

## Morpho-histological comparative study of the liver in White-eared bulbul (*Pycnonotus leucotis*), Mallard duck (*Anas platyrhynchos*), and Gull (*Larus canus*)

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### Summery

This study was conducted to compare some of anatomical features and histological structure of the liver in three species of birds that varied in their size, taxonomy, and food environment. The study revealed that the liver in the mallard, gull and white-eared bulbul was bilobed big gland, and the left lobe was smaller than the right one. It was observed that the two lobes in mallard were undivided, while the right lobe in gull has two parts, whereas the left lobe in white-eared bulbul is subdivided into two parts. Histologically, the liver capsule in gull appeared thicker than other two species. The hepatic parenchyma was not shown to be clearly defined lobules in three species. The hepatocytes were organized radially around the central vein as plates or cords of one-two cell thick in mallard and gull, and of two-several cell thick in white-eared bulbul, and those plates were separated by blood sinusoids. It turned out that the hepatic portal triads were less numerous in white-eared bulbul compared with other two species. It was found that there are differences in measurements of some histological structures of the liver among the three species.

**Keywords:** Liver, Histology, Gull, Mallard duck, Bulbul.

### Introduction

The liver is an essential gland in the body; it plays a crucial role in numerous processes for sustaining the life, such as synthesis of blood proteins, production and secretion of bile, detoxification, nutrients absorption, metabolism several substances and store the metabolites (1 and 2). The bird liver is divided into two portions forming the left and right lobes (3). The size or subdivision of the two lobes varies among different species. The right lobe appears greater than the left one as in ostrich and bustard (4 and 5); however, some species of birds have analogous sizes of the hepatic lobes as in galliformes (6). Hepatic parenchyma in birds showed similarity with that observed in most mammals except the variation in some histological characteristic (7). In coot birds (*fulica atra*), (8) reported that the hepatic parenchyma is subdivided into defined lobules and the hepatocytes are organized around the central vein in radially manner. The present study was carried out to investigate some of the anatomical features and histological structure of the liver in three species of birds that vary in their size, taxonomy, and food environment. They are carnivorous (gull), omnivorous (mallard duck,

and feed on fruits and insects (white-eared bulbul) respectively.

### Materials and Methods

At the course of the study, three species of birds were selected as comprising Mallard duck (*Anas platyrhynchos*), Gull (*Larus canus*) and White-eared bulbul (*Pycnonotus leucotis*). Six birds in good healthy state of each species were used in this comparative study. The birds were obtained from the local market of different places in Baqubah, Diyala Province, and Baghdad Province Iraq. All birds were subjected to deep anesthesia using a combination of diazepam and ketamine at dose 5 mg/kg and 25 mg/kg of body weight intramuscularly respectively then authenticate (9). The body mass of each bird was weighted. After isolating the livers from the celomic cavity and making an examination of them, the weight of each one was recorded. The specimens from different lobes of the livers were taken and immediately fixed in 10% neutral buffered formalin, after that they were processed routinely and the slides stained with Hematoxline and Eosin stain and examined under light microscope (10). The histological structures were measured by using ocular

micrometer. Statistical analysis was achieved by using SPSS version 13.00 (11). It was calculated the standard deviation and standard error for the mean of values of each parameters, and the regression analysis was performed for some parameters.

### Results and Discussion

The anatomical examination of the liver in white-eared bulbul, mallard and gull species revealed that it was a big gland situated in mid-celomic cavity, in close correlation with the spleen and gizzard, and caudal to the heart (Fig. 1, 2 and 3). It has dark brown color in gull, whereas the color of the liver in mallard and white-eared bulbul are reddish brown. This variation in the color of the liver among those species may be related to the difference in their nutrition. This result was consistent with (12) who said that the nutritional state of the birds might affect their liver color.

The liver in those three species was composed of asymmetrical two lobes, which were connected together cranially at the midline. It appeared that the left lobes in those species were smaller than right lobes (Fig. 1, 2 and 3). A similar finding was reported by (13) in fowl and common moorhen, but this differed with (14) who mentioned that the left lobe of the liver was greater than the right one in local moorhen. The left lobe was undivided in the mallard and gull species, while in white-eared bulbul it had two portions. These results disagreed with (4 and 15) who observed three subdivision of the left lobe in ostrich and passenger pigeon, but the finding in white-eared bulbul was conformed with (12 and 16) who reported that the left lobe in domestic fowl comprised two parts. This study showed that the right lobe in mallard and white-eared bulbul species was undivided, as that observed by (17) in turkey, whereas this lobe in gull species showed two parts at the caudal end (Fig. 3).

It was observed that the proportion of liver mass in relation to total body mass in mallard, gull, and white-eared bulbul were 1.95%, 2.08%, and 2.62% respectively. The difference in the relative liver mass of those species refers to the negative correlation between liver mass and body mass. This result was coincided with previous study by (18) who recorded that

the relative mass of liver in emus 1.87% of body mass compared to 2.71% in zebra finches, while (19) who was believed that the metabolic rate of the body and the type of food reception could be effect on the liver mass.

Histologically, the current study showed that the liver parenchyma in mallard, gull, and white-eared bulbul was covered by a capsule, consists of irregular dense connective tissue includes at most collagen fibers and some of elastic fibers (Fig. 4, 5 and 6). This structure was detected also in the liver of other species like in chicken (20), and in geese (21). This capsule seems in mallard was thinner than in gull and was thicker than in white-eared bulbul. The (mean  $\pm$  S.E.) of thickness the liver capsule were  $80.52 \pm 6.38 \mu\text{m}$ ,  $86.23 \pm 7.14 \mu\text{m}$  and  $21.8 \pm 2.09 \mu\text{m}$  in mallard, gull, and white-eared bulbul respectively.

In this study, the presence of the liver lobules was not shown clearly in those bird species because of the absence or indiscernible of hepatic connective tissue septa. This finding was not compatible with observations of (8) in coot bird, but agreed with reports of (7) in quail, (17) in turkey and (20) in chicken. The hepatic parenchyma in those species of birds were consisted of hepatocytes organized as irregular plates or cords radiated around the central vein, forming small acini or lobules, and the blood sinusoids were distributed among those plates (Fig. 7, 8 and 9). The plates of hepatocytes were arranged of one-two thick cell in mallard and gull, whereas they were two-several thick cell in white-eared bulbul. This finding in mallard and gull species resembled the description in (13) in the common moorhen, and differed from (22) who said that the hepatocytes arranged in cords mostly with one cell thick in birds, and disagreed with (20 and 23) who found that two thick cells formed the hepatocyte plates in turkey and chicken. In mammals and higher vertebrates, the hepatic plates are arrangement in one-thick cell type (24), while the arrangement of these cells in fish as plates of multilayered hepatocytes (25).

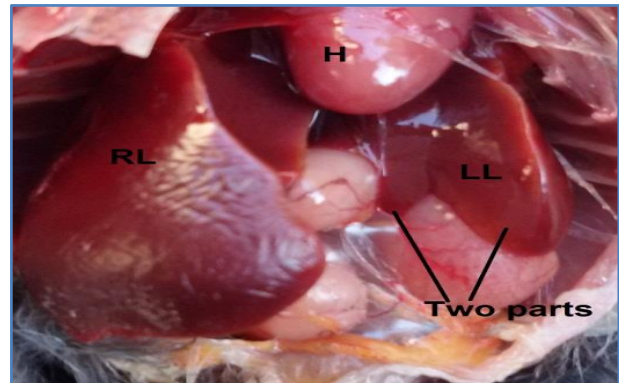
The blood sinusoids were distributed between the hepatic plates throughout the hepatic parenchyma. In mallard and gull, it appeared irregular in shape and lined by flattened endothelial cells with existence of a

large kupffer cells (Fig.10, and 11). These observations were consistent with (26) in liver of ostrich. In white-eared bulbul, the sinusoids were small, very narrow and less numerous within the parenchyma in compared with other two species (Fig. 9). The hepatocytes appeared large in mallard and gull and their nuclei were large, rounded and centrally located with dark distinct nucleoli (Fig. 10 and 11). The shapes of these cells varied in those two species from polyhedral, irregular and oval shaped. In contrast, the hepatocytes in white-eared bulbul were more compacted and mostly rounded or oval shaped (Fig. 9), but these cells also contained large nuclei with prominent nucleoli as that investigated in other two species. These variations in the shape and size of these structures among the three species of birds could be related to the species differences or activity of hepatocytes.

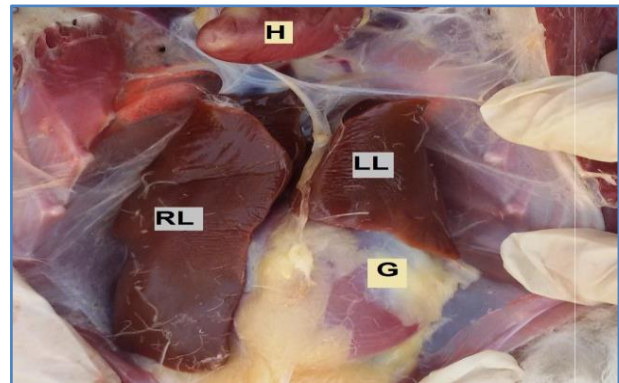
This study showed that the hepatic tissue in three species of birds encompassed several regions enclosed by connective tissue and dispersed throughout the parenchyma without a defined arrangement. These regions represented the portal triad, and each region contained the terminal branches of portal vein, hepatic artery and bile duct (Fig. 12, 13, and 14), as that proved in many other domestic birds and vertebrates (14 and 27). These areas were less prevalent within the liver parenchyma in white-eared bulbul compared with the other two species, while it was noted that these areas were more numerous in gull than in mallard.

The bile duct was lined with epithelium of simple cuboidal, while the portal vein had a large lumen with thin wall and lined by endothelial cells, whereas the hallmark of hepatic artery was a thick wall, small lumen and lined by endothelial cells. These results agreed with observations which detected in the liver of moorhen and domestic fowl (13). These vessels and duct varied in diameters among the species, and the (mean  $\pm$  S.E) of the diameter of bile duct, hepatic artery and portal vein recorded  $135.5 \pm 4.85$ ,  $231.64 \pm 7.08$  and  $786.15 \pm 13.20$   $\mu\text{m}$  in mallard respectively, whereas in gull they were  $147.21 \pm 3.13$ ,  $201.75 \pm 6.17$  and  $625.5 \pm 12.27$   $\mu\text{m}$  respectively, while they were recorded in white-eared bulbul as of the mean of  $26.69 \pm 0.54$ ,

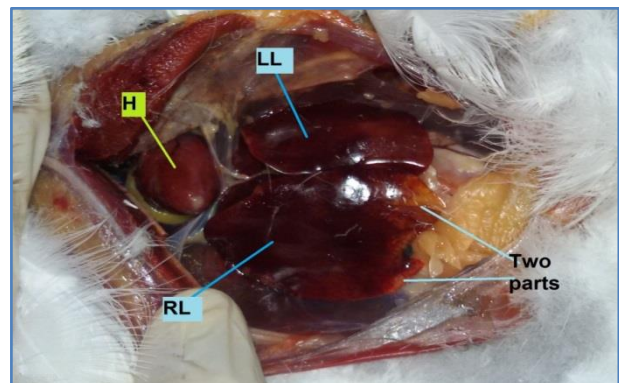
$38.24 \pm 1.93$  and  $144.31 \pm 4.17$   $\mu\text{m}$  respectively. The diameters of central veins in the present study showed differences in measurements among the three species. The mean diameter of central vein in mallard, gull and white-eared bulbul were of  $461.15 \pm 11.25$ ,  $387.42 \pm 9.06$  and  $98.76 \pm 1.41$   $\mu\text{m}$ , respectively. This variation in measurements in vessels and ducts could be due to species differences.



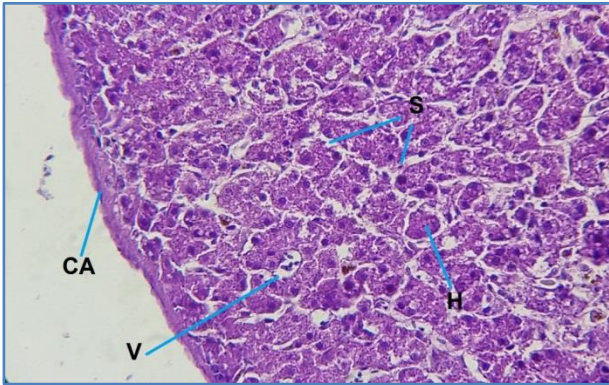
Figure, 1: Shows the location and shape of the liver in white-eared bulbul. The left lobe (LL), the right lobe (RL), the heart (H),



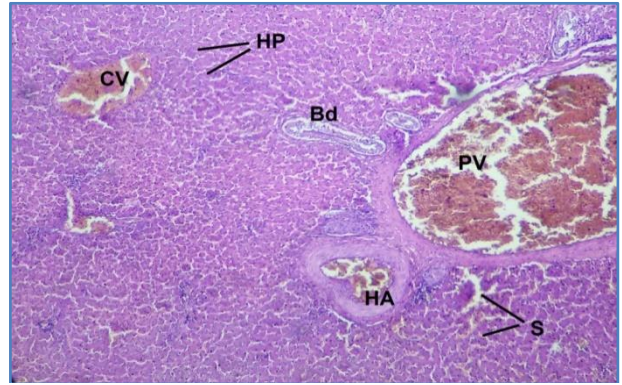
Figure, 2: Shows the location and shape of the liver in mallard duck. Left lobe (LL), Right lobe (RL), Heart (H), and gizzard (G).



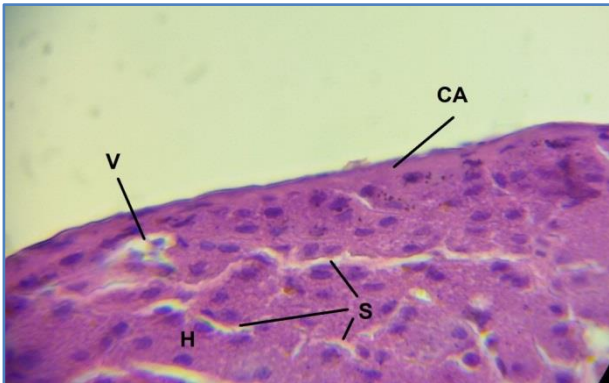
Figure, 3: Shows the location and shape of the liver in gull. The left lobe (LL), Right lobe (RL) which contains two parts, and presence the heart (H).



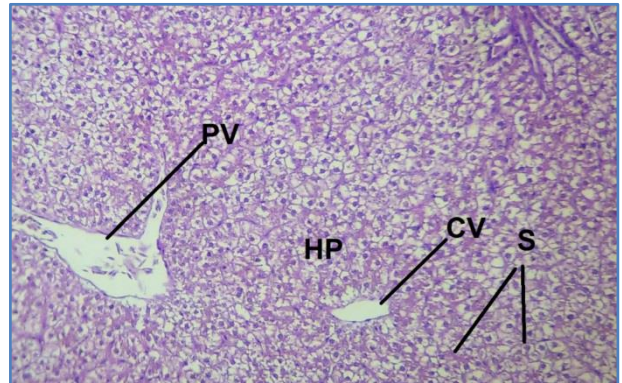
Figure, 4: Histological section of the liver in gull shows the thick capsule (CA), hepatocyte (H), sinusoids (S), vein (V) (H and E 20X).



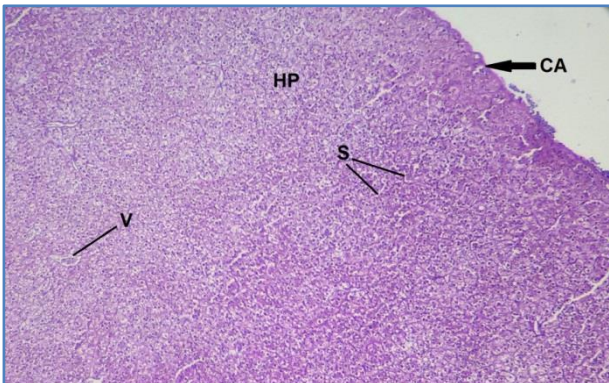
Figure, 8: Histological section of the liver in gull shows, the central vein (CV), hepatocyte plates (HP), sinusoids (S) Portal vein (PV), hepatic artery (HA), bile duct (Bd) (H and E 20X).



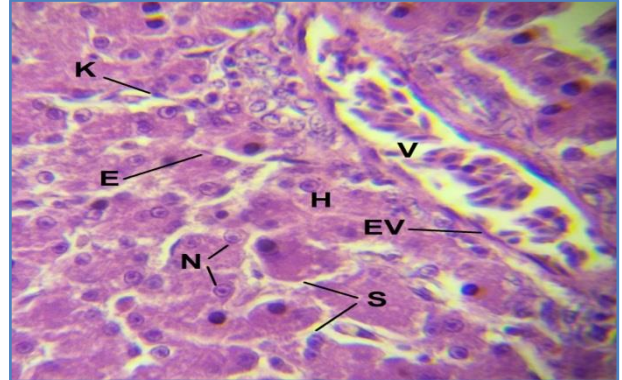
Figure, 5: Histological section of the liver in mallard duck shows, the capsule (CA), hepatocyte (H), sinusoids (S), vein (V) (H and E 40X).



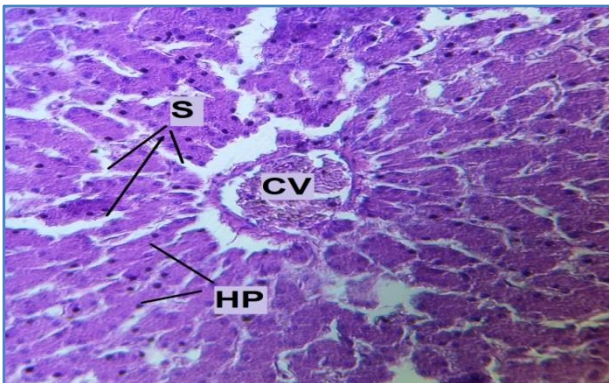
Figure, 9: Histological section of the liver in white-eared bulbul shows, the central vein (CV), hepatocyte plates (HP), sinusoids (S) Portal vein (PV) (H and E 40X).



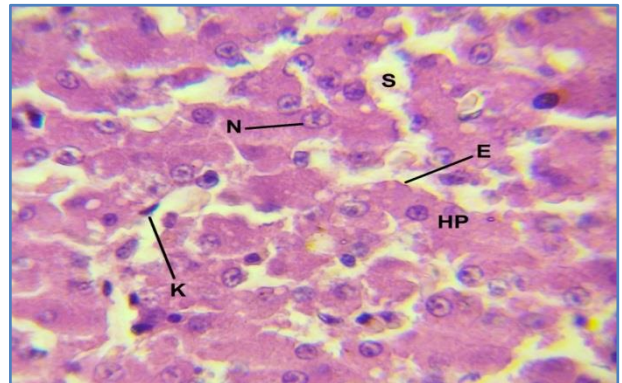
Figure, 6: Histological section of the liver in white-eared bulbul shows, the capsule (CA), hepatocyte (H), sinusoids (S), vein (V) hepatic plates (HP) (H and E 20X).



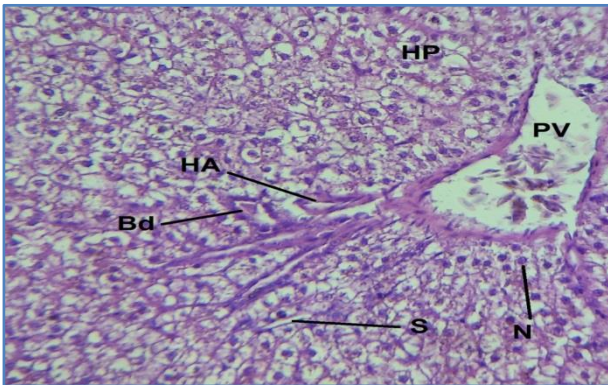
Figure, 10: Histological section of the liver in mallard duck shows, the vein (V), hepatocyte (H), sinusoids (S), nucleus of hepatocyte (N), kupffer cell (K), endothelial cell of sinusoid (E), endothelial cells of vein (EV). (H and E 100X).



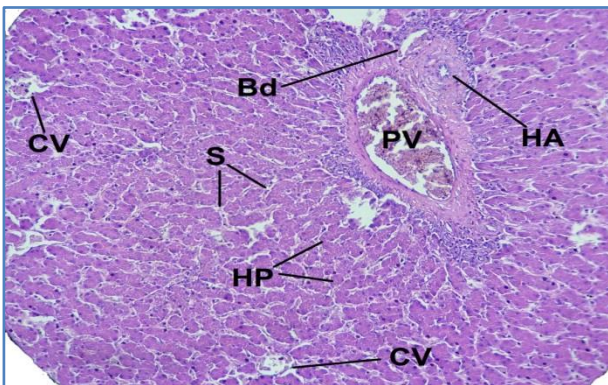
Figure, 7: Histological section of the liver in mallard duck shows, the central vein (CV), hepatocyte plates (HP), sinusoids (S) (H and E 40X).



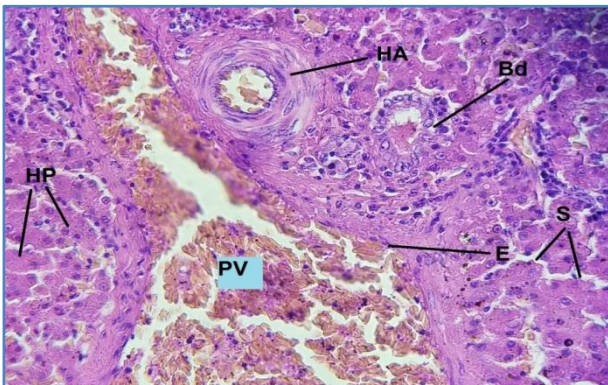
Figure, 11: Histological section of the liver in gull shows, the hepatocyte plates (HP), sinusoids (S), nucleus of hepatocyte (N), kupffer cell (K), endothelial cell of sinusoid (E) (H and E 100X).



Figure, 12: Histological section of the liver in white-eared bulbul shows, the portal triad. Portal vein (PV), hepatic artery (HA), bile duct (Bd), and sinusoids (S), hepatic plate (HP) (H and E 100X).



Figure, 12: Histological section of the liver in mallard duck shows, the portal triad. Portal vein (PV), hepatic artery (HA), bile duct (Bd) and central vein (CV) sinusoids (S), hepatic plate (HP) (H and E 20X).



Figure, 14: Histological section of the liver in gull shows, the portal triad. Portal vein (PV), hepatic artery (HA), bile duct (Bd) and sinusoids (S), hepatic plate (HP), endothelial cells of portal vein (E) (H and E 40X).

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### دراسة نسيجية شكلية مقارنة للكبد في البلبل أبيض الأذنين والخضيري والنورس

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#### الخلاصة

أجريت هذه الدراسة لمقارنة بعض الصفات التشريخية والنسجية للكبد في ثلاثة أنواع من الطيور التي تختلف في الحجم، والتصنيف، وبيئة الطعام. وأوضحت الدراسة أن الكبد في الخضيري والنورس والبلبل أبيض الأذنين هو غدة كبيرة ذات فصين، وأن الفص الأيسر أصغر من الفص الأيمن. ولوحظ أن كلا الفصين في الخضيري كانت غير مقسمة، في حين أن الفص الأيمن في النورس مقسم إلى جزئين، وإن الفص الأيسر في البلبل أبيض الأذنين مقسم إلى جزئين. نسيجياً، محفظة الكبد في النورس أكثر سمكاً من النوعين الآخرين. وإن متن الكبد لم يظهر فصيصات محددة بوضوح في الأنواع الثلاثة. وأن الخلايا الكبدية قد نظمت اشعاعياً حول الوريد المركزي بشكل صفائح أو حبال بسمك خلية إلى خليتين في الخضيري والنورس وبسمك عدة خلايا إلى خليتين في البلبل أبيض الأذنين وهذه الصفائح مفصولة بواسطة الفجوات الدموية. واتضح أن الباحات البوابية للكبد كانت أقل عدداً في البلبل أبيض الأذنين مقارنة مع النوعين الآخرين. وتبين وجود اختلافات في القياسات لبعض التراكيب النسيجية للكبد بين أنواع الطيور الثلاثة.

الكلمات المفتاحية : الكبد، انسجة، النورس، الخضيري، البلبل.