Sex Variations in the Haematological Profile of Japanese Quails (\textit{Coturnix coturnix}) Reared in a Hot Humid Climate

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With 2 tables and 46 references

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ABSTRACT

The influence of sex on haematological parameters was investigated in the Japanese quail birds. Statistical comparisons of the means were made between male and female Japanese quails using Student’s \textit{t}-test. Statistical significant sex differences were found in the blood composition of the male and female Japanese quail birds. The haematocrit (PCV), erythrocyte count (EC), erythrocytic indices (MCV, MCH and MCHC), hemoglobin concentration (Hb), total leucocyte count (TLC), absolute heterophil count (AHC) and absolute lymphocyte count (ALC) mean values in the male quail birds were significantly higher than the recorded mean values for the female birds (\(p<0.05\)). No statistically significant sex differences were observed in the mean total protein and blood glucose concentration of the male and female birds (\(p>0.05\)). There was a significant difference in the mean serum cholesterol value of the male and female quail birds, with the males recording a higher mean value (\(p<0.05\)). This study provides information database for some haematological and biochemical values of healthy Japanese quails in the tropics and will serve as a reference point, primarily in avian clinical pathology diagnosis and haematology.

Key words: Japanese quail, sex, haematological values, biochemical values

Introduction

Insufficient animal protein coupled with increasing demand for it in the diet of an average Nigerian has been recognized as a problem [FAO, 1997; Obinne and Okorie, 2008]. The solution or answer to this lies in stepping up the production of fast maturing micro-livestock such as Japanese quails, snails, grass-cutters, giant rats, etc., which at the same time yield high quality meat [Odunaiya and Akinyemi, 2008]. In recent times, substantial research efforts have been made to domesticate some of these non-conventional micro-livestock and to introduce them into areas where they were originally non-existent [Onyimongyi and Okeke, 2000].

Japanese quail (\textit{Coturnix coturnix japonica}), a small domesticated avian species, has not only assumed importance world-wide as a laboratory animal [Wilson \textit{et al}., 1961], it is also commercially exploited for meat and egg production [Panda and Singh, 1990]. Fast growth rate, early sexual maturity, short generation interval, high rate of lay and less feed and space requirements per bird than those for chicken are some distinct and positive characteristics associated with Japanese quail [Thiyagasundaram, 1989; Panda and Singh, 1990]. Consequent upon these
attributes is the establishment of quail enterprise with low capital coupled with quick generation of income.

This species of micro-livestock was first introduced in Nigeria by the National Veterinary Research Institute (NVRI), Vom, Plateau State, with the intention of improving animal protein through meat and egg production. From Vom and some other external sources, quail production has spread to various parts of Nigeria including Nsukka, located on latitude 06° 52’ N and latitude 07° 24’ E, and on altitude of 447.2 m above sea level.

The packed cell volume (PCV), haemoglobin concentration (Hb), total protein and other haematological parameters have not only been reported to be very important in the health status and disease of poultry [Campbell, 1986; Hawkey and Samour, 1988], they are also good indices of livestock adaptability to prevailing environmental conditions [Kaushish et al., 1976]. Stated more clearly, blood parameters are indicators of the physiological health of organ systems that necessitate the optimal functions of the liver, kidney, haemopoietic system, immune system and maintenance of electrolyte balance [Pamela et al., 2000]. More so, physiological conditions such as sex and environmental changes in the life of birds have been suggested by some authors to influence blood parameters [Hoffman et al., 1985; Wolf et al., 1985; Work, 1996; Prichard et al., 1997].

Since it is clear from the foregoing that sex and the environment affect the haematology of birds, this study was, therefore, designed to evaluate the influence of sex on the haematological profile of Japanese quails (Coturnix coturnix japonica) raised in Nsukka area of South-Eastern Nigeria, bearing in mind that the birds are foreign to the said environment. The results obtained will no doubt serve as baseline values for other birds of the same species raised in the same environment.

Materials and Methods

Experimental birds and housing

The experimental birds comprised of 20 adult quail birds of equal number of males and females. The birds were procured from the National Veterinary Research Institute Vom, Plateau State, Nigeria. They were kept in fly proofed battery cages and allowed a three week period of acclimatization.

Experimental feed

The birds were fed with commercial broiler starter ad libitum. All the experimental birds had access to clean drinking water throughout the period of the experiment.

The laboratory proximate analysis of the broiler starter was carried out according to the AOAC procedures [AOAC, 1990]. The proximate compositions of the feed were: crude protein (26.25%), fat (8.50%), crude fibre (10.40%), ash (6.20%), moisture (8.00%), calcium (1.20%) and phosphorous (0.45%).

Experimental design and blood collection

The 20 birds, i.e., ten males and ten females were kept separately in fly proof battery cages. Handling, management and use of animals for experimentation were in conformity with the Laboratory Animal Rights Regulation of the University of Nigeria, Nsukka. The blood samples for laboratory assays were collected via venipuncture between the hours of 8 and 10 am immediately after the 3 weeks of acclimatization. The samples were transferred into duplicate Bijou bottles, one containing EDTA, an anticoagulating agent, and the other without EDTA for haematological and biochemical assays, respectively.

Haematological assays

The following parameters were measured: packed cell volume (PCV), haemoglobin concentration (Hb), erythrocyte count (EC), erythrocytic indices (mean corpuscular volume - MCV, mean corpuscular haemoglobin - MCH and mean corpuscular haemoglobin concentration - MCHC), total leucocyte count (TLC) and differential leucocyte count (DLC).

Packed cell volume (PCV, %)

This was determined by the microhaematocrit centrifugation [Jain, 1986]. Values were expressed in percentages.

Haemoglobin concentration (Hb, g/l)

This was carried out using the Drabkin’s reagent [ICSH, 1965]. A 0.02 ml of blood sample was added to 5 ml of Drabkin’s reagent held in a test tube, and mixed properly. After 5 minutes, the mixture was poured into a cuvette, paired with another cuvette, containing only the Drabkin’s reagent. The absorbance of the diluted blood sample was measured in a spectrophotometer at a wavelength of 540 nm. The haemoglobin concentration in grams per litre was then derived from the absorbance value by matching against pre-determined reference standards and calibration curves.
Erythrocyte count (EC, \( \times 10^6/\mu l \))

The erythrocyte counts were determined by standard methods [Coles, 1986]. Four millilitres of erythrocyte diluting fluid was used to dilute 0.02 ml of blood. A Neubauer hemocytometer was charged with the diluted blood and examined under a light microscope using the \( \times 40 \) objective lens. The cells were counted using a tally counter and the number of cells counted was multiplied by a factor of 10,000 to give the total number of erythrocytes per microlitre of blood.

Erythrocytic indices

This is also referred to as erythron values. The total erythrocyte count, haemoglobin concentration and haematocrit were employed in calculating the erythron values [Meyer and Harvey, 1998].

Mean corpuscular volume (MCV)

This was determined by dividing the PCV by the EC and then multiplying by a factor of 10. Values obtained were expressed in femtolitre (fl)

\[
MCV = \frac{PCV(\%)}{EC} \times 10 \text{ (femtolitre)}
\]

Mean corpuscular haemoglobin (MCH)

The MCH was calculated by dividing the haemoglobin concentration (Hb) by the EC and then multiplying by a factor of 10. The values were expressed in picogram (pg).

\[
MCH = \frac{Hb(g/dl)}{EC} \times 10 \text{ (picogram)}
\]

Mean corpuscular haemoglobin concentration (MCHC)

This was calculated by dividing the Hb concentration by the PCV and then multiplying by a factor of 100. The values were expressed in grams per litre (g/l)

\[
MCHC = \frac{Hb(g/dl)}{PCV(\%)} \times 100 \text{ (g/l)}
\]

Total leucocyte count (TLC \( \times 10^3/\mu l \))

Total leucocyte counts were determined by standard methods [Coles, 1986]. A 0.02 ml of well mixed blood sample was pipetted using a micropipette and added to 0.38 ml of leucocyte diluting fluid in a test tube. The diluted blood sample was used to charge the Neubauer chamber placed on the microscope. The leucocytes in the four corner squares of the Neubauer chamber were counted using the tally counter. The number of cells counted was multiplied by a factor of 50 to get the total number of leucocytes per microlitre of blood.

Differential leucocyte count (DLC \( \times 10^3/\mu l \))

With the aid of a micropipette, a gently rocked blood sample was aspirated and a drop of the blood sample placed on one end of a clean microscope slide. Using a smooth edge spreader, the drop of blood was spread and drawn, first backwards and then pulled forward to give an even thin smear on the slide which was later air-dried and subsequently stained with Leishman’s stain. The stained slides were observed under the microscope using the oil immersion objective (\( \times 100 \)). The differential white blood cell counter was used to count a total of 100 different leucocytes. Each cell type was recorded as a percentage of the total. The different percentages were later converted to absolute number of cells per microlitre of blood by multiplying the specific percentages with the total leucocyte counts.

Biochemical assays

Total protein

The determination of serum total protein was done using the direct Biuret method [Lubran, 1978], for the \textit{in vitro} determination of total protein in serum or plasma.

Procedures

1. Five clean test tubes were arranged and labeled according to sample identifications. Also labeled were two test tubes for standards (SD) and two test tubes for blanks (BL), i.e., SD1, SD2, BL1, and BL2.
2. Added to each sample labeled test tube was 0.02 ml (20 microlitres) of each serum sample. Also added to the test tube labeled standards was 0.02 ml of the standard (SD1 and SD2). Nothing was added to the two blank test tubes.

3. Thereafter, 1.0 ml of Biuret reagent was added into the sample, standard, and the blank test tubes.

4. The content of each test tube was properly mixed and allowed to stand for 10 minutes at room temperature (20-25°C).

5. The absorbance of samples and standards were read off against the blank in a spectrophotometer at 540 nm wavelength.

6. Total protein concentration for each sample was calculated thus:

\[
\text{Total protein} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times 5 \text{ (g/dl)}
\]

Total cholesterol

Determination of total cholesterol was done using the Quimica Clinica Applicada cholesterol test kit (QCA, Spain). One millilitre of the working reagent was added to a set of clean labeled test tubes. Two of the test tubes were labeled standard 1 and standard 2 (SD1 and SD2, respectively) and one test tube was labeled “blank” (BL). A 0.01 ml of the serum sample was added to the appropriately labeled test tubes and 0.01 ml of the standard added to each of the test tubes labeled SD1 and SD2. Thereafter, the contents of the test tubes were mixed and allowed to stand for 10 min at room temperature. The absorbance of samples and standards were read off against the blank in a spectrophotometer at 505 nm wavelength and the cholesterol content of each sample calculated thus:

\[
\text{Total cholesterol} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times 200 \text{ (mg cholesterol/dl)}
\]

Blood glucose concentration

Blood glucose level was determined using the ACC-CHEK active diabetes monitoring kit (Roche Diagnostics GmbH, Mannheim, Germany), based on the glucose oxidase method [American Diabetes Association, 2003].

Procedure

1. The key code was properly inserted into the glucometer (Model Number ACC-CHEK ACTIVE GLUCOMETER GN05016046) key code opening.

2. Following that, a test strip was inserted into the glucometer (to make sure that the code on the glucometer matched the code on the test strip).

3. Thereafter, a fresh new test strip with an orange colour pad (faced up) was inserted into the glucometer opening for test strip. After few seconds, the image of a flashing blood appeared on the glucometer screen which signified that the apparatus (glucometer) was ready.

4. With the aid of a capillary tube, a drop of the test blood sample was placed at the centre of the square of the orange pad of the test strip.

5. The test result was immediately read off the glucometer screen in g/dl (blood glucose concentration in g/dl).

Statistical analysis

Data obtained from the study were computed into means and standard deviations. Thereafter, statistical comparisons of the means were made between male and female Japanese quails using Students’ t-test.

Results

Presented in Table 1 is the comparison of the haematological parameters of adult male and female Japanese quail birds (mean ± SD). Several sex related differences in the blood profile of the Japanese quail raised in Nsukka were observed.

Packed cell volume (PCV)

The mean PCV for the male quail was significantly higher than that of the female (p<0.05).

Haemoglobin concentration (Hb)

From the result of this experiment, the Hb concentration stood at 10.38 ± 2.14 g/dl with a range value of 6.47 to 12.41 g/dl. The male Hb value was found to be significantly higher than that of the female (p<0.05).

Erythrocyte count (EC)

The EC of the Japanese quail was found to be 6.14 ± 2.79 ×10⁶/μl, with a range value of 3.89 × 10⁶ to 15.63
$\times 10^6/\mu l$, with the value for the male being significantly higher than the female (p<0.05).

Table 1. Comparison of haematological parameters of male and female quails

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male</th>
<th>Female</th>
<th>All</th>
<th>t-value (male vs. female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>42.25 ± 3.33</td>
<td>33.75 ± 4.30</td>
<td>38.0 ± 5.75</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(38 - 48)</td>
<td>(27 - 41)</td>
<td>(27 - 48)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>12.20 ± 0.86</td>
<td>10.38 ± 2.14</td>
<td>10.38 ± 2.14</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(10.80 - 12.41)</td>
<td>(6.47 - 10.00)</td>
<td>(6.47 - 12.41)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>EC ($10^6/\mu l$)</td>
<td>7.56 ± 3.35</td>
<td>4.71 ± 0.09</td>
<td>6.14 ± 2.79</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>(5.35 - 15.63)</td>
<td>(3.89 - 5.87)</td>
<td>(3.89 - 15.63)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>60.93 ± 13.58</td>
<td>72.56 ± 7.68</td>
<td>66.74 ± 12.24</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(30.71 - 71.43)</td>
<td>(61.33 - 84.83)</td>
<td>(30.71 - 84.83)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Hb (g/dl)</td>
<td>17.78 ± 4.36</td>
<td>18.40 ± 2.47</td>
<td>18.08 ± 3.44</td>
<td>0.62</td>
</tr>
<tr>
<td></td>
<td>(17.81 - 22.14)</td>
<td>(15.74 - 22.75)</td>
<td>(17.61 - 22.75)</td>
<td>(p&gt;0.05)</td>
</tr>
<tr>
<td>MCHC (g/dl)</td>
<td>28.98 ± 3.41</td>
<td>25.34 ± 1.71</td>
<td>27.16 ± 2.70</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(24.77 - 32.21)</td>
<td>(21.57 - 26.82)</td>
<td>(21.57 - 32.21)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>31.56 ± 7.63</td>
<td>17.94 ± 1.30</td>
<td>24.75 ± 8.80</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(18.4 - 44.9)</td>
<td>(16.2 - 19.6)</td>
<td>(16.2 - 44.9)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Heterophil ($10^3/\mu l$)</td>
<td>11.30 ± 2.56</td>
<td>5.63 ± 0.83</td>
<td>8.47 ± 3.46</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(31 - 39)</td>
<td>(26 - 35)</td>
<td>(26 - 39)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Monocytes ($10^3/\mu l$)</td>
<td>19.80 ± 5.18</td>
<td>11.83 ± 1.13</td>
<td>15.86 ± 5.59</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(58 - 67)</td>
<td>(61 - 73)</td>
<td>(58 - 73)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Eosinophils ($10^3/\mu l$)</td>
<td>0.38 ± 0.30</td>
<td>0.29 ± 1.41</td>
<td>0.34 ± 0.23</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>(0 - 3)</td>
<td>(1 - 3)</td>
<td>(0 - 3)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Basophils ($10^3/\mu l$)</td>
<td>0.00 ± 0.00</td>
<td>0.09 ± 0.14</td>
<td>0.05 ± 0.11</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0 - 1)</td>
<td>(0 - 2)</td>
<td>(0 - 2)</td>
<td>(p&lt;0.05)</td>
</tr>
</tbody>
</table>

Values are means ± SD

**Erythrocytic indices**

The female quail birds raised in Nsukka tended to have significantly lower mean MCV value than the males (p<0.05). No significant sex based difference was observed for MCH (p>0.05). The mean MCHC value for the male quail birds varied significantly from the mean value of the female, with the male quail birds having a higher mean value (p<0.05).

**Total leucocyte count (TLC) and differential leucocyte count (DLC)**

In this study, the male quail birds had significantly higher mean TLC value than the female quail birds (p<0.05). A comparison of the male and female quail bird mean heterophil and lymphocyte values revealed that the male quail birds had significantly higher values than the female quails (p<0.05). However, no significant difference existed in the mean monocyte, eosinophil and basophil values of the male quail birds when compared to the female birds (p>0.05).

**Biochemical assays**

Table 2 shows the results of the comparison of the biochemical assays of the adult male and female Japanese quail birds (mean ± SD).

Table 2. Comparison of some biochemical parameters of male and female quail

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male</th>
<th>Female</th>
<th>All</th>
<th>t-value (male vs. female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total protein (g/dl)</td>
<td>5.14 ± 0.26</td>
<td>5.08 ± 0.45</td>
<td>5.11 ± 0.36</td>
<td>0.771</td>
</tr>
<tr>
<td></td>
<td>(4.91 - 5.43)</td>
<td>(4.14 - 5.39)</td>
<td>(4.14 - 5.43)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Blood glucose (mg/dl)</td>
<td>242.38 ± 26.87</td>
<td>239.25 ± 23.41</td>
<td>240.81 ± 24.40</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>(200 - 272)</td>
<td>(208 - 282)</td>
<td>(200 - 2820)</td>
<td>(p&lt;0.05)</td>
</tr>
<tr>
<td>Serum cholesterol (mg/dl)</td>
<td>278.24 ± 29.03</td>
<td>191.95 ± 41.34</td>
<td>235.09 ± 56.36</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(235.56 - 293.33)</td>
<td>(126.67 - 246.67)</td>
<td>(126.67 - 293.33)</td>
<td>(p&lt;0.05)</td>
</tr>
</tbody>
</table>

Values are means ± SD
The mean serum total protein and blood glucose concentration of the male and female Japanese quail birds did not vary significantly from each other (p>0.05), but there existed a significantly higher mean cholesterol value in the male quail birds relative to the mean value for the female birds (p<0.05).

Discussion

Variation within species in areas of life history pattern, diet and activity level [Ewins, 1993] as well as some physiological conditions, such as sex and environmental changes [Hoffman et al., 1985; Wolf et al., 1985; Work 1996; Pritchard et al., 1997] influence blood parameters in birds. In this study, the male Japanese quail birds raised in Nsukka recorded significantly higher mean PCV, Hb, EC, MCHC, TLC, heterophil and lymphocyte values than the female birds. From the works of Lazar et al. [1991] and Itoh [1992], male geese and budgerigars were shown to have higher values in most of their blood parameters relative to their female counterparts. In all these species mentioned above, there is always higher erythrocyte count number in the male birds which almost always results in higher PCV, Hb, MCV, MCH and MCHC values. Sex, age, diet and hormones are known to influence blood cell absolute and relative numbers [Puerta et al., 1990]. Androgens have been associated with increase in number of erythrocytes in male quail birds [Nimalan and Robinson, 1972]. High blood estrogen levels in female birds [Herbert et al., 1989] possibly may be an explanation for the observed reduction in the recorded blood parameters of the female quail birds in this study. Erythropoietin (haemopoietin stimulating factor) production has reportedly been suppressed by excess estrogen [Thrall et al., 2004] thereby depressing erythropoiesis which will invariably lead to low EC value, thus resulting in the reduction of most other blood parameters such as PCV (haematocrit). Haematocrit and erythrocyte counts have generally been used to evaluate the normality of the oxygen transport system [Gessaman et al., 1986; or adaptation [Polo et al., 1992]. On the other hand, the androgens and thyroxin encourage erythropoiesis [Herbert et al., 1989; Itoh, 1992].

The mean TLC value of the male Japanese quail birds in this study was significantly higher than the mean value for the female birds. This observation is in contrast to the findings of Lucas and Jamroz [1961] who observed a higher leucocyte count values in female birds relative to the males. Apparently, the time of sampling these birds might have contributed to the recorded TLC values in both sexes. However, various factors such as age, sex, metabolism, nutritional status, environment and vaccination have been known to influence TLC values in poultry [Priya and Gomathy, 2008]. Datta et al. [1996] have shown in selected avian species (ducks) that the total number of erythrocytes and leucocytes as well as haemoglobin levels increases in these groups of birds when they are exposed to lower or higher temperatures. Further more; it is important to mention that age, sexual maturity, phase of erythrocytes and leucocytes as well as haemoglobin levels increases in these groups of birds when they are exposed to lower or higher temperatures. Further more; it is important to mention that age, sexual maturity, phase of reproductive cycle, species differences, feed and environment with reference to climate and the type of housing system influence blood parameters in both males and females (mammals and avian species) [Strakova et al., 1994; Suchy et al., 1997; Kral and Suchy, 2000].

For the differential leucocyte count (DLC) of this study, the male Japanese quail birds recorded higher absolute heterophil and lymphocyte values relative to the females. Campbell [1994] also recorded the same higher absolute heterophil and lymphocyte values in male avian species relative to the females. Lymphocytes are the most abundant leucocyte in the avian species but in some species, the heterophil appears as the most abundant cell [Leonard, 1982; Cooper et al., 1986]. This variation in absolute heterophil and lymphocyte numbers may be due to the different methodologies used in assessing them [Sturkie, 1965]. There was no noticeable significant difference in the mean monocyte values of both sexes. The mean absolute eosinophil and basophil values for the male and female quail birds were not significantly different from each other. From the mean values of these two different leucocytes (eosinophil and basophil), one may be tempted to term them as not being present in the blood at all and this may be as a result of the granules within the avian eosinophil and basophil being water soluble [Hodges, 1974] which might have made them to stain poorly in the Leishman stain. The total leucocyte count and differential cell counts (lymphocytes, heterophils, eosinophils and basophils) are regarded as indicators of the state of the immune system [Pamela et al., 2000].

A comparison of the biochemical parameters revealed that there was no significant difference in the mean serum total protein and the blood glucose levels of the male and female adult Japanese quails. This observation is in contrast with the work of Lumeji [1997] who stated that adult female birds have a higher serum total protein value than the adult males and young birds. This is probably as a result of the fact that females of the oviparous species demonstrate a marked increase in plasma total protein level just before egg production and this estrogen-induced hyperproteininaemia is associated with an increase in vitellogenin and lipoprotein, which are necessary for yolk production [Yamamura et al., 1995]. Chicken vitellogenin, a serum lipoprotein specific to laying hens, has been thought to be proteolytically cleaved into the heavy and light chain lipovitellins and phosvitin, the major yolk granule proteins, during or after transportation into the oocyte [Yamamura et al., 1995]. On the other hand, Pitt et al. [1980] had earlier reported a higher blood glucose level in the male birds.

The level of the mean serum cholesterol in this study was higher in the male Japanese quail birds when compared with the females. Gilbert [1971] who observed almost the same higher values in cholesterol level in some
avian species revealed that cholesterol is the precursor of steroid hormone synthesis which at the end finds application in yolk formation. Possibly, the low level of cholesterol in the female birds (layers) as concluded by Gilbert [1971] might be due to increased levels of steroid hormone and yolk formation.

This present study will not only serve as a database of some hematological and biochemical values of healthy Japanese quails (Coturnix coturnix), but will also serve as a reference point, primarily in avian clinical pathology diagnosis and hematology.

References
Datta, C., Roy, S., Gbosh, S. P., Roy, B. N. and Bhattacharya, B. (1996). Effects of different ambient temperature application in yolk formation. Possibly, the low level of cholesterol in the female birds (layers) as concluded by Gilbert [1971] might be due to increased levels of steroid hormone and yolk formation.

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