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MORPHOLOGICAL DESCRIPTION AND COMPARATIVE HISTOLOGICAL STUDY OF THE LIVER IN TWO IRAQI MAMMALS : WEASEL (*HERPESTES JAVANICUS*) AND EASTERN GRAY SQUIRREL (*SCIURUS CAROLINENSIS*)

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ABSTRACT : The results of the current study showed that the liver of *H. javanicus* appeared as large lobulated organ divided into six distinct lobes, that filled the cranial region and little extended to the middle region of abdominal cavity. On the other hand, liver of *S. carolinensis* laid against the diaphragm, occupied the cranial region of the abdominal cavity and consisted of five lobes. The liver is surrounded with a thin capsule of dense regular collagenous connective tissue and few numbers of smooth muscles fibers can be seen in the capsule that covered the squirrel liver. The liver parenchyma divided into a large number of interconnected hepatic lobules marked only by the abundant amount of connective tissue bordered the triads, and within these lobules, polyhedral shaped hepatocytes are arranged as cords of one cell thick. The liver cords are enclosed by irregular hepatic sinusoids and ordered in radial fashion around the central vein. The portal areas are consisting of branches of the hepatic portal vein and hepatic artery as well as (1-4) branches of the bile duct that appear in different sizes.

Cuboidal epithelium type is lined the small branches of these ducts, while the large sized of them is lined by columnar epithelium type, in which the goblet cells appeared to be more frequently and clearer in *H. javanicus* than *S. carolinesis*. In weasel, sometimes the triad structures of large and small sized portal areas are embedded together in one abundant mass of connective tissue.

Key words : *Herpestes javanicus*, *Sciurus carolinensis*, histological study.

INTRODUCTION

The liver is one of the most important, largest and well appreciated organ in the body and is intimately associated with the digestive tract (Dawood and Khamas, 2017; Faraj, 2018; Subhan, 2009). It has both endocrine and exocrine functions by secreting substances into a excretory ducts and into the blood sinusoids (Eroschenko, 2008). It is reported to have a wide range of functions in the body and plays an important role in the intermediate metabolism of proteins, carbohydrates and lipids compounds and also play an important role as a storage organ for fat-soluble vitamins, such as A and D and glucose molecules in the form of glycogen (Eroschenko, 2008). In addition, the liver is considered an extremely powerful organ that responsible for detoxification and removal of toxin compounds and other harmful materials, and production of the most plasma proteins including albumins and lipoproteins as well as the synthesis and secretion of the bile (Rogers and Dintzis, 2018). Decomposition of erythrocytes and removing of bacteria from blood sinusoids are another liver functions that achieved by Kupffer cells (Eroschenko, 2008). The mammalian liver is a lobulated organ consisting as much as four to six lobes completely surrounded by capsule of connective tissue fibers known as Glisson's capsule (Rogers and Dintzis, 2018; El-Salkh *et al*, 2008; Stan, 2018). In general, the liver parenchyma consists of hepatic lobules and portal canals. The hepatic lobules are made of hepatocytes arranged in irregular plates or cords surrounding a network of f sinusoidal capillaries that are lined with endothelial cells and Kupffer cells (Eroschenko, 2008). The parenchymal tissue of mammalian liver contains one layer of hepatocytes that arranged in cords alternative with the hepatic sinusoids and organized in radiating manner around the central vein (Frappier, 20068).

Many studies have been published on the macro and microscopic featuresof the vertebrate species liverin the world (Petcoff *et al*, 2006; Ikpegbu *et al*, 2014; Madhanand Raju, 2014; Siddig *et al*, 2014; Ahmed *et al*, 2018), but comparatively were few about Iraqi vertebrae species and most of these papers focused onthe liver of avian types (Alshamarry *et al*, 2010; Kareem, 2013), thus

this aimed to investigate the morphological and histological differences of the livers in tow species of the Iraqi wild mammals, *H. javanicus* which represented a pattern of carnivores animals and *S. carolinensis* which represented a pattern of herbivores animals (Al-Sheikhly and Haba, 2014).

MATERIALS AND METHODS

In the present study, six adult animals were used including three of the Weasel (*Herpestes javanicus*) and three of Eastern Gray Squirrels (*Sciurus carolinensis*). Samples were obtained from Najaf Governorate and Souk Al-Ghazil in Baghdad; then the animals were classified according to the classification key presented by the field directory of wild animals in Iraq (Al-Sheikhly and Haba, 2014). The animals were anesthetized and dissected by longitudinal incisions in ventral area, and then the liver was removed. Samples from different liver lobes regions were fixed in formalin (10%) in order to prepare these specimens for the histological study. The samples were passed with an ascending series of alcohols (70%, 80%, 90%, 100%); then all the samples are cleared using xylene and embedded in paraffin wax blocks. The paraffin wax blocks were cut by using microtome to prepare sections with 6 ìm in thickness; the sections were stained using Haris Haematoxylin and Eosin stain (Bancroftand Gamble, 2002). The slides were then examined under photographed microscope that connected to a digital camera which was used to take pictures for the selected sections of the livers.

RESULTS AND DISCUSSION

Morphological description

The results of the present study revealed that the liver of *H. javanicus* appeared as large lobulated and bright red-brown colored organ it filled the cranial region and extended posteriorly to the upper third of the middle region of the abdominal cavity, its divided into six distinct lobes as follow: left lateral, left medial and well developed caudate lobe, which was further subdivided into the caudate process and papillary process. It was also observed that the right medial lobe was larger than other lobes, while the right lateral lobe was wider than other lobes this result is agreement with results of El-Salkh *et al* (2008) in desert rodents and Stan (2018) in guinea pigs.

The liver of *S. carolinensis* laid against the diaphragm occupied the cranial region of the abdominal cavity. It was dark red brown in color and consisted of five lobes: lateral right lobe, medial right lobe, lateral left lobe, medial left lobe and caudate lobe, which were seen on the visceral surface. The lateral left lobe was larger than other lobes and partially covered by the left medial lobe. The caudate lobe was not well developed and subdivided into two segments: superior caudate segment, which was attached to the right lobe and inferior papillary segment, the papillary segment in turn subdivided into two parts, the first part had a papilla shaped and the second part appeared as a fan in shaped. It was also observed that the right medial lobe subdivided by a shallow, narrow incisures into two portions between them, the terminal part of gall bladder extended. The present result was accords with the result of Rogers and Dintzis (2018), Stan (2018), Siddig *et al* (2014). However, the current study did not agree with Indigenous Gazelle (Dawood and Khamas, 2017; Stan, 2018) in chinchillas and rats and Siddig *et al* (2014) in one humped camel, where the liver consists of four lobes.

Histological structure

The liver of *H. javanicus* and *S. carolinensis*is surrounded with a thin Glisson's capsule composed of dense regular collagenous connective tissue, overlaid by a layer of flattened mesothelial cells. Scattered smooth muscle fibers can be seen in the deep portion of the liver capsule in *S. carolinensis*as reported by Mathur (2012) in Marwari goat and by Madhu (2013) in black buck. Trabeculae, are extended from the capsule into the liver tissue to divide it into a number of interconnected hepatic lobules with no barriers of connective tissue except those present around triads structures and marked the borders between the adjacent lobules (Fig. 1). These results are in agreement with the previous finding found in the white mouse (Rogers and Dintzis, 2018), the Egyptian rodents (El-Salkh *et al*, 2008), the European bison (Prunescu *et al*, 2002) and the African palm squirrel (Ikpegbu *et al*, 2014). However, these results are not consistent with the results that found in camel and pig, whereas the hepatic lobule found with hexagonal shape and its borders clearly defined by thick interlobular septa (Frappier, 2006; Siddig and Abdalla, 2015).

The parenchyma of liver essentially formed from central veins and hepatic cells that are arranged as cords named hepatic cords, each of which is one cell thick (Fig. 2) and this result is similar to that observed in other mammalian species (Frappier, 2006; Madhan and Raju, 2014). The hepatic cords are radially arranged around the central vein that occupies the core of lobule. It was also observed that liver cords directly located below the capsule extend parallel to this capsule. The hepatic cords are branching out and then interact to enclose the hepatic sinusoids, which have large lumens. In both animals, the hepatocytes were polyhedral shaped with a centrally located, large, spherical nucleus in which one or more than one distinct dark nucleoli were present. Fewer

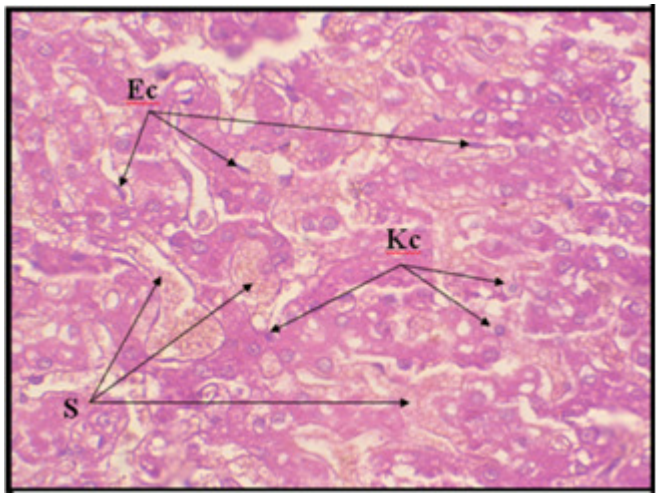

Fig. 1 : Cross section of the liver WEASEL (*Herpestes javanicus*).

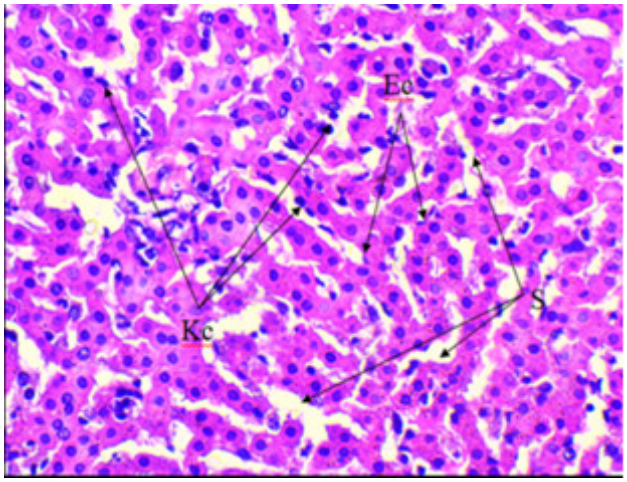

Fig. 2 : Cross section of the liver Eastern gray squirrel (*Sciurus carolinensis*).

numbers of bi-nucleate hepatocyte were also observed in the liver parenchymal tissue. This result is consistent with previous studies of El-Salkh *et al* (2008), Ikpegbu *et al* (2014), Madhan and Raju (2014), Alshamarry *et al* (2010). The hepatic cells are responsible for the physiological functions of the liver (Frappier, 2006); the shape of hepatic cells is due to several external factors including mechanical pressure or surface tension, as well as the effect of the environment on the genotypes that led to the adaptation of animals to living in different conditions. The cytoplasm of hepatocyte was eosinophilic and containing of more fine granules and fewer vacuoles in squirrel than those present in weasel (Fig. 2). The differences in the hepatic cell's cytoplasm appearance may be due to the function of the liver as a storage organ of glycogen material (Kareem, 2013), that deposit as granules in the cytoplasm; on the other hand the vacuolar appearance of the cytoplasm in weasel may be due to the deposition of lipid droplets.

The hepatic sinusoidal spaces are large and irregular in shape and filled with more number of erythrocytes in weasel than those present in squirrel. These sinusoids in bothanimals were lined by two types of non-parenchymal cells, the endothelial cells and phagocytic Kupffer cells. The former cells are the main type that form the non-continuous lining of the liver sinusoid and distinguished by their dark longitudinal nuclei, while the later cells (Kupffer cells) are found in few numbers between the endothelial cells of the hepatic sinusoids and recognized easily with their pale stained, ovoid nuclei., this result is consistent with the findings of previous studies of El-Salkh *et al* (2008), Ikpegbu *et al* (2014), Alshamarry *et al* (2010). Kupffer cells may play a role in removing foreign and toxic materials from the portal blood. However, this result is not consistent with previous studies of Madhu (2013) in spotting deer and nigali and Ikpegbu *et al* (2014) in squirrel, whereas the bile duct is lined by lowering simple cuboidal epithelial tissue in the small sized ducts and high cuboidal epithelial tissue in large sized ducts (Alshamarry *et al*, 2010). Most of the branches of bile ducts surrounded by a thick coat of connective tissue and few number of them were also covered by muscular coat. The solitary bile duct encountered in the liver parenchymal tissue of the adult European bison were lined by typical cuboidal biliary cells and were covered by a thick layer of collagen fibers (Prunescu *et al*, 2002).

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