

Morphological and histological study of the liver in migratory starling bird (*Sturnus vulgaris*)

Saddama Saed Faraj, Genan Adnan Al-Bairuty

Department of Biology, Collage of Education for Pure Science-Ibn Al-Haitham, Baghdad University, IRAQ

Article info

Received
23/3/2016

Accepted
22/5/2016

ABSTRACT

The present work was aimed to form the baseline data of normal morphological and histological structure features of liver in migratory starling (*Sturnus vulgaris*). Anatomically, the starling liver bird was dark red -brown in colour and located in the cranial third of the abdominal cavity and consisted of undivided lobes (left and right). The liver right lobe was larger than the left. Histological examination revealed that the liver parenchyma was covered by a connective tissue capsule which appears to be thicker in the rim of liver lobes than other area in the liver lobe. Liver parenchyma was arranged in an unlimited hepatic lobules, which composed of polygonal hepatocytes organized as irregular, radial interconnecting cords or laminae of one or two cells thickness around a central vein and separated by blood sinusoids. In the boundary of each lobule showed a portal area which consists of a branch of hepatic artery; one or more branches of hepatic vein and one to four branches of the bile duct which lining by cuboidal cells that characterized by their empty non-staining cytoplasm. The histochemical observation by using PAS staining in the current study revealed that the glycogen granules arranged close to the central vein and in the rim of liver lobules.

Keywords: Birds, Liver morphology, liver histology.

الخلاصة

يهدف العمل الحالي الى تشكيل الخط الاساس لبيانات البنية الطبيعية الشكلية والنسجية في كبد الزرزور المهاجر (*Sturnus vulgaris*). تشريحياً كبد طائر الزرزور ذو لون احمر- بني ويقع في الثلث القحفي من التجويف البطني ويتكون من فصين متصلين غير مقسمين (ايمن وايسر). ويكون الفص الايمن من الكبد اكبر من الفص الايسر. وكشف الفحص النسجي ان برنكيما الكبد كانت محاطة بمحفظة من النسيج الضام والتي تظهر اكثر تسمكاً في حافة فصوص الكبد من المناطق الاخرى للفصوص. يكون ترتيب البرنكيما الكبدية بشكل فصوص كبدية غير محددة والتي تتكون من خلايا كبدية متعددة الاضلاع غير منتظمة الترتيب مرتبطة مع بعضها البعض بشكل حبال او صفائح شعاعية بسمك خلية واحده او خليتين حول الوريد المركزي ومفصولة بواسطة الجيوب الدموية. تظهر في حدود كل فصيص منطقة الباحة والتي تتكون من فرع الشريان الكبدي واحد او اثنان من فروع الوريد الكبدي وواحد الى اربعة فروع من القناة الصفراوية المبطننة بخلايا مكعبة والتي تتميز بسايتوبلازمها الفارغ وغير المصبوغ. كشفت الملاحظات الكيمونسجية باستخدام صبغة PAS في الدراسة الحالية ان حبيبات الكلايوجين تكون مرتبة على مقربة من الوريد المركزي ومن حافة فصيصات الكبد.

INTRODUCTION

Starling birds are distinguished by black skinny, glossed purple or green and spangled with white, especially strongly so in winter. The adult male of starling are less spotted than those of adult females [1] as shown in Figure 1.

This bird is migrated to the south of Iraq from January to April [2] and is classified as follow:

Kingdom: Animalia
Phylum: Chordata
Class: Aves

Order: Passeriformes
 Family: Sturnidae
 Genus: *Sturnus*
 Species: *vulgaris* (Linnaeus, 1758)



Figure 1: Male and female of starling bird (*Sturnus vulgaris*).

The liver is one of the accessory organs of the alimentary canal that deliver their secretory products to the small intestine by excretory ducts [3] and is the largest gland of the bird's body which have dark brown or red brown colour. The right side of the liver has both endocrine and exocrine gland, which are releasing several substances directly into the blood stream and secreting bile into the duct system [4 and 5]. The liver is bi-lobed (right and left lobes) that located ventrally and posteriorly to the heart associated with proventriculus and spleen. This organ is one of the most metabolically active organs in the body and serves many vital functions such as plasma proteins synthesis, glycogen storage, decomposition of erythrocytes, hormone production, degradation of alcohol and drugs [6, 7] as well as detoxification of substance [8]. Despite of the avian liver vital functions to our knowledge, few studies have been performed to clarify its structure and most of these studies focused on domestic birds. So the goal of the present study is to investigate the morphology and histology of the liver in starling migratory birds.

MATERIALS AND METHODS:

Ten adult healthy migratory starling birds (*Sturnus vulgaris*) of both sexes were obtained from the local markets in Baghdad. The birds were anesthetized by ethyl ether inhalation, immediately, after that birds were scarifying and then samples of liver were collected and

washed with (0.9%) normal saline solution. The specimens were taken from the left lobe of each liver and fixed in (10%) formalin for (48) hours at room temperature, dehydrated through ascending grades of ethanol, cleared in xylene and finally embedded in paraffin wax. Histological sections of 6 μ m of thickness were obtained and they were stained with H&E for general observations, periodic acid-Schiff (PAS) stains for identification of glycogens contents; and Masson trichrome stain for detection of connective tissues. All the above revealed methods were done as described in [9]. After slide examination, sections were photographed by a digital camera attached to an Olympus light microscope.

RESULTS AND DISCUSSION

Anatomically, the liver of the starling bird in the current study has a dark red brown color and located in the cranial third of the abdominal cavity like other study [10]. The liver consists of undivided left and right lobes which were connected cranially at the midline by an interlobar portion. The top of the left lobe has a concave shape where the heart stabilized, whereas the ventral side of the right lobe has concave shape where the gizzard was stabilized [11]. The right lobe of the liver was larger than the left lobe [12] (see Figure 2). This finding was agreed with [13] who reported that the liver of Iraqi local ducks consists of two undivided lobes, the right lobe is larger than the left lobe. Whereas in chicken, both lobes have equal size [14].



Figure 2 Photograph of liver starling showing liver lobes right (R) and left (L).

The cytoplasm of hepatic cells had foamy appearance and contained bright red or brown of glycogen granules which have irregular distribution within the cytoplasm (Figure 4b).

This may be due to deposition of lipid globs or glycogen in the liver, which can be considered as a source of energy for the bird in case of hunger or early pre hatching life [21-23].

The hepatic sinusoids space is large and irregular in shape and lined by two types of cells flattened endothelial cells, which formed un-continuous lining layer and vonKupffer's or hepatic macrophage (Figure 5b). Endothelial cells are small cells and have a weakened cytoplasm with a small nucleus. VonKupffer cells are large cells with large basophilic nuclei and have several processes with an irregular or stellate outline that projects into the sinusoids. However, vonkupffer cells are located between the endothelial cells of the hepatic sinusoids and may play a role in removing foreign and toxic material from the portal blood and releasing beneficial mediators [24]. Additionally, there was a fine network of connective tissue fibers (collagen fibers) support the sinusoid (Figure 3 and Figure 6a). The results of [15] as well as [12] confirmed this finding of the current study. The sinusoids lumen of starling liver in this study was filled with an enormous number of erythrocytes (Figures 4a, 4b, 5b).

The present results showed that the central vein in starling liver was lined by endothelial cells and surrounded by a thin layer of connective tissue (Figure 6a).

The portal triad in starling liver were consist of, branch of the hepatic artery (Figure 6b), one or more branches of hepatic portal vein and bile duct (Figure 6a). Both small and large sizes of bile duct observed in the portal triad, and this triad also contain 1-4 of bile ducts (Figure 6a & 7). The interlobular bile duct was composed of simple cuboidal epithelium in which there are large rounded nuclei occupied the central position in the cells and surrounded by empty non-staining cytoplasm and in some cases there are smooth muscles surrounded the large bile ducts (Figure 7). [16] found that the portal area in the local coot liver composed of hepatic veins, portal vessels (lined by a thin layer of endothelial cells) and bile ducts (lined by cuboidal epithelial cells). In addition to the components previously mentioned, portal area also contains a network of collagen fibers around the bile ducts and the hepatic vessels (Figure 6a). These results agree with the

finding of [15] and are contrasted with [11] that reported the presence of fibroblasts besides the collagen fibers in *Larus canus*.

The lumen of hepatic artery was smaller than vein and both of them lined by simple squamous epithelium. Red blood cells have been seen in the sinusoids and the lumens of central vein, portal vein and portal artery (Figure 5b, 6a and b). Aggregation of lymphocytes was observed between the hepatic cords and closed to the central vein (Figure 5b). This may point to a focal area of lymphocytes as immune area as that recorded in the liver of ostrich [15].

The histochemical observation of the current study by using PAS staining revealed that the glycogen granules arranged close to the central vein and in the rim of liver lobules (Figure 8). The content of these granules was differ from bird to another. This could indicate that some birds were in starvation period and need energy. Therefore, the animal could get the energy from the rim of liver lobules firstly and then from the area close to the central vein [25].

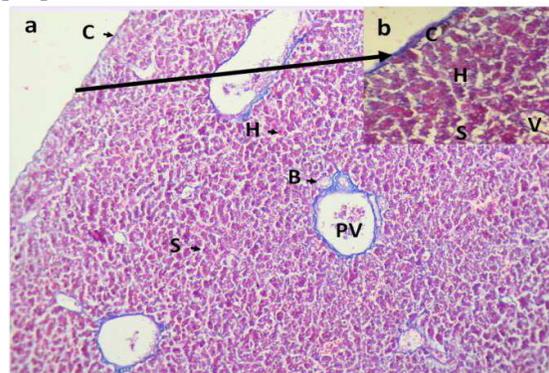
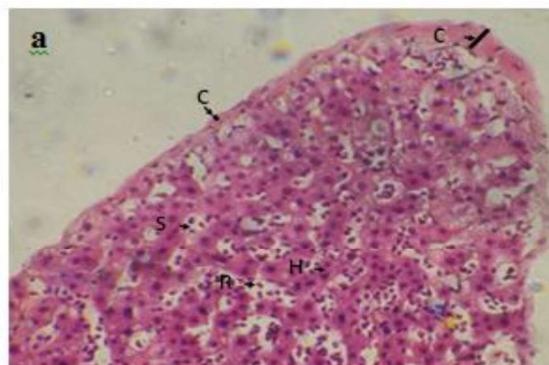


Figure 3 Histological section of starling liver in (a) 10 x (b) 40x, shows a thin layer of connective tissue capsule (c), hepatocytes (H), sinusoid space (S), portal hepatic vein (PV). Stained with masson trichrome stain.



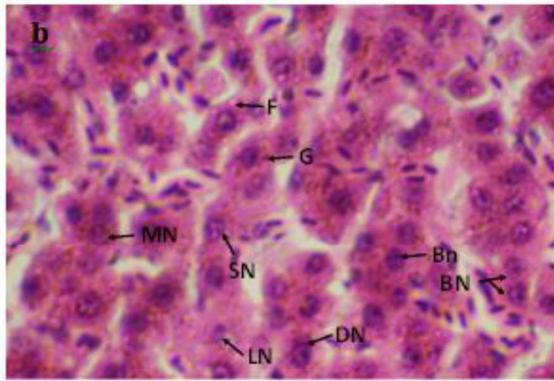


Figure 4: Histological section of starling liver shows:
 A. A thicker layer of the capsule (c) in the rim of liver lobes than other area in the liver, hepatocytes (H), sinusoid space (S) filled with red blood cells (R). X 40, stained with H&E.
 B. The hepatic cell structure showed foamy cytoplasm (F), the cytoplasm contain granules (G), the nucleus in some cell was light staining (LN) and in other was dark staining (DN), mitotic nuclei (MN), hepatocytes contains single (SN) or bi nucleus (BN) with two or more nucleolus (Bn), X 100, stained with H&E.

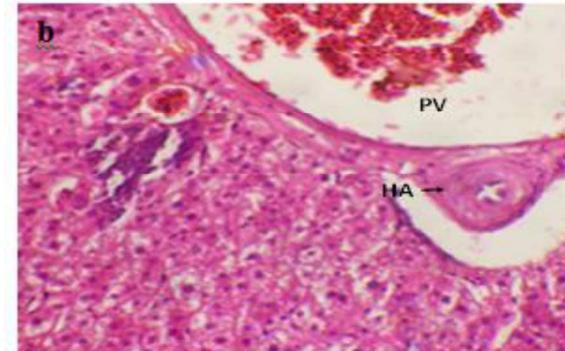
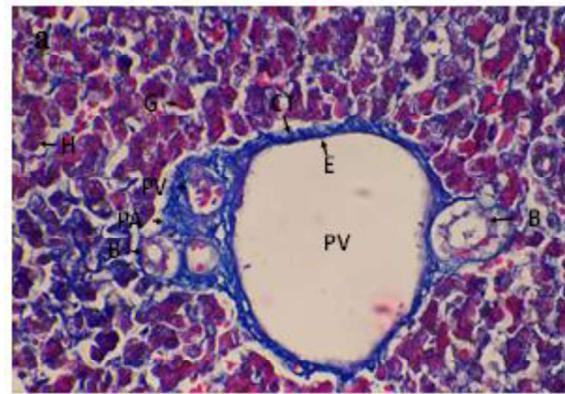


Figure 6: Histological section of starling liver shows:
 A. The portal area (PA), which contains a branch of the hepatic vein (PV) and bile duct (B). The portal hepatic vein (PV) surrounded by a connective tissue (CT) and lined by endothelial cell (E). Glycogen granules (G) in the cytoplasm of hepatocytes (H). X 40, stained with Masson trichrome.
 B. The portal area contains a branch of the hepatic artery (HA) and the hepatic vein (PV). X 40, stained with H&E stain.

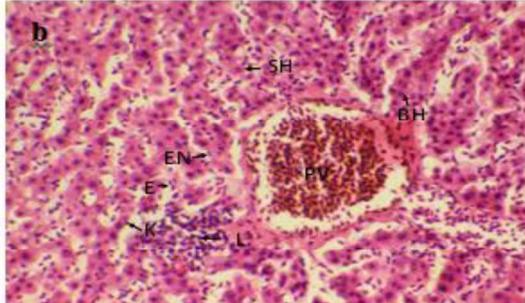
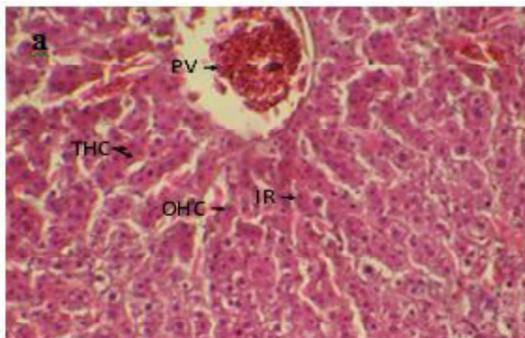


Figure 5: Histological section of starling liver shows:
 A. The irregular radiation form of hepatic cords (IR) around the portal hepatic vein (PV) with one (OHC) or two (THC) cells thick of hepatocytes (HC). X 40, stained with PAS.
 B. The vonkeppfer cells (K), patches of lymphocytes (L), bi-hepatic cords (BH), single cords (SH), sinusoid space lined with un-continuous endothelial cells and contains erythrocytes (E), and portal hepatic vein filled with erythrocytes. X 40, stained with H&E

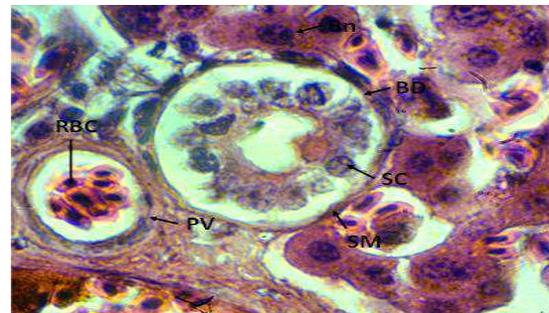


Figure 7: Histological section of starling liver shows the bile duct rest on the single layer of smooth muscle (SM), bi nucleolus hepatic cell (Bn), Bile duct (BD), which lining of simple cuboidal cells (SC), the portal hepatic vein (PV) contain erythrocytes (RBC). X 100, H&E stain.

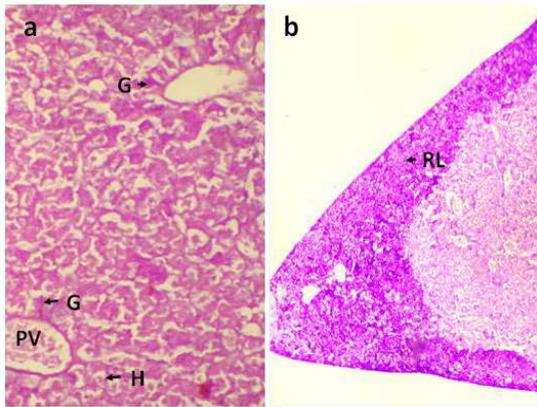


Figure 8: Histological section of starling liver shows the position of glycogen granules (G): in (a) close to the central vein (CV) and (b) in the rim of liver lobules (RL), hepatocytes (H). Stained with PAS.

CONCLUSION

Missing data about the morphological and histological structure of liver in migratory starling led us to design this experiment. Generally, the liver in migratory bird (male and female) has the same structure and is similar to that of domestic bird with some differences. The starling liver exhibited one or two cells thick arranged irregularly around a central vein and separated by blood sinusoid that filled with a large number of erythrocytes. Additionally, the portal area contains 1-4 branches of the bile duct, a branch of hepatic artery, and one or more branches of hepatic vein. The liver cells contain glycogen granules arranged close to the central vein and in the rim of liver lobules and have a bright pink in color.

REFERENCES

- [1] Higgins P. J., Peter J. M. and Cowling S.J. Handbook of Australia, Newzland and Asia Birds, Volumes 7, Boatbill to starling oxford university press, Melbourne, Pp: 1924, 2006.
- [2] Salim M. A., Porter R., Christensen S., Schiermacker-Hansen P., Christensen C. and Al- Jboor S. (2006). Field guide to birds of Iraq (in Arabic). Nature Iraq and Birdlife International: 284 pp.
- [3] Eroschenko V.P. Difior's Atlas of histology with functional correlations, 3rd, Lippincott Williams & Wilkins/a
- [4] Krause W. J. and Cuts J. H. Concise text of Histology, Second edition Pp: 330-334, 1986.
- [5] Dyce K. M., Sack W. O. and Wensing C. J. G. Text book of veterinary anatomy fourth edition. Saunders Elsevier. Pp: 135-138, 2010.
- [6] Copstead L. C. and Banasik J. L. Pathophysiology, 5th ed, Saundersan, Elsevier Inc., China, Pp 765, 2013.
- [7] Sembulingam K. and Sembulingam P. Essentials of medical physiology. 6th ed Japee Brothers Medical publishers (p) Ltd. New Delhi. Pp. 249-256, 2012.
- [8] Brunn H., Schmidt E., Reinacher M., Manz D, Eigenbrodt E. Histology and histo-chemistry of the liver of chicken after induced hepatocarcino-genesis and ingestion of low chlorinated biphenyls, Arch. Toxicol. J., 60(5):337-42, 1987.
- [9] Bancroft J. D. and Gamble M. Theory and practice of histological techniques. 6th ed. Elsevier Health Sciences. Pp: 725, 2008.
- [10] McLelland J. A color atlas of avian anatomy. 1st ed. Aylesbury, Wolfe Publishing Ltd. England. Pp.57-122, 1990.
- [11] Hamodi H. M., Abed A. A. and Taha A. M. Comparative anatomical, histological and histochemical study of the liver in three species of birds. Raf. J. Sci., 24(5): Pp. 12-23, 2013.
- [12] Moslem D. Histological study of the African ostrich liver and anatomical comparison of it with poultry liver. Biological Forum – An International Journal, 7(1) 1185-1188, 2015.
- [13] Al-Abdulla M.A.A. Histological and histochemical study of the liver of Iraqi local ducks. Bas. J. Vet. Res., 14(1):70-78, 2015.

Wolters Kluwer health, Philadelphia., USA, Pp: 235, 2008.

- [14] Schmidt R. E., Reavill D. R. and Phalen D. N. Pathology of pet and aviary birds. First edition. Iowa, Iowa state press, a Blackwell Publishing company. Pp: 67-68, 2003.
- [15] Attia H. F. and Soliman S. M. Histological and histochemical studies on the Ostrich's liver. Benha. Vet. Med. J. 16(2): 1-11, 2005.
- [16] Selman A. H. Morphological and histological study for liver in local coot birds *Fulica atra*. Bas. J. Vet. Res. 12(1):152-158, 2013.
- [17] Abed E. H and Al-Bakri N. A. Morphological description and histological structure of the liver in *Passer domesticus* (House sparrow). J. Madenat Alelem college, 3(2):48-60, 2011.
- [18] Randall J. and Reece R. Color Atlas of Avian Histopathology, Mosby Wolfe, London, Pp:75-77, 1996.
- [19] Bhatnagar M .K. and Singh A. A. Ultrastructure of turkey hepatocytes. Anat .Rec. United Kingdom.202: 473-482, 1982.
- [20] Peckham M. Histology at a glance, John Wiley & Sons Ltd, UK. Pp: 1-108, 2011.
- [21] Breazile J. E. 1971. Textbook of Veterinary Physiology, cited by Wong G. K. & Cavey M. J. Development of the liver in the chicken embryo. II- Erythropoietic and granulopoietic. Anat. Rec., 235: 131-143, 1993.
- [22] Zayed A. E. and Mohammed S. A. The posthatching development of the liver in quail. Kafr El-Sheikh Vet. Med. J., 2(1): 17-33, 2004.
- [23] El-Zoghby I. M. A. Pre and post hatching developmental studies of the quail's liver. Zag. Vet. J., 33(1): 185-193, 2005.
- [24] McCuskey R. S. and McCuskey P. A. Fine structure and function of kupffer cells. J. Elec. Microsc. Tech., 14: 237-246, 1990. doi: 10.1002/jemt.1060140305
- [25] Junqueira L. C., Carneiro J. and Kelley R. O. Basic Histology. Seventh edition. Appleton & Lange, Pp: 320-33, 1992.