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**Histomorphological Study of the Liver in Muscovy Duck
(*Cairina moschata domestica*)**

ABSTRACT

Although; the liver has been studied in several types of birds, but regarding, Muscovy Duck, it is yet not to be done. Thus the current study has been accomplished to identify the anatomical features and recognize the histomorphological architecture and the differences in the structural components of the liver in this bird. The study was achieved on eight birds of both sexes, aged (ten to fifteen) months, slaughtered by the halal method and divided into two groups: anatomical and histological. Anatomical results showed that the liver of Muscovy duck is situated at the cranial part of the celomic cavity; the shape is adapted to the adjacent internal body wall and related organs like the proventriculus, gall bladder and gizzard. Histologically our results revealed that no histological difference between the right and left lobes of liver and it's a large lobed gland enclosed by serosal coat or covering which have a delicate capsule from connective tissue that extends to divided the gland into lobes with less extension to lobules. The liver parenchyma made of hepatic cells called hepatocytes that organized in branching cords that separated via sinusoids and be radiated around the central vein.

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INTRODUCTION

Poultry production has an important role in agricultural production in several world portions. Poultry meat is one of the most broadly eaten foods in the world at the rate of 30% of the worldwide production of meat (Iqbal et al., 2014).

The liver is the major of the associated glands of the digestive system in fowl that consider a vital organ in the maintenance of energy source, as well as, its role in the catalyze of bio-synthetic and bio-degrative methods as well as expels ending metabolic products (Katz, 1992; Whitlow, 2000). The liver has secretary abilities, because it's a big role in excreting, providing, storing, purifying, metabolizing, esterifying, and phagocytizing. Briefly it considers the controller of the digestive system; it works as mix gland: exocrine and endocrine (Dyce and Wensing, 2002).

The liver is divided into two lobes that joined at the cranial surface of the midline. The right lobe is bigger than the left in turkey and other fowl, while the left one is split into a dorsal part and a ventral part (Whitlow, 2000; Caceci, 2006). The parenchymatous tissue of the avian liver resembles that of mammals except some alteration in the histological architecture like the lacking of lobules and trabeculae between them (Dyce and Wensing, 2002; Caceci, 2006; King and Mclelland, 1984). It is located nearly caudal to heart and lungs. The parenchyma contains chains of hexagonal hepatic lobules that contain a portal area at each corner consist of: hepatic artery, hepatic vein, a

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branch of the vagus nerve, lymphatic vessels and bile duct. Cords of hepatocytes are arranged in radiation matter and connect the portal canal with the central vein, separated via sinusoids that drain into the central vein. The surface of each adhered cords forming bile canaliculi which release their product into the near portal canal (Aughey and Frye, 2001).

Lymphatic aggregations of irregular shape sparsely located containing mostly lymphocytes are scattered through the parenchyma (Hu'nigen et al., 2016). The liver has many functions of storage and conversion of metabolites (Richard, 2005). Avian liver acting a big role particularly in the metabolism and synthesis of fats, since lipogenesis happens mainly in the liver, in the comparison with mammals, the site of lipogenesis occurs in adipose tissues (D'Andre et al., 2013).

Unluckily, foods that release great energy used in the saleable poultry business like carbohydrates foods excite lipogenesis (Govaerts et al., 2000). In broilers, pathological conditions like fatty liver and kidney syndrome arise underneath a number of feeding rules (Richard, 2005).

The aim of the present study is to identify the anatomical features and to recognize the histomorphological architecture and the differences in the main structural components of the liver in Muscovy duck, since; the liver has been studied in several types of birds, but regarding, this type of birds it is yet not to be done.

MATERIALS AND METHODS

The current study was achieved on eight adult Muscovy Ducks, of both sexes, aged (ten to fifteen) months, who were slaughtered by the halal method and divided into two groups: anatomical and histological. In the anatomical study (four) adult birds used, the celomic cavity was opened, to study the macroscopic anatomy, location and description of the liver with its boundaries then it dissected out separately on a special sheet to view the external and internal features of the liver grossly, and some anatomical parameters such as the length and width were done.

While in the histological study the samples taken from the rest birds were treated by using the routine histological technique steps as the following: liver fixed in 10% neutral buffered formaldehyde and put in a fixation material for twenty-four hours. Samples that fixed then washed in tap water later dehydrated in gradual concentrated of alcohol with the rates of 70%, 80%, 90%, and 100%, for two hours of each stage, then the clearing stage with xylene for one and a half hour and infiltrate with paraffin for three hours then overnight later embedded in blocks made of paraffin.

The sections thickness about (five) microns by using the microtome then put on glass-slides by the presence of adhesive material like Mayer's albumin. The drying of slides at the temperature of the room occurs and later staining by Haematoxylin – Eosin and Van- Gieson's stains then dehydrated and covered (Bancroft et al., 2013). The stained slides finally were photographed by using of digital camera and light microscope with different powers (4x; 10x; 20x; 40x).

RESULTS AND DISCUSSION

The present study showed the liver of Muscovy Duck is a big organ with reddish brown to dark brown in color, placed in the cranial portion of the celomic cavity and positioned caudal and ventral to the heart and cranial to the gizzard (Fig. 1), these results are analogous to the description that documented by (Al-A'Araji, 2015) in male indigenous turkey and (Ibrahim et al., 2016) in local Moorhen and (Al- Abdulla, 2015) in the local duck, but was differ from (Hamodi et al., 2013) who described the color of liver in three species of birds as light to dark red and (Alshamy et al., 2019) who stated that the color of liver in the broiler chicken ranged from light brown to reddish brown depending on the age of bird, so, it was pale-brown on day one of hatching because of the rich yolk pigment, but, at the end of the first week, it become darker to a light brown. While (Clark, 2005) reported that the color of the avian liver changed depending on the nutritional state in the adult bird, it's usually had a dark red to reddish-brown in color which may change into a yellow-tan color if the bird fed on a high-fat diet.

The shape of the liver adapts to the adjacent internal body wall and correlated organs like the proventriculus, gall bladder and gizzard. It has a clear transverse groove lie at the visceral surface of both lobes which exposes the entry of the hepatic arteries, portal veins, bile ducts and gall bladder (fig.1,2) similar findings previously reported by (Maher, 2019) in Broiler Chicken. The gall

bladder positioned on the dorsal surface of the right lobe, which was lacking in several other species like ostrich, pigeon and parrot as reported by (McLeland, 1990) , (Stornelli et al., 2006) in ostrich.

The current study also indicated that the liver of Muscovy Duck is separated into two lobes: the right lobe bigger than the left that also split into two secondary portions (fig.1,2) this result was agreed with (Whitlow, 2000; Dyce and Wensing, 2002; Caceci, 2006) in fowl that described the liver of birds involved double lobes: the left is smaller and divided into dorsal and ventral parts, this result also agree with (Selman, 2013) in local coot bird and (Shafey, 2006) in a comparable study of the liver between ducks, chicken and pigeon, but our findings are disagreement with that detected by (Faraj, 2018) who reported that the liver of marsh harrier is a bi-lobed organ divided into right and left lobes, both are approximately at the same size and not divided into minor lobes and (Bailey et al., 1997) who stated that no additional subdivisions are present in the liver lobes of bustard. The current study also disagreement with (Stornelli et al., 2006) in ostrich, and (Nickel et al., 1977) in Pigeon who say that the left lobe of the liver involves three parts: distal part, median part and one on each side dual it's mass, and (Al-hamadawi et al., 2017) who stated that in the Laughing dove and White throated kingfisher the right lobe is bigger than left one while in common kestrel the left was the bigger. While (Hamodi et al., 2013) said that the left and right lobes merged cranially at the midline by an interlobar portion.

Histological results showed that no histological difference between the right and left lobes of Muscovy duck and this observed agreed with (Bacha and Wood, 1990; Randall and Reece, 1996). It's a large lobed gland enclosed by serosal covering which has a delicate capsule from connective tissue that extends to divided the gland into lobes with less extension to lobules (fig.3) this result is parallel to that of (Aughey and Frye, 2001) who shows that the chicken liver enclosed by a capsule of mesothelium, collagen fibers and smooth muscle termed Glisson`s capsule, this result is parallel to that of (Al- Abdulla, 2015) in the local ducks and (Selman, 2013) in the local coot birds.

Liver Parenchyma in the duck is contained lots of lobules that are not obviously well-defined and merged together at the margins because of the deficiency of the interlobular septa, excluding the portal canals that considered the only signs that delineated the lobules of liver clearly (fig.3), parallel findings documented previously by (Stornelli et al., 2006) in ostrich, (Al- Abdulla, 2015) in duck and (Al-A`Aaraji, 2015) in turkey.

The Parenchyma in Muscovy duck made of functional cells named (hepatocytes) that are organized in branching plates (cord-like); arranged in thickness about 2 cell rows, these plates separated by sinusoids and are radiated around a central vein (fig.4). The shape of hepatocytes is polygonal with a round nucleus, with the presence of sinusoids between hepatocords, the sinusoids are irregular in shape, large and lining with two cell types: flat endothelial cells and stellate cells termed Kupffer's or (hepatic macrophage cells) which noticed either in close contact to the endothelium of sinusoids or free arranging in their lumen. (fig.5) These observations were similar to that previously described by (Al-A`Aaraji, 2015) in indigenous turkey and (Ibrahim et al., 2016) in Moorhen bird, (Bacha and Wood , 1990) in chicken; (Beresford and Henninger, 1986) in fowl; (Bhatnagar and Singh, 1982) in turkey; they show that plates of the hepatocytes arranged in thickness about 2 cells, in contrast to the description of (Aughey and Frye, 2001; Hamodi et al., 2013; Bacha and Wood, 1990; Beresford and Henninger, 1986) in the three species: (*Laruscanus*, *Agaporinsfischeri* and *Numidameleagris*) and Ruffed grouse as well as Pintail duck, which say that the plates or cords of the hepatocytes are of thickness between 1-2 cells.

The present study showed the portal area which comprises a bile duct that lining with a single layer of simple cuboidal epithelium resting on a basal lamina as well as a portal vein branch and a hepatic artery branch (fig.6) these observations are comparable to those detected by (Bacha and Wood, 1990) who described the presence of bile duct and blood vessel scattered through the liver parenchyma.

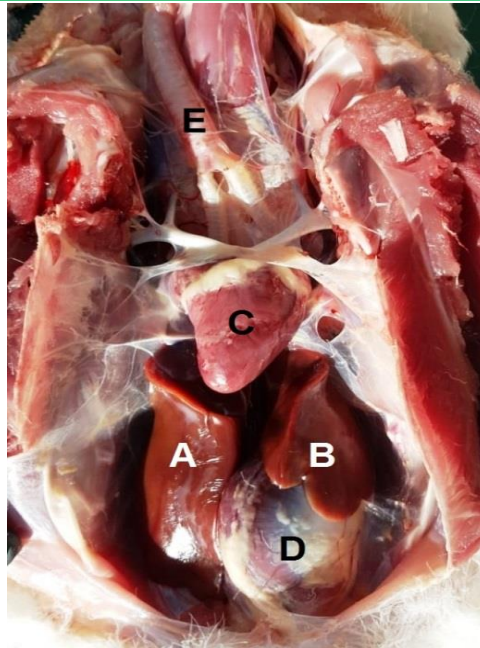


Fig. (1): Ventral view show the situation and relationships of liver in the Muscovy Duck inside the celomic cavity: A- Right Lobe of Liver B- Left Lobe of Liver C- Heart D- gizzard E-Trachea.

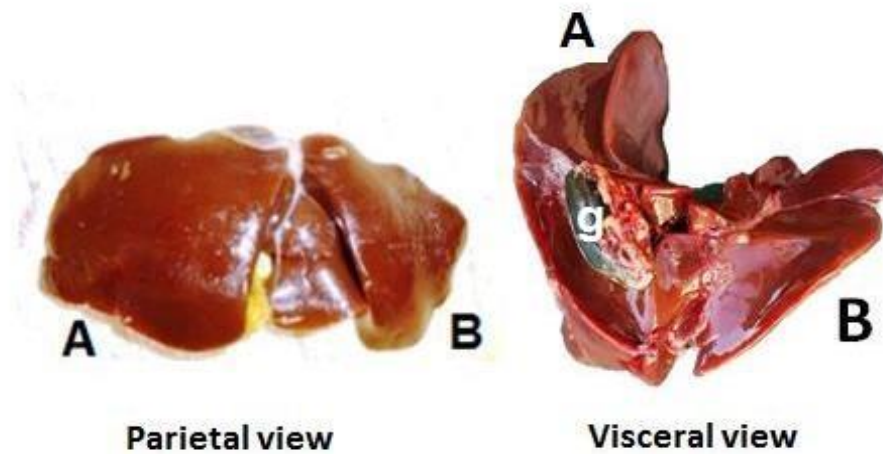


Fig. (2): Morphological photograph of the liver in Muscovy Duck show the parietal view and visceral view: A- Right lobe B- Left lobe g- gall bladder.

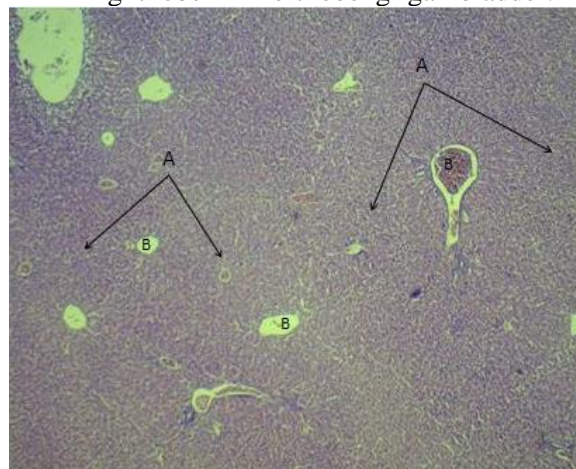


Fig. (3): Histological section of liver in Muscovy Duck show: A- liver lobules B- central vein (H & E stain 40 X).

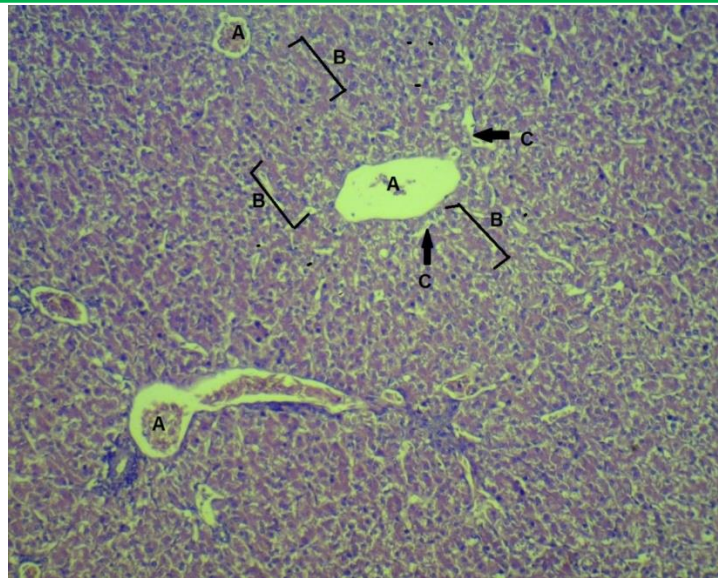


Fig. (4): Histological section of liver in the Muscovy Duck show: A- central vein B- Hepatocyte plates C- Sinusoids (H & E stain 100 X).

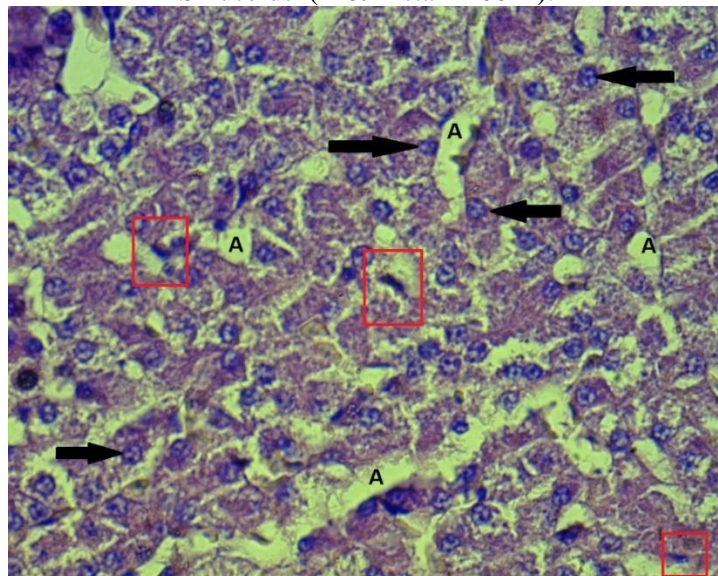


Fig. (5): Histological section of liver in the Muscovy duck show: A- Sinusoids; Hepatocytes (black arrow heads); Kupffer's cells (red square) (H & E stain 400 X).

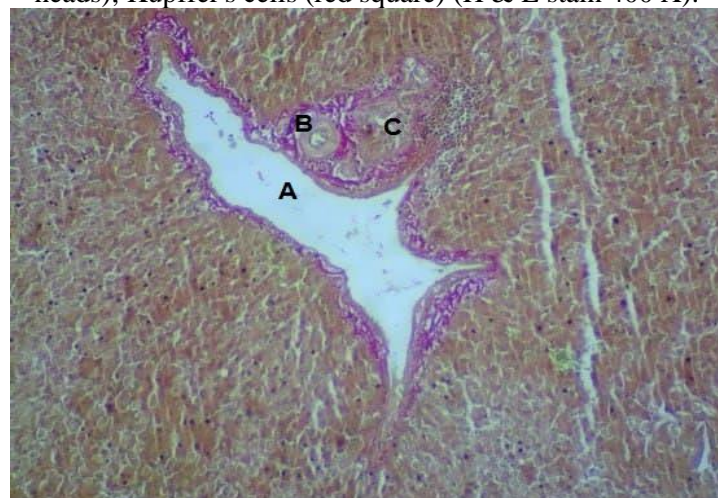


Fig. (6): Histological section of liver in the Muscovy Duck show: A- Hepatic portal vein B- hepatic portal artery C- bile duct, (Van- Gieson's stain, 200 X).

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دراسة نسيجية شكلية للكبد في البط الموسكوفي (*Cairina moschata domestica*)

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الخلاصة

على الرغم من ان الكبد قد درس في عدة أنواع من الطيور، ولكن فيما يتعلق، بالبط الموسكوفي، فإنه لم يتم بعد. ولهذا تم إنجاز الدراسة الحالية لتحديد السمات التشريحية والتعرف على الصفات النسيجية والاختلافات في المكونات الهيكلية للكبد في هذا الطائر ، اجريت هذه الدراسة على ثمانية طيور من كلا الجنسين، تتراوح أعمارهم بين (10-15) شهرا، ذبحت بالطريقة الحلال وقسمت إلى مجموعتين: تشريحية ونسيجية. أظهرت النتائج التشريحية أن الكبد في البط الموسكوفي يقع في الجزء الامامي من التجويف الجسمي، بحيث تلائم شكله مع الجدار الجسمي الداخلي المجاور والأعضاء المتعلقة أو المجاورة مثل المعدة الغدية ، المرارة و القانصة. أما نسيجيا فقد كشفت النتائج انه لا توجد فروق نسيجية بين الفصين الايمن و الايسر من الكبد في البط الموسكوفي وانه غدة ذات فصوص كبيرة محاطة بمحفظة مصلية أو مغلف بكبسولة رقيقة من النسيج الضام والتي تمتد لتقسيم الغدة الى فصوص مع امتداد قليل الى داخل الفصيصات. يتكون النسيج الحشوي للكبد من خلايا تسمى الخلايا الكبدية التي تنتظم على شكل حبال متفرعة تفصل عن بعضها البعض عن طريق الجيبانيات الكبدية وتكون مشعة حول الوريد المركزي.

الكلمات المفتاحية:
الكبد، علم الهيئة، علم الأنسجة،
البط الموسكوفي