**Iraqi Journal of Veterinary Sciences**

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# Impact of breed, sex and age on hematological and biochemical parameters of local quail

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**Article information**

***Article history:***
Received April 25, 2020
Accepted October 10, 2020
Available online June 23, 2021

***Keywords***:
Age
Breed
Hematological parameters
Quail
Sex

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**Abstract**

The current work aimed to study the normal values of some hematological and biochemical criteria of local quail and the effect of the breed, sex, and age on them. Two hundred quail (100 birds belong to each of white and light brown feathers local breeds), they were randomly distributed at 1st-day-age into 5 replicates, 20 birds/ replicate for each breed, and the study continued till the age 84 days. The results of the current study had revealed that the breed and the age, each alone did not significantly affect the physiological and biochemical parameters in this study, whereas the sex factor affects significantly most of the study parameters. The males were highly significant as compared to the females in the following parameter values: red blood cells count, hemoglobin concentration, packed cell volume, mean corpuscular hemoglobin concentration, monocytes, basophils, glucose, cholesterol, uric acid concentrations and aspartate aminotransferase activity. While the females were significantly higher to the males in mean corpuscular volume, lymphocytes, triglycerides, total protein, globulin, and alanine aminotransferase activity. In conclusion, the sex of the bird alone and its interaction with breed and age had the greatest impact on the hematological traits.

DOI: 10.33899/ijvs.2020.126960.1432, 

## Introduction

In the last years, the interest to quail had been increased in Iraq including Mosul city, as a scientific and economic aspect (1). Many studies were conducted on quail in the standard (normal) and different conditions (2-4), it is used as a laboratory animal in scientific research experiments because it has high growing rate, high production rate and a short generations period (5-7). Many researchers were mentioned many different tests and values in refers to quail, whether physiological or productive, but the most important thing is to determine the normal physiological status of quail by providing reference values for physiological blood parameters to help researchers and those who are interested in production and reproduction of quail (8). It is well known that the blood is an important indicator of the physiological status of the body, and reflects the individual's health and pathological condition (9), and it can reflect many factors that affect its components like sex and age variation, sexual maturity, breed, nutrition, productive status, season and stress status, as well as the blood diseases (10). This study aims to provide reference values of some normal physiological blood parameters of males and females quail, also to study and evaluate the differences resulting due to the effect of each of the breed, sex, age, and their interaction at day 42 and 84 of age. Quail were reared in standard environmental conditions according to (2). These results can be considered as basic reference data for local white and light brown quail in Mosul, which could be of benefit for veterinarians and physiologists.

## Materials and methods

A total of two hundred quail (100 birds belong to each of white and light brown feather local breed), they were randomly distributed at 1st-day-age into 5 replicates, 20

birds/ replicate for each breed. The birds were reared in cages (50 x 50 x 50 cm for the length, width and height respectively). Ration and water were offered ad libitum, ration mixture and its protein and energy content were prepared according to the (11). The growing ration was from 1- 35 days (24% crude protein 3000 kcal/kg metabolizable energy) after that the finisher ration was given till the end of the experiment at the age of 84 days (22% crude protein 2942 kcal/kg metabolizable energy). Also, all the appropriate environmental conditions (temperature, ventilation, and lighting) were provided for rearing birds depending on birds age (2), and the experiment was continued till the age of 84 days as follows: 1st group (White feathers quail), and the 2nd group (light brown feathers quail).

At the age of 42 and 84 days, 6 birds from each sex and from both groups (white and light brown) were slaughtered, and the blood samples were collected directly at the slaughtering from healthy birds in two types of tubes: with anticoagulant tubes (EDTA tubes) which used for determination the packed cell volume (PCV), red blood cell counts (RBCs) was carried out by using Natt and Herrick's solution (12,13) and hemoglobin concentration (Hb) was determined by Drabkin's reagent by using Biosystems Kit (Spain). Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated according to Campbell (12). Blood smears were dyed with fresh Giemsa stain for differential leukocyte count (DLC) as reported in Campbell (12). Other tubes without anticoagulant (Plane tubes) were used to isolate the blood serum, which then kept in the Eppendorf tubes at -20°C till the biochemical tests were carried out, which include the determination of glucose, cholesterol, triglycerides, total protein, uric acid, AST and ALT by using Biosystems kits (Spain).

**Statistical analysis**

Statistical analysis was conducted using a complete randomized design (CRD) in a 2*2*2 factorial experiment, including two breeds (white and light brown breed), two sexes (male and female), and two ages (42 and 84 days), the data were analyzed by General Linear Model (GLM) procedure (14) according to the following mathematical model: $Y_{ijkl} = \mu + B_i + S_j + A_k + BS_{ij} + BA_{ik} + SA_{jk} + BSA_{ijk} + E_{ijkl}$. i = 1, 2j = 1, 2k = 1, 2l = 1, 2, 3, 4, 5.Where: (μ) is the overall mean, ($B_i$) ($S_j$) ($A_k$) is the effect of breed, sex, and age respectively, ($BS_{ij}$) is the interaction between breed and sex effect, ($BA_{ik}$) is the interaction between breed and age effect, ($SA_{jk}$) is the interaction between sex and age effect, ($BSA_{ijk}$) is the interaction between breed, sex and age effect, ($E_{ijK}$) is the experimental error, and (l) is a replicate, and to test the significant differences between the means, the Duncan's Multiple Range Test was used according to the Steel and Torrie (15).

**Results**

The results showed that the breed (white or light brown) and age (42 or 84 days) had no significant effects on quail blood picture, whereas sex of the bird had a great effect on blood picture as represented by the significant increase of RBCs, Hb, PCV%, MCHC, monocytes % and basophils %, and the significant decrease of MCV and lymphocyte % in male as compared with female quail (Tables 1 and 2).

In regard to the interaction effects of the three factors (breed, sex, and age), table 1 revealed that the best interaction effects were recorded on groups white male at 42 and 84 days age, also on groups light brown male at 42 and 84 days age for the RBCs, Hb, PCV%, MCHC and MCV. Current study revealed also that the higher values for the interaction effects were recorded on white female at 84 days (lymphocytes %), white male at 42 days (monocytes%) and light brown male at 42 days age (basophils%) (Table 2).

Also, the results revealed that the breed (white and light brown) and age (42 and 84 days) also had no significant effects on quail blood serum traits, whereas the sex of the bird had a significant effect as represented by the significant increase in glucose, cholesterol, uric acid, and AST values in male birds as compared with females at ($P \leq 0.05$), and the significant increase in triglycerides, total protein, globulin, and ALT values in female birds as compared with males (Tables 3 and 4).

In respect to the interaction effects the higher values for glucose was recorded in light brown male at 42 days, and for cholesterol, uric acid and AST the higher significant values were recorded in light brown male at 84 days, but for triglycerides, total protein and ALT the higher significant values were determined in groups white female at 42 and 84 days age, light brown female at 42 and 84 days age, while the higher significant globulin value ($P \leq 0.05$) was in white female at 42 days age.

**Discussion**

The results showed that breed and age (42 and 84 days) had no significant effect on the RBCs, Hb, PCV, MCV, MCH, and MCHC, whereas sex had great effects on blood picture as represented by the significant increase of RBCs, Hb, PCV, and MCHC and the significant decrease of MCV in male birds as compared with females. These results are in agreement with Abou-Kassem and his colleagues (16), who suggested that the testosterone may stimulate/ promote the erythropoiesis in the bone marrow. It is also known that the effect of testosterone on kidneys is induced the erythropoietin secretion, which leads to an increase in RBCs production by erythropoiesis in the bone marrow of males and other related parameters (17).

Table 1: Effect of breed, sex, age and their interactions on blood picture of local quail (Means ±SE)

| Parameters | RBCs Count $10^6/mm^3$ | Hb g / dl | PCV % | MCV $\mu^3$(fl) | MCH Pg | MCHC g / dl |
|---|---|---|---|---|---|---|
| Breed Effect | | | | | | |
| White | 2.64±0.11 a | 10.16 ±0.3 a | 41.67±0.92 a | 162.20±5.15 a | 39.66±1.51 a | 24.44±0.4 a |
| Light brown | 2.56±0.11 a | 9.81±0.38 a | 41.38±0.95 a | 166.47±5.74 a | 38.76±0.93 a | 23.62±0.6 a |
| Sex Effect | | | | | | |
| Male | 3.03±0.05 a | 11.43±0.18 a | 45.54±0.49 a | 151.34±2.80 b | 37.99±0.90 a | 25.16±0.48 a |
| Female | 2.17±0.07 b | 08.54±0.19 b | 37.50±0.33 b | 177.33±6.11 a | 40.43±1.49 a | 22.90±0.54 b |
| Age Effect | | | | | | |
| 42 days | 2.57±0.11 a | 09.87±0.35 a | 41.71±0.93 a | 167.05±5.61 a | 39.13±1.19 a | 23.57±0.49 a |
| 84 days | 2.63±0.11 a | 10.09±0.35 a | 41.33±0.94 a | 161.61±5.26 a | 39.30±1.32 a | 24.49±0.61 a |
| Effect of Interaction Between Breed, Sex, and Age | | | | | | |
| W M 42 | 3.05±0.09 a | 11.48±0.30 a | 45.67±1.05 a | 150.33±05.07 b | 37.89±1.88 a | 25.16±0.55 a |
| W M 84 | 3.10±0.14 a | 11.42±0.53 a | 45.67±0.88 a | 149.18±09.00 b | 37.29±2.88 a | 25.11±1.40 a |
| W F 42 | 2.22±0.16 b | 08.56±0.27 b | 37.67±0.71 b | 173.56±11.79 ab | 39.76±3.62 a | 22.73±0.62 ab |
| W F 84 | 2.19±0.14 b | 09.16±0.28 b | 37.67±0.71 b | 175.72±10.84 ab | 43.71±3.49 a | 24.77±0.72 a |
| L M 42 | 2.94±0.08 a | 11.37±0.28 a | 45.50±1.28 a | 155.07±04.92 b | 38.79±1.48 a | 25.11±1.07 a |
| L M 84 | 3.01±0.08 a | 11.44±0.37 a | 45.33±0.88 a | 150.77±03.02 b | 37.99±0.81 a | 25.27±0.87 a |
| L F 42 | 2.06±0.15 b | 08.09±0.27 b | 38.00±0.68 b | 189.24±14.12 a | 40.06±2.60 a | 21.28±0.62 b |
| L F 84 | 2.22±0.18 b | 08.34±0.55 b | 36.67±0.56 b | 170.78±13.79 ab | 38.20±2.37 a | 22.82±1.69 ab |

Different letters in the same column indicate a statistical difference (P≤0.05).
W: White breed; L: Light brown breed; M: Male; F: Female; 42, 84: Age (days).

Table 2: Effect of breed, sex, age and their interactions on differential leukocyte count values of local quail (Means ±SE)

| Parameters | Lymphocyte% | Heterophils% | Monocytes% | Eosinophils% | Basophils% | H / L |
|---|---|---|---|---|---|---|
| Breed Effect | | | | | | |
| White | 69.67±0.84 a | 26.42±0.56 a | 2.21±0.20 a | 1.42±0.17 a | 1.00±0.18 a | 0.38±0.01 a |
| Light brown | 69.04±0.77 a | 26.71±0.70 a | 2.00±0.19 a | 1.00±0.17 a | 1.25±0.16 a | 0.39±0.01 a |
| Sex Effect | | | | | | |
| Male | 67.58±0.67 b | 27.04±0.61 a | 2.50±0.21 a | 1.38±0.18 a | 1.50±0.16 a | 0.40±0.01 a |
| Female | 71.13±0.70 a | 26.08±0.65 a | 1.71±0.14 b | 1.04±0.16 a | 0.75±0.15 b | 0.37±0.01 a |
| Age Effect | | | | | | |
| 42 days | 68.46±0.84 a | 27.08±0.74 a | 2.25±0.20 a | 1.17±0.17 a | 1.33±0.16 a | 0.40±0.02 a |
| 84 days | 70.25±0.74 a | 26.04±0.49 a | 1.96±0.19 a | 1.25±0.18 a | 0.92±0.18 a | 0.37±0.01 a |
| Effect of Interaction of Breed, Sex, and Age | | | | | | |
| W M 42 | 67.17±1.49 b | 26.83±1.54 a | 2.83±0.48 a | 1.50±0.43 a | 1.67±0.21 ab | 0.40±0.03 a |
| W M 84 | 68.00±1.29 b | 26.83±0.87 a | 2.50±0.43 ab | 1.67±0.33 a | 1.00±0.45 abc | 0.40±0.02 a |
| W F 42 | 70.33±1.36 ab | 27.00±0.07 a | 1.83±0.31 ab | 1.17±0.31 a | 0.83±0.31 abc | 0.39±0.19 a |
| W F 84 | 73.17±1.70 a | 25.00±1.00 a | 1.67±0.21 ab | 1.33±0.33 a | 0.50±0.34 c | 0.34±0.18 a |
| L M 42 | 66.33±1.61 b | 28.17±1.58 a | 2.33±0.42 ab | 1.33±0.33 a | 1.83±0.31 a | 0.43±0.03 a |
| L M 84 | 68.83±1.01 ab | 26.33±0.92 a | 2.33±0.42 ab | 1.00±0.37 a | 1.50±0.22 abc | 0.39±0.02 a |
| L F 42 | 70.00±1.95 ab | 26.33±1.91 a | 2.00±0.37 ab | 0.67±0.21 a | 1.00±0.26 abc | 0.38±0.04 a |
| L F 84 | 71.00±1.06 ab | 26.00±1.21 a | 1.33±0.21 b | 1.00±0.45 a | 0.67±0.33 bc | 0.37±0.02 a |

Different letters in the same column indicate a statistical difference (P≤0.05).
W: White breed; L: Light brown breed; M: Male; F: Female; 42, 84: Age (days).

Table 3: Effect of breed, sex, age and their interactions on some blood parameters of local quail (Means ±SE)

| Parameters | Glucose mg/dl | Cholesterol mg/dl | Triglycerides mg/dl | T. Protein g / l | Albumin g / l | Globulin g / l |
|---|---|---|---|---|---|---|
| Breed Effect | | | | | | |
| White | 299.89±2.37 a | 178.83±2.98 a | 512.00±78.01 a | 40.84±1.22 a | 17.87±0.27 a | 22.97±1.27 a |
| Light brown | 304.75±2.94 a | 182.07±3.10 a | 522.68±77.25 a | 40.11±1.08 a | 17.88±0.30 a | 22.23±1.02 a |
| Sex Effect | | | | | | |
| Male | 306.22±2.69 a | 184.72±2.62 a | 151.53±04.29 b | 35.54±0.46 b | 17.73±0.23 a | 17.81±0.50 b |
| Female | 298.41±2.50 b | 176.17±3.21 b | 883.15±20.02 a | 45.40±0.58 a | 18.02±0.33 a | 27.38±0.66 a |
| Age Effect | | | | | | |
| 42 days | 301.70±2.94 a | 176.71±2.57 a | 502.27±75.42 a | 41.25±1.02 a | 17.58±0.27 a | 23.66±1.07 a |
| 84 days | 302.94±2.47 a | 184.18±3.30 a | 532.41±79.67 a | 39.70±1.25 a | 18.17±0.28 a | 21.53±1.20 a |
| Effect of Interaction of Breed, Sex, and Age | | | | | | |
| W M 42 | 300.92±6.08 ab | 177.83±1.76 ab | 142.63±09.34 b | 36.71±0.89 b | 18.04±0.39 a | 18.66±0.98 c |
| W M 84 | 299.97±3.50 ab | 191.57±6.61 a | 148.83±07.91 b | 34.61±0.88 b | 18.03±0.45 a | 16.58±0.88 c |
| W F 42 | 296.55±5.98 b | 174.93±6.58 ab | 863.45±37.85 a | 46.13±0.87 a | 17.30±0.65 a | 28.84±1.10 a |
| W F 84 | 302.12±3.85 ab | 170.97±5.03 b | 893.10±54.54 a | 45.90±1.76 a | 18.10±0.67 a | 27.80±1.86 ab |
| L M 42 | 313.55±4.67 a | 178.03±4.98 ab | 149.32±09.23 b | 36.80±0.75 b | 17.24±0.39 a | 19.56±0.87 c |
| L M 84 | 310.45±5.82 ab | 191.45±4.20 a | 165.35±06.92 b | 34.06±0.71 b | 17.61±0.60 a | 16.45±0.86 c |
| L F 42 | 295.77±4.92 b | 176.03±7.02 ab | 853.68±38.64 a | 45.36±0.85 a | 17.76±0.74 a | 27.59±1.11 ab |
| L F 84 | 299.22±5.91 ab | 182.75±7.55 ab | 922.37±29.93 a | 44.22±1.08 a | 18.92±0.52 a | 25.30±0.82 b |

Different letters in the same column indicate a statistical difference (P≤0.05).
W: White breed; L: Light brown breed; M: Male; F: Female; 42, 84: Age (days).

Table 4: Effect of breed, sex, age and their interactions on serum uric acid, AST and ALT of local quail (Means ±SE)

| Parameters | Uric acid (mg/dl) | AST (U/L) | ALT (U/L) |
|---|---|---|---|
| Breed Effect | | | |
| White | 10.82±0.32 a | 242.48±7.78 a | 13.37±0.57 a |
| Light brown | 11.22±0.27 a | 242.27±7.60 a | 13.59±0.56 a |
| Sex Effect | | | |
| Male | 11.75±0.24 a | 274.08±4.18 a | 11.29±0.31 b |
| Female | 10.29±0.27 b | 210.67±3.65 b | 15.67±0.35 a |
| Age Effect | | | |
| 42 days | 10.85±0.29 a | 237.69±6.64 a | 13.68±0.54 a |
| 84 days | 11.19±0.30 a | 247.06±8.50 a | 13.270.58 a |
| Effect of Interaction of Breed, Sex, and Age | | | |
| W M 42 | 11.34±0.53 ab | 271.42±5.36 ab | 11.18±0.82 b |
| W M 84 | 11.79±0.53 a | 279.93±9.44 ab | 11.01±0.58 b |
| W F 42 | 10.14±0.68 b | 215.03±6.46 c | 15.55±0.58 a |
| W F 84 | 10.00±0.62 b | 203.55±7.14 c | 15.73±0.71 a |
| L M 42 | 11.87±0.39 a | 259.13±5.95 b | 11.96±0.61 b |
| L M 84 | 12.01±0.53 a | 285.83±9.34 a | 11.01±0.48 b |
| L F 42 | 10.07±0.41 b | 205.18±8.41 c | 16.04±0.63 a |
| L F 84 | 10.95±0.46 ab | 218.92±6.95 c | 15.34±1.00 a |

Different letters in the same column indicate a statistical difference (P≤0.05).
W: White breed; L: Light brown breed; M: Male; F: Female; 42, 84: Age (days).

Agina and his colleagues (8) reported a significant difference PCV and RBCs between males and females, current results were in agreement with the results of those researchers. Also, the results showed a significant increase (P≤0.05) in each of the red blood cells count and values of hemoglobin and PCV of males (white and light brown) at 42 and 84 days age compared with the females (white and light brown) at 42 and 84 days age). While the MCV values in males were lower than the values of females and it was significant in light brown female at 42 days, and the lowest

value of MCHC was recorded in light brown female at 42 days compared with all groups. Our results are inconsistent with Mohammad (1). The differences may be due to sex, gonadotrophic hormones (LH, FSH) and metabolic hormones (18,19).

Current study revealed that the breed and age (42 and 84 days) had no effect on the differential leukocyte count, while were affected by sex. In the male, the monocytes and basophils were higher than in females, but the lymphocytes count in females it was higher than they were in males at level ($P \leq 0.05$). Our results disagreed with the results of Mohammad (1), and they agreed with those of Mihailov and his colleagues (20). It could be explained the results by sex-related differences between males and females. The effects of the interaction between the 3 factors on differential leukocyte count revealed that the higher lymphocytes % was recorded in the group of white female at 84 days, and the higher monocytes % was recorded in the group of white male at 42 days, whereas the higher basophils % was recorded in the group of light brown male at 42 days.

The results showed that the breed and age did not have a significant effect on some biochemical parameters that were measured in this study, while the sex effect on the blood glucose, cholesterol, uric acid and AST in males was significantly higher than in females, whereas the level of triglycerides, total protein, globulin, and ALT in females it was significantly higher than in males. Our results are in agreement with Agina and his colleagues (8) who observed that serum total protein of females was higher than of males. While it disagreed with Ali and his colleagues (10), who reported that values of cholesterol and total protein were increased with the age.

In regard to the interaction between the breed, sex, and age, it was found that the males were superior to females on blood glucose, cholesterol, and uric acid, especially at 84 days old. While females were significantly superior to males on triglycerides, total protein, globulin, and ALT. During egg production, an increase in the hepatic syntheses of triglycerides, total protein, and globulin were observed which reflected in the high concentration of those parameters in the blood, in contrast to males (21,22). It may be due to increased estrogen secretion which led to an increase in production of the precursors of egg yolk (egg yolk precursor's) lipoproteins and thus increased the total protein and triglycerides in the blood (21).

In regard to the levels of globulin and ALT in females, they were significantly higher than those in males, this may be due to the increased egg production which exerts great effects on liver (8), whereas the uric acid and AST in males significantly ($P \leq 0.05$) higher than those in females, this may reflect the higher muscular activity of males as compared with females (23). Albumin levels did not differ significantly between the two sexes.

## Conclusion

From the results of the present study, it could be concluded that the sex of the bird alone and its interaction with breed and age had a great effect on the studied criteria.

## Acknowledgments

The authors would like to thanks the University of Mosul and College of Agriculture and Forestry for their kindly assistance in carrying out this research.

## Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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# تأثير السلالة والجنس والعمر في المعايير الدموية والكيموحيوية لطائر السلوى المحلي

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قسم الإنتاج الحيواني، كلية الزراعة والغابات، جامعة الموصل، الموصل، العراق

**الخلاصة**

هدف العمل الحالي إلى دراسة القيم الطبيعية لبعض المعايير الدموية والكيموحيوية لطائر السلوى المحلي وتأثير كل من السلالة والجنس والعمر عليها. إذ وزع عشوائياً بعمر يوم واحد ٢٠٠ طائراً من السلوى المحلي (١٠٠ طائراً / سلالة محلية ذات الريش الأبيض والبني الفاتح) وبواقع ٥ مكررات / سلالة (٢٠ طائراً / مكرراً)، واستمرت الدراسة إلى عمر ٨٤ يوماً. أظهرت نتائج الدراسة أن كل من السلالة والعمر لوحدهما لم يؤثرا بشكل معنوي في المعايير الفسيولوجية والكيموحيوية لطائر السلوى في هذه الدراسة، في حين أن عامل الجنس أثر معنوياً في معظم المعايير المدروسة. إذ كانت الذكور متفوقة معنوياً على الإناث في كل من المعايير الآتية: عدد خلايا الدم الحمر وتركيز الهيموكلوبين وحجم خلايا الدم المرصوصة ومعدل تركيز هيموكلوبين الكرية الحمراء والنسبة المئوية للخلايا وحيدة النواة والنسبة المئوية للخلايا القعدة وكلوكوز الدم والكولسترول وحامض اليوريك وفعالية إنزيم ناقلة أمين الاسبارتيت. بينما كانت الإناث متفوقة معنوياً على الذكور في معدل حجم الكرية الحمراء والنسبة المئوية للخلايا اللمفاوية والكليسيريدات الثلاثية والبروتين الكلي والكلوبيولين وفعالية إنزيم ناقلة أمين الالنين. نستنتج من ذلك أن تأثير الجنس لوحده وتداخلاته مع السلالة والعمر كان له أكبر تأثير في المعايير الدموية.

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