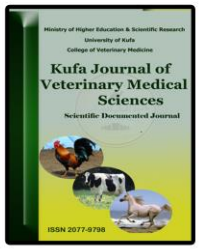
Kufa Journal for Veterinary Medical Sciences Vol.(7). No.(1)B 2016

Kufa Journal for Veterinary Medical Sciences

www.vet.kufauniv.com



hgMorphology ,Histology and Histochemical comparative study of the Liver in adult female domestic fowl(*Gallus Gallus)*, common moorhen*(Gallinula chloropus*)in South Iraq

Adel Jabbar Hussein* Diyar M. Hussein**

*Department Of Anatomy and Histology, College Of Veterinary Medicine , University of Basrah . Basrah. Iraq.

**College Of Veterinary Medicine , AL- Muthanna University. Muthanna .Iraq

Abstract

The aim of this study was determined compared between morphological features and histological structures in the liver of two species of birds that differ in their classification and food habitat by using light microscope.This birds were domestic fowl (*Gallus Gallus)*, common moorhen*(Gallinula chloropus*).Twenty birds were used to conduct the current study. These birds were collected from common markets at Basrah province. Themorphologicalresultshowed the liverin both species was large and bilobed organ.It was consist of two parts (right lobe was larger thenleft lobe).the left lobe issubdivided into two parts .The histological structure of the organ consist of several lobules separated from each other by tiny trabeculae of connective tissue and was covered by connective tissue capsule.The liver tissue composed of hepatic cells and blood sinusoidsin two species of birds.Thebasic unit of liver is hepatocyte which arranged in plates that radiated around the central vein and between these cords there is sinusoids lined by alayer of fenestrated endothelial cells and Kupffer's cells. The histochemical result revealed that the hepatocyte in the two species of birds were weakly positive to periodic acid Schiff (PAS) while they were positive to bromophenol blue reaction(MBB).

Key words: liver,histology, histochemical, , *Gallus Gallus,Gallinula chloropus*

دراسه مظهرية, نسيجية وكيمياء نسيجيه مقارنة للكبد لنوعين من الدجاج البالغ دجاج اللحم المحلي ودجاج الماء في جنوب العراق .

عادل جبار حسين ديار محمد حسين كاظم

فرع التشريح والانسجة كلية الطب البيطري جامعة البصرة البصرة العراق

كلية الطب البيطري جامعة المثنى المثنى العراق

الملخص

هدفت الدراسة الحالية للمقارنة بين الصفات المظهرية والتراكيب النسجية لنوعين من الطيور التي تختلف في التصنيف وتغذيتها بواسطة المجهر الضوئي. وهذه الطيور هي دجاج اللحم المحلي ودجاج الماي. واستخدمت في هذه الدراسة عشرون طيرا . هذه الطيور جمعت من السوق المحلي في محافظة البصرة .اظهرت النتائج المظهرية ان الكبد في كلا النوعين هو عضو كبير وثنائي الفص يتكون من جزئين هما (الفص الايمن والذي يكون اكبر من الفص الايسر) والفص الايسر يكون مقسم الى جزئين . بينما اظهرت نتائج التركيب النسجي ان

الكبد يتالف من عدة فصيصات مفصولة عن بعضها بواسطة حواجز صغيرة جدا من النسيج الضام ويكون محاط بمحفظةمن النسيج الضام .كما بينت الدراسة ان نسيج الكبد متكون من خلايا الكبدية والجيبانيات الدموية في كلا النوعين من الطيور. الوحدة الاساسية في الكبد هي الخلايا الكبدية والتي تكون مرتبة بشكل صفائح شعاعية حول الوريد المركزي وبين هذه الحبال توجد الجيبانيات التي تبطن بطبقة مثقبة من الخلايا الاندوثيلية. في حين اظهرت نتائج الدراسة الكبمياء النسجيةوجود تفاعلا موجبا ضعيفا مع تقنية حامض البريوديك- كاشف شيف بينما اظهرت تفاعلا موجبا مع ازرق البروموفيول للخلايا الكبدية في كلا النوعين.

Introduction

The poultry production has full a main role between agricultural industries in several parts of the world, Chicken meat production has been increase in all regions with the principal in Asia and South America, The Asia is important the world in poultry meat production, followed by North and Central America which had thelead until 1990 (Daghir, 2008). Poultry meat is the thenmaximumextensively eaten meat in the world, accounting for about 30% of meat production worldwide (Raloff, 2003).

The liver is the large organ of the body and the largest gland tissue. Its roles include absorption of nutrients, production of bile, detoxification and keep of the body metabolic homeostasis which contains the processing of carbohydrates, proteins, lipids and vitamins.The liver also role in the synthesis of plasma proteins, like albumin, fibrinogen, and complement factors (Genten *et al.*, 2009).

The liver in avian provides exocrine secretions to the digestive tract and its exocrine secretion is called bile, which mix fats and raise the pH of the duodenal digest,Bile is created in the hepatocytes and secreted into bile canaliculi situated on the lateral surfaces of connecting liver cells,These canaliculi drain into interlobular ducts, which unite to form the right and left hepatic ducts, which in turn drain into the gall bladder (Hoppe, 1999).

The adult chicken usually has a dark red to brown red colored liver (Clark, 2005).The liver is separated into right and left portions which are fused cranially at the midline, the right lobe is larger in the domestic fowl and turkey the left lobe is divided into the dorsal and ventral parts (Whitlow. 2000) .The parenchyma ofliver in birds resemble the liver of mammalian but there is some unlike in histological features such as lacking of lobules and interlobular trabeculae,the principal cell of liver is the hepatocyte.(Caceci , 2006).

The liver of coot bird (*fulica atra)*is resample to the liver of fowl that it lies in the ventral part of the body cavity and appearsred-brown in color and separated into two lobes, right and left , Histologically the liver of coot bird surrounded by thin capsule of connective tissuethat continue to subdivided the liver into lobules, The hepatocyte which arranged radially around the central vein,These cells are polygonal in shape and have roundednucleus and there is present of sinusoids between hepatocyte which lined by flattened endothelial cells.(Hanan, 2013).

The liver of Mallardshowed result histochemical study formed differ size of glycogen granules in cytoplasm of hepatocytes and in some specimen the glycogen large granules arranged around the centralvein because the bird in starvation period.(Maha,2015).

The aim of the study was determined compared between domestic fowl (*Gallus Gallus)*and common moorhen*(Gallinula chloropus*) morphological ,histological, histochemical finding and

measurement of some structures in the liver .

Materials And Methods

A total twenty birdsconsist of two group ,each group contain tendomestic fowl (*Gallus Gallus)*,ten common moorhen *(Gallinula chloropus)* were used in this study.These birds were collected from common markets at Basrah province, this study carried out in college of veterinary medicine/University of Basrah.The birds anesthesia by the drug Diazepam at a dose of (5 mg / kg) of body weight (Shindala,1999).. Liver were isolated from the celomic cavity the organ cut into pieces (5cm).The specimens were immersed in 10% neutral buffered formalin solutionfor 2 days, after well fixation the specimens was dehydrated by (70%, 80%, 90%, 95% and 100%) ethanol Alcohol each for two hours and then specimens was cleared in xylene for one hour after that embedded in paraffin wax and then the blocks were sectioned serially at 6µm thickness and stained with following stains. Mayer's Hematoxylin and Eosin routine stain for general features identification, Lillies Allochrome stain for connective tissueand Masson's Trichromestain for the staining of the collagenous and smooth muscle fibers (Bancroft and Stevens, 2010).Periodic Acid schiff (PAS**)**stain lt is especial stain used for carbohydrate, muco-proteint, glycoprotein and basement membrane(Luna,1968),Mercury Bromophenol blue (MBB) stainfor protein detection(Widhi Dubey and Trivedi ,2012).The measurement of each structure by ocular micrometer to histometrical analysis.

Result

A gross examination of the liver in the two species of birds is largest gland in domestic fowl(*Gallus Gallus),*common moorhen*(Gallinula chloropus)*.it located caudally and ventrally to the heartand was associated with the gizzardthat lied in the mid-coelomic cavity of the body.The liver have two surface.This surface character smooth convex ,concave and thegland subdivided two parts right and left lobe. The lobe left declines represent proventriculus sites, part of the gizzard and spleen as there are declines in the right lobe also represent sites both part of the gizzard and both ends of the duodenum upward and downward. (fig.1)

The liver of thedomestic fowl(*Gallus Gallus*)was larger than the common moorhen (*Gallinula chloropus)* and it was dark red in colour and consisted of left and right lobes which were joined cranially at the midline by an interlobar portion. The left lobe has concavity in its top where the heart stabilized, and it was subdivided two secondary lobes (dorsal and ventral) the dorsal lobe was wider and shorter than the ventral lobe, while the right lobe has concavity from its ventral side where the gizzard was stabilized, and it didn't contain the incision that divided it into secondary lobes as it is in the left lobe. (fig. 2,A)

The liver of the common moorhen (*Gallinula chloropus)*was appearsred-brown in color and divided into parts this of left and right lobes like the liver of (*Gallus gallus*)but it is smaller in size.Theleft lobe was subdivided into the dorsal and ventral parts smaller in size from the right lobe and it has concavity in its top where is the gizzard was stabilized .The right lobe is greater and longer than the left lobe.(fig. 2,B)

The histological our results of this study revealed that the liver in the two species of birdswerecovered of capsule which is composed of irregular

dense connective tissue and collagen withsome elastic fibers withMayer's Hematoxylin and Eosin(fig.3,A) and showed with the Masson's trichromestaind (fig.3,B).

This capsule appears thickerin the common moorhen (*Gallinula chloropus)*was(165 µm ±12.8452),whereas , in the (*Gallus gallus*) was(72.5µm± 17.5000). The capsule called Glisson`s capsuleand that separated the gland in to basic units that hepatic lobules. The lobulation that not clear in the birds because the ill distinct hepatic septa and found between the liver lobules the portal area which consist of branch of portal vein and branch of the hepatic artery and bile duct that lining by one layar cuboidal cells resting on basal lamina (fig.3,D).(fig.4,D)

The mean diameter of center vein in domestic fowl (*Gallus Gallus)*, common moorhen *(Gallinula chloropus)* were(735µm±42.9535) and (445 µm ± 42.0119) respectively.

The means diameter ofportal vein, hepatic artery and hepatic duct indomestic fowl (*Gallus Gallus)*were (320.79µm± 202.284311),(250µm ±26.4575) and(315µm±22.9129) respectively, whereas incommon moorhen *(Gallinula chloropus)* were (610.19 µm± 193.056338),(235µm ±28.3725)and (395µm±32.3265) respectively.

The parenchymal of liver consist of hepatocytes constitute parallel cords to the capsule whereas it was arranged radially inward composing small lobules and acini.This hepatocytes it is polyhydral in shape, and have rounded nucleus and this plates are separated by blood sinusoids and arranged in radiation form around centralvein.(fig.3,A)(fig.4,A)

Also observedthe presence of blood sinusoids in the liver and the board that are lined with two types of cells, the first type cells are flattened endothelial cells which are nuclei elongated , dark-colored, linked to this type cells with each other loosely . The second type of cells is Kupffer cells, which are drenched in cavitiesof blood sinusoids as phagocyte cells and nuclei which are spherical in shape dark, cytoplasm are projections and extends this as larger than the previous type cells.

It showed the branchesof portal triads that lined by endothelial cells and surrounded by some smooth muscles fiber(fig.5,B) so that consisted hepatic vein which features thin wall and large lumen while hepatic artery that features thick wall and small, winding cavity and contain internal elastic membrane as for bile duct were detected at the periphery of parenchymal lobules which lined by simple cuboidal epithelium and surrounded by a loose connective tissue. Thereare smooth muscles around larger ducts.

Histochemically ,The hepatocytes were weakly positive to periodic acid Schiff(PAS) reaction in the two species of birds.(Fig.5,A) (fig.6,A) The hepatocytes in the study of birds showed a positive reaction withbromophenol blue reaction(MBB) stain for the proteins which showed the collections of protein inside the hepatocytes.(Fig.5,C) (fig.6,B)

Discussion

Themorphological results in this study in the liver of the two species of birds was a red bilobed and large organ that lied in the mid-coelomic cavity, these agreed with (Whittow, 1998; Schmidt *et al.,* 2003) such as captive bustards (Bailey *et al.*, 1997), ostrich (Illanes *et al.*, 2006; Stornelli *et al.*, 2006) and other vertebrates (Petcoff *et al.*, 2006; Seyrafi *et al.*, 2009; Monsefi *et al.*, 2010;El-Bakary and El-Gammal, 2010; Alshamarry *et al.*, 2010).

Theliversh ow in this study presence of two secondary lobes in the end of the left lobe of the liver .The later result also disagree in theostrich where the left lobe of the liver was subdivided into three secondary lobes while theright lobe was undivided (Stornelli *et al.*, 2006)while there were no further lobular subdivisions in the liver of Houbara Bustards (Bailey*et al*,.1997) and in contrast with (Nickel*et al*,.1977) who described that the left lobe of Passenger Pigeon liver consist of three parts, distal processes a small median one, and one upon either side of double its size, the result agreed with (Shaymaa,2015) that described the liver in *Coturnix coturnix*it was the left lobe divided into two portion ,dorsal and ventral lobe.

Histologically , our result of the liver in study birds is large lobed lining by capsule which composed of irregular dense connective tissue that continue to subdivided the liver in to lobes and appears thicker in thecommon moorhen*(Gallinula chloropus*)these agreed which appears thicker in the *Larus canus*in (Hani*et al*,.2013). This capsule also reported in other birds and vertebrates (Sheybani and Adibmoradi,2002; Schmidt *et al.*, 2003; Illanes *et al.*, 2006; Firmiano *et al.*, 2011and Xie *et al.*, 2011).

The parenchymal of liver showed a arrangementconsisting of hepatocytes, which were arranged in either cords one cell or two cells thickness around sinusoids While it resembled the results of the studies that have described for many vertebrates that have hepatocytes cords consisted of one - two cell thickness (Stornelli *et al.*, 2006; Bertolucci *etal.*, 2008; El-Bakary ; El-Gammal, 2010; Sayrafi *et al.*, 2011and Xie *et al.*, 2011and Eyhab*et al.*,2016). The hepatocytes vary in shape among the two species, the reason of that may due to the difference of each animal species (Alshamarry *et al.*, 2010).

Lumen of sinusoids contained erythrocytes and macrophages also the wall of sinusoids contained Kupffer cells which are important for the maintenance of liver functions under physiological and pathological circumstances (Wardle,1987). They play an important role in the modulation of immune responses via antigen presentation and suppression of cell activation and proliferation of T-cells (Sun *etal.*, 2003)

Histochemically, showed that the hepatocytes were weakly reactive to PAS and positive reaction with MBB in the two species of birds. These results check the importance of the liver in the metabolism of fats, carbohydratesand other nutrients and this also are agreed with the results of previous studies on the liver in different vertebrates (Akiyoshi and Inoue, 2004; Petcoff *et al.*, 2006;Seyrafi *et al.*, 2009; El-Bakary and El-Gammal, 2010; Immanuel and Palavesam, 2010; Firmiano *et al.*, 2011; Sayrafi *et al.*, 2011and Xie *et al.*, 2011).

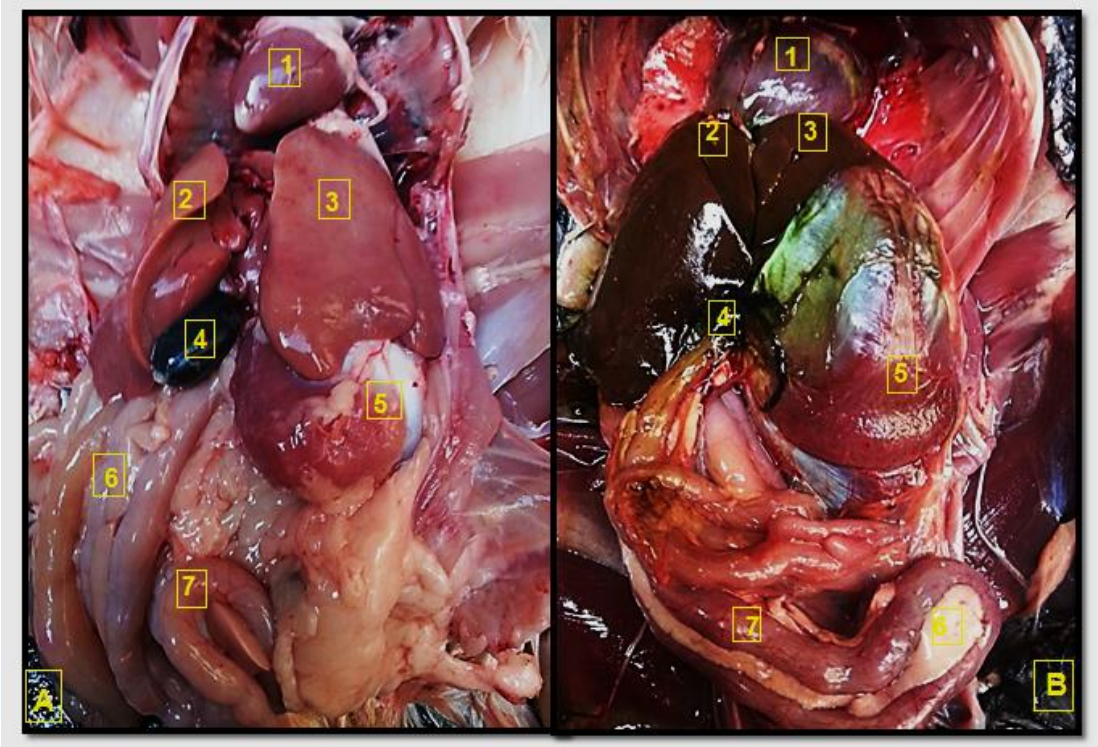


Fig.(1):Dissected of abdominal cavity show the position and relation of liver : (A)-domestic fowl (*Gallus Gallus*) , (B)common moorhen(*Gallinula chloropus*):-1-Heart, 2- right lobe of Liver, 3- left lobe of Liver, 4-gall bladder, 5- Ventricular ,6-Pancreas and 7-Duodenum.

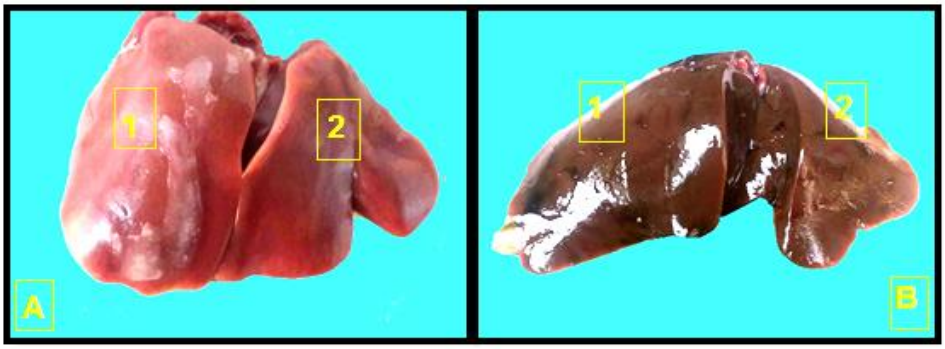


Fig. (2) The liver showing: (A) domestic fowl (*Gallus Gallus*) .(B) common moorhen (*Gallinulachloropus*). 1- Right lobe 2- left lobe.

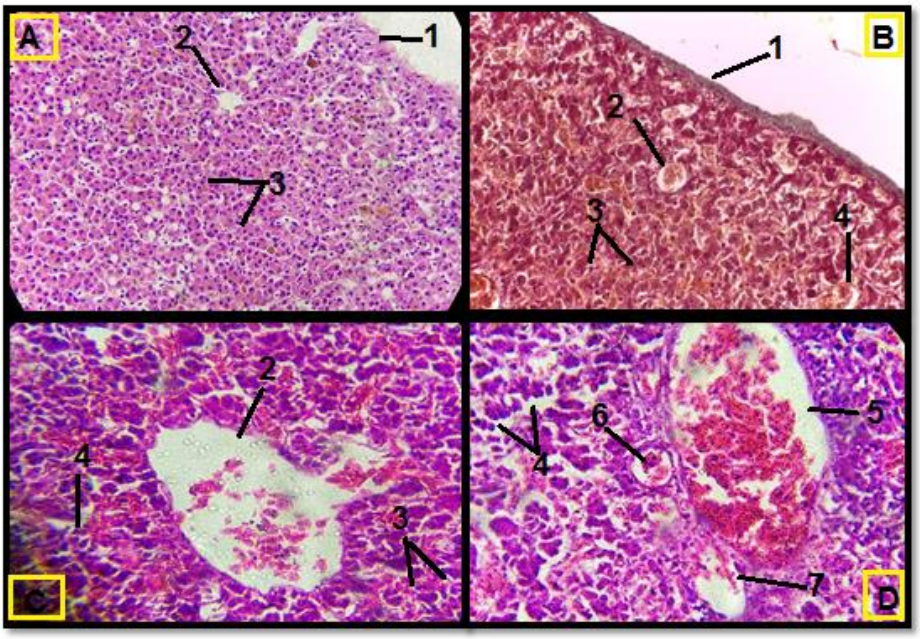


Fig. (3):Cross section of the Liver in (*Gallus Gallus*) showing:
(**A**) 1. Capsule , 2. Central vein, 3.Hepatocyte (H & E stain X40).
(**B**) 4. Sinus (Masson's Trichrome stain, X100)
(**C**) (H & E stain X400)
(**D**) 5.portal vein, 6. Hepatic artery and 7.Bile duct (H & E stain X100).

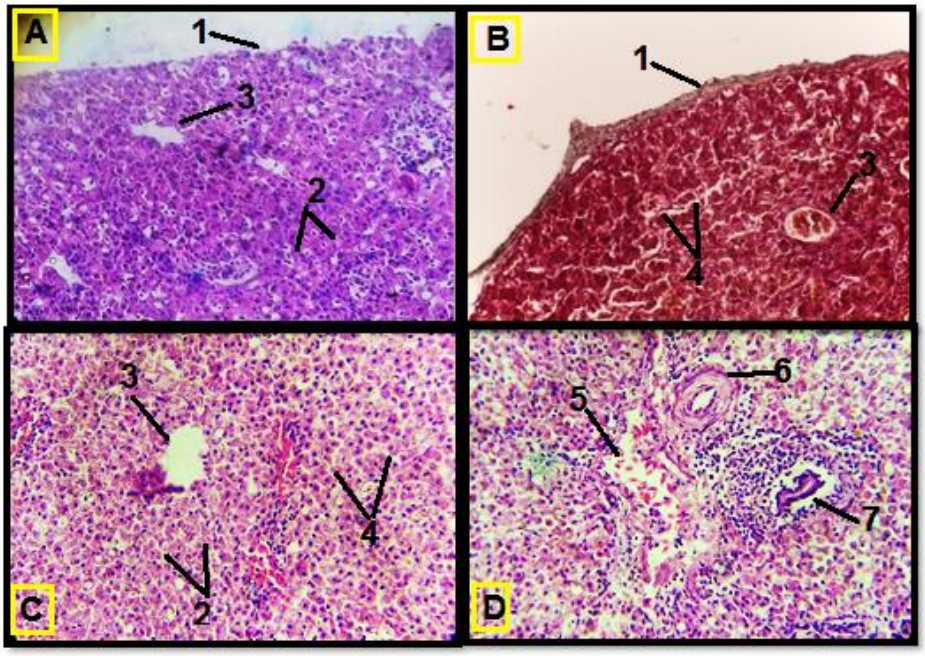


Fig. (4): Cross section of liver in *(Gallinula chloropus*) showing:
(**A**) 1- Capsule, 2- Hepatocyte 3- Central vein (H & E stain X40).
(**B**)4-liver sinusoid (Masson's Trichrome stain, X100).
(**C**) (H & E stain ,X400).
(**D**) 5-portal vein 6- Hepatic artery and 7- Bile duct (H & E stain ,X100).

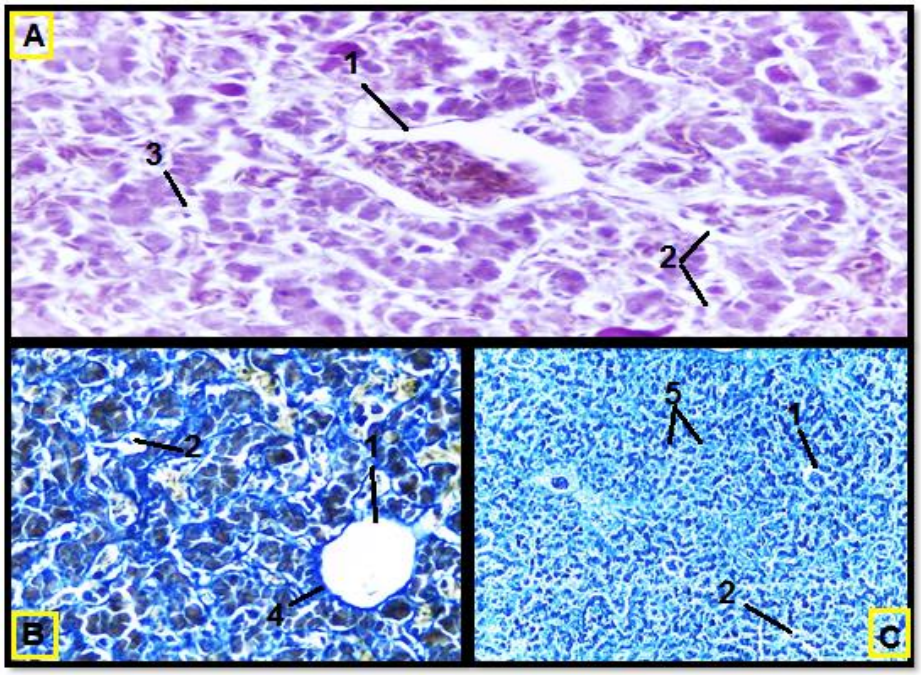


Fig. (5) Cross section of Liver (Gallus Gallus) showing that :
(**A**) 1-central vein 2- liver sinusoid, 3- Kupffer's cells (PAS stainX400).
(**B**) 4- endothelial cell (Lillies Allochrome stain, X100).
(**C**) 5- Hepatocyte(MBB stainX40).

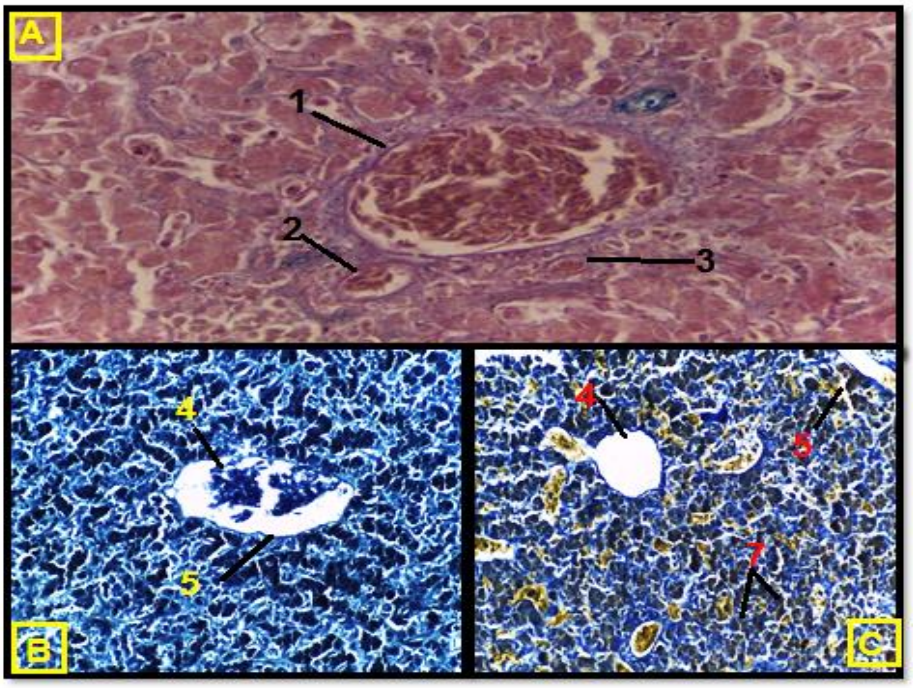


Fig.(6) Cross section of the Liver *(Gallinula chloropus*) showing that :
(**A**) 1- Hepatic portal vein, 2- Bile duct and 3- Hepatic portal artery (PAS stain X400).
(**B**) 4- central vein and 5- endothelial cell (MBB stain, X400).
(**C**) 6- liver sinusoid 7- Hepatocyte (Lillies Allochrome stain, X100).

References

1. Daghir, N. J. 2008.Poultry Production in Hot Climates, (2nd Ed.) Published by CAB International, Wallinford,Oxfordshire, UK, Pp.387.Damerow, G. 1995. A Guide to Raising Chickens. Storey Books. ISBN 0-88266-897-8.
2. Raloff, J. 2003.Food for Thought: Global Food Trends. Science News.Online.http://www.sciencenews.org/view/generic/id/3902/description/GlobaFood Trends.
3. Genten, F.; Terwinghe, E.; Danguy, A.(2009)."Atlas of Fish Histology". Science Publishers,Enfi eld, NH, USA. 92 p.
4. Sarkarati, F. and Y. Doustar. 2012. The frequency of liver lesions of broilers slaughtered in Tabriz abattoir.Ann. of Biol. Res., 3(7):3439-3443.
5. Hoppe, P.P. 1999.Poultry International: Asia Pacific Ed., 38(11):52-62.
6. Clark, F. D. 2005. Normal Birds - A Review of Avian Anatomy. Avian Advise.7:1.
7. Whitlow, G.G. 2000.Gastrointestinal Anatomy and Physiology. Avian Physiology. (5th ed.), Academic Press,Honoiula Hawaii Pp:299-304 .
8. Caceci, T. 2006.Avian digestive system. Academic Press, Itheca, New York. Pp;1-94.
9. Selman H.A. (2013): Morphological and histological study for liver local coot birds *Fulica Atra*. Bas. J. Vet. Res.Vol.12, No.1. Pp: 152-158.
10. Al- Abdulla M.A. (2015): Histological and Histochmemical study of the liver of Iraq local ducks. Bas.J.Vet.Res.Vol.14,No.1.2015.
11. Shindala, M**.** K. (1999). Anaesthetic effect of ketamine and ketaminewith diazepam in chicken. Iraq. J. Vet. Sci., 12: 261-265.
12. Bancroft, J. D. and Stevens, A. (2010): In Theory and Practice of Histological Techniques. 2nd ed, Churchill Livingstone. New York.
13. Luna,L.G.(1968): Manual of histologic staining methods of armed forces institute of pathology. 3rd ed . New York , U.S.A. McGraw-Hill book company. Pp:39-110.
14. Widhi Dubey and Trivedi P.C.(2012): Histochemical localization of proteins and nucleic acids in healthy and meloidogyne incognita, infected okra (Abelmoschus Esculentus (L.) Moench). Indian Journal of Fundamental and Applied Life. Vol. 2 (2) April-June, pp.345-354.
15. Whittow, G.C. (1998). 'Sturkie's Avian Physiology". 5th ed. Academic Press. 305 p.
16. Schmidt, R.E.; Reavill, D.R.; Phalen, D.N. (2003). "Pathology of Pet and Aviary Birds". A Blackwell Publishing Company. 67 p.
17. Bailey, T.A.; Mensah-Brown, E.P.; Samour, J.H.; Naldo, J.; Lawrence, P.; Garner, A.(1997). Comparative morphology of the alimentary tract and its glandular derivatives of captive bustards. *J. Anat.*, 191, 387–398.
18. Illanes, J.; Fertilio, B.; Quijada, M.; Leyton, V.; Verdugo, F. (2006). Histologic Description of the Annexed Glands from the Ostrich Digestive System (*Struthio camelus var. domesticus*). *Int. J. Morphol.*, 24(3), 297-302.
19. Stornelli, M.R.; Ricciardi, M.P.; Giannessi, E.; Coli, A. (2006). Morphological and histological study of the ostrich (*Struthio camelus* L.) liver and biliary system. *It. J. Anat. Embryol.*, 111(1), 1-7.
20. Petcoff, G.M.; Diaz, A.O.; Escalante, A.H.; Goldemberg, A.L. (2006). Histology of the liver *Oligosarcus jenynsii* (ostariophsi, characidae) from Los Pades Lake, Argentina. *Ser. Zool.*, 96(2), 205-208.
21. Sayrafi, R.; Najafi, Gh.; Rahmati-holasoo, H.; Hajimohammadi, B.; Athari, S.Sh. (2009). Histological study of Hepatopancreas in iridescent shark catfish (*Pangasius hypophthalmus*). *J. Anim. Vet. Adv.*, 8(7),1305-1307.
22. Monsefi, M.; Gholami, Z.; Esmaeili, H. (2010). Histological and Morphological Studies of digestive tube and liver of the Persian tooth-carp, *Aphanius persicus* (Actinopterygii:

Cyprinodontidae). *IUFS J. Biol.,* 69(1), 57-64.

23. El-Bakary, N.E.R.; El-Gammal, H.L. (2010). Comparative histological, histochemical and ultrastructural study of the liver of Flathead Grey Mullet (*Mugil cephalus*) and Sea Bream (*Sparus aurata*). *Glo. Vete.,* **4**, 548-553.

24. Alshamarry, H.A.; Sucar, D.K.; Taha, T.J. (2010). Comparative Histological study for The Iraqi Camels (*Camelus dromedarius*) liver and Cows (*Bos indicus*). *J. Thi. Sci.,* 2(3),39-48.

25. Nickel ,R.; Sccummer, A. and Seiferk,E. (1977) . Anatomy of the Domestic Birds. Verlag. Paul parey Berlin .

26. Hamodi, H. M., Abed A. A. and Taha, A. M. (2013): Comparative Anatomical, Histological and Histochemical Study of theLiver in Three Species of Birds. *Raf. J. Sci*., Vol. 24, No.5 Pp. 12-23.

27. Sheybani, M.T; Adibmoradi, M. (2002). Histological study of the liver and pancreas and their ducts in *Acipenser stellatus*. J. Fac.Vet. Med. Uni. Tehran., 57(1), 19-23.

28. Schmidt, R.E.; Reavill, D.R.; Phalen, D.N. (2003). "Pathology of Pet and Aviary Birds". A Blackwell Publishing Company. 67 p.

29. Firmiano, E.M.S.; Cardoso, N.N.; Vieira, D.A.; Sales, A.; Santos, M.A.J.; Mendes, A.L.S Nascimento, A.A. (2011). Histological study of the liver of the lizard *Tropidurus torquatus* Wied 1820, (Squamata: Tropiduridae). *J. Morphol. Sci.*, 28(3),165-170.

30. Xie, Z.H.; Zhong, H.B.; Li, H.J.; Hou, Y.J. (2011).The structural organization of the liver in the Chinese fire-bellied newt (*Cynops orientalis*). *Int. J. Morphol.*, 29(4),1317 1320.

31. Bertolucci, B.; Vicentini, C.A.; Vicentini, I.B.F.; Bombonato, M.T.S. (2008). Light microscopy and ultrastructure of the liver of *Astyanax altiparanae* Garutti and Britski, 2000 (Teleostei, Characidae). *Acta Sci. Biol. Sci.,* 30(1),73-76.

32. Sayrafi, R.; Najafi, G.; Rahmati-holasoo, H.; Aref, H.; Ramin, A.; Shokrpoor, S.; Ghadam, M. (2011). Histological study of hepatopancreas in Hi Fin Pangasius (*Pangasius sanitwongsei*). *Afr. J. Biotech.,* 10(17), 3463-3466.

33. Wardle, E.N. (1987). Kupffer cells and their function. *Liver*.**7**, 63-75.

34. Sun, Z.; Wada, T.; Maemura, K.; Uchikura, K.; Hoshino, S.; Diehl, A.M.; Klein, A.S. (2003). Hepatic allograft-derived Kupffer cells regulate T cell response in rats. *Liver Trans.,* 9(5), 489-497.

35. Akiyoshi, H.; Inoue, A. (2004). Comparative histological study of teleost livers in relation to phylogeny. *Zool. Sci*., **21**(8), 841-850

36. AL-Samawy E.R; Jarad A.S and Muhamed A.A.(2016): Histo-morphometric and Histochemical comparative study of the Liver in Collard Dove (*Frivaldszky*), Ruddy Shelduck (*Pallas*) in South Iraq.

37. AL-Abedi SH.J.G. (2015) : Anatomical and Histological study of the liver in three species of adult Iraqi birds. M.Sc.Tesis.University of Kufa. Najaf. Iraq.