



Anatomical, Histological and Transmission Electron Microscopic Examination of Liver in Chinese Goose (*Anser cygnoides*)

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ABSTRACT

Background: The liver, the main organ in the continuity of energy supply, is the largest gland in the body. The liver, which has functions such as cleansing the body from toxins, synthesizing bile, secreting the synthesized bile and regulating metabolism, acts as an endocrine and exocrine gland. The liver is a complex organ that processes the digested and absorbed substances, stores them for the benefit of other organs or transfers them to the circulatory system, thus creating a transition zone between the digestive system and the circulatory system. The aim of this study is to examine the Chinese goose (*Anser cygnoides*) liver Anatomically, Histologically and by Transmission Electron Microscopy (TEM).

Methods: In this study Chinese geese (*Anser cygnoides*) were procured from a private farm in Aksaray, 6 females and 6 males, were utilized.

Result: Tissue samples were examined under a light microscope with Hematoxylin Eosin (HE) staining method. Histologically, it was observed that the liver in Chinese goose (*Anser cygnoides*) did not have the typical lobule structure, consisted of many lobules and the interlobular septum was thin. Hepatocytes were oval and centrally located and merged to form remark cords and these remark cords were separated by sinusoids. Kupffer cells were present. Lymph nodules were intensely observed in the examined tissues. Bile duct, arteria hepatica and vena porta forming the Kiernan's space were found. It was determined that each unit with the vena centralis was similar to the lobule structure. Healthy mitochondrial structures and heterochromatic-appearing hepatocytes and Kupffer cells were observed electron microscopically. The nucleus of the hepatocyte was round and euchromatic, the nuclear membrane was healthy and intact and the nucleolus was centrally located. The cytoplasm contained a very small number of small vacuoles. It was observed that the cytoplasm was homogeneously distributed. Mitochondria were normal in appearance, with regular double membranes and healthy cristae. A very prominent bile duct and a healthy endoplasmic reticulum structure were observed.

Key words: Chinese goose, Histology, Liver, Transmission electron microscopy (TEM).

INTRODUCTION

The Chinese goose (*Anser cygnoides*) is one of the small but remarkable breeds. It is distinguished from other goose species by the knob on its head. An important feature of the knob is that it can be used for gender determination at an average age of 6-8 weeks if no gender determination has been carried out before. The knob of male geese is larger than that of females (Tilki and Saatçi, 2013). The Chinese goose (*Anser cygnoides*), which is widespread and is still being raised in China, has two varieties. Adult live weight is around 4-5,5 kg in white Chinese goose (*Anser cygnoides*) and around 4-5 kg in brown Chinese goose (*Anser cygnoides*) (Cilavdaroğlu *et al.*, 2020). White Chinese geese (*Anser cygnoides*) have orange beaks, shanks and knobs, while brown Chinese geese (*Anser cygnoides*) have orange shanks, but have black or dark green beaks and knobs (Buckland and Guy, 2002).

The liver, the main organ in the continuity of energy supply, is the largest gland in the body. The liver, which has functions such as cleansing the body from toxins, synthesizing bile, secreting the synthesized bile and regulating metabolism, acts as an endocrine and exocrine gland. In poultry, the liver is connected in the middle by a parenchymal bridge and is divided into two lobes, right and

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left. Although the liver parenchyma of poultry is similar to that of mammals, there are some differences between them. In poultry, the capsule and interlobular septum surrounding the organ are thinner than in mammals and there is no lobular structure. Each section with the vena centralis is considered as the equivalent of a lobule. As in mammals, Kupffer cells are also present in poultry. Lymph follicles and lymphocyte infiltrations are also seen in the liver of poultry (Koçak and Özyayın, 2019).

No anatomical, histological and electron microscopic studies on Chinese goose liver were found in the literature. The aim of this study was to examine the liver in Chinese goose (*Anser cygnoides*) by anatomical, histological and scanning electron microscopic methods.

MATERIALS AND METHODS

This study was conducted in 2022 at Aksaray University, Faculty of Veterinary Medicine, Histology and Embryology Department Laboratory. In the study, 12 Chinese geese (*Anser cygnoides*), 6 females and 6 males, were used. After the approval was obtained with the decision dated 25/08/2022 and numbered 2022/101 of Selçuk University Veterinary Faculty Experimental Animal Production and Research Center Ethics Committee (SÜVDAMEK), Chinese Geese (*Anser cygnoides*) taken from a private farm in Aksaray were injected intramuscularly with 12-15 mg/kg xylazine for premedication and 40-50 mgr/kg ketamine for anesthesia. Then, liver tissue samples were taken. For light microscopic examination, the tissues were fixed in tubes containing 10% buffered formaldehyde for 1 day and then washed. After routine histologic tissue follow-up, the tissue samples were blocked using paraffin. 5-6 micron thick sections were taken from the paraffin-blocked tissues and examined under a light microscope using Hematoxylin and Eosin (H&E) staining method and photographs of the necessary areas were taken.

The tissues taken for examination under transmission electron microscope were divided into 1 mm pieces and kept overnight in a fixation solution consisting of 20 ml of PBS and 3 ml of Glutaraldehyde, washed 3 times with PBS for 15 minutes and then examined in HITACHI HT 7800 Transmission Electron Microscope (TEM). Transmission Electron Microscope analyzes were performed at Eskişehir Osmangazi University Central Research Laboratory Application and Research Center (ARUM). The macro anatomical terms in the study were based on Nomina Anatomica Veterinaria (World Association of Veterinary Anatomists *et al.*, 2017) and micro anatomical terms were based on Nomina Histologica Veterinaria (Veterinaria, 2017).

RESULTS AND DISCUSSION

Anatomical findings

It was observed that the liver of Chinese goose (*Anser cygnoides*) was located in the cavum peritonei hepatis ventralis and was dark brown in color between the 2nd and 8th costae (Fig 1). The liver of Chinese goose (*Anser cygnoides*) was covered with membranes called tunica serosa on the outside and tunica fibrosa on the inside.

It was determined that the liver had two faces, facies parietalis (anterior) and facies visceralis (posterior). It was seen that facies parietalis was convex, while facies visceralis was concave. On the posterior side, formations named impressio ventricularis, impressio proventricularis, impressio

splenalis, impressio cardiaca, impressio duodenalis and fossa vesicae felleae were detected.

It was determined that the liver was composed of two lobes named lobus hepatis dexter (right) and lobus hepatus sinister (left) and the right lobe was larger and more elongated caudally than the left lobe (Fig 2). While the right lobe was in one piece, the left lobe consisted of two lobules, lateral and medial. The right and left lobes were separated from each other by two notches, superficial inc. interlobaris cranialis anteriorly and deeper inc. interlobaris caudalis posteriorly. In addition, it was determined that the right and left lobes were connected by a parenchymal bridge in the middle of the liver. A pit called fossa transversa was observed on the parenchymal bridge connecting the lobes. Behind the fossa transversa, protrusions called proc. intermedius were observed in the right and left lobes.

An elongated tubular gallbladder was observed on the dorsal surface of the right lobe and it did not extend to the caudal edge of the lobe. There was a canal through which the vena cava caudalis passed through the right lobe. The liver was connected to the pericardium and sternum *via* lig. falciforme.

Light microscopic findings

Histological findings

Hepatocytes with large nuclei seen in the liver of mammals and poultry were found (Fig 3). Kupffer cells, which belong to the mononuclear phagocytotic system group and which are found in the liver of mammals and poultry, were observed (Fig 4). Central vein involved in circulation, remark cords composed of hepatocytes and sinusoids separating remark cords were observed (Fig 5). Bile ducts with single layer prismatic cells involved in secretion production and portal vein and hepatic artery involved in circulation were found (Fig 6). Lymph nodes playing a role in immunity were



Fig 1: Anatomical location of the Chinese goose (*Anser cygnoides*) liver.

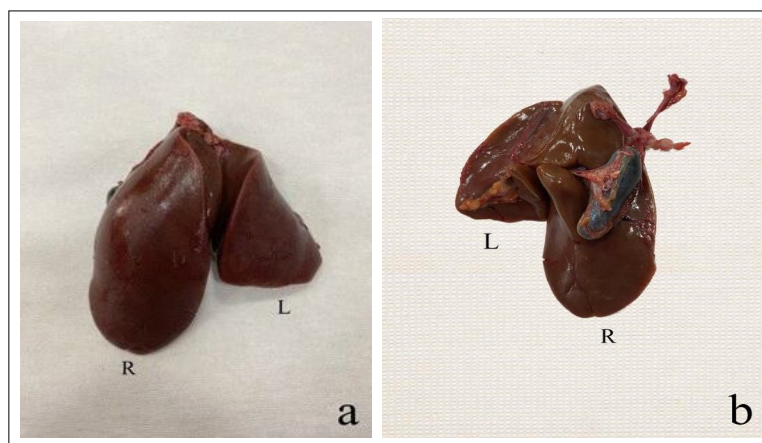
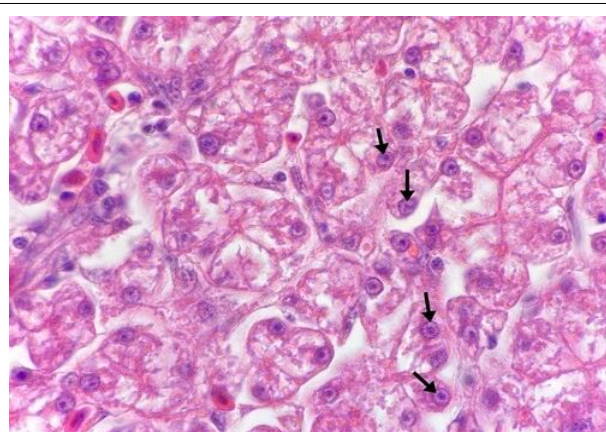
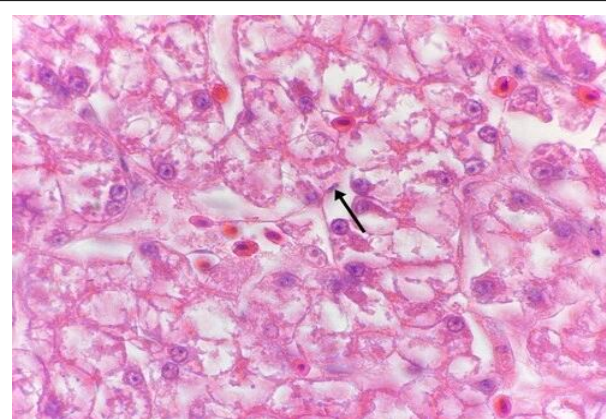


Fig 2: Ventral (a) and dorsal (b) views of Chinese goose (*Anser cygnoides*) liver (R: Right, L: Left).



Hepatocytes in the tissue (arrows). Hematoxylin eosin (HE) staining $\times 100$.

Fig 3: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.



Kupffer cell in the tissue (arrow) Hematoxylin eosin (HE) staining $\times 100$.

Fig 4: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.

found (Fig 7). A thin connective tissue that connects, supports and surrounds the tissues was detected (Fig 8).

Transmission electron microscopic (TEM) findings

Transmission electron microscopy (TEM) analysis revealed that in Chinese goose healthy mitochondria structures and heterochromatic-appearing hepatocytes and Kupffer cells (Fig 9). The nucleus of the hepatocyte was round and euchromatic, the nuclear membrane was healthy and intact and the nucleus was centrally located. The cytoplasm contained very few small vacuoles. It was also observed that the cytoplasm was homogeneously distributed (Fig 10). Mitochondria with normal appearance, regular double membranes and healthy cristae were detected (Fig 11). A very prominent bile duct and a healthy endoplasmic reticulum structure were observed (Fig 12).

In the studies by Selman (2013) in Eurasian coots, Faraj and Al-Baurity (2016) in starlings, Karan *et al.* (2018) in Japanese quail, it was observed that the liver consists of two lobes and has a dark red-brown color and that the two lobes are joined by a parenchymal bridge in the midline. Moslem (2015) reported that the liver of ostriches and poultry is dark red-brown in both species and that the liver of ostriches consists of four lobes, while chickens consists of two lobes. In this study, similar findings was observed that the liver of the Chinese goose (*Anser cygnoides*) is dark red brown in color and consists of two lobes, lobus hepatis dexter and lobus hepatis sinister and these two lobes are joined by a parenchymal bridge in the middle of the liver.

Bahadır *et al.* (1992) found that the liver is between the 2nd and 8th costa in domestic geese, between the 3rd and the last costa in domestic duck and starts from the 4th costa and exceeds the last costa in Pekin. In this study, it was determined that Chinese goose (*Anser cygnoides*) liver is between the 2nd and 8th costa as in domestic goose.

In this study, it was determined that the right lobe is larger than the left lobe as reported by Nickel and Seiferle

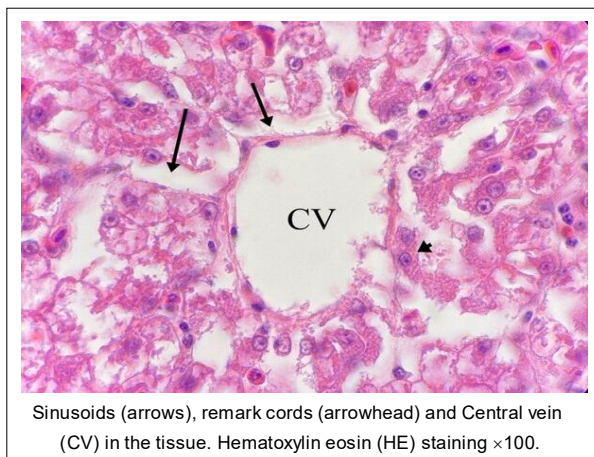


Fig 5: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.

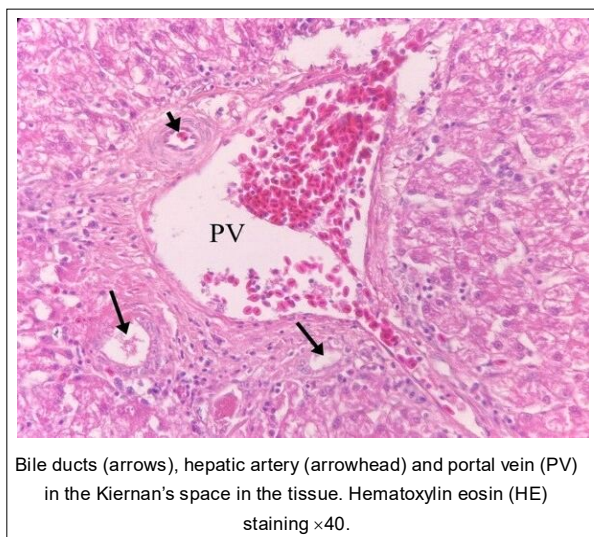


Fig 6: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.

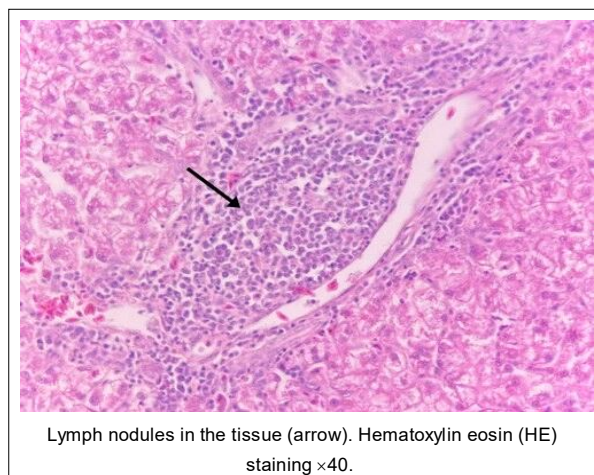


Fig 7: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.

(1977) in domestic birds, Bahadır *et al.* (1992) in domestic ducks, domestic geese and pekin, Denbow (2015) in Turkey, Taşçı *et al.* (2018) in hawks, Karan *et al.* (2018) in Japanese quail, Zaefarian *et al.* (2019) in domestic poultry. However, in the studies by Taşbaş (1978) in turkeys and Klasing (1999) in birds, it was reported that both lobes are of equal size.

Nickel and Seiferle (1977) found that the right lobe is longer than the left lobe in ducks and geese and Karan *et al.* (2018) found that both lobes are of equal length in Japanese quails. In this study, it was observed that the right lobe is longer than the left lobe.

In the studies by Taşbaş (1978) in chickens, roosters and turkeys, Denbow (2015) in domestic birds and turkeys, Karan *et al.* (2018) in Japanese quails, Zaefarian *et al.* (2019)

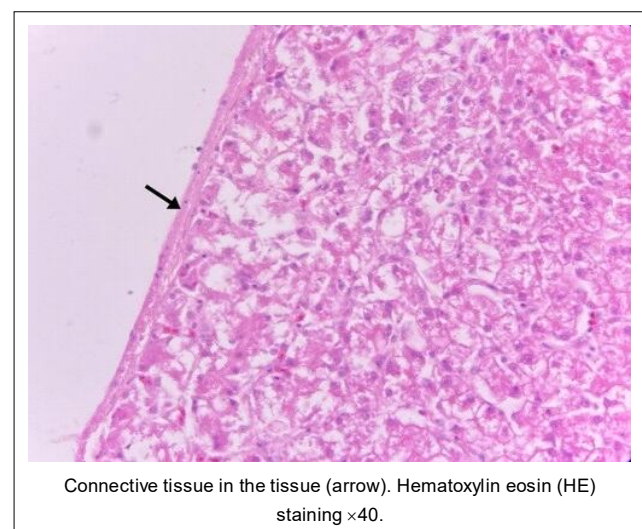


Fig 8: Light microscopic image of Chinese goose (*Anser cygnoides*) liver.

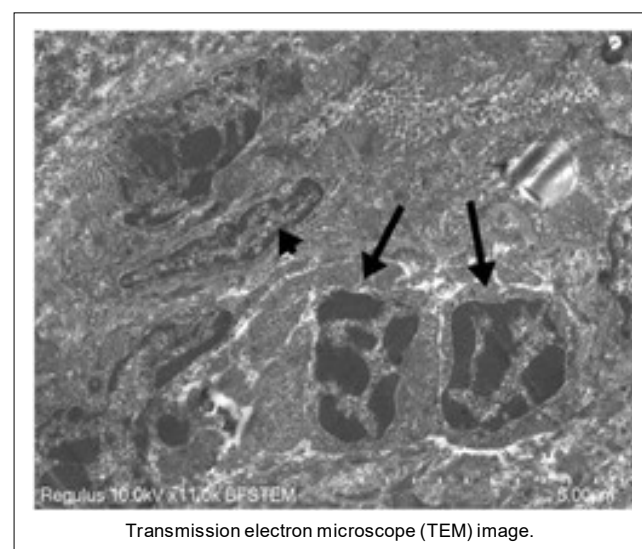


Fig 9: Kupffer cells (arrowhead) and hepatocytes (arrows) in Chinese goose (*Anser cygnoides*) liver.

in domestic poultry and turkeys, it was reported that the right lobe of the liver is in one piece, while the left lobe is divided into two lobes, lateral and medial, with a notch. Similar findings were also found in the present study in Chinese goose (*Anser cygnoides*), the right lobe being one piece and the left lobe is divided into two lobes, lateral and medial, with a notch.

Taşbaş (1978) reported that the gallbladder is spindle-shaped in chickens, as reported by Karan *et al.* (2018) in Japanese quail. Nickel and Seiferle (1977) stated that the gallbladder is pear-shaped in domestic birds. In this study, it was observed that the gallbladder of the Chinese goose (*Anser cygnoides*) is in the form of an elongated tube.

In the studies by Bahadır *et al.* (1992) in ducks and geese, Taşbaş (1978) in chickens and turkeys, it was reported that the gallbladder is located on the dorsal surface of the right lobe of the liver and does not pass through the caudal part. In their study in Japanese quail, Karan *et al.* (2018) reported that the gallbladder was on the dorsal surface of the right lobe of the liver and passed through the caudal part. The present study, it was observed that the gallbladder is on the dorsal surface of the right lobe of the liver and does not pass through the caudal part.

In the studies by Selman (2013) in Eurasian coot and Al-Abdulla (2014) in mallard ducks, it was reported that the liver consists of many lobules, which are separated by a thin connective tissue. In this study, it was observed that the Chinese goose (*Anser cygnoides*) liver consists of many lobules separated from each other by a thin connective tissue.

In this study, it was observed that liver of Chinese goose (*Anser cygnoides*) does not have the typical lobule structure, as reported by Swatland (1994) in poultry.

In the studies by Selman (2013) in Eurasian coots, Hamodi *et al.* (2013) in guinea fowl, lovebirds and gulls, Iqbal *et al.* (2014) in chickens, Al-A'araji (2015) in male wild turkeys, Faraj and Al-Baurity (2016) in starlings, Karan *et al.* (2018) in Japanese quail, Zaefarian *et al.* (2019) in domestic poultry and turkeys, they observed oval and centrally located hepatocytes, remark cords consisting of radially arranged hepatocytes, sinusoids separating remark cords, phagocytically active Kupffer cells, bile ducts consisting of single-layer prismatic cells involved in secretion production and hepatic artery portal vein and central vein involved in circulation. In this study, hepatocytes, remark cords, sinusoids, hepatic artery forming the Kiernan's space, portal vein and bile duct, kupffer cells and central vein were observed in the liver of Chinese goose (*Anser cygnoides*).

In their study in poultry, Zaefarian *et al.* (2019) found that hepatocytes in the liver have a complex cell structure with large nuclei and abundant mitochondria. Similarly, in this study, hepatocytes were determined to have a complex cell structure with large nuclei and abundant mitochondria.

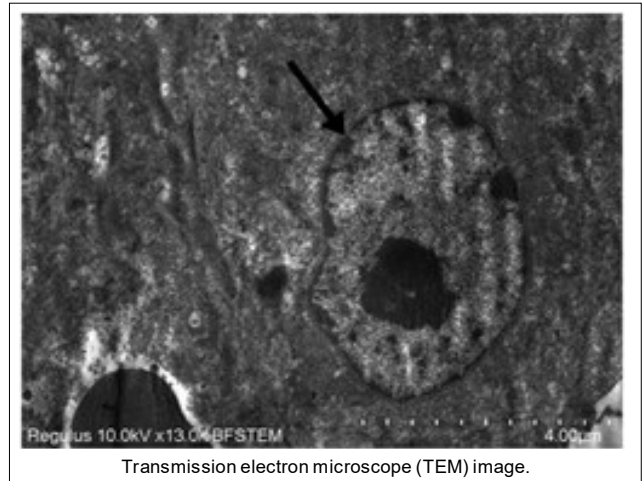


Fig 10: A healthy hepatocyte of Chinese goose (*Anser cygnoides*) liver with a round nucleus and intact nuclear membrane (arrow).

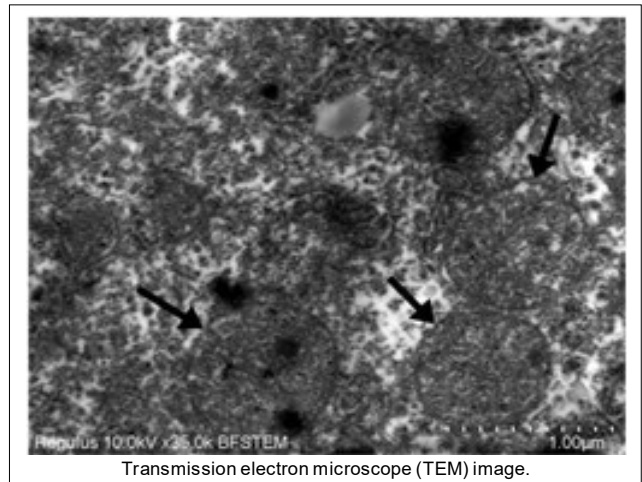


Fig 11: Mitochondria (arrows) in Chinese goose (*Anser cygnoides*) liver.

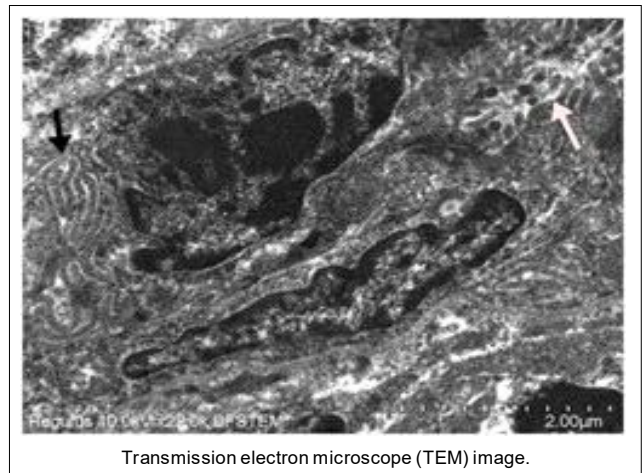


Fig 12: Bile duct (white arrow) in Chinese goose (*Anser cygnoides*) liver and endoplasmic reticulum (black arrow) in a healthy hepatocytes.

CONCLUSION

This study was conducted to examine the liver of the Chinese goose (*Anser cygnoides*), which has an important place in goose breeding, in terms of anatomical and histological aspects and to investigate its similarities and differences with similar species.

When examined anatomically, no significant difference was found between the liver of other birds and Chinese geese (*Anser cygnoides*).

As a result of histological examinations, It was observed that the liver of the Chinese goose (*Anser cygnoides*) did not have the typical lobule structure, it consisted of many lobules and the interlobular septum was thin. It was determined that hepatocytes had large nuclei and united to form remark cords, which were separated by sinusoids. Kupffer cells were found. Lymph nodes were observed densely in the examined tissues. The bile duct, arteria hepatica and vena porta forming the Kiernan's space were found. It was observed that each unit containing the vena centralis had a lobule structure.

According to the findings of this study, it was determined that liver in Chinese goose (*Anser cygnoides*) had denser lymph nodes than the liver of other birds and was histologically similar. We believe that this study will contribute to the literature by analyzing both histological and electron microscopic images of the Chinese goose (*Anser cygnoides*) liver.

ACKNOWLEDGEMENT

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Conflict of interest

All authors declare that they have no conflicts of interest.

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