 times per minute. When stress is present, respiratory symptoms are also seen. This has an effect on bodily functions, weight loss, and mortality rates. Fruits with a high antioxidant content can, nevertheless, lessen stress. *Parquetina nigrescens* leaf extract is a good source of antioxidants and is high in polyphenols, according to research by [12]. They also noted that PNLE has high levels of phenols, alkaloids, terpenoids, flavonoids, thiamine, niacin, and vitamins C, E, and A. This may account for the respiration rate still falling within the normal range however, birds administered 0.4 to 0.8ml PNLE were the best in terms of the respiratory rate and this further substantiated the antioxidant potentials of PNLE in Japanese quails.

There was no significant difference in rectal temperature however the values were close to the average rectal temperature of 40.27 to 40.68 ℃ reported for broilers by [63, 64] also stated that chickens' normal rectal temperatures range from 40.5 to 41.5 C. Rectal temperature is a measurement where any variation shows that heat exchanges on the body's surface are insufficient to maintain thermal equilibrium. There are numerous references in the literature about the appropriate temperatures for broiler chickens, ranging from 41 to 42 °C for a comfortable condition [65] to temperatures as high as 46 °C for thermal stress conditions at 42 days of life [66]; in this case, the broilers died. This is an indication that the birds were raised in their comfort zone coupled with the antioxidant potentials of PNLE. Fast-growing broiler chickens that are prone to ascites consistently exhibit a substantial drop in heart rate (HR) [67]. According to research by [68, 69, 70], the heart rate (HR) of normal chickens' increases early after hatching, reaches a plateau at 4 weeks of age, and then gradually decreases until maturity.

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Table 7: Cardiovascular Vital Tests of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Finisher Phase

	T1	T2	T3	T4	T5
RR (breaths per minute)	42.50 ± 3.97^{ab}	55.13 ± 4.75^{b}	37.00 ± 4.52^{a}	38.88 ± 5.52^{a}	49.63 ± 5.05^{ab}
Oxygen Concentration (%)	56.63 ± 8.77	64.63 ± 7.48	58.63 ± 5.44	54.00 ± 4.12	58.75 ± 5.23
Pulse Rate	84.88 ± 8.03	81.75 ± 8.31	82.25 ± 8.53	83.88 ± 6.75	78.38 ± 10.49
Rectal Temperature (°C)	38.98 ± 0.97	39.69 ± 0.51	38.93 ± 0.39	39.05 ± 0.28	38.55 ± 0.78
Pulse Index	2.60 ± 0.70	1.86 ± 1.00	0.74 ± 0.22	3.06 ± 1.21	0.99 ± 0.21
Body Mass Index (g/cm^2)	0.28 ± 0.02	0.32 ± 0.02	0.32 ± 0.01	0.31 ± 0.02	0.31 ± 0.03

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05)

Adequacy of systemic oxygenation becomes a significant problem in animals who are unable to adjust HR during growth since the rise in HR is a crucial part of the physiological adjustment of cardiac output (CO) during the vigorous growth phase in normal young chickens. The relationship between oxygen demand and oxygen supply is ultimately what determines the sufficiency of systemic oxygenation. In this context, a decreasing heart rate (HR) during the rapid growth period of broilers may cause a reduction in cardiac output (CO), insufficiency in systemic blood flow, and insufficient oxygenation. The normal significance of pulse rate, pulse index, oxygen concentration and body mass index in the present study substantiate that the Japanese quails were not fast growing and prone to cardiac arrest as the values observed with birds administered PNLE were similar to the control.

The study examined the effects of *Parquetina nigrescens* leaf extracts on various parameters in male Japanese quails. The focus of this study was on viscerals, which are the internal organs of the birds. The results showed that the administration of the leaf extracts had no significant effect (p>0.05) on absolute and relative weights of liver, spleen and heart (Tables 8 and 9). The relative weights of the animals' internal organs may deviate from the normal range in response to dietary toxins [15, 16, 71]. In this study, the PNLE did not affect (p > 0.05) the relative internal organs' weights of Japanese quails. The stability of the relative organ weights in this trial indicates that the administration of PNLE supports the healthy development of the internal organs (liver, heart and spleen) relative weight of the birds. This result/observation suggests that dietary treatment did not pose a harmful threat to the chickens' relative lung weights.

Table 8: Viscerals of Male Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts

	T1	T2	T3	T4	T5
Liver Weight (g)	3.00 ± 0.00	2.00 ± 0.00	2.00 ± 1.00	2.00 ± 0.00	2.00 ± 0.00
Relative Liver Weight (%)	2.21 ± 0.07	1.67 ± 0.00	1.57 ± 0.74	1.59 ± 0.00	1.95 ± 0.03
Spleen Weight (g)	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Heart Weight (g)	2.00 ± 0.00	1.50 ± 0.50	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Relative Heart Weight (%)	1.47 ± 0.04	1.25 ± 0.25	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05)

Table 9: Viscerals of Female Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts at Finisher Phase

	T1	T2	T3	T4	T5
Liver Weight (g)	3.00 ± 1.00	4.00 ± 1.00	3.50 ± 0.50	3.50 ± 0.50	4.50 ± 0.50
Relative Liver Weight (%)	2.06 ± 0.69	2.58 ± 0.77	2.41 ± 0.49	2.27 ± 0.38	3.30 ± 0.15
Heart Weight (g)	2.00 ± 0.00	1.50 ± 0.50	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
Relative Heart Weight (%)	1.47 ± 0.04	1.25 ± 0.25	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

Note: $^{a,b;}$ Means with different superscripts along the same row are significantly (P<0.05)

The effects of plant extracts and liquid minerals on broiler chicken growth performance, organ weight, and meat quality were investigated[72] and there was no significant difference in the absolute or relative organ weights of broiler chickens. The findings of the current investigation demonstrated that PNLE had no effect on the relative weights of the spleen, liver, or heart. The results from the present study were consistent with the reports of [73, 74, 75]. They came to the conclusion that essential oils and herbal powders had no effect on the relative weights of internal organs. Table 10 showed the haematological response of Japanese quails to the administration of *Parquetina nigrescens* leaf extracts. The results showed that the administration of PNLE had significant effect (p<0.05) on packed cell volume (PCV), red blood cells count (RBC), total white blood cells counts (TWBC), haemoglobin concentration (Hb) and lymphocytes but no significant difference (p:>0.05) was observed in platelets, heterophils, monocytes, basophils and eosinophils. Birds with administration of PNLE had significantly higher (p<0.05) values for PCV, RBC and Hb but birds in treatment 3 (0.4ml of PNLE) had significantly highest (p<0.05) for these parameters. However, birds administered 0.4ml of PNLE had significantly least (p<0.05) values for TWBC and lymphocytes.

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Table 10: Haematological Response of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts

Parameter	T1	T2	T3	T4	T5
PCV (%)	31.00 ± 1.16[a]	39.00 ± 6.00[ab]	46.00 ± 0.00[b]	36.50 ± 0.50[ab]	43.50 ± 0.50[ab]
RBC Count (X 10^6µ)	3.37 ± 0.38[a]	4.50 ± 0.61[ab]	4.30 ± 0.00[ab]	4.95 ± 0.05[b]	5.25 ± 0.05[b]
TWBC (mm^3)	48066.67 ± 1337.08[bc]	40800.00 ± 4200.00[ab]	34000.00 ± 4000.00[a]	51500.00 ± 500.00[c]	39050.00 ± 50.00[ab]
Platelet	236666.67±36552.85	185000.00±13228.76	175000.00±35000.00	231000.00±1000.00	187500.00± 2500.00
Hb (g/d)	10.30 ± 0.40[a]	13.00 ± 2.00[ab]	15.30 ± 0.00[b]	12.15 ± 0.15[ab]	14.25 ± 0.05[ab]
MCV (fl)	9.47 ± 1.24	8.79 ± 1.03	10.70 ± 0.00	7.38 ± 0.18	8.29 ± 0.17
MCH (µµ/g)	3.15 ± 0.42	2.93 ± 0.34	3.56 ± 0.00	2.46 ± 0.06	2.71 ± 0.02
MCHC (%)	0.33 ± 0.00	0.33 ± 0.00	0.33 ± 0.00	0.33 ± 0.00	0.33 ± 0.01
Heterophils (%)	42.00 ± 6.43	46.33 ± 3.67	50.50 ± 1.50	44.50 ± 0.50	49.50 ± 0.50
Lymphocytes (%)	42.33± 1.45[b]	41.00±0.00[ab]	37.00 ± 2.00[a]	43.50± 0.50[b]	40.50±0.50[ab]
Monocytes (%)	8.33 ± 1.20	9.00 ± 3.00	8.00 ± 1.00	5.50 ± 0.50	5.50 ± 0.50
Basophils (%)	2.67 ± 0.67	1.33 ± 1.33	1.50 ± 0.50	2.50 ± 0.50	2.50 ± 0.50
Eosinophils (%)	2.33 ± 0.88	2.00 ± 0.00	3.00 ± 0.00	2.50 ± 0.50	2.50 ± 0.50

a,b,c: Means within the same row with different superscript letters were significantly different (P<0.05), : PCV- Packed Cell Volume, Hb - Haemoglobin, RBC- Red Blood Cell, TWBC – Total White Blood Cell, MCV – Mean Corpuscular Volume, MCH – Mean Corpuscular Haemoglobin, MCHC – Mean Corpuscular Haemoglobin Concentration

Due to herbs' capacity to act as immune stimulants by promoting and modulating the production of blood cells and other haematological indices and immune responses to alleviate diseases [40, 76, 77], application of herbs has been observed to improve animal health and well-being. According to [40, 78], hematopoietic parameters are reliable measures of an animal's physiological state. Blood serves as a pathological indicator of the health of animals that have been exposed to toxins and other situations [79]. Animals with healthy blood composition are more likely to perform well. In the transport of oxygen and ingested nutrients, packed cell volume is important[80]. Anemia is avoided by increased packed cell capacity, which demonstrates improved transportation [81]. This outcome is in line with the claims that packed cell volume can quickly signal an increase in the quantity of red blood cells or a decrease in the volume of circulating plasma.[82] According to reports, toxic compounds in feed tend to decrease haemopoietic tissues, which results in less white blood cell production [83]. The findings of this study provide more support for [84] assertion that *Parquetina nigrescens* leaf extracts can lessen hemorrhagic anemia. Hematinic, anti-diabetic, cardiotonic, anti-ulcerative, and antioxidant effects of the plants have been demonstrated [85, 86, 87, 88]. However, the results of the current study were consistent with those of [89] who noted significant increases in RBC and WBC counts, as well as in Hb and PCV values. The findings of the current study concurred with those of [90], who found that adding phytobiotics like cinnamic aldehyde, thymol, and carvacrol to broiler chicken diets significantly increased erythrocyte counts and hemoglobin levels compared to controls. However, the outcome of the current investigation was in line with previous studies that found no evidence of a significant change in MCV, MCH, or MCHC in experimental broiler hens fed POLM *Moringa oleifera* leaf meal (MOLM) supplements. [89, 91] The findings of [92] who examined the hematological and biochemical parameters of *Parquetina nigrescens* root extract in albino rats, were also in agreement with the results. They found that MCH, MCV, MCHC, neutrophil and lymphocytes did not exhibit significant differences at any doses of administration. The increase in PCV, TWBC and Hb with subsequent reduction in TWBC when compared with the control showed that PNLE is not toxic and could help in blood production which would subsequently improve nutrients absorption.

Table 11 showed the results on the effect of *Parquetina nigrescens* leaf extracts on the antioxidant and biochemical parameters of Japanese quails. The results showed that the administration of PNLE significantly influenced (p<0.05) all the oxidative biomarkers (Total Antioxidant Counts, malodialdehyde concentration, catalase, superoxide dismutase, glutathione peroxidase) and some biochemical parameters (albumin and high density lipoprotein). The birds administered 0.4 ml of PNLE had significantly highest (p<0.05) values for TAC, catalase, SOD and albumin while MDA was significantly highest (p<0.05) in MDA. The process of oxidation affects lipids, pigments, proteins, DNA, carbohydrates, and vitamins in a very broad way [93], but when it occurs in excess, it can be highly damaging. The antioxidative impact is frequently assessed using a variety of markers. As indicators for radical-induced damage and endogenous lipid peroxidation (LPO), isolated malondialdehyde (MDA) levels and antioxidant enzymes are typically measured in blood samples [94, 95]. According to some research [95, 96, 97], the use of diets containing natural antioxidants rich in polyphenols and flavonoids, such as medicinal herb mix and fruit extract, may have lessened many of the detrimental effects of lipid oxidation and oxidative stress in poultry. Polyphenols have been demonstrated to possess the ability to function as potent antioxidants by scavenging free radicals and putting an end to oxidative reactions [98]. According to studies [99, 100], herbal plant polyphenols have been investigated as potential antioxidants. As a result of its high levels of polyphenols, flavonoids, and other antioxidant vitamins (vitamins A, C, and E), PNLE possesses antioxidant potentials, according to [12]. However, the findings of this study were consistent with those of [88] who investigated the antioxidant properties of *Parquetina nigrescens*.

Table 11: Biochemistry and Antioxidants of Japanese Quails to administration of *Parquetina nigrescens* Leaf Extracts

	T1	T2	T3	T4	T5
Total Antioxidants Counts (U/ml)	9.08 ± 0.03^{c}	10.01 ± 0.01^{d}	10.61 ± 0.01^{e}	7.77 ± 0.03^{a}	8.18 ± 0.18^{b}
Malondialdehyde (nmol/ml)	3.02 ± 0.02^{c}	2.52 ± 0.02^{b}	2.56 ± 0.01^{b}	2.91 ± 0.10^{c}	2.21 ± 0.01^{a}
Catalase (umol/L)	0.58 ± 0.02^{c}	0.48 ± 0.03^{b}	1.78 ± 0.01^{e}	1.01 ± 0.01^{d}	0.19 ± 0.01^{a}
Superoxide dismutase (U/mL)	0.45 ± 0.01^{b}	0.89 ± 0.02^{d}	1.91 ± 0.01^{e}	0.34 ± 0.01^{a}	0.79 ± 0.01^{c}
Glutathione peroxidase (umol/L)	2.05 ± 0.05^{a}	3.11 ± 0.11^{b}	3.40 ± 0.01^{c}	4.38 ± 0.03^{e}	3.96 ± 0.04^{d}
Cholesterol (mg/dl)	134.00 ± 12.70	137.33 ± 12.25	139.50 ± 0.50	159.00 ± 0.00	156.50 ± 0.50
Triglycerides (mg/dl)	119.33 ± 4.41	119.00 ± 6.03	123.00 ± 2.00	134.00 ± 0.00	125.50 ± 0.50
Low Density Lipoproteins (mg/dl)	44.33 ± 9.82	42.33 ± 15.72	45.00 ± 1.00	73.00 ± 0.00	69.50 ± 0.50
High Density Lipoproteins (mg/dl)	66.00 ± 2.52^{ab}	71.33 ± 3.28^{b}	70.00 ± 2.00^{b}	59.00 ± 0.00^{a}	62.50 ± 0.50^{ab}
Total protein (g/dl)	16.43 ± 0.77	16.30 ± 1.21	15.75 ± 2.25	19.05 ± 0.05	15.25 ± 0.05
Albumin (mg/dl)	3.33 ± 0.38^{ab}	4.07 ± 0.38^{ab}	4.65 ± 0.55^{b}	3.25 ± 0.05^{a}	4.05 ± 0.05^{ab}
Globulin (mg/dl)	13.10 ± 0.91	12.23 ± 1.07	11.10 ± 1.70	15.80 ± 0.00	11.20 ± 0.00
Creatinine (mg/dl)	4.40 ± 0.29^{b}	3.80 ± 0.12^{b}	4.15 ± 0.05^{b}	3.05 ± 0.05^{a}	3.00 ± 0.00^{a}

a,b,c: Means within the same row with different superscript letters were significantly different (P<0.05)

They found that the flavonoid extracts of the plant extract reduced liver damage, likely through the induction of catalase and superoxide dismutase while also utilizing reduced glutathione (GSH). These ultimately resulted in a decrease in lipid peroxidation in the *P. nigrescens*-treated mice, validating the antioxidant effects of *P. nigrescens* extracts that were found in vitro [88]. However, they came to the conclusion that the antioxidant qualities displayed by *P. nigrescens* extracts appear to suggest that the extracts may have health benefits for routine consumers or that they may have a well-known therapeutic utility in the treatment of liver disease. Lipid peroxides include malondialdehyde. When its concentration rises, it can damage membrane proteins, affect nucleic acid metabolism and function, and cause autoimmune disorders [101]. The release of several enzymes, like glutathione peroxidase and superoxide dismutase, which are vital to the body's defense against peroxidation, is increased to combat lipid peroxidation and harmful free radicals. The injection of PNLE in the current study markedly reduced the MDA level while raising the glutathione peroxidase level. As a result, administration can be crucial in preserving animals' normal physiology, production, health, and wellbeing. PNLE treatment had no effect on total protein or globulin levels. In a similar vein, [102] found no discernible difference between the control group and the *Origanum majorana* supplemented group in terms of total protein or urea. In order to protect lipids from the peroxidation process, which results in oxidative damage to the structures of lipid components of tissues and a decrease in malondialdehyde levels, the antioxidant effect of PNLE modifies the activity of antioxidant enzymes, increasing the total antioxidant counts. However, birds administered 0.4 ml of PNLE had the best antioxidant abilities and better protein utilization as well as better lipids metabolism as reflected in the HDL values.

Conclusion

It can be concluded that the administration of PNLE to Japanese quails had no detrimental effect on the growth pattern, cardiovascular response and blood profile of the birds while for optimum performance, administration of 0.4ml in 500ml of water is recommended.

Conflicts of interest

The authors declare that there is no conflicts of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article are original and that any liability for claims relating to the content of this article will be borne by them.

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