

Some Physiological and Serum Biochemical Reference Values of Adult Chukar Partridge (*Alectoris chukar Kurdistanica*) in Kurdistan Region-Iraq

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Abstract

The physiological parameters and blood biochemical parameters of wild Chukar partridges in the Sulaymaniyah Governorate of the Kurdistan Region-Iraq were measured in this study. During this research, 27 healthy *Alectoris chukar* partridges (9 males, 18 females), 8–12 months, were captured in the mountains of Penjwin district in the east of Sulaimani City from March to July 2022. Physiological parameters, including weight, heart rate (HR), respiratory rate (RR), and cloacal temperature (CT), were recorded for each partridge. Blood samples were collected from the jugular or wing vein to determine the serum biochemical parameters such as alanine transaminase levels, aspartate transaminase, blood urea nitrogen, creatinine, gamma-glutamyl transferase, total proteins, albumin, globulin, glucose, and total bilirubin. The males were significantly larger in weight (498.7 g) than the females (446.5 g). However, no significant differences were observed in the physiological parameters' values between the sexes. Also, the serum biochemical parameters showed no sex-related differences between the sexes, except that the alanine transaminase level was significantly higher in the males ($p < 0.05$). The birds were released to their natural habitat after the studies were conducted. As a pioneer work, these physiological and serum biochemistry values may serve as a reference range of Chukar partridge in diagnostic procedures for both physiological and pathological conditions.

Keywords: Biochemistry, Chukar partridge, Physiological parameters, Subspecies *kurdistanica*, Wildlife

بعض المعايير الفسلجية والكيميائية الحيوية في المصل لحجل شوكار البالغ (*Alectoris chukar Kurdistanica*) في إقليم كوردستان العراق

الخلاصة

تم في هذه الدراسة القيم الفسلجية والبايوكيميائية لدم حجل شوكار البري في محافظة السليمانية في إقليم كوردستان العراق. خلال هذا البحث، تم القبض على 27 حجلًا صحيًا من نوع *Alectoris chukar* (9 ذكور و 18 أنثى) في جبال منطقة بنجوين في شرق مدينة السليمانية من مارس إلى يوليو 2022. المعايير الفسلجية، بما في ذلك الوزن ومعدل ضربات القلب (HR) ومعدل التنفس (RR)، ودرجة حرارة المذرق (CT)، تم تسجيلها لكل حجل. تم جمع عينات الدم من الوريد الجناحي لتحديد المعلمات الكيميائية الحيوية في الدم مثل مستويات ترانس أميناز ألانين، ترانس أميناز الأسبارتات، نيتروجين اليوريا في الدم، الكرياتينين، جاما جلوتاميل ترانسفيراز، البروتينات الكلية، الألبومين، الجلوبيولين، الجلوكوز، والبيليروبين الكلي. كان الذكور أكبر وزنا (498.7 جم) إحصائيا من الإناث (446.5 جم). ومع ذلك، لم يلاحظ وجود فروق ذات دلالة إحصائية في قيم المعايير الفسلجية بين الجنسين. أيضا، لم تظهر المعايير الكيموحيوية في المصل أي فروق معنوية مرتبطة بالجنس بين الجنسين، باستثناء أن مستوى ترانس أميناز ألانين كان أعلى بشكل ملحوظ في الذكور ($p < 0.05$). تم إطلاق الطيور إلى بيئتها الطبيعية بعد إجراء الدراسات. كعمل رائد، قد تكون قيم الكيمياء الحيوية الفسلجية والمصلية هذه بمثابة نطاق مرجعي لحجل Chukar في إجراءات التشخيص لكل من الحالات الطبيعية والمرضية.

Introduction

Veterinary medicine is not only restricted to maintaining the health of livestock anymore. Many exotic animal species are now kept by animal lovers and brought to veterinary clinics more often than ever. These animals can transmit many zoonotic and infectious diseases, whose control is among the veterinarians' responsibilities. However, information about the average ranges of physiological and blood parameters in these species is often unavailable, making it challenging to determine the general health status of these species.

Chukar partridge (*Alectoris chukar*, Family Phasianidae, Order Galliformes), Pakistan's national bird, has a natural habitat ranging from Pakistan to Afghanistan in Asia (1). *Alectoris chukar* resembles the red-legged partridge (*A. rufa*), which is present in western areas and was first introduced as a game bird to North America in 1893. The Chukar exists in Palestine, Lebanon, Türkiye, Iraq, Iran, India, Central Nepal, Afghanistan, Pakistan, and the Himalayas (2). The bird's range spans from the Balkans to eastern Asia. *A. chukar* favors habitats like high mountain valleys, as in the Kurdistan Region, northern Iraq (3). Chukars have been familiarized worldwide, but there is inadequate information on their life features (e.g., dispersal, habitat range, and persistence). They have a short lifetime, demographically offset by high reproductive rates (4). Chukar partridges are not difficult to breed in captivity and can be reared under intensive captive circumstances with great productivity

rates.

The Chukar is a stout, upright, intermediate partridge with a striped head and throat, plain upper parts, a highly banded abdomen, and a rufous outer tail plume about 15 inches tall. A heavy black line contrasts the white throat from the grey head and breast over the brow, eyes, and neck. There is no seasonal change, and both sexes have the same plumage appearance (5). Males are more prominent in length and bulk than females. The beak, eyelid borders, legs, and feet are coral pink to deep red or crimson. A tiny tarsal spur can be found in both sexes, but it is more common in males. The partridge can run quickly and fly, although it still flies small distances, generally downhill (6).

Partridge is used exclusively in commercial enterprises in Australia, and there is special care for these birds in the Kurdistan Region of Iraq as game birds (7). They are also used to fight and even kept as pets for their shiny and beautiful feather or vocalization and singing as ornamental birds. Commercial partridge breeding for producing eggs and meat has risen recently, reducing partridge populations in the wild. There are several species of partridges in Türkiye, but the number of wild birds has reduced drastically due to extreme hunting and damage to natural habitations (8). Moreover, Chukar partridges are sensitive animals, and any mismanagement results in a crisis that can lead to immediate shock and death. Chukars with injuries that require a clinical check-up or the determination of serum biochemical tests for necessary treatment are

frequently presented to veterinarians (9). Practitioners face situations where blood analysis is required before anesthesia and surgical treatment of injured Chukars, where the most confusing part of the puzzle is the lack of a reference value. Therefore, having a standard to rely on for assessment is crucial. The research aims to measure the average physiological and biochemical values of Chukar partridges under physical restraints without any medicaments of the bird. It provides detailed reference values essential for life-saving situations with this bird.

Materials and methods

This study was conducted on *A. chukar*, subspecies *Kurdestanica*, from March to the end of July 2022 in the Kurdistan Region of Iraq. Mature female and male Chukar partridges with no apparent clinical signs of illness were included in the study (10). Their ages were determined by the size of the spur, and an experienced partridge enthusiast was consulted. The partridges were obtained from the wild after being caught in the Penjwin district from the Sulaymaniyah Governorate in Kurdistan Region/Iraq. Geographical coordinates were 35.6239° N (latitude) and 45.9491° E (longitude) with an altitude of 1292 m (Google Maps).

The birds' welfare was considered in every stage of the study. Specially designed atraumatic wooden cage traps were used, and all Chukar partridges were kept in conventional partridge cages for approximately seven days before each experiment to adapt. Food and water were provided *ad libitum*. The food was a balanced diet

from a mixture of seeds and pellets offered freely to the birds to meet their nutritional necessities (15% protein and 2,900 kcal/kg food).

The study started one week after the arrival of partridges at the animal house to ensure they were in good health and did not carry infectious diseases. Meanwhile, they had free access to water and food except for fifteen minutes before and during the examination. All partridges were handled gently, and any stress-inducing factors, such as extreme light, noise, and unnecessary handling, were avoided. Body weight, Heart rate (HR), respiratory rate (RR), and cloacal temperature (CT) were recorded using appropriate measuring methods. The birds were physically restrained without anesthesia or sedation to avoid any changes in the normal physiological parameters caused by the medications. A special restraint box and hood were used for restraining and covering the eyes during the procedures (Figure 1). The bird was left in the restraining box for 1–2 minutes to calm down so that a correct measurement of the physiological parameters was recorded. After the measurements were completed, the bird was returned to its cage gently, and feed and water were provided.



Figure 1. Hood and special restraint box.

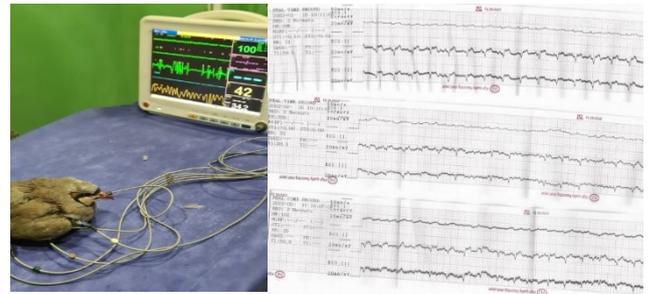


Figure 2. A fixed electrocardiograph on a Chukar partridge (left) and three electrocardiograms (right).

Physiological Parameters

The cardiopulmonary parameters, such as HR, RR, and CT (11), were measured by Veterinary Monitor Machine (Ver. 1.0, model DK-8000S, Shenzhen Technology Co., Ltd. China). Besides, an ECG (electrocardiogram) was measured when the Chukar partridges were calm and stress-free using a direct recording electrocardiograph (Figure 2). The ECG was used to measure the HR accurately by calculating the duration of R-R intervals in five cardiac cycles. Then, the HR was measured using the following formula: $HR = \frac{60 \text{ sec}}{\text{Average R-R interval (sec)}} \quad (12)$. The average of five cardiac cycles was calculated for each bird to obtain an accurate measurement. Crocodile clip electrodes were applied to the skin at the bases of the left and right wings and the gastrocnemius muscles of the left and right limbs (Figure 3).

The respiratory rate was measured by placing a bird feather before the nasal opening to detect air movement from the nasal passages. Also, body temperature was measured by inserting a thermometer into the cloaca for about 30 seconds (13).

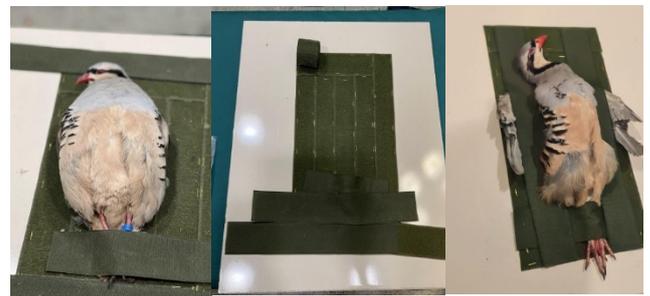


Figure 3. A handmade restraint plate and application of a monitoring machine.

Biochemical Tests

Approximately 1.0 mL of blood was taken from the jugular vein of each partridge and put into plain tubes without anticoagulants for biochemistry tests. Sometimes, the blood samples were drawn from the brachial vein (also called ulnar wing vein, ulnar/basilic vein, or vena cutanea ulnaris superficialis). The skin in the area

was cleaned with 70% ethyl alcohol before inserting the needle to disinfect the area. If the bird was not calm, we had to use a handmade avian restraint device to facilitate blood withdrawal. Blood was collected using disposable syringes, following safety rules and ensuring animal ethics. Blood was collected in a vacutainer without EDTA for blood serum analysis. Samples were analyzed within 2–2.5 hours after the blood collection. The MNCHIP Celercare V5 machine (Tianjin, China) was used to assess the plasma biochemical parameters. Organ functions were assessed using serum biochemical tests such as liver function tests (alanine aminotransferase (ALT) and aspartate transaminase (AST)) in addition to renal function tests (serum creatinine (CRE) and blood urea nitrogen (BUN)). Other investigated plasma biochemical parameters were total protein (TP), albumin, globulin, bilirubin, gamma-glutamyl transferase (GGT), and glucose, the kit that was used for this test called Health Check Profile (Tianjin, China, Lot No: 211157). (12)

Results and Discussion

Physiological parameters

Twenty-seven Chukar partridges (18 females and nine males) were captured in the mountains of Penjwin in Sulaymaniyah, northeast of Iraq. The partridges were 8–12 months old, based on the size of their spurs and physical appearances. The females were 446.5 g on average, and the males were significantly larger by 11.7%. The average heart rate in the males was 305.4 beats

per minute (bpm), ranging between 300.0 and 309.0 BPM, which was not significantly different from the females ($p = 0.9$). Also, the RR was not different between the sexes ($p = 0.4$), ranging between 58.0 and 65.0 breaths/min in the males and 57.0–62.0 in the females. Moreover, the body temperature was around 42°C with no differences between the sexes. Data for weight and physiological parameters of Chukar partridges are summarized in Table 1.

Serum biochemical parameters

Biochemical parameters of serum provide necessary information about the general health status of an individual and are routinely performed in private clinics for this purpose (14). One of those parameters is the total serum proteins, which averaged 4.5% in both sexes with no statistically significant difference ($p = 0.4$). The total serum proteins in Iranian Chukar partridges recorded in a previous study were close to the values recorded in this study (Table 3). However, in a study on captive Chukar partridges from the Punjab province of Pakistan (15), the total serum proteins in male and female partridges were 78% and 128% higher than the values recorded in this study. These differences imply that the levels of serum proteins can vary drastically in partridges from different areas, and it is crucial to establish reference values for animals in a given geographical location. Albumin levels were around 2.1% in males and 2.0% in females (Table 2). On the other hand, globulins constituted 2.4% and 2.5% of the serum in males and females, respectively.

The serum AST and ALT are liver function tests, as their increase indicates liver tissue injuries (16). The ALT level was 27.3 U/L in the male partridges, higher than in the females (25.9 U/L) but with no statistical difference. Also, there was no statistical difference in the AST levels between the males and females. GGT is an enzyme found throughout the body, but high levels are present in the liver (17). The blood levels of GGT are measured as an indication of liver health, and elevated levels indicate liver damage. In this study, there was no statistically significant difference in the serum GGT concentrations between males and females. Bilirubin is a byproduct of erythrocyte breakdown that passes through the liver and is eventually excreted through bile (18). The serum level of this pigment is measured to indicate hepatobiliary problems, as high serum levels of bilirubin may indicate different hepatic and biliary duct problems. The total bilirubin was 7.4 $\mu\text{mol/L}$ in the male partridges and 7.2 $\mu\text{mol/L}$ in the females, with no sex-based differences.

The levels of BUN and CRE are measured as an indication of renal efficiency, and elevated levels indicate inefficient renal functions (19). In this study, the BUN concentrations were 7.6 and 7.2 mmol/L in males and females, respectively, and there was no sex-based difference between the Chukar partridges. Also, the CRE concentration showed no difference between the sexes (Table 2).

The blood glucose levels ranged between

13.5 mmol/L and 18.5 mmol/L in both sexes, averaging 15.9 mmol/L in the males and 14.9 mmol/L in the females. However, no statistically significant difference was present between them.

different values. Moreover, the tests conducted in this study were more comprehensive. The concentrations of the biochemical parameters in our study were close to those of the Iranian chukar partridge. This outcome is possibly due to the similarity in the weather and land topography in these two areas. However, the results obtained in this study showed that the total proteins, ALT, AST, and creatinine were higher in Chukar partridges from the Punjab province of Pakistan. Moreover, the parameters obtained in this study were measured using physical restraint only to obtain the most accurate values and avoid any changes in these values caused by using sedative or anesthetic agents.

Conclusion

Laboratory tests are essential to the general diagnostic measures for both normal physiological and abnormal pathological conditions. Studying the normal physiological parameters in Chukar partridges is essential to provide data about the general health status when these birds are brought to veterinary clinics. The physiological and serum biochemical parameters recorded in this study might serve as reference values for wild Chukar partridges in the north of Iraq since the data from previous studies indicated discrepancies in these values according to the location and type of management.

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Conflict of interest

The authors declare no conflict of interest.

Article highlights

- Partridges are distributed worldwide and kept as pets in many parts.
- Chukar partridges are the second most reared bird in the Kurdistan Region/Iraq.
- This article provides information about the average physiochemical values of Chukar partridges.

Table 1. Weight and physiological parameters of Chukar partridges

Parameters	Males (n = 9)		Females (n = 18)		P Value*
	Mean \pm SEM	Min–Max	Mean \pm SEM	Min–Max	
Weight (g)	498.7 \pm 5.6	475.0–525.0	446.5 \pm 1.9	435.0–465.0	0.02
Heart rate (BPM)	305.4 \pm 1.2	300.0–309.0	304.3 \pm 0.8	300.0–311.0	0.9
Respiratory rate (breaths/min)	60.8 \pm 0.7	58.0–65.0	59.8 \pm 0.3	57.0–62.0	0.4
Cloacal temperature ($^{\circ}$ C)	42.2 \pm 0.1	42.0–42.5	42.1 \pm 0.04	41.8–42.5	0.7

*P values represent statistical differences between the average values of males and females (test = independent samples t-test). BPM = beats per minute; SEM = standard error of the mean.

Table 2. Serum biochemical parameters of Chukar partridges

Parameters	Males (n = 9)		Females (n = 18)		P Value*
	Mean ± SEM	Min–Max	Mean ± SEM	Min–Max	
Total proteins (g/L)	45.1 ± 0.5	42.2–46.5	44.9 ± 1.0	40.0–47.0	0.4
Albumin (g/L)	21.0 ± 0.6	18.0–23.0	19.8 ± 0.5	17.5–23.0	0.8
Globulin (g/L)	24.1 ± 0.9	21.2–28.5	25.1 ± 0.6	21.0–28.5	0.5
Albumin/globulin	0.6 ± 0.1	0.4–1.0	0.7 ± 0.04	0.5–1.0	0.9
Total bilirubin (µmol/L)	7.4 ± 0.2	6.5–8.0	7.2 ± 0.1	6.0–8.0	0.7
ALT (U/L)	27.3 ± 0.8	24.3–31.0	25.9 ± 0.6	24.3–28.9	0.1
AST (U/L)	395.1 ± 5.7	372.0–426	385.6 ± 2.8	372.0–406.0	0.2
AST/ALT	14.6 ± 0.4	13.0–16.5	14.9 ± 0.2	13.9–16.5	0.2
GGT (U/L)	31.3 ± 1.3	26.0–38.0	29.0 ± 0.6	24.0–33.0	0.1
BUN (mmol/L)	7.6 ± 0.3	6.5–9.0	7.2 ± 0.2	6.5–9.5	0.6
CRE (µmol/L)	23.2 ± 0.4	21.0–25.0	22.5 ± 0.4	19.0–26.0	0.2
BUN/CRE	3.0 ± 0.1	2.6–3.4	31.5 ± 0.1	2.6–3.5	0.7
Glucose (mmol/L)	15.9 ± 0.7	13.5–18.5	14.9 ± 0.4	13.5–18.5	0.1

*P values represent statistical differences between the average values of males and females (test = independent samples t-test). ALT = alanine transaminase; AST = aspartate transaminase; BUN = blood urea nitrogen; CRE = creatinine; GGT = gamma-glutamyl transferase; SEM = standard error of the mean.

Table 3. Serum biochemical parameters of Chukar partridges reported by other studies

Parameters	Species			
	Iranian Chukar partridge		Chukar partridge in Punjab province-Pakistan	
	Males (n = 88)	Females (n = 143)	Males (n = 10)	Females (n = 18)
Total proteins (g/L)	46.3 ± 1.4	45.8 ± 3.7	80.5 ± 3.7	102.8 ± 21.9
Albumin (g/L)	ND	ND	23.9 ± 2.2	24.8 ± 1.0
Globulin (g/L)	ND	ND	ND	ND
Total bilirubin (µmol/L)	0.3 ± 0.1	0.9 ± 0.3	ND	ND
ALT (U/L)	ND	ND	13.3 ± 3.9	13.9 ± 3.7
AST (U/L)	272.2 ± 24.3	394.0 ± 28.3	18.6 ± 4.7	68.4 ± 50.6
GGT (U/L)	ND	ND	ND	ND
BUN (mmol/L)	ND	ND	60.6 ± 10.1	35.0 ± 5.2
CRE (µmol/L)	17.0 ± 1.5	23.3 ± 1.6	4010.7 ± 1379.0	6497.4 ± 1663.7
Glucose (mmol/L)	16.0 ± 0.6	16.5 ± 0.6	ND	ND
Reference	(20)		(15)	

Values represent the averages ± SEM. ND = not done.

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