Al-Mukhtar Journal of Agricultural, Veterinary and Environmental Science 02 (2): 38-47, 2024
Doi: https://doi.org/10.54172/n5r61847

Research Article **Open Access**

A Descriptive Study of The Barbary Partridge in the Green Mountain Region of Cyrenaica - Libya

Tarek A. S. Altief [1*], Rayiqh A. Saeid [2], Salem A. Amaizik[3]

***Corresponding author:**
tarekhhakam@gmail.com,
Department of Animal Production, Faculty of Agriculture, Omar Al-Mukhtar University, Libya.

[2, 3] Department of Animal Production, Faculty of Agriculture, Omar Al-Mukhtar University, Libya.

Received:
30 June 2024

Accepted:
16 December 2024

Publish online:
31 December 2024

Abstract: This study was on the Barbary partridge found in the Jabal Al Akhdar region / Cyrenaica / Libya, (8) birds were captured, 4 males and 4 females, their estimated age (25 months). Body weight, body length, tail length and claw leg length were non-significantly increased in males. The distance between the tips of the wings was significantly higher ($P < 0.05$) in males. Beak length was non-significantly longer in females. The weight of the viscera in females was significantly higher ($P < 0.05$). The weight of the liver and gizzard of females was non-significantly higher. Heart weight in males is high without significance. The weight of the crop, glandular stomach and intestine was significantly higher ($P < 0.05$) in females. Red and white blood cells, hemoglobin, PCV, MCV, MCH, MCHC, platelets, glucose, calcium, magnesium, alkaline phosphatase, GOT, and LDL were elevated in females without significance. The urea concentration of males was significantly higher ($P < 0.05$). Triglycerides and VLDL were significantly higher ($P < 0.05$) in females. The level of uric acid, protein, albumin, potassium, cholesterol, GPT, total bilirubin, direct bilirubin, and indirect bilirubin was high without significance in males. Creatinine, sodium, chloride, and globulin are almost identical between males and females.

Keywords: Partridge, Blood, Blood Biochemistry, External Measurements, Viscera.

دراسة وصفية لطائر الحجل في منطقة الجبل الأخضر برقة– ليبيا

[1,2,3] قسم الإنتاج الحيواني، كلية الزراعة، جامعة عمر المختار، ليبيا.

المستخلص: هذه الدراسة كانت على حجل البربري الموجود في منطقة الجبل الأخضر برقة – ليبيا، تم حصول على 8 طيور 4 ذكور و4 إناث وتقدر اعمارها (25 شهر). وزن الجسم طول الجسم وطول الذيل والساق المخلب مرتفعة بدون معنوية في الذكور. بسطة الجناحين كان مرتفع معنويا ($P< 0.05$) في الذكور. طول المنقار كان أطول بدون معنوية في الإناث. وزن الأحشاء في الإناث كانت مرتفعة معنوية ($P< 0.05$). وزن الكبد والقانصة للإناث اعلى بدون معنوية. وزن القلب في الذكور مرتفع بدون معنوية. وزن الحوصلة والمعدة الغدية والامعاء كان مرتفع بمعنوية ($P < 0.05$) في الإناث. خلايا الدم الحمراء والبيضاء والهيموجلوبين و PCV و MCV و MCH و MCHC وللصفائح الدموية والجلوكوز والكالسيوم والماغنسيوم و Alkaline phosphatase و GOT و LDL مرتفع في الإناث بدون معنوية. تركيز اليوريا للذكور مرتفع معنويا ($P < 0.05$). الجلسريد الثلاثي و VLDL مرتفع معنويا ($P< 0.05$) في الإناث. مستوى لكل من حمض اليوريك والبروتين والالبومين والبوتاسيوم وكولسترول و GPT و Total bilirubin و Direct bilirubin و Indirect bile كان مرتفع بدون معنوية في الذكور. الكرياتينين والصوديوم والكلوريد والجلوبيولين شبه متطابق ما بين الذكور والإناث.

الكلمات المفتاحية: الحجل، الدم، التركيب الكيموحيوي للدم، القياسات الخارجية، الأحشاء.

INTRODUCTION

The Barbary partridge (*Alectoris Barbara)* is widespread in North Africa from Morocco to Egypt. The local partridge has been identified in Morocco, Algeria, Tunisia, and Libya, and may have become extinct in Egypt (Madge & McGowan, 2002). Partridges of the Phasianidae family, Galliformes species are widely distributed across southern Europe and North Africa (Libya, Algeria, Morocco, and Tunisia). Partridges have a short lifespan, which corresponds demographically to high hatching rates as reported by (Mahmood, et al., 2019). The partridges are among those species that have adapted to harsh climatic and environmental conditions and reproduce successfully. Partridges have strong beaks and legs. Partridges often coexist in family or social groups (flocks), especially outside the breeding season, and both sexes have similar plumage (Jennings, 2010). The partridge is one famous bird in Libya, whether in mountainous forests or semi-desert areas. Partridges in Libya:

During the summer and fall, in groups, but at the end of the year, they are in pairs or a few individuals. This bird builds its ground nests made of dry grass. During March and April, the female lays 8-16 eggs, which hatch within 22 days. they spend most of their time on the ground. They are fast running birds, and this adaptation helps them escape from enemies. They may resort to flying short distances. They breed once a year depending on environmental conditions and their breeding season usually ranges from October to February (Pavel, Abbas, & Dyary, 2023). Partridges are herbivores and eat leaves, seeds, grains, fruits, and sometimes insects if available. The declining numbers of this bird in Libya are attributed to overhunting by humans and egg collectors, or predation of eggs, chicks, and adults by jackals or foxes, as well as overgrazing, which leads to the deterioration of environmental conditions for this bird and the destruction of its living places and nesting sites. It was supported by (Gruychev, Dyakov, & Dimitrov, 2014). It is known that unregulated hunting of wild birds causes the mortality of more than 15% of breeding populations that produce 2-5 chicks per pair (Sandercock, Nilsen, Brøseth, & Pedersen, 2011). Several factors that increase this sharp decline in chick survival due to the use of pesticides, the loss of suitable areas due to intensive agriculture and the use of advanced agricultural mechanization, a decrease in the hatching rate, and an increase in predation (Wymenga, 2009). Tests are usually performed on domesticated birds and serve as supplementary data obtained by conducting various experiments.

The blood values of partridges in Libya are still unknown. No program has been conducted to inventory or estimate the numbers of these birds and to provide external descriptions and physiological tests and use them as a database for this bird in Libya. Due to the lack of research on the external description and some parts of the digestive tract and biochemical tests for the blood of partridges in Libya, this experiment was conducted on both sexes of partridges in Jabal al-Akhdar region in Cyrenaica/Libya as the beginning of a database about this bird to benefit in establishing reserves to preserve this bird from extinction

MATERIALS AND METHODS

Eight Barbary partridge birds were captured, 4 males and 4 females, their estimated age (25 months). The lengths of some of the external parts and the weight of some of the internal organs were measured. Blood samples were analyzed to measure each of the total number of red blood cells (RBC), the total number of white blood cells (WBC), packed cell volume (PCV), hemoglobin Hb, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC**)** and platelets (Plt.) using a device (Nihon Kohaden). Blood

samples were separated by centrifugation at 750 g (2500 rpm) for 15 minutes and stored at -20 °C until further analysis. Biochemical parameters of blood samples by a device (GBA 1000), and ions by a device (Diestro).

The data were statistically analyzed using the statistical program SPSS (Version 25), Kinnear and Gray, 2017, where LSD was used to compare means according to difference. Overall, p-values less than 0.05 were regarded as statistically significant.

RESULTS AND DISCUSSION

Table (1) shows the average body weight and lengths of some external parts for both sexes. Body weight was non-significantly but high in males, and this agrees with what is found for Gray partridges (Kokoszyński, et al., 2017) and (Kokoszyński, Bernacki, Korytkowska, Wilkanowska, & Frieske, 2013) and for Green-legged partridges (Kasperek, et al., 2021). However, (Mohammed & Al-Barzinji, 2022) in the Rock partridge and (Kirikçi, Tepeli, Çetin, Yilmaz, & Günlü, 2017) in the Barbary partridge, body weight was significantly higher ($P < 0.05$) in males than in females, and this may be due to The weight of the chest and thigh muscles of males, while (Nowaczewski, Kolanos, Krystianiak, Kontecka, & Gorecki, 2014) found that the weight of female Gray partridges is non-significantly higher than males. Body, tail, and claw leg length were non-significantly high in males. The distance between the tips of the wings was significantly higher ($P < 0.05$) in males than in females and was close to the values found by (Nowaczewski, Kolanos, Krystianiak, Kontecka, & Gorecki, 2014) and without significance. While beak length was non-significantly longer in females**.**

Table (1). Average external description of the two sexes of partridge.

Statement	Males	Females	SE±	Average
Body weight/g	328	308	11.9	320
Body length/cm	36.6	35.7	0.53	36.3
Tail length/cm	11.3	10.3	0.46	10.9
Wing span/cm	53.4^{a}	49.3^{b}	0.79	51.9^{***}
Beak length/cm	1.9	2.0	0.06	1.94
Claw leg length/cm	9.6	8.7	0.31	9.3

($P < 0.05$) a,b

The weight of the viscera in Table (2) of females was significantly higher ($P < 0.05$) than males. This may be due to the higher weight of the liver, gizzard, glandular stomach, and intestines in females, or to the percentage of the abdominal fat pad in females, as it was found in the Green-legged partridge (Kasperek, et al., 2021). The liver weight of females is non-significantly higher than that of males, consistent with what was reported for the Green-legged partridge (Kasperek, et al., 2021), the Gray partridge (Kokoszyński, et al., 2017), and in the Chukar partridge (Sevim, et al., 2020). While the general average was lower than Gray partridge (Putaala & Hissa, 1995). Heart weights in males are insignificantly higher than those in females, as in the Green-legged partridge (Kasperek, et al., 2021) and the Gray partridge (Kokoszyński, et al., 2017). It is significantly high ($P < 0.05$) in male Chukar partridge (Sevim, et al., 2020). The overall mean for this measurement was lower than for Gray partridge (Putaala & Hissa, 1995). The weight of the gizzard in females is non-significantly higher than in males, and it agrees with both (Putaala & Hissa, 1995), (Kokoszyński, et al., 2017) in Gray partridge and Chukar partridge (Sevim, et al., 2020). The overall mean of the

gizzard in this study was lower than that of the Sardinian partridge (Cappai, Arru, Manconi, Muzzeddu, & Pinna, 2016). The weight of the crop, glandular stomach, and intestines were significantly higher ($P < 0.05$) in females than in males.

Table (2). Average weight of internal viscera for both sexes of partridge.

Statement	Males	Females	SE±	Average
Weight of viscera/g	29.8^{b}	32.7^{a}	0.77	30.9
Liver weight/g	4.91	5.38	0.22	5.09
Heart weight/g	2.03	1.67	0.11	1.90
Gizzard weight/g	12.0	12.9	0.40	12.4
Weight of crop, glandular stomach and intestine/g	10.8^{b}	12.7^{a}	0.45	11.5^{*}

($P < 0.05$) a,b

Table (3) shows the total number of WBC and RBC blood cells, some of their characteristics, and some biochemical compositions of the plasma. RBC was non-significantly higher in females than in males, contrary to what (Farooq, et al., 2019) found in Chukar partridge. The general mean RBC was close to what was published (Straková, Suchý, Kábelová, Vitula, & Herzig, 2010) for the Chukar and Gray partridge, and was least for the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977). The total WBC count in females was high without significance, and this is in contrast to what was found in the Chukar partridge (Farooq, et al., 2019), where it was found to be higher in males and also without significance. The level of Hb was high in females without significance, while (Farooq, et al., 2019) found it higher in males of Chukar partridge, as well as (Kasperek, et al., 2021) in Green-legged partridge, it was significantly high ($P < 0.05$) in males. This difference may be due to the sex of the bird (Fallaw, Jones, & Hughes, 1976). The overall average Hb was lowest for Chukar and gray partridge (Straková, Suchý, Kábelová, Vitula, & Herzig, 2010). The PCV level was high in females without significance. It does not agree with what was published on the Chukar partridge (Farooq, et al., 2019), where this measurement was found to be high in males, and also what was reported by (Kasperek, et al., 2021) about the Green-legged partridge, so it was Significantly higher ($P < 0.05$) in males, this difference may also be due to the sex of the bird (Fallaw, Jones, & Hughes, 1976).

The overall mean PCV in the study was consistent with what was found (Straková, Suchý, Kábelová, Vitula, & Herzig, 2010) for the Chukar and Gray partridge, and lower than what was found (Rico, Braun, Benard, & Burgat-Sacaze, 1977) for the Red-legged partridge. The MCHC level for this measurement in this research was higher in females without significance, while in Chukar partridge, the opposite was found, as it was higher in males than females (Farooq, et al., 2019). The overall average MCHC was similar to that of the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977), and lower than that of the Chukar and Gray partridge (Straková, Suchý, Kábelová, Vitula, & Herzig, 2010). Total number Plt. it was non-significantly higher in females than in males, and this agrees with that of the Chukar partridge (Farooq, et al., 2019).

Glucose concentration was higher in females than males and without significance, which agreed with the Chukar partridge for both (Sevim, et al., 2020) and (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011). This may be due to the physiological state of the birds, or the collection of blood samples in the stage of preparation for laying eggs, and at this stage ,many changes in the organs may lead to high blood glucose levels in females, as in chickens (Adewole, et al., 2021). This average glucose concentration in this study was higher than that of the Red-legged partridge (Ozbey & Esen, 2006) and (Rico, Braun, Benard, & Burgat-Sacaze, 1977), and lower than that of the Chu-

kar partridge (Simsek, et al., 2020). The protein concentration in birds ranges between (3-5 g/dl) (Khazraiinia, Saei, Mohri, Haddadzadeh, & Darvisihha, 2006). Total blood protein levels increase with age, and this is due to the development and improvement of protein biosynthesis processes, which is associated with the growth and development of the digestive system in partridges (Topchiyeva, 2022). Increased blood protein concentration can be due to dehydration or chronic infections with low plasma protein due to low protein content in the leech and decreased albumin formation in the liver. The protein was high in males without significance, consistent with what was published about the Chukar partridge (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011).

The value of the average overall protein in this study is consistent with what was reported by (Ozbey & Esen, 2006) in the Rock partridge, (Rico, Braun, Benard, & Burgat-Sacaze, 1977) in the Red-legged partridge, and higher than what was reported by (Topchiyeva, 2022). Albumin level was higher in males than females and without significance. The globulin concentration was like that in males and females. The urea concentration in this research was significantly higher ($P < 0.05$) in males than in females, while (Sevim, et al., 2020) found that the urea level was higher in males than females, but without significance. While (Kasperek, et al., 2021) found that, this measurement in Green-legged partridge is higher in females than in males, without significance. The average urea in this study was higher than what was found in the Rock partridge (Ozbey & Esen, 2006), the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977), and the Chukar partridge (Simsek, et al., 2020). High-protein diet intake, increased protein metabolism, stress, and dehydration affect blood uric acid concentration because it is produced because of protein metabolism (Odunitan-Wayas, Kolanisi, & Chimonyo, 2018). The uric acid level was non-significantly high in males, and may be due to the higher metabolic rate in males due to sexual activities and the development of secondary sexual characteristics (Rodríguez, Tortosa, & Gortázar, 2006).

The uric acid level is consistent with that of both gray partridge and Shukar partridge (Nikolov & Kanakov, 2021). While it is contrary to what was found in the Chukar partridge (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011). The overall mean of this measure in this study was higher than for the Gray partridge and the Chukar partridge (Nikolov & Kanakov, 2021), the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977), and the Chukar partridge (Simsek, et al., 2020). Knowing the level of creatinine determines the functional status of the kidneys. In this study, creatinine was almost identical between males and females, with a slight increase in males, consistent with what was mentioned by (Nikolov & Kanakov, 2021) in Gray partridge and Chukar partridge, and it may be due to skeletal muscle activity. The level of this measurement is not consistent with what was found in Chukar partridge (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011), where creatinine was found to be significantly higher ($P < 0.05$) in females than in males. While (Kasperek, et al., 2021) found that, this measurement in Green-legged partridge is higher in males than females without significance. The overall average for this measure in this study was lower than for the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977) and (Nikolov & Kanakov, 2021) Gray partridge and Chukar partridge.

Cholesterol was higher in males than females and without significance, consistent with what was written by (Simsek, et al., 2020) and in Chukar partridge (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011). While it was higher in female Green-legged partridges than in males (Kasperek, et al., 2021). The general mean value of this measurement is higher than what was found by (Ozbey & Esen, 2006) in the Rock partridge and (Rico, Braun, Benard, & Burgat-Sacaze, 1977) in the Red-legged partridge. Triglyceride is significantly higher ($P < 0.05$) in females than in males, consistent with what was published by (Sevim, et al., 2020) and (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011) in Chukar partridge and (Kasperek, et al., 2021) in the Green-legged partridge,

and this difference between the sex may be due mainly to physiological factors (Scholtz, Halle, Flachowsky, & Sauerwein, 2009) or the effect of preparation for laying eggs (Adewole, et al., 2021). The overall mean of this measurement in this study was higher than that of Rock partridge (Ozbey & Esen, 2006) and Chukar partridge (Simsek, et al., 2020). This study found that calcium level was high in females without significance, as found by (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011) in Chukar partridge, where this measurement was found to be higher in females than in males. The average concentration in this research is consistent with that of the Rock partridge (Ozbey & Esen, 2006), and higher than (Simsek, et al., 2020) in the Chukar partridge.

The sodium level between males and females was identical; this result is consistent with what was found in Rock partridge (Ozbey & Esen, 2006). The overall mean was identical to that of the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977). The potassium measurement for males was non-significantly higher than for females, and its average was lower than that of Rock partridge (Ozbey & Esen, 2006). The overall mean was slightly lower than for the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977). There were no significant differences between chloride between males and females, and the average concentration was very close to what was published by (Ozbey & Esen, 2006) about the Rock partridge. The general average was highest for the Red-legged partridge (Rico, Braun, Benard, & Burgat-Sacaze, 1977). Magnesium was slightly and non-significantly high in females. The phosphate concentration in males was higher than its level in females without significance, consistent with what was mentioned by (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011) in Chukar partridge. Alkaline phosphatase level was non-significantly higher in females than males. The general average was lower than what was reported (Rico, Braun, Benard, & Burgat-Sacaze, 1977).

The activity of the enzyme Alanine aminotransferase (ALT) in the blood of the partridge indicates the destruction of tissue cells that contain this enzyme, and its increased activity in the blood of the partridge may appear before the appearance of pathological signs (Topchiyeva, 2022). This measurement was non-significantly higher in males than females, consistent with the Green-legged partridge (Kasperek, et al., 2021), while (Nikolov & Kanakov, 2021) found it to be higher in females than males in the Gray partridge and (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011) in Chukar partridge. The overall mean in this study was higher than that found for Rock partridge (Ozbey & Esen, 2006) and lower than for Gray partridge (Nikolov & Kanakov, 2021).

The level of aspartate transaminase (AST) was higher in females than males and without significance, consistent with the Gray partridge (Nikolov & Kanakov, 2021), the Green-legged partridge (Kasperek, et al., 2021), and the Chukar partridge (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011). The overall mean for this measurement in this research was lower than (Nikolov & Kanakov, 2021) in Gray partridges and (Ozbey & Esen, 2006) in Rock partridges. These enzymes are negatively affected by factors such as muscle injury, organ disruption, nutritional status, physical activity, hemolysis, treatment, and preservation method of plasma samples (Adewole, et al., 2021). Serum proteins act as a transport medium for bilirubin and hormones.

The level of total bilirubin was higher in males than in females without significance, while (Nazifi, Mosleh, Ranjbar, & Khordadmehr, 2011) a significant increase ($P < 0.05$) was found for this measurement in females of the Chukar partridge than in males . The levels of both Bili direct and Bili indirect are higher in males than in females without significance. The level of High Density Lipoprotein (HDL) was higher in males than in females, without significance. Low Density Lipoprotein (LDL) plays a role in providing cholesterol to the body's tissues because LDL is the main carrier of cholesterol and triglycerides from the liver to the body's tissues, so the level of LDL in the blood is

affected by the cholesterol concentration. LDL in females is non-significantly higher than in males, and the overall average in this study was higher than that of the Chukar partridge (Simsek, et al., 2020). Fatty acid synthesis in birds is mainly in the liver, and adipose tissue growth and subsequent fattening depend on the availability of plasma triglycerides, which are transported as components of lipoproteins by Very Low-Density Lipoproteins (VLDL) (Dominique, 1997). The VLDL level in females is significantly higher ($P < 0.05$) than in males, consistent with that of broiler chickens (Angoua, Soualio, Howélé, Julia-Francine, & Angoué, 2021).

Table (3). Average measurements of blood and plasma components for both sexes of partridge.

Statement	Males	Females	SE±	Average
Red blood cells (106 /µl)	2.33	2.34	0.12	2.34
White blood cells (103 /µl)	111	116	9.7	113
HGB(g/dL)	8.7	10.8	1.38	9.5
PCV(%)	38.5	40.4	1.89	39.2
MCV(fl)	166	172	3.47	169
MCH pg	30.5	38.1	4.08	33.0
MCHC(g/dl)	22.0	26.7	3.19	23.8
PLT (103 /µl)	22.2	31.0	8.39	25.5
Glucose (mg/dL)	34.5	2.45	40.1	39.1
Protein (mg/dL)	4.39	4.29	0.23	4.35
Albumin (g/dL)	1.26	1.15	0.12	1.22
Globulin (mg/dL)	3.13	3.14	0.25	3.13
Urea (mg/dL)	11.9[a]	6.5[b]	1.05	9.9
Uric acid (mg/dL)	12.9	5.7	2.18	10.1
Creatinine (mg/dL)	0.43	0.42	0.02	0.43
Cholesterol (mg/dL)	246	242	12.2	244
Triglycerides (mg/dL)	88.2[b]	160[a]	6.56	115
Calcium (mg/dL)	10.4	10.7	0.14	10.54
Sodium (mg/dL)	154.5	154.6	0.55	154.5
Potassium (mg/dL)	5.98	5.80	0.06	5.91
Chloride (mg/dL)	115.8	115.3	0.34	115.6
Magnesium (mg/dL)	2.03	2.23	0.09	2.10
Alkl. Phosphate U/L	693	1086	194	841
GPT / ALT (U/L)	23.6	13.8	8.07	19.9
AST/ GOT (U/L)	14.7	19.6	5.36	16.5
Bilitotal (mg/dL)	0.134	0.107	0.02	0.123
Bili direct (mg/dL)	0.042	0.027	0.007	0.036
Bili direct (mg/dL)	0.092	0.080	0.015	0.088
HDL (mg/dL)	149	155	1.87	151
LDL (mg/dL)	79.6	55.0	13.0	70.4
VLDL (mg/dL)	17.6[b]	31.7[a]	2.86	22.9

($P < 0.05$) a,b

Conclusion and recommendation

This bird is considered one of these birds that symbolizes the identity of Libya. Previously, postage stamps carried the image of this bird. This study is the beginning of conducting multiple researche to create a broad database that may establish reserves for that kind of bird. Also knowing the positive and negative impacts, especially on birds and farm animals. We recommend that research be conducted on the partridge bird on a broader scale that includes all research interests.

ACKNOWLEDGEMENT

The work team extends its sincere thanks to the Department of Wildlife Materials, College of Natural Resources, especially Dr. Kamila Al-Wahsh, as well as the faculty members in the Department of Animal Production, Faculty of Agriculture, Omar Al-Mukhtar University, for the scientific guidance they provided that would benefit the research.

Duality of interest: The authors declare that they have no duality of interest associated with this manuscript.

Author contributions : Contribution is equal between authors.

Funding: No specific funding was received for this work.

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