

A Comparative Anatomical and Histological Analysis of some Iraqi Birds' Liver: Review

Isrra Adnan Auda Khadhim^{1*}, Wurood Alwan Kadhim²
Manar Mohammad Hasan Al-Murshidi³

1 College of Education for Pure Science (Ibn Al-Haitham), University of Baghdad, isrra.a@ihcoedu.uobaghdad.edu.iq,
Baghdad, Iraq.

2College of Science for Women, University of Babylon, wsci.wurood.kadhim@uobabylon.edu.iq, Babylon, Iraq.

3College of Science for Women, University of Babylon, manarbio2@gmail.com, Babylon, Iraq.

*Corresponding author email: isrra.a@ihcoedu.uobaghdad.edu.iq; mobile: 07745958533

تحليل تشريحى ونسجى مقارن لكبد بعض الطيور العراقية: مراجعة

اسراء عدنان عودة كاظم^{1*}, ورود علوان كاظم², منار محمد حسن المرشدي³

1 كلية التربية للعلوم الصرفة (ابن الهيثم), جامعة بغداد, isrra.a@ihcoedu.uobaghdad.edu.iq, بغداد, العراق

2 كلية العلوم للبنات، جامعة بابل، wsci.wurood.kadhim@uobabylon.edu.iq، بابل، العراق

3 كلية العلوم للبنات، جامعة بابل، anarbio2@gmail.com، بابل، العراق

Accepted:

28/12/2025

Published:

31/12/2025

ABSTRACT

Background:

As a critical organ of the avian digestive system, the liver is involved in metabolism, detoxification, bile production, and the synthesis of proteins. It is an organ that typically appears bilateral in birds, being positioned ventrally to the body cavity. The right lobe is usually larger than the left in most species. The color and structure of the liver, and the presence or absence of a gallbladder, depend on species, diet, and physiology.

Materials and Methods:

This review is based on an analysis of morphological and histological data from research conducted on livers of various Iraqi birds. The data included anatomical descriptions, lobular organization, vascular organization, and histological characteristics of the liver such as hepatocyte organization and sinusoidal structure.

Results:

The reviewed data show that in Iraqi birds, the avian liver is bilobed, encapsulated in connective tissue (Glisson's capsule), and divided into lobules that vary in distinctness. Hepatocytes are polygonal in shape and organized in cords surrounding the central vein; sinusoids are lined by endothelial and Kupffer-like cells. The portal triad includes the hepatic artery, portal vein, bile duct, and lymphatic vessels.

Conclusion:

The morphological and histological characteristics of the livers from Iraqi birds show both uniformity of structure as well as species differences. These differences reflect ecological adaptations, dietary habits, and evolutionary traits. Understanding these liver features provides essential insights into avian physiology, health, and comparative anatomy among Iraqi bird species.

Key words: Anatomical description, Bird, Liver, Histological structure, Morphological description



INTRODUCTION

The liver is considered the most vital and important gland in the body and shows a essential role in a variety of physiological processes, like the syphoning of blood proteins, the synthesis and secretion of bile substances detoxification the absorption of nutrients, absorption the metabolism of various materials, and the storage of many metabolites [1, 2].

The liver is a gland that serves as an auxiliary organ of the digestive system and is the largest gland in the body [3]. It is positioned at the anterior end of the body cavity and is centered close to the intrinsic superficial of the body wall [4]. As well as nearby and surrounding structures such as the heart and pericardium the subterranean gizzard, spleen, gall bladder intestinal loop and lungs [5].

The bird liver consists of two parts with the right and left lobes being separate [6]. The size of these cardinal lobes can change from species to species, with ostriches and bustards having large right lobes in comparison of left lobes [7, 8].

There are species in which the left lobe is larger than the right of the liver and both lobes may be subdivided into secondary lobules [9, 10].

The gall bladder is located on the visceral area of the right lobe of the liver and is a typical characteristic of birds that have a gall bladder. Nonetheless, certain birds including pigeons, ostriches and parrots, have a gall that cannot work refined [11, 12].

The livers of birds in Iraq induce similarities to those of mammals, with the exclusion of the absence of connective tissue septa among the lobules and the extraportal zone [13, 14]. The purpose of the review is to determine the morphological description and histological structure of Iraqi birds' livers.

ANATOMICAL DESCRIPTION OF LIVER IN BIRDS

The liver of birds has been studied by numerous researchers. The study by [15] showed that the liver involved two lobes, a large right lobe, and a smaller left lobe. The liver of the coot is positioned in the ventral part of the body cavity, according to [16], who studied its colour and divided it into two lobes. The right lobe of the liver appeared enlarged in comparison to the left lobe, which is similarly separated into two portions. *Larus canus*, *Aquaporin's fischer* and *Numida meleagris* are three Iraqi bird species whose livers were analysed by [17]. Compared to the other two species *Numida meleagris* had a larger liver, which was dark red in colour and composed of left and right lobes connected cranially at the midline through an interlobar segment [18]. The dorsal and ventral accessory lobes, which were detached and connected to the bottom of the left lobe, were shorter and wider than the ventral lobe. The gallbladder is attached to the dorsal side of the right lobe and is long and well-developed [19].

Like the liver of *Numida meleagris* the liver of *Agaporins fischeri* was pale red in colour and had both left and right lobes; however, the left lobe lacked the gall bladder and accessory lobes. The liver of *Larus canus* has two lobes, similar to those of the other two species, with the left lobe being slighter than the right. It looks to be dark red in colour and is large than that of *Agaporins fischeri*, just smaller than that of *Numida meleagris* [17].

In their study of the livers of broiler chickens, other researchers cited [20], the liver of broiler chickens consists of two lobes connected in the center, with the right lobe being large than the left lobe, which in turn is separated into a dorsal and a ventral section.

In their study of the livers of moorhens and domestic fowl in southern Iraq, [21] showed that the livers of these two bird species were the largest glands. The liver of the domestic fowl was



larger than that of the moorhens, and had a dark red colour as well as being distinct into secondary lobules (dorsal and ventral). The left and right lobes were linked cranially at the midline by an interlobar incision. The liver of the moorhens had a brown appearance and was distinct into left and right lobes similar to the *Gallus gallus* liver just smaller. The left lobe was also divided into dorsal and ventral portions which were smaller than the right lobe. In contradiction of [22], who reported that the left lobe of the liver of pigeons and passengers birds consists of three parts, whereas [8] found that the liver of ostriches has three parts piece the liver of pigeons has an undivided right lobe

The dark reddish-brown starling liver is located in the cranial region of the abdominal cavity. It consists of unsegmented left and right lobes intimately connected cranially at the midline by the interlobar part, according to [23]. The right lobe of the liver appeared enlarged in comparison to the left lobe and the right lobe is the larger of the two lobes that induce of the liver in birds, according to the observations of experts world who have studied the subject. According to several studies, this confirms their findings [24, 25, 26, 27]. Nonetheless this contradicts the findings of [28], who showed that the two lobes of chicken livers are the same size.

The cranial third of the abdominal cavity contains the starling liver, which has a dark reddish-brown colour. Accordant to [23], it consists of undivided left and right lobes intimate cranially at the midline an interlobar segment. The right lobe of the liver was larger than the left. Studies that deliberate this subject have concluded that the right lobe is the larger of the two lobes that induce rising the avian liver. This supports the conclusions of a number of studies [24, 25, 26, 27]. Nonetheless, this contradicts the results of [28], who showed that the liver of a chicken has two lobes of equal size.

According to [29], the liver is a large gland located in the middle coelomic body cavity in both the mallard and the gull birds. The liver of the gull was dark brown in colour, while the liver of the mallard was reddish brown. The liver of both animals consisted of asymmetrical lobes. In contrast to [8], it showed that the left lobe was undivided into two bird species and smaller than the right lobe in two species.

In a study of the livers of three Iraqi birds, [30] indicated that the livers of the kestrel, the laughing pigeon and the white-cheeked kingfisher were set in the center of the coelom between the ventral and thoracic regions. In the kestrel bird, the left lobe of the liver appeared enlarged in comparison to the right lobe, while in the laughing pigeon and the kingfisher the right lobe of the liver was enlarged in comparison to the left lobe. In contrast to [28] who discovered that the lobes of liver chickens are comparable in size, the results show that the kestrel's right lobe is smaller than its left.

According to [31] the liver is a large gland located in the middle coelomic cavity, closely related to both the spleen and gizzard, and located caudal to the heart in mallards, white-eared bulbuls and gulls. In these three species, the liver consisted of two asymmetrical lobes connected cranially at the midline. These species appeared to have smaller left lobes than right lobes. [21] reported that similar finding, but it was different from [32] who found that the liver's left lobe appeared enlarged in comparison to the right lobe in the native moorhen bird, the left lobe was undivided in the mallard bird and gull bird and had two parts in the white-eared bulbul. This determination contradicts [8] and [22] just agrees with [33]. Likewise, [34] found in Turkey birds, the right lobe was undivided in mallard birds and mouse-eared bullock birds, whereas this lobe had two parts at the caudal end in gull species.



The liver of an Iraqi black partridge was analysed by [35]. This study found that the liver consisted of two lobes with the right lobe seemed larger than the left lobe and the left lobe segmented into two portions. This was accordant with other studies that explained the separation of the left lobe into dorsal and ventral portions [16, 25 and 26].

According to the study of [36] the marsh harrier liver is a large organ that ranges in colour from reddish brown to dark brown. It is positioned in the anterior part of the body cavity, cranial to the gizzard and ventral and caudal to the heart. The liver of the Montagu's harrier was a bilobed organ with the left and right lobes being approximately the same size and not subdivided into secondary lobules. This is accordant with [28] who found that the two lobes of the liver are of equal size in chickens. Nonetheless, this contradicts the findings of [16], according to which the liver of the native coot has two lobes, with the right lobe being larger than the left lobe, which in turn is subdivided into two secondary lobes.

In contrast to [32] who found that the left lobe of the liver appeared enlarged in comparison to the right lobe in local moorhens. [37] in their study on the liver of native adult homing pigeons stated that the liver was located in the right and left hepatoperitoneal cavities and was reddish brown in colour. The liver is separated into undivided left and right lobes with the right lobe existence large than the left, this agrees with [24], [25], and [26]. [38] study examined the liver of a Muscovy duck and found it to be a large organ that was reddish brown to dark brown in colour. It was positioned in the cranial portion of the coelomic cavity caudal and ventral to the heart and cranial to the gizzard. The liver of a Muscovy duck is separate into two lobes, with the right lobe existence large than the left lobe

There are several studies on the avian liver [16, 24, 26, 35], and [39] found that the liver of a barn owl consists of two lobes, with the right lobe seeming enlarged in comparison to the left lobe and the gall bladder located in the right lobe and is consistent with numerous observations.

[40] described in their study of the kingfisher liver that the kingfisher liver exhibits bilateral symmetry, with the right lobe appearing slightly enlarged in comparison to the left lobe. This is line with [16] and [35].

HISTOLOGICAL STRUCTURE OF LIVER IN BIRDS

Glisson capsules, capsules made of connective tissue, surround the liver in birds, as studies and research on this subject show. This is in line with many studies [41].

According to [36] the condensation consists primarily of collagen fibres, smooth muscle fibres, specifically in the deeper areas, fibroblasts and blood vessels. This construction of the capsule is comparable to that of the ostrich, as noted by [42].

According to various studies the Glisson's capsule is thin and originates from its septa, which in turn divide the liver into lobules. Nonetheless, the lobule was not clear [35, 40] and the lobule was similarly seen in other birds. This is consistent with the explanation of [39] that the liver had a true lobule. In agreement with several studies, the liver is composed of hepatocellular cords or sheets and these cords are grouped around the central vein [16, 20, 35, 36, 39 and 40].

The liver cords consist of one or two thick cells and are divided by a tiny hole representing the blood sinusoids which are lined with two different kinds of cells. According to many studies [39], the first cell type is represented by endothelial cells, which look as flattened cells with prolonged nuclei, and the second cell kind is Kupffer cells, which resemble big cells with round nuclei, were the second type of cells.

According to numerous studies [23, 35] the portal area of the liver consists of the portal vein, and branches of each of the hepatic artery, bile duct, and lymphatic vessels. The hepatic artery was delineate with an internal elastic membrane the lining of the bile duct consisted of simple cuboidal cells with smooth muscle fibres the lumens of the hepatic arteries were smaller than those of the veins, and both were lined by simple squamous epithelium.

CONCLUSION

In most birds the left lobe of the liver appeared enlarged in comparison to the right lobe and the gall bladder is located on the right lobe of the liver which is enclosed via a capsule of connective tissue. The liver weave consists of amp serial corduroys or plates from side sinusoids. The portal veins the partition of the hepatic artery the bile duct and the blood vessels form the portal region of the liver.

Conflict of interests:

The authors declare that there is no conflict of interest regarding the publication of this paper

References

- [1] E. I. Odokuma and E. I. Omokaro, "Comparative histologic anatomy of vertebrate liver," *Annals of Bioanthropology*, vol. 3, no. 1, pp. 1–6, 2015.
- [2] H. K. Mohajan, "A study on functions of liver to sustain a healthy liver," *Innovation in Science and Technology*, vol. 4, no. 1, pp. 77–87, 2025.
- [3] M. Hassani, "Liver structure, function and its interrelationships with other organs: A review," *International Journal of Dental and Medical Sciences Research*, vol. 4, no. 1, pp. 88–92, 2022.
- [4] V. Mahadevan, "Anatomy of the liver," *Surgery (Oxford)*, vol. 38, no. 8, pp. 427–431, 2020.
- [5] D. Smith, "Anatomy and postmortem examination," in *Pathology of Pet and Aviary Birds*, pp. 1–64, 2024..
- [6] S. J. H. Al-Abedi, *Anatomical and Histological Study of the Liver in Three Species of Adult Iraqi Birds*, M.Sc. Thesis, University of Kufa, Najaf, Iraq, 2015.
- [7] M. R. Stornelli, M. P. Ricciardi, E. Gianassi, and A. Coli, "Morphological and histological study of the ostrich (*Struthio camelus L.*) liver and biliary system," *Italian Journal of Anatomy and Embryology*, vol. 111, no. 1, pp. 1–7, 2006.
- [8] J. Faaborg, *Book of Birds: Introduction to Ornithology*, Texas A&M University Press, 2020..
- [9] L. Geerinckx, E. Van der Vekens, J. H. Saunders, I. Lautenschläger, and A. I. Van Caelenberg, "Literature review of radiographic measurements of internal organs in Psittaciformes," *Journal of Exotic Pet Medicine*, vol. 28, pp. 60–68, 2019.
- [10] Z. A. Alabdallah, "Morphological and histological comparison of the internal organs of birds," *Clinical Reviews and Case Reports*, vol. 3, no. 1, 2024.
- [11] N. Pathak, *Avian Nutrition: Poultry, Ratite and Tamed Birds*, CRC Press, 2020.
- [12] A. J. Al-Yasery, M. A. Al-Waeely, and I. M. Khaleel, "Morphological, histological, anatomical and histochemical study of the liver in poultry, love birds and racing pigeon," *Euphrates Journal of Agricultural Science*, 2nd Veterinary Conference, pp. 775–785, 2017.



[13] J. Illanes, B. Fertilio, M. Quijada, V. Leyton, and F. Vertigo, "Histology description of the annexed glands from the ostrich digestive system," *International Journal of Morphology*, vol. 24, no. 3, pp. 297–302, 2006.

[14] R. S. Khulef and N. A. Al-Bakri, "Morphological and histological study of the liver and gallbladder in the Iraqi pin-tailed sandgrouse," *Al-Anbar Journal of Veterinary Sciences*, vol. 17, no. 2, pp. 1–10, 2024.

[15] E. Ibrahim, "Histological study of the native hens liver," *Al-Qadisiyah Journal of Veterinary Medical Sciences*, vol. 1, pp. 1–7, 2008.

[16] H. A. Selman, "Morphological and histological study of the liver in local coot bird," *Basrah Journal of Veterinary Research*, vol. 12, no. 1, pp. 152–158, 2013.

[17] H. Hamadi, A. A. Abed, and A. M. Taha, "Comparative anatomical, histological and histochemical study of the liver in three species of birds," *Rafidain Journal of Science*, vol. 24, no. 5, pp. 12–23, 2013.

[18] M. D. Abdulkareem and M. S. Dawood, "Anatomical study of trachea and lung of local breed adult dog," *Acta Biomedica*, vol. 94, no. 2, e2023094, 2023.

[19] I. N. Gerogiannis, R. K. Ali, M. Sidhom, G. Bointas, and E. Tsoutsou, "Anatomy of the gallbladder," *IntechOpen*, 2025.

[20] S. H. M. Al-Nassiri and A. H. Ebrahim, "Comparative anatomical and histological study of liver in broilers," *Tikrit Journal of Agricultural Sciences*, vol. 13, no. 3, pp. 134–142, 2013.

[21] D. M. Hussein and A. J. Hussein, "Morphology, histology and histochemical comparative study of the liver in domestic fowl and common moorhen," *Kufa Journal of Veterinary Medical Sciences*, vol. 7, no. 1, pp. 36–45, 2016.

[22] S. A. A. Ismaeil and H. Emam, "Morphological, histological and histochemical investigations of the liver in young homing pigeon and cattle egret," *Advances in Animal and Veterinary Sciences*, vol. 10, pp. 607–620, 2023.

[23] S. S. Faraj and G. A. Al-Bairuty, "Morphological and histological study of the liver in starling bird," *Al-Mustansiriyah Journal of Science*, vol. 27, no. 5, pp. 11–16, 2016.

[24] T. Carcetti, *Avian Digestive System*, New York, USA: Academic Press, 2006.

[25] H. M. Hamodi, A. A. Abed, and A. M. Taha, "Comparative anatomical, histological and histochemical study of the liver in three species of birds," *Rafidain Journal of Science*, vol. 24, no. 5, pp. 12–23, 2013.

[26] M. A. A. Abdullah, "Histological and histochemical study of the liver of Iraqi local ducks," *Basrah Journal of Veterinary Research*, vol. 14, no. 1, pp. 70–78, 2015.

[27] F. Zaefarian, M. R. Abdollahi, A. Cowles, and V. Ravindran, "Avian liver: the forgotten organ," *Animals*, vol. 9, no. 2, p. 63, 2019.

[28] I. M. Khaleel, K. I. Al-Khazraji, and M. H. Al-AAmeli, "Comparative morphological and histological study of the liver in gull and mallard duck," *Advances in Animal and Veterinary Sciences*, vol. 5, no. 7, pp. 307–311, 2017.

[29] H. A. Al-Hamadawi, A. J. Alnaaly, J. K. Alumeri, and A. V. Al-Bideri, "Comparative anatomical and histological study of the liver in wild birds in Iraq," *Journal of Global Pharma Technology*, vol. 16, no. 9, pp. 387–394, 2017.

[30] K. I. A. Al-Khazraji, "Morpho-histological comparative study of the liver in white-eared bulbul, mallard duck and gull," *Iraqi Journal of Veterinary Medicine*, vol. 41, no. 2, pp. 94–99, 2017.



[31] R. S. Ibrahim, A. A. Hussein, and W. J. Al-Kelaby, "Histomorphological study of the liver in local moorhen birds," *Kufa Journal for Veterinary Medical Sciences*, vol. 7, no. 2, pp. 187–192, 2016.

[32] A. S. Al-A'araji, "Anatomical and histological characteristics of the liver of indigenous turkey," *Basrah Journal of Veterinary Research*, vol. 14, no. 2, pp. 150–157, 2015.

[33] I. A. A. Khadhim, I. M. Mnati, and B. H. Mutlak, "Morphological and histological study of liver in Iraqi black partridge," *Biochemistry and Cellular Archives*, vol. 18, suppl. 1, pp. 1055–1058, 2018.

[34] S. S. Faraj, "Morphological description and histological structure of the liver in marsh harrier bird," *International Journal of Science and Research*, vol. 7, no. 1, pp. 528–532, 2018.

[35] K. H. Kadhim, D. H. Sadiq, and D. M. Hussein, "Histomorphological studies of the healthy liver and pancreas of local adult homing pigeon," *Indian Journal of Public Health Research and Development*, vol. 10, no. 5, pp. 1–5, 2019.

[36] A. Alshammary and H. Kareem, "Histomorphological study of the liver in Muscovy duck," *Tikrit Journal of Agricultural Sciences*, vol. 21, no. 3, pp. 112–118, 2021.

[37] I. A. A. Khadhim, I. S. Al-Jumaily, and I. M. Mnati, "Morphological and histological study of liver in barn owl," *Biochemistry and Cellular Archives*, vol. 21, suppl. 1, pp. 2585–2588, 2021.

[38] I. A. A. Khadhim, W. A. Kadhim, N. H. O. Al-Mamoori, and F. M. S. Sadeq, "Analysis of the liver morphology and histology in white-breasted kingfisher," *Journal of Wildlife and Biodiversity*, vol. 7, special issue, pp. 129–137, 2023.

[39] D. J. Abed Ali and S. J. Ghyadh, "Comparative histological study of liver in male *Anas crecca*," *Al-Kufa University Journal for Biology*, pp. 229–233, 2016.

[40] H. F. Attia and S. M. Soliman, "Histological and histochemical studies on the ostrich liver," *Beha Veterinary Medical Journal*, vol. 16, no. 2, pp. 1–10, 2005.



الخلاصة

الخلفية:

يُعد الكبد أحد الأعضاء الحيوية في الجهاز الهضمي للطيور، إذ يشارك في عمليات الأيض وإزالة السموم وإنتاج العصارة الصفرافية وتخليل البروتينات. يظهر الكبد عادةً بشكل ثنائي الفصوص في معظم أنواع الطيور، وبتوضُّع في الجهة البطنية من تجويف الجسم. يكون الفص الأيمن عادةً أكبر من الأيسر في أغلب الأنواع. كما تختلف بنية الكبد ولونه وجوده أو غياب المراة تبعًا لنوع الطائر ونظامه الغذائي وحالته الفسيولوجية.

المواد والطائق:

استندت هذه المراجعة إلى تحليل ومقارنة البيانات الشكلية والنسيجية المستخلصة من دراسات سابقة تناولت أكباد أنواع مختلفة من الطيور العراقية. شملت البيانات أوصافًا تشريحية وتنظيم الفصوص والبنية الوعائية، بالإضافة إلى الخصائص النسيجية مثل ترتيب الخلايا الكبدية وبنية الجيوب الكبدية.

النتائج

أظهرت البيانات التي تمت مراجعتها أن كبد الطيور العراقية يتكون من فصين اثنين، ويُعَلَّف بمحفظة من النسيج الضام تُعرف بمحفظة غليسون (Glisson's capsule)، كما يُقسم إلى فصوص تختلف في وضوحيتها من نوع لآخر. الخلايا الكبدية متعددة الأضلاع وتتظم على شكل صفائح أو حبال تحيط بالوريد المركزي، وتشُطُّن الجيوب الدموية بخلايا بطانية وأخرى شبّيهة بخلايا كوفر. كما يحتوي الحيز البابي على ثلاثة بابٍ التي تشمل الشريان الكبدي والوريد البابي والقناة الصفرافية والأوعية اللمفية.

الاستنتاج

تُظهر الخصائص المورفولوجية والنسيجية لأكباد الطيور العراقية تجانسًا بنويًا عامًا مع وجود اختلافات بين الأنواع. تعكس هذه الفروقات تكيفات بيئية وعادات غذائية وصفات تطورية متنوعة. ويسهم فهم هذه السمات الكبدية في تعزيز المعرفة بفسيولوجيا الطيور وصحتها وتشريحها المقارن ضمن الأنواع العراقية المختلفة.

الكلمات المفتاحية: الوصف التشريحي، الطيور، الكبد، البنية النسيجية، الوصف المورفولوجي.