Research Article

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Morphological and Histological Study of The Liver and Gallbladder in the Iraqi Pin-Tailed Sandgrouse *Pterocles alchata* (L.1766)

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Abstract

A morphological and histological study was conducted on the liver and gallbladder in the Iraqi pin-tailed sandgrouse *Pterocles alchata.* Which were collected from the local market in the city of Baghdad ,there were 8 samples and their ages ranged from 11months to year ،the organs were extracted for the purpose of Study after the animals were anesthetized by inhaling Chloroform. The study showed that the liver is located at the upper part of the thoracic cavity; its weight is (0.14±7.63) gm, its length is (0.13 ±35.13) mm and its width is (0.68 ±31.00)mm. The liver consists of two large parts: The right lobe with a length (0.13±35.13) mm, and the left lobe with a length (0.3 3±28.50) mm and is characterized with a reddish-brown colour. The gallbladder is located at the visceral side of the right lobe of the liver, its length is (0.38±12.38) mm and its width is (0.31 ±5.88) mm. Further, it appears in oval or pear shape and has green colour; it consists of the head, body and neck. The liver parenchyma consists of hepatocyte cells arranged in the form of cords known as hepatic cords arranged radially towards the central vein, spread within the parenchyma of the liver portal area, surrounded by connective tissue. Besides, it includes the hepatic portal area, branch hepatic artery, bile duct lymphatic vessels, which are scattered within the connective tissue surrounding the portal area. The gallbladder consists of the mucous tunic consisting of elongated columnar cells with basal oval nuclei located, below them is the lamina propria, then a layer of smooth muscle fibers arranged to form the tunica muscularis, followed by the tunica serousa or adventitia, which consists of loose connective tissue.

Keywards: Bird ، Gallbladder ، Liver ، *Pterocles alchata*.

دراسة مظهرية نسجية للكبد وكيس الصفراء في طائر القطا العراقي مسنن الذيل (L. 1766) *Pterocles alcata*

اجريت دراسة مظهرية نسجية على الكبد وكيس الصفراء في طائر القطا العراقي مسنن الذيل ، جمعت عينات الدراسة من السوق المحلية في مدينة بغداد وكان عددها 8 عينات وأعمارها تتراوح بين (11شهر –سنة) واستخرجت الاعضاء لغرض الدراسة بعد ماتم تخدير الحيوانات بأستنشاق الكلوروفورم ، اظهرت نتيجة الدراسة ان الكبد يقع في الجزء العلوي من التجويف البطني بلغ وزنه (0.14±7.63) غم، بلغ طوله (0.13±35.13) ملم و بلغ عرضه (0.68±31.00) ملم ، يتكون الكبد من فص ايمن كبير بلغ طوله (0.13±35.13) ملم ،وفص ايسر صغير بلغ طوله(28.50 ±0.33) ملم، ذو لون بني محمر، يقع كيس الصفراء في الجانب الاحشائي للفص الايمن ويظهر بشكل كيس بيضوي الشكل اخضر اللون ، يتكون من الراس ، عنق وجسم طوله (0.38±12.38) ملم وعرضه (0.31±5.88) ملم ،يحاط الكبد بطبقة من نسيج ضام هي محفظة كليسون، يتكون متن الكبد من خلايا كبدية مرتبة بشكل حبال تعرف بالحبال الكبدية تترتب شعاعيا وتتجه نحو الوريد المركزي تنعزل الحبال الكبدية عن بعضها البعض بواسطة الجيبانيات الكبدية التي تبطن بالخلايا البطانية مغزلية الشكل وخلايا كفر البلعمية ، يتواجد ضمن متن الكبد الباحة البابية التي تحاط بنسيج ضام وتتكون من فروع قنوات الصفراء وفروع الشرايين الكبدية والقنوات اللمفاوية ، يتكون جدار كيس الغلالة المخاطية التي تتكون من ظهارة عمودية تليها طبقة من الالياف العضلية الملساء ثم الغالالة المصلية التي تتكون من نسيج ضام مفكك .

Introduction

The liver is considered as the main organ in vertebrates, is responsible for stabilizing the body and its balance, and provides it with the necessary energy. It is one of the largest glands accessories with the digestive system (1). Further, it has multiple functions, including the ability to store metabolism of proteins and fats(25), and the secretion of gallbladder, detoxification and phagocytosis substances and foreign bodies entering the body (2, 3, 4, 5, 6) ، Purifing blood from toxins (24)(27) and diagnosing diseases using liver enzymes (26)

The liver is located in the middle anterior ventral body, and its largest part is located within the thoracic ribs region of the body cavity while the other part is located on the opposite side of the sternum (7, 8, 9, 10). The liver is divided into two lobes: The right and left lobes and the size of the two varies according to the species of birds (11).

The liver lobe is connected to the middle side, and the right lobe is larger than the left one. In most birds, the parietal surface of the liver is convex while the visceral or dorsal surface is concave and the gallbladder takes an internal location of the right lobe from the liver (12). The gallbladder is in the form of a green cystic structure and consists of three areas: Head, Body and Neck (13).

The birds' liver consists of an outer layer that has mesothelia cells called the peritoneal layer. Below this layer there is an irregular dense connective tissue (14). This tissue includes a small number of collagen as well as elastic fibers. This layer is represented by the Glisson capsule (15). The liver consists of hepatic parenchyma consisting of hepatocytes, hepatic sinusoids, hepatic cords, central veins, and portal area (16, 17).

Hepatocytes are arranged in the form of a network of cords consisting of (4-6) cells each. The thickness of the two polygonal cells is characterized with a single oval-shaped nuclei that is close to the basal part of the hepatocyte connected by tight junctions (18). Hepatocytes perform many functions, including detoxification, storage of fats, carbohydrates and vitamins, as well as metabolism (19). The gallbladder consists of three layers (tunics): The first layer is the tunica mucosa, comprising columnar cells with basal nuclei arranged in one row of cells. Besides, they appear in other areas in a form of striated columnar epithelium tissue due to the elongation of the cells, which gives them a stratified appearance. This tunica may contain some goblet cells, followed by the lamina propria layer consisting of loose connective tissue interspersed with capillaries and lymphocytes alone or in clusters, where the muscularis mucosa is absent. The mucosa layer consists of microvilli-like folds and appears when the gallbladder is empty and their number and shape vary according to the size of the bile. Between these folds are structures known as crypts (20), the tunica muscularis, which consists of smooth muscle fibers arranged in a circular shape and is followed by the tunica serosa if its surface is free (loose) or called the tunica adventitia if its surface is not free (21).

The gallbladder is of great importance, as it is a store for the bile material, which works to digest lipids, as it secretes a mucous substance by the cells lining it, which forms a protective layer for the outer cells of the gallbladder (22, 23).

Due to the importance of the birds, many studies have been conducted in this field, including that of (29,30,31,32,47,48),the current study also aims to study morphological and histological structure of the liver and gallbladder of the Iraqi pain tailed Sandgrouse .

Material and Methods

The study exposes the histological structure of the liver and the gallbladder of the Iraqi pin-tailed sandgrouse (*Pterocles alchata*). The study samples includes (8) male samples that were separated liver and gallbladder after the slaughter and dissect of animals .

The samples are kept with formalin solution at a concentration of (10%) for the purpose of fixation for a period of (48) hours (28).

The samples underwent routine steps for preparing histological slides

Samples are stained with Harris hematoxylin-eosin stain for demonstrating the general histological components, Periodic acid Schiff (PAS), (Massoin stain) and (Gemsia stain) for distinguish carbohydrates and

Research Article
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Vol. 17 Issue:2, (2024) ISSN: P-1999:6527 E-2707:0603

Collagen fibers, based on,(32), then examined using the compound light microscope from the Japanese company Meijitechn with a power of 4x, 10x, 40x, 100x.

Results and Discussion

The liver :-

The study showed that the liver is located at the upper part of the thoracic cavity,(Figure:1) its weight is (0.14±7.63) gm, its length is (0.13±35.13) mm and its width is (0.68±31.00) mm and is a reddish-brown in colour. It consists of two large right lobes with length (0.13±35.13) mm and a small left lobe with length (0.33±28.50) mm. (Figure:2),this is similar to what is found in some birds such as :*Passer domesticus* (34), *Larus canus* ,*Agaporins fischeri* ,*Numida meleagris* (35),*Fulica atra* (36),*Sturnus vulgris*(37),*Gallinulachloropus*(38), *Columbae livia domestica* (39).While the left lobe is larger than the right lobe in *Struthio camelus L.* (40),(41), *Melopsittacus undulates* (42).

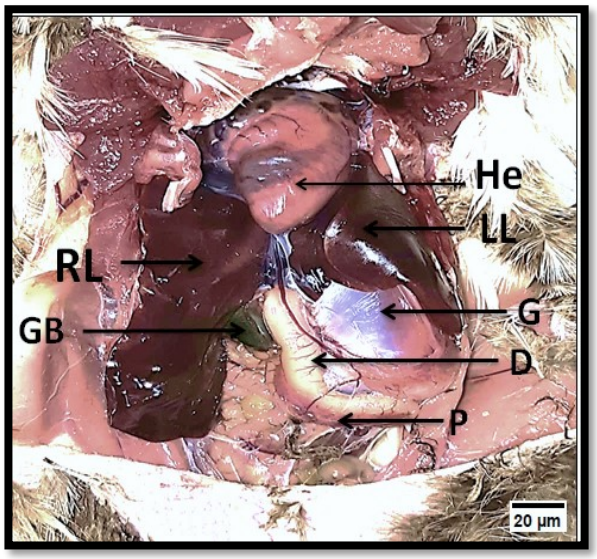

Figure 1. Ventral view of the Iraqi pin-tailed sandgrouse *Pterocles alchata* showing Dudenum (D), Gall Bladder (GB), , Gizzard (G), Heart (He) Left Lobe (LL) Pancreas (P), Right Lobe (RL), Scale bar 20µm.

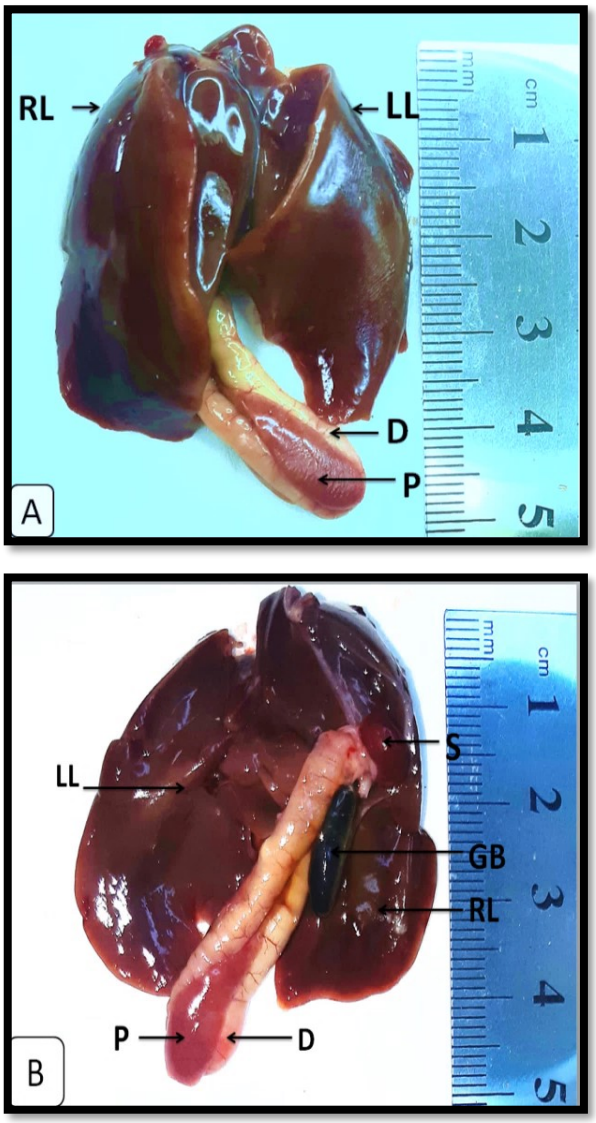

Figure 2. The liver in Iraqi pin-tailed sandgrouse *Pterocles alchata* , Showing : Dodenum (D), Gall Bladder (GB), Left Lobe (LL), Pancreas (P), Right Lobe (RL), Spleen (S), (A)- Dorsal view (B)- Ventral view.

The liver is surrounded from the outside by a layer of connective tissue known as the Glisson capsule;(Figure:3)

Research Article
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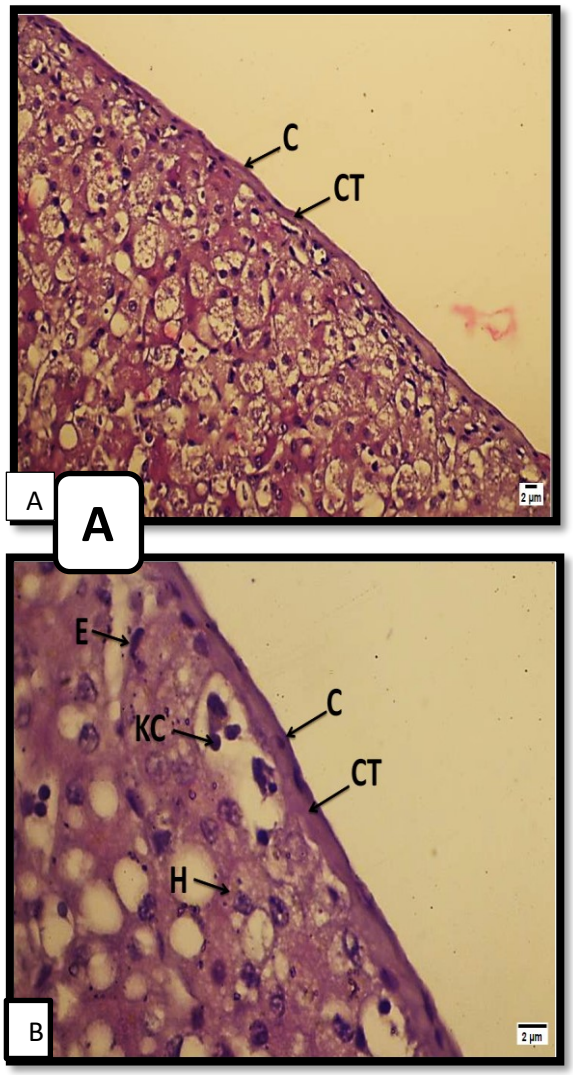

Figure 3. Transverse section of the liver in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing Glisson capsule (C), Connective tissue(CT), Hepatocyte (H), Kupffer Cell (KC),Endotheilum cell (E), A:40 X, B:100 X, (H&E), Scale bare= 2µm.

the liver parenchyma consists of polygonal hepatocytes with spherical nuclei arranged radially in the form of cords known as hepatic cords and heading towards the central vein. Hepatic cords are isolated by spaces known as hepatic sinusoids, which are lined with two types of cells, the first type of cells is endothelial cells that are flat with elongated nuclei and the second type is Kupffer cells that are larger in size with large spherical nuclei, spread within the liver tissue(Figure :4),

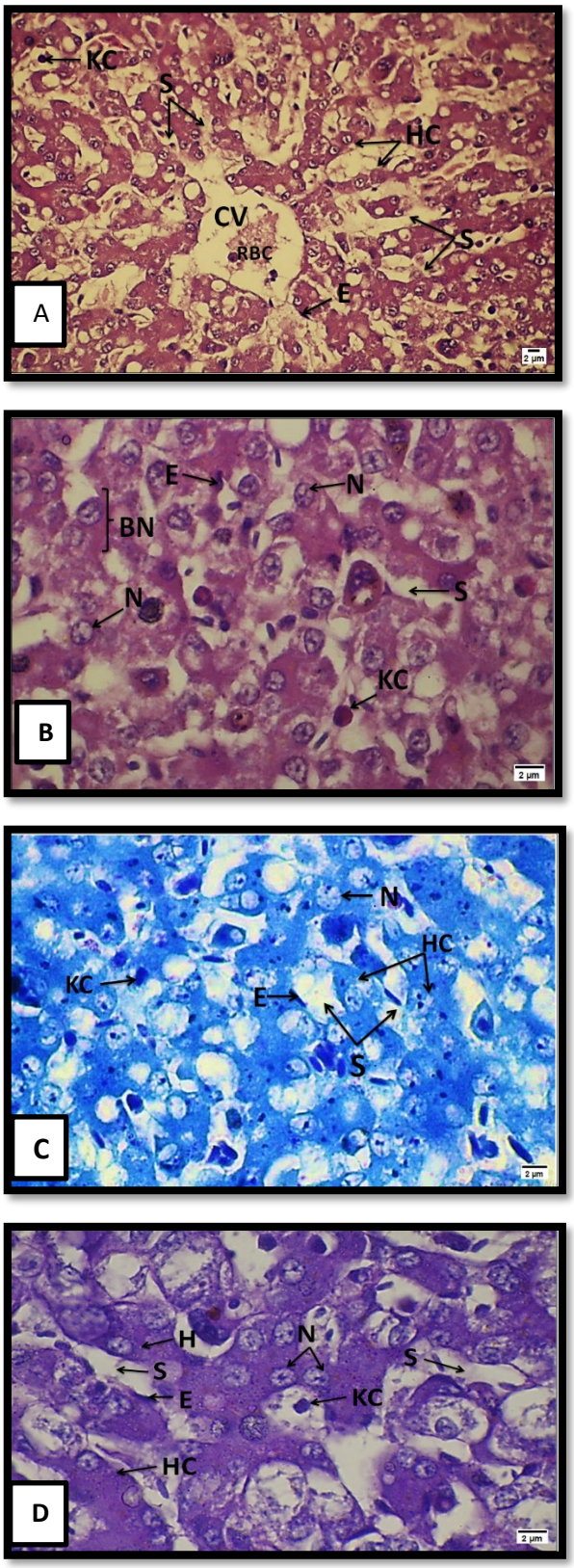

Figure 4. Transverse section of the liver in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing, Bi nucleated (BN)، central Vein (CV), Endothelial cells (E), Hepatic Cords (HC), Hepatocytes (H), Kupffer Cells (KC), hepatocyte nuclei (N), Red Blood Cells (RBC), Sinusoids (S), A: 40X, B: 100X (H&E) , C:100X (Geimsa stain), ,D: 100X (PAS), Scale bare = 2µm.

Research Article
AL- ANBAR JOURNAL OF VETERINARY SCIENCES
Vol. 17 Issue:2, (2024) ISSN: P-1999:6527 E-2707:0603

the portal area, which is surrounded by connective tissue. It includes the branch of the hepatic portal vein is large in size and lined with epithelial cells and a layer of smooth muscle fibers,(Figure:5), The bile ducts are lined with cuboidal epithelial cells surrounded by smooth muscle fibers. The lymphatic vessel is located in the form of a small cavity spread within the connective tissue that surrounds the portal area,(Figure:6), these results are similar with the liver of the *Passer domesticus* (34) , *Sturnus vulgaris* (37),*Gallinula chloropus* (38),*Columbae livia domestica* (39) ,*Frivaldszky*(44) and *Tyto alba* (47). the branch of the hepatic artery with a thick wall and a narrow cavity lined with spindle cells whose nucleus is directed towards its cavity and is surrounded by two or more layers of smooth muscle fibers(Figure:7),these results are similar to what is found in the liver of *Gallinula chloropus* (38*),Melopsittacus undulates* (42),*Frivaldszky*(44) and *Coturnix coturnix japonica* (45*).*

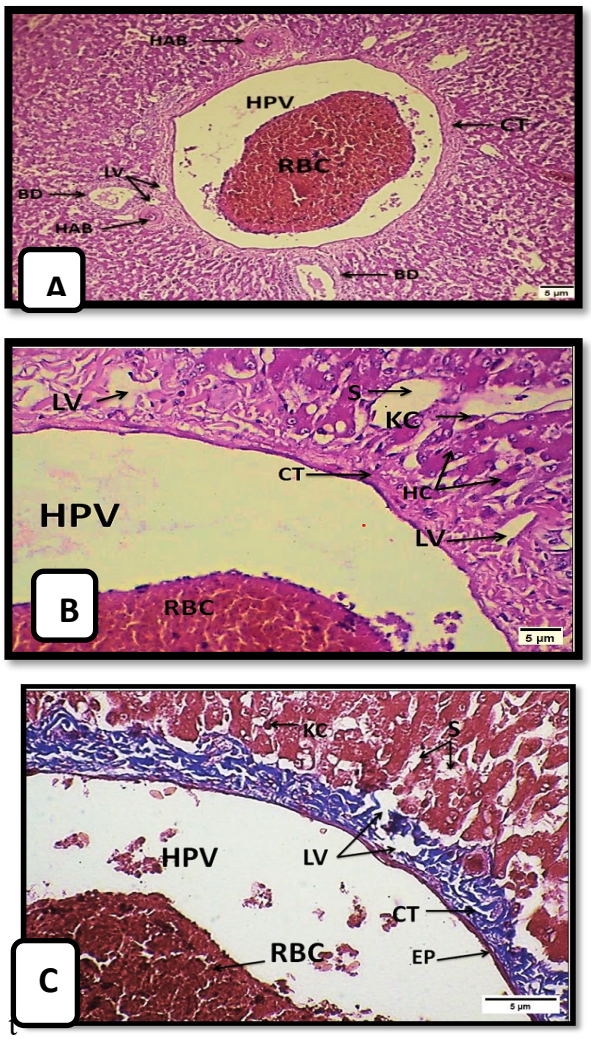

Figure 5. Transverse section of portal area (Pa) in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing, Bile Duct (BD), connective tissue (CT), Hepatic portal Vein (HPV) Hepatic Artery Branch (HAB), Hepatic cords (HC), Kupffer cell (KC) Lymphatic Vessel (LV), Red Blood Cells (RBC), Sinusoids (S), A:10X, B:40X (H&E), C:40X (Massoin stain), Scale bare = 5µm.

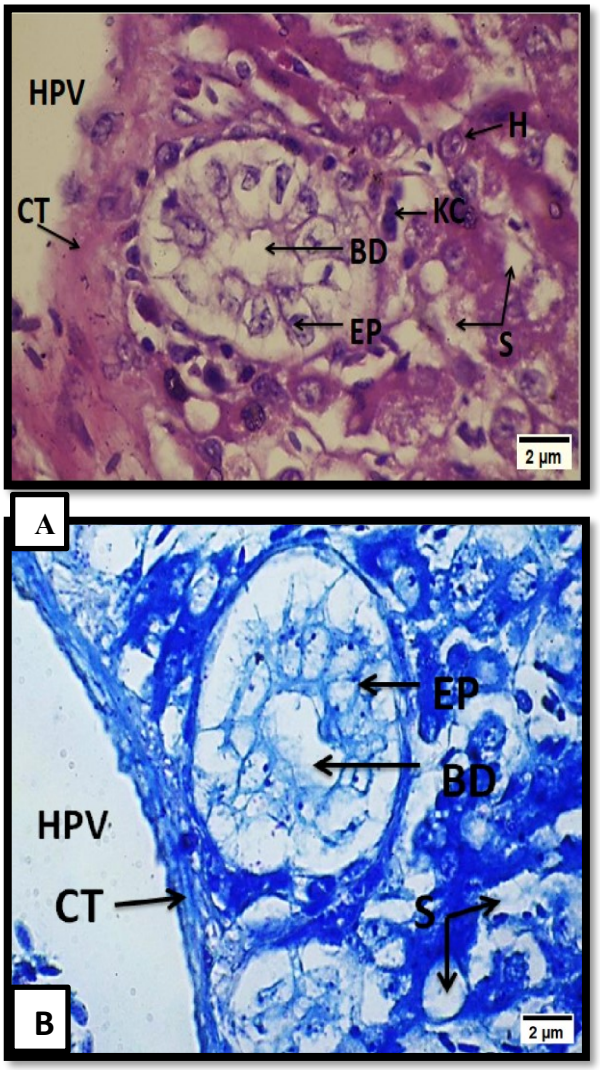

Figure 6. Transverse section of portal area in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing, Bile Duct (BD), connective tissue (CT), Hepatic portal Vein (HPV), Kupffer cell (KC), Hepatocyte (H), Epithluim cell (EP), Sinusoids (S) A:bile duct (H&E), B:bile duct (Geimsa), 100X, Scale bare = 2µm.

Research Article
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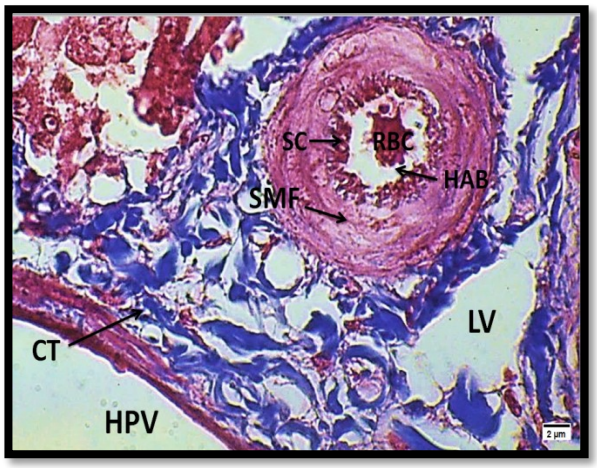
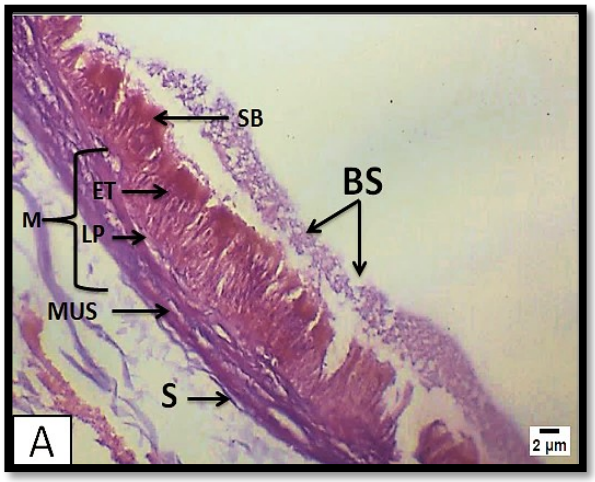
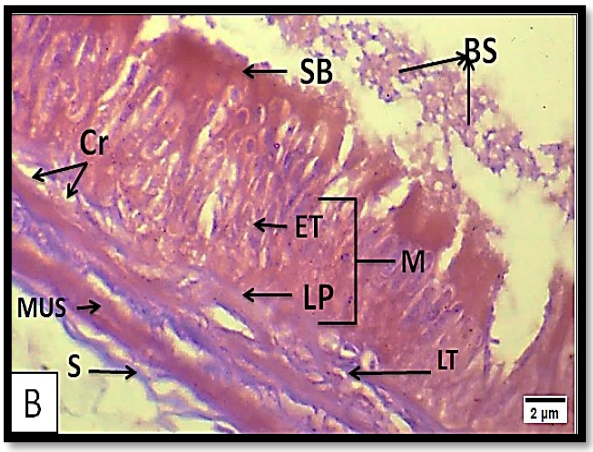


Figure 7. Transverse section of portal area in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing, connective tissue (CT), Hepatic portal Vein (HPV), Hepatic Artery Branch (HAB), Smooth macules fibers (SMF), Squamous Cell (SC), Lymphatic vesseles (LV), (Massoin stain), 100X,Scale bare =2µm.

The gall bladder :-

. The gallbladder is located within the visceral surface of the right lobe of the liver, its length is (0.38±12.38) mm and its width is (0.31±5.88) mm an oval or pear-shaped cyst with a green colour consisting of the head, body, and neck(Figure:2),.this result similar with gallbladder in *Passer domesticus* (34) and *Gallinula chloropus* (38) ,the gallbladder is cylindrical in shape in *Anser banikarval* ,While in *Anas gallo pavo* it looks like a been (43), the gallbladder is not present in *Melopsittacus undulates* (42).





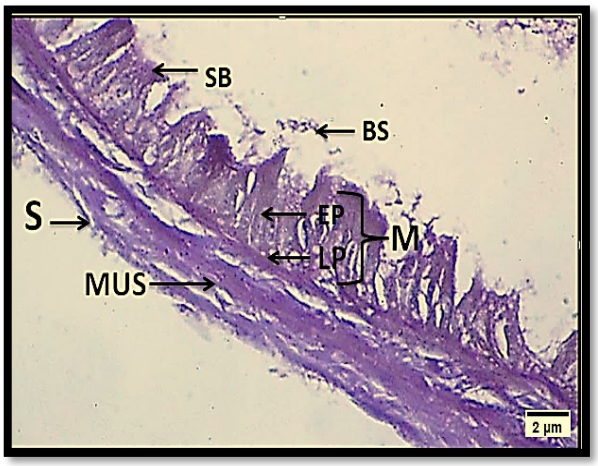


Figure 8. Transverse section of the gallbladder in Iraqi pin-tailed sandgrouse *Pterocles alchata* showing, Bile Secretions (BS), crypts (Cr), Epithelial Tissue (ET), Lamina Propria (LP), Lymphoid tissue (LT), tunica mucosa (M), tunica muscular (MUS), tunica serous (S), Stratified Border (SB), A: 40X, B: 100X, (H&E), C: 40X, (PAS), Scale bar 2 µm.

The gallbladder consists of the tunica mucosa, which in turn consists of Stratified columnar epithelial tissue, based on the lamina propria layer. This layer comprises loose connective tissue interspersed with a few clusters of lymphocytes and crypt, and is followed by tunica muscularis comprising of smooth muscle fibers and the tunica serous or adventitia that is composed of loose connective tissue.(Figure:8),this result is similar with gallbladder in *Gallus gallus domesticus* (46) ,

Conclusion

The liver in *Pterocles alchata* consist of a large right lobe and small left lobe of rddish-brown color , surrounded on the out side by Glessoin capsule ,the liver paranchyma consist of hepatic

cells arrange in the form of cords heading towards the central vein separating the cords from the sinusoids that are lined with endothelium cells and Kuffer cells , the portal area consist of hepatic portal vein ,the branches of the bile duct,the hepatic artery and lymphatic vessels.the gall bladder appears on the visceral side of the right lobe in the form of green oval sac consisting of three tunica ,the mucosa ,the muscularis and the serosa .

Acknowledgment

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Conflict of interest

There are no conflicts of interest.

Ethical Clearance

The samples were gained according to Local Research Ethics Committee approval in College of Education for Pure Sciences (Ibn Al-Haitham), University of Baghdad, No. EC-6 in 4/3/2024.

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