Bull. Iraq nat. Hist. Mus.
(2019) 15 (4): 425-441

https://doi.org/10.26842/binhm.7.2019.15.4.0425

COMPARATIVE ANATOMICAL AND HISTOLOGICAL STUDY OF SOME ORGANS IN TWO FISH SPECIES *CYPRINUS CARPIO* LINNAEUS, 1758 AND *MESOPOTAMICHTHYS SHARPEYI* (GÜNTHER, 1874)(CYPRINIFORMES, CYPRINIDAE)

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Received Date: 27 July 2019, Accepted Date: 14 October 2019, Published Date: 26 December 2019

ABSTRACT

The present study aims to give some details about the normal anatomical and histological structure of the liver, pancreas and gall bladder in *Cyprinus carpio* Linnaeus, 1758 and *Mesopotamichthys sharpeyi* (Günther, 1874). Anatomical results revealed that the liver of *C. carpio* is a reddish-brown in color, located in the anterior part of abdominal cavity and dispersed between most of the intestines, which is divided into two lobes, while in *M. sharpeyi* the liver is light brown in color located in the anterior part of abdominal cavity and extends to the end of the intestinal tract with two lobs. The gallbladder situated in the right side of the liver. Histological results in both species showed that the liver consists of hepatocyte arranged radially around a central vein, separated by blood sinusoids, not divided into distinct hexagonal lobules, no portal traids as in higher vertebrates. The wall of gallbladder consisted of three distinct layers: Tunica mucosa, tunica muscularis and tunica serosa. Microscopic results showed that exocrine pancreatic tissue was diffused type in both species located in liver and consists of acini as "hepatopancreas " however pancreatic tissue diffused between the intestinal coiling in *C. carpio* and the internal surface of the liver in *M. sharpeyi*. Endocrine parts of pancreas were observed in few numbers of cell masses in various sizes among exocrine pancreatic cells.

Key Words: *Cyprinus*, Histology, Liver, *Mesopotamichthys*, Pancreas.

INTRODUCTION

The liver is the major and the important organs in alimentary tract, and is an indicator of health in the fish body (Sarvestani, 2017). The liver in teleost is a relatively large, dense organ located ventral in the cranial part of the general cavity (Taddese *et al*., 2014). Its shape, size and volume are adapted to the space available between other visceral organs (Vicentini *et al*., 2005). The gall bladder in fish is an accessory organ of the digestive system that secretes and stores concentrated bile (Holt, 2011); it is usually found within the liver somewhere, a hollow structure of the fundus at the end of the sac and body as well as the neck that opens in the cystic duct (Mohammed, 2001). The anatomy of the organs, including the pancreas, greatly

varies among different species of fish, the pancreas of fish, similar to that of all vertebrates, has two main components: an exocrine and an endocrine component (Farrell *et al*., 2011). The pancreas of teleosts fish was classified into disseminated, compact and diffuses within liver or spleen; pancreas in many teleosts becomes quite reduced, and diffuse in the adults (Mokhtar, 2017).

The digestive system in fish shows marked variety in its anatomy and function; this is associated with the taxonomy and various feeding behaviors, as well as the shape of the body (Abdulhadi, 2005). Morphological documents on the digestive system can provide a better understanding of species performance in their biological ecosystems or in fish farming, and may provide bioindicators of environmental alterations (Fagundes *et al*., 2016).

The Cyprinidae family is one of the largest and most important freshwater families spread all over the world involving Iraq, also occupies the first place in Iraq economically (Ibrahim *et al*., 2013). *Cyprinus carpio* Linnaeus, 1758 characterized with, rapid growth, high fertility, disease resistant acceptability and tolerance to abnormal conditions and is found to be appropriate for many farming system (Mohapatra and Patra, 2014).

There are few studies associated with the normal histological structures of the digestive system of fish, in particular glands in the digestive system, so it has been a motivation for the design of the current study. Thus, this work objectives to understand the anatomical and histological structure of liver, pancreas and gall bladder in both fish species *C. carpio* and *Mesopotamichthys sharpeyi* (Günther, 1874).

MATERIALS AND METHODS

Ten of healthy adult females of *C. carpio* were collected from fish farm in Saqlawiya in Al-Anbar province during the period of October to December 2018. The length mean was 41.300± 0.9781 cm, and the mean of body weight 1600.000 ± 77.824 g, also ten of healthy adult females of *M. sharpeyi* were collected from Al-Tharthar Lake with average of length 46.600 ± 0.5416 cm and average of body weight 1434.000 ± 34.00 g. All specimens were dissected immediately; the liver and gall bladder were exposed through a longitudinal incision in the abdominal wall. Gross pictures were taken to recognize the shape, position and color and its relation to other organs; all these observations were photographed with camera (Microscope Camera, Eyepiece KoPa/ China).

Specimens were dissected at 1x1x.05 cm, and were immediately fixed in formalin solution 10%. The fixed materials were dehydrated in an ascending series of ethanol (70% to 100%), cleared in xylene, then embedded in paraffin; sections 5µ were stained with routine hematoxylin and eosin according to Bancroft and Stevens's method (1982). Sections were observed in the microscope (Olympus, Japan).

RESULTS AND DISCUSSION

Anatomical observations

Liver: The anatomical results of the present study which concerned with liver showed that the liver of the *C. carpio* was relatively large, reddish-brown in color, longitudinal in shape, hepatic tissues that surrounded and dispersed between most of the intestine (Pl.1), these results come in parallel with what has been mentioned by Farag *et al*. (2014). The liver is divided into two lobes, a large part of liver is located in the right side of the body cavity in contact with a gallbladder, and the left lobe presses up against the spleen.

These results were agreed with, Faccioli *et al*. (2014) who described the liver of *Hemisorubim platyrhynchos* (Valenciennes,1840) and with Mokhtar (2018) who described the liver of *Ctenopharyngodon idella* (Cuvier & Valenciennes, 1844) which have two lobes, while disagree in paddlefish *Polyodon spathula* (Walbaum,1792), the liver has three principle lobes (Weisel, 1973).

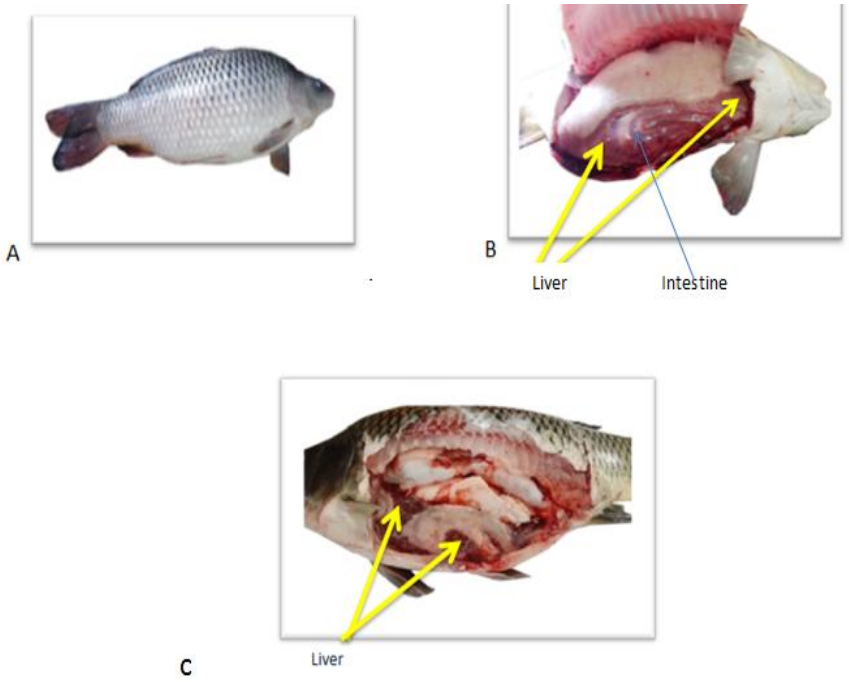


Plate (1): *Cyprinus carpio*; (A) Habitat, (B) The right side of carp showing the coiling of the intestine, was overlapped with the liver, (C) Liver at the left side.

The liver of carp rest below the transverse septum; at the right side is large extending in the right lateral part of the cavity, spreading and overlapped with the intestine.

Liver of *M. sharpeyi*, which is also known by its synonymous name *Barbus sharpeyi* Günther, 1874, is light brown in color; the tissue of the liver is very soft tissue, with both left and right lobs, has a thickest form at the interior part, and the thin at the posterior part. The right lobe is at the right side of the abdominal cavity along the gonads, and the left lobe is at the left side of the abdominal cavity. Both lobes combine at the posterior end of the body (Pl.2), these observation similar in Nile tilapia *Oreochromis niloticus* (Linnaeus,1758) liver is a large organ and has only two lobes (Vicentini *et al*., 2005), but differ of what was reported by Krishnan (2018) the liver of *Etroplus maculatus* was trilobed and united anteriorly.

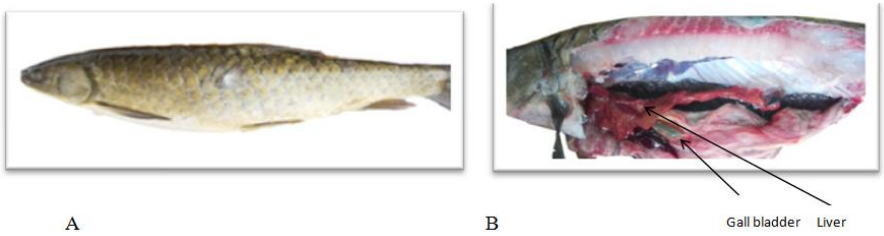


Plate (2): *Mesopotamichthys sharpeyi*; (A) Habitat, (B) Abdominal cavity opened and liver, and gallbladder were observed.

Gall bladder: The gallbladder in *C. carpio*, is a large oval or pear sac, greenish – yellow in color, situated in the right side of the liver (Pls.3, 4), these results agree with Mohammed (2001) who described the shape of gall bladder pear shaped in *Silurus triostegus* (Heckel), and with Hassan (2013) in *Epinephelus chlorostigma* (Valenciennes, 1828). Whereas the gallbladder *M. sharpeyi* showed an elongated form located under the right lobe of the liver (Pls.3, 4). These results were agreed Faccioli *et al*. (2014) who described the gallbladder in *Hemisorubim platyrhynchos* (Valenciennes, 1840) possesses elongated shape. The gallbladder divided into three main sections, fundus, body and neck.

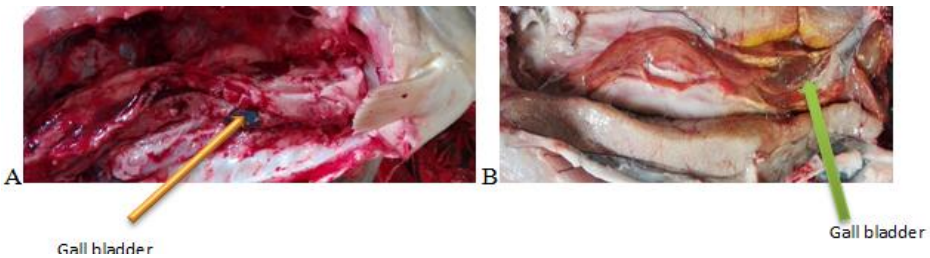


Plate (3): The gallbladder; (A) *C. carpio*, (B) *M. sharpeyi*

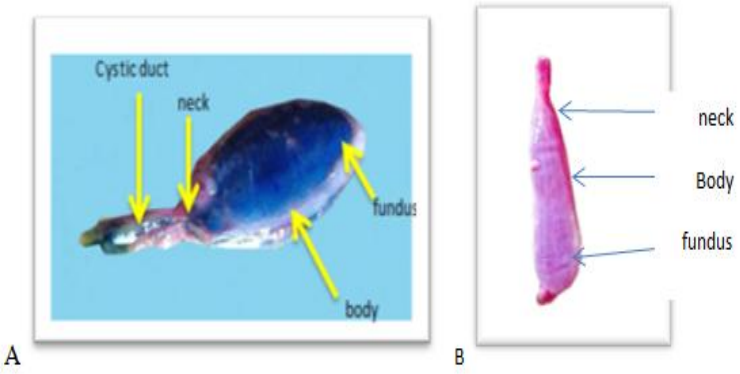


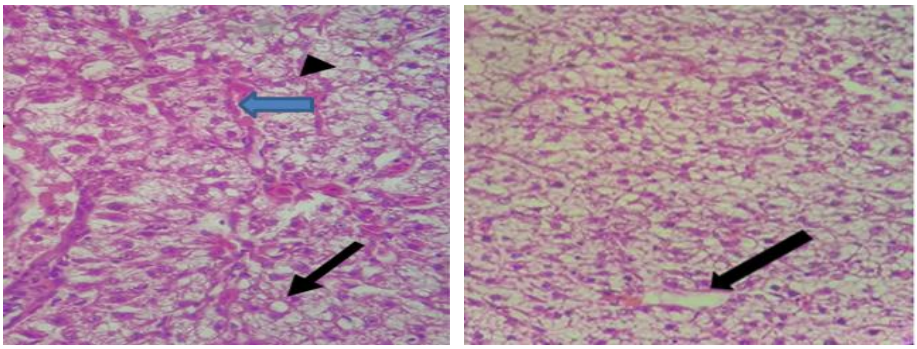
Plate (4): Parts of gallbladder; (A) *C. carpio*, (B) *M. sharpeyi*.

Pancreas: The pancreas showed many differences in its structure, anatomy and morphology among the teleosts (Ghosh and Chakrabarti, 2016). In the present study showed that the pancreatic tissues in *C. carpio*, were observed in diffused form with liver as hepatopancreas being attacked by the mesentery in contact with the intestine. Pancreatic tissues showed a diffuse type in the different regions; in the liver in the anterior part, and located between the coils of intestine, and in the spleen as spleenpancreas**.** These results in agreement with a study of Nejedli and Gajger (2013) as well as Fortin *et al*. (2015).

In *M. sharpeyi* , like to *C. carpio* and many of teleoste the liver is a composite of the liver and pancreas elements as called hepatopancreas, pancreatic acini observed in the internal surface of the liver or at the dorsal side of intestinal tract, and near the gall bladder, exocrine pancreas spreads around the branches of the hepatic portal veins within the tissue of the liver, these results are similar in *Pangasius sanitwongsei* Smith, 1931 (Sayrafi *et al*., 2011**)**. The pancreas also observed within the spleen as spleenpancreas, and these results were similar to the other fishes as in *Luciobarbus pectoralis* Heckel, 1843 (Mahabady *et al*., 2012), *Barbus grypus* (Mohsin, 2016), *Barbus Luteus* (Karim, 2017). But these results in both species differ from *Pimelodus maculatus* Lacepede, 1803 which the pancreas is compact, enclosed by a thin layer of connective tissue and is attached to the stomach and intestine wall as small masses of glandular tissue (Vicentini *et al*., 2005).

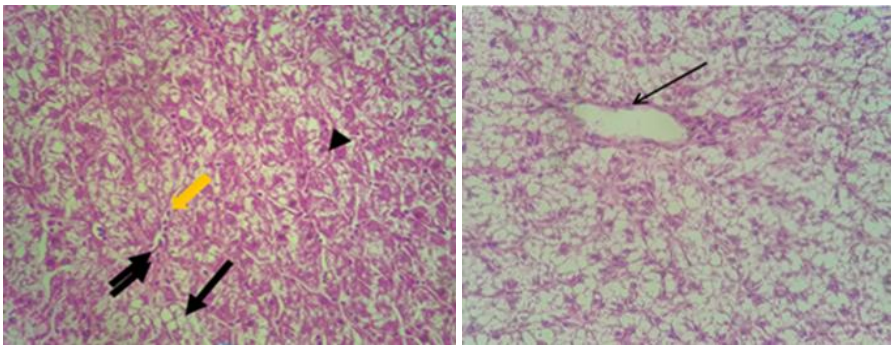
Histological Description

Liver: The histological preparation of the liver, stained with hematoxylin and eosin, of the investigated species of fish revealed that the liver in both species consisted of a continuous mass of large hepatic cells. Hepatic cells were roundish or polygonal in shape containing spherical nucleus located centrally, surrounded by a narrow layer of cytoplasm, the hepatocytes were arranged radially around of central vein, similar in other fishes that described by Ribeiro and Fanta (2000), Petcoff *et al*. (2006), Faccioli (2014), Nazlić *et al*. (2014) and Lakshmaiah (2016). The hepatic parenchyma in *C. carpio* was made up of two cellular plates surround the sinusoids, the hepatocytes were organized in tubular form and looked as plates, two or more hepatocytes in thick; Kupffer cells were seen in the liver of *M. sharpeyi* within sinusoids (Pls. 5, 6).



(A) (B)

Plate (5): Liver of *C. carpio*; (A) Hepatocytes (arrow head), sinusoids (blue arrow), Vacuole of glycogen (arrow), (B) Central vein (arrow) (H&E 40X).



(A) (B)

Plate (6): Liver of *M. sharpeyi*; (A) Vacuoles of glycogen (arrow), hepatocyte (arrowhead) and Kupffer cell (double arrow), sinusoids (yellow arrow) (H & E 10x), (B) Central vein (arrow) (H & E 40X).

There are no distinct hexagonal structural lobules were found, as they are in livers of higher vertebrates (Pls. 5, 6); these results resembled that described by Vicentini *et al*. (2005), Ikpegbu *et al*. (2012), Noskor *et al*. (2013), Krishnan (2018) and Mokhtar (2018). Glycogen vacuoles have also been detected in both species in the hepatocytes.

Our results showed the bile duct in both species *C. carpio* and *M. sharpeyi*, had the isolated type and other combined with the portal-tract type (Pl. 7); these results are consistent with what found by Noskor *et al*. (2013) and Mohsin (2016**)** showed the bile duct was located separately or isolated type in the hepatic tissues.

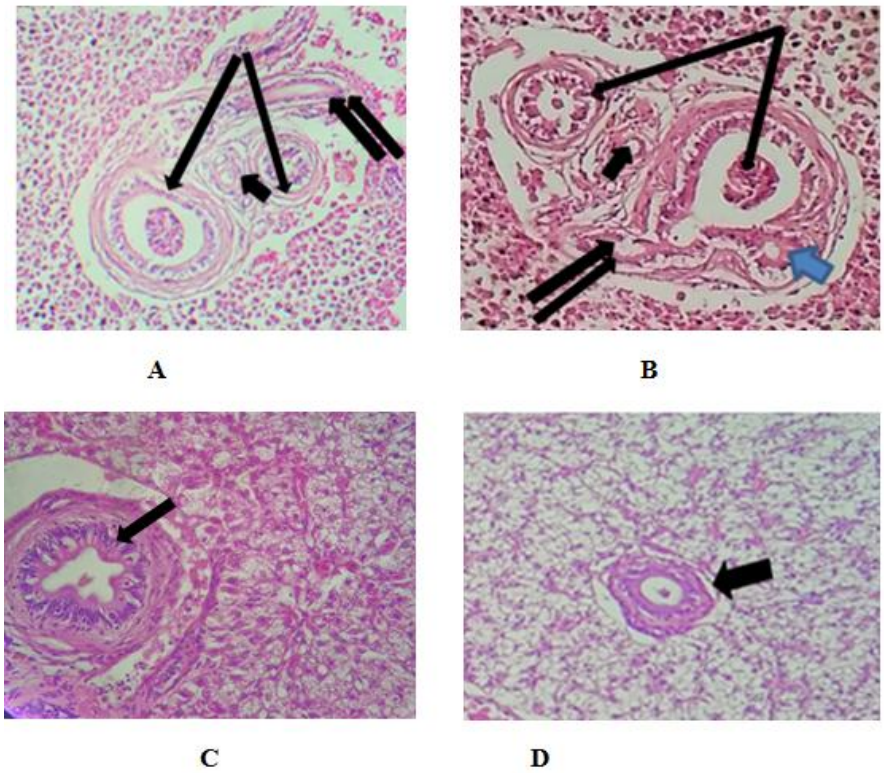


Plate (7): Bile duct in portal tract type; (A) *C. carpio*, (B) *M. sharpeyi*, bile duct (arrow), bile ductule (blue arrow), artery (arrow head), vein (double arrow), (C and D) Isolated type *C. carpio* and *M. sharpeyi*, a bile duct was located alone in the hepatic tissues. (A, B, D: H&E 10X; C: H&E 40X).

The current study showed that the bile duct associated in the hepatic tissue with hepatic portal vein and hepatic artery in both species, and surrounded by hepatocytes. However; it cannot be considered "a true hepatic triads" or portal traid (Pl.7 A, B). These results compatible with Vicentini *et al*. (2005), Ikpegbu *et al*. (2012), Faccioli *et al*. (2014) and Krishnan (2018).

Histologically, the diffuse pancreas was seen in the studied fishes as acinar arrangement separated from hepatic parenchyma by a thin layer of connective tissue; the pancreas tissues were invaded the liver around blood vessels, these results agreement with Sayrafi *et al*. (2011) and Nejedli and Gajger (2013).

Pancreas: A typical feature of the pancreas in teleost was a diffuse exocrine pancreas, which expanded through the mesentery, or disseminated within the intraperitoneal adipose tissue (González *et al.*, 1993). The present study showed that the exocrine cells are tall and columnar have a dark cytoplasm, distinct nuclei, and many zymogen granules that deposited heavily in the cells (Pl.8A). These observations agreed with Sinha (1986), Petcoff *et al.* (2006), Faccioli *et al.* (2014), Nazlić *et al*. (2014), Ebrahimi (2015) and Alonso *et al*. (2015).

Pancreas of *C. carpio* within liver tissue showed: exocrine acinar cell, islet of Langerhans and hepatic portal vein; intralobular pancreatic duct and interlobular pancreatic duct (Pl. 8).

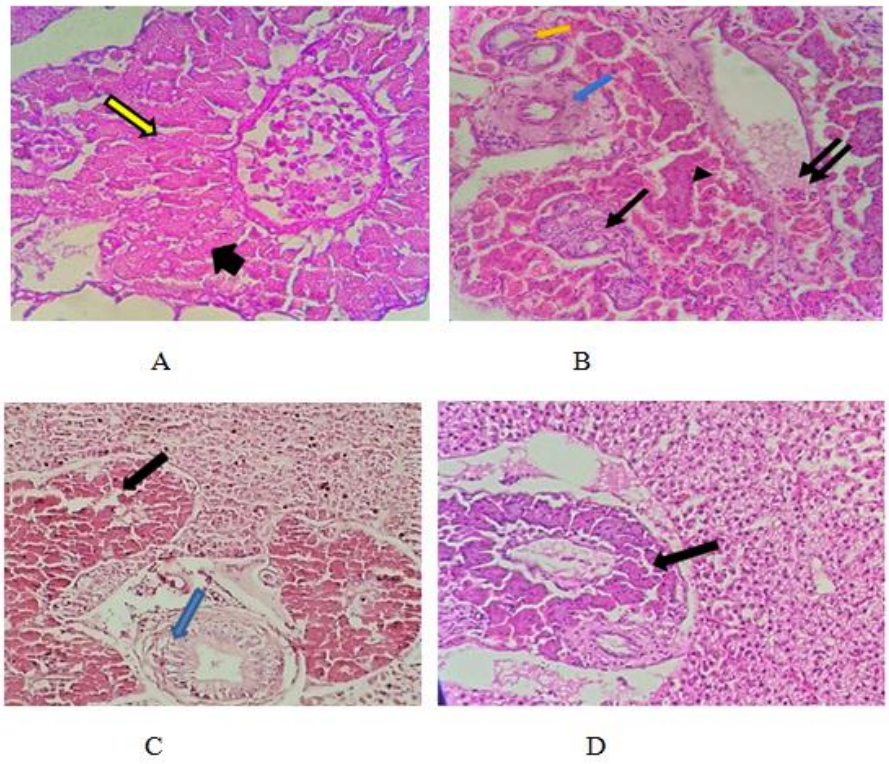
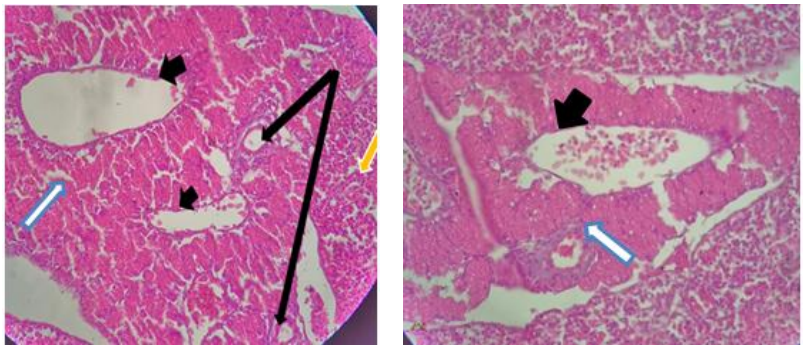


Plate (8): Pancreas of *C. carpio* within the liver tissue; (A) Exocrine acinar cells (arrowhead), nucleus (yellow arrow), (B) Islet of Langerhans (arrow) and portal vein (double arrow), intralobular pancreatic duct (yellow arrow), interlobular pancreatic duct (blue arrow), (C) Pancreas diffused around the bile duct (black arrow), bile duct (blue arrow), (D) Centroacinar cells (arrow). (A, B: H&E 40X), (C, D: H&E 10X).

The pancreatic tissues in *C. carpio* which observed within the spleen as "spleenopancreas ", the exocrine acinar cells in the form of numerous clusters around a blood vessel in the spleen were also noted (Pl. 9). These results were similar to the investigations of grass carp *Ctenopharyngodon idella* (Mokhtar, 2015) and *Labeo calbasu* F. Hamilton, 1822 (Ghosh and Chakrabarti, 2016).



A B

Plate (9): The Spleen in *C. carpio*; (A and B) showed diffuse pancreas located as apart within the spleen as (spleenopancreas), pancreatic cells (whit arrow), splenic tissue (yellow arrow), intralobular pancreatic duct (black arrow), blood vessel (arrow head). (H & E 40X).

M. sharpeyi possess a diffuse pancreas which also similar to what exists in *C. carpio*, the exocrine pancreas compounds acinar cells diffused within the hepatic tissue, around the branches of the portal vein, and around the bile duct, also acini or secretory units scattered within spleen as "Spleenopancreas" (Pl.10), these results were compatible with Mahabadyj *et al*. (2012) in *B. pectoralis.*

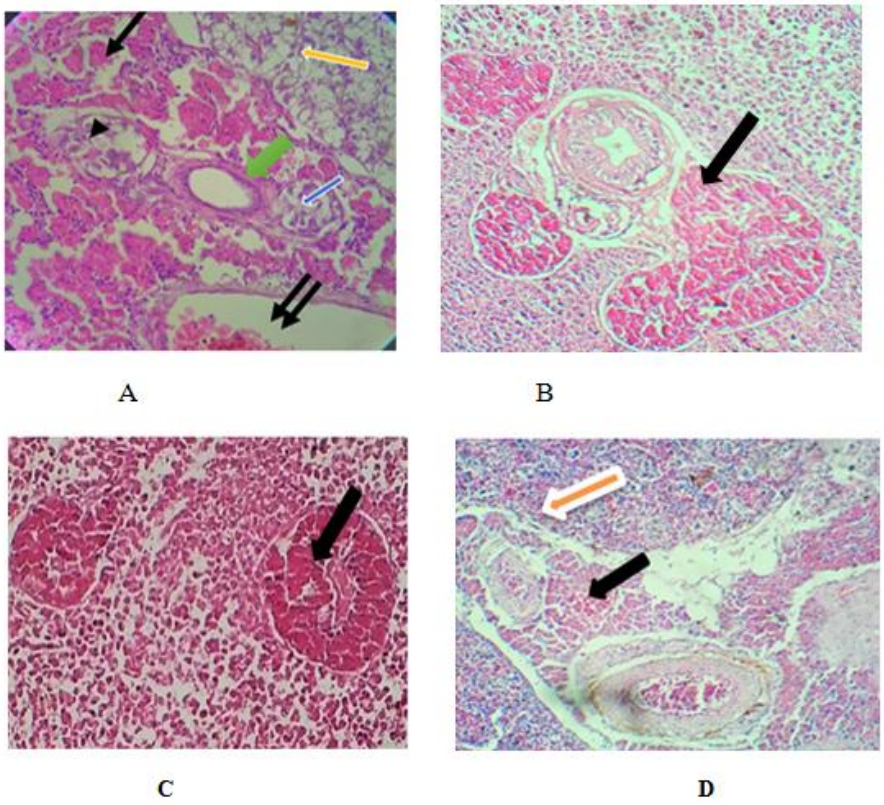


Plate (10): Pancreas of *M. sharpeyi*; (A) Within liver tissue (hepatopancreas) showed exocrine acinar cell (black arrow), islet of Langerhans (arrow head) and hepatic portal vein (double arrow), hepatocyte (yellow arrow), intralobular pancreatic duct (green arrow), (B) The pancreas diffused around the bile duct (arrow), (C) Centroacinar cells (arrow), (D) Showed diffuse pancreas (arrow) located as apart within the spleen as (spleenopancreas), spleen (yellow arrow). (A: H&E 40X; B, C, D: H & E 10X).

In agreement with Hale (1965), the main concentration of exocrine tissue lies around the bile and pancreatic ducts in both species, as shown in the above (Pls. 8C, 10B).

The endocrine pancreas in both species distributed within exocrine pancreatic tissue in the liver. The endocrine pancreatic cells of *C. carpio* are mainly distributed among the intestinal coils. Similar findings were also observed by Ghosh *et al*. (2016) in *Labeo bata* Hamilton, 1822. In *M. sharpeyi*, endocrine pancreas surrounded by exocrine located in the anterior part of the liver lobs. The islets vary in size, there are small and medium, as well as differ in shape, islets are rounded and irregular. Endocrine pancreatic cells are either round or oval which appears as purple in histological section and have distinct nuclei (Pls.8 B, 10A). Karim (2017) described the endocrine pancreas in *Barbus luteus* was represented by a large and irregular islet surrounded by a number of islets that seem small in size. In some species, there is one major islet, known as the Brockmann body (Mumford *et al.*, 2007).

Gall bladder: Gallbladder wall in the *C. carpio* and *M. sharpeyi* are made of three layers: the tunica mucosa, the tunica muscularis, and the outer layer (tunica serosa). The mucosal surface layer of *C. carpio* and *M. sharpeyi* exhibits simple columnar epithelium, cells are narrow and elongated. The epithelial cells posse deeply stained spherical nuclei, and a thin layer of lamina propria under epithelial cells, these results agree with Mohammed (2001) and Nazlić *et al*. (2014). The muscular layer occupies more than half of the wall width and consists of longitudinal and oblique smooth muscle fibers (Pls.11, 12), this results compatible with Gilloteaux *et al*. (2011).

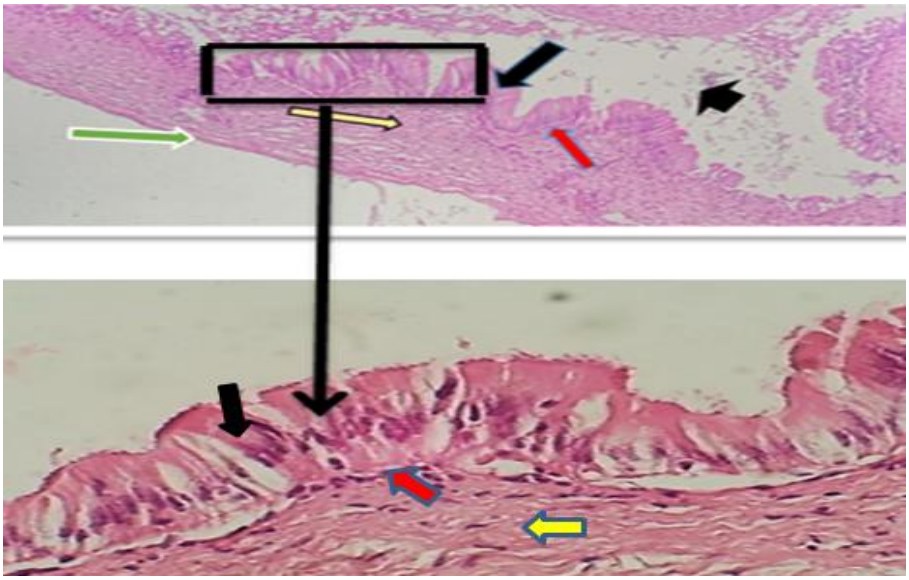


Plate (11): Wall of gallbladder in *C carpio*, lumen of the gall bladder (arrow head) and columnar epithelium cells (black arrow), lamina propria (red arrow) tunica mascularis (yellow arrow), tunica serosa (green arrow) (H&E 10X and 40X).

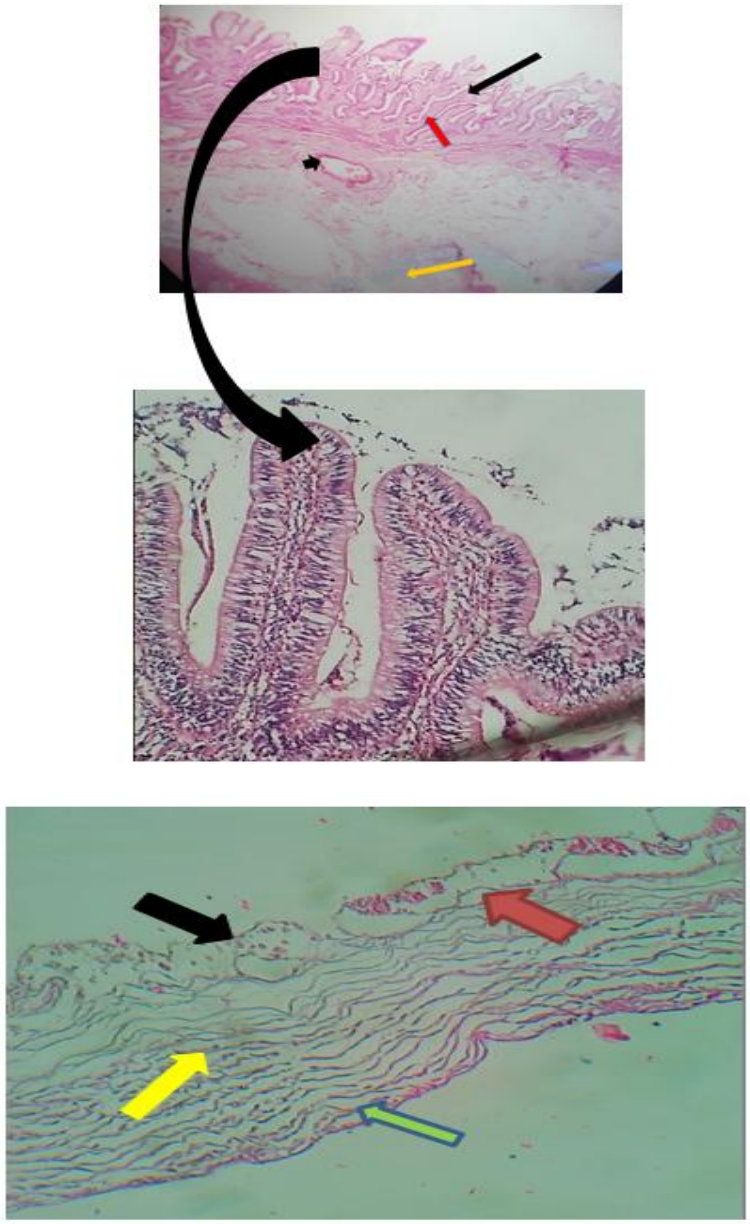


Plate (12): Section through the wall of gallbladder in *M. sharpeyi*, epithelium cells (black arrow), lamina propria (red arrow), tunica mascularis (yellow arrow), tunica serosa (green arrow), blood vessel (arrow head) (H& E 10X).

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دراسة تشريحية مقارنة لبعض الاعضاء في نوعين من الأسماك الكارب الاعتيادي *Cyprinus carpio* Linnaeus, 1758 والشبوط *Mesopotamichthys sharpeyi* (Cypriniformes, Cyprinidae) (Günther, 1874)

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تأريخ الاستلام: ٢٠١٩/٠٧/٢٧ ، تأريخ القبول: ٢٠١٩/١٠/١٤ ، تأريخ النشر: ٢٠١٩/١٢/٢٦

الخلاصة

هدفت هذه الدراسة إلى إعطاء بعض التفاصيل حول التركيب التشريحي والنسيجي للكبد والبنكرياس وكيس الصفراء في سمكتي الكارب *Cyprinus carpio* Linnaeus, 1758 والبني *Mesopotamichthys sharpeyi* (Günther,1874) بينت النتائج التشريحية أن كبد سمكة الكارب يكون ذو لون بني محمر، يقع في مقدمة التجويف البطني ويتألف من فصين يمتدان بين الأمعاء، بينما في سمكة البني لونه بني فاتح يقع في الجزء الأمامي من تجويف البطن ويمتد حتى نهاية الامعاء ويتكون من فصين ايمن وأيسر. يقع كيس الصفراء في الجزء الأيمن من الكبد في كلا النوعين ويكون بيضويا في الكارب ومتطاولا في البني. أظهرت النتائج النسيجية لكلا النوعين أن الكبد يتكون من خلايا كبدية مرتبة بصورة شعاعية حول الوريد المركزي، وليست مقسمة إلى فصوص سداسية متميزة كما هو الحال في الفقاريات العليا. يتكون جدار كيس الصفراء من ثلاث طبقات مميزة: الغشاء المخاطي، والطبقة العضلية والغلالة المصلية.

أظهرت نتائج الفحص المجهري أن أنسجة البنكرياس الخارجية هي من النوع المنتشر اي يتواجد في انسجة الكبد والطحال حول الاوعية الدموية ويتكون من عنيبات بنكرياسية، لوحظ البنكرياس منتشرا بين التفافات الامعاء في سمكة الكارب وكذلك في الجزء الامامي من الكبد اما في سمكة البني يتواجد البنكرياس في السطح البطني للكبد في الفص الامامي منه وقرب كيس الصفراء. اما جزء الافراز الداخلي فقد لوحظ عدد قليل من الخلايا بأحجام واشكال مختلفة محاطة بخلايا البنكرياس خارجية الافراز.