Research Article

BASRAH JOURNAL OF VETERINARY RESEARCH, 2023, 22(1):19-28
https://bjvr.uobasrah.edu.iq/

Histomorphological study of the duodenum in swan goose (*Anser cygnoides*)

Raed Khahat maajal, Sameer Ahmad Abid Al-Redah
Department of Anatomy and Histology, College of Veterinary medicine, University of Al-Qadisiyah.

Corresponding author Email: sameer.abidalredah@qu.edu.iq

ORCID: 000-0003-2693

DOI: 10.23975/bjvetr.2023.178293

Received: 29 Dec. 2022 **Accepted:** 13 Feb. 2023

Abstract

The current study aimed to observe the morphological, and histological features of the small intestine (duodenum) in adult male and female swan geese. The study was carried out on 10 adult geese, with ages ranging from(one-two) years. These birds were used for morphological and histological study. The birds were weighed, then euthanized by injection of Ketamine and xylazine intramuscularly in the pectoral muscle. The coelomic cavity was dissected and photographed to identify the intestinal morphology and the location of organs. Duodenum were grossly described and measured (weight, relative weight, length, relative length, and diameter, relative diameter, and volume, relative volume). Histologically, the specimens were fixed in 10% neutral buffered formalin for histological study. The sections were stained using a (Hematoxylin-Eosin) and PAS stain. The morphological study showed that the small intestine is composed of three segments (duodenum, jejunum, and ileum). The duodenum formed from a U-shaped tube occupies the pancreas, and the ileum appeared shorter part of the small intestine, the mucous membrane of the small intestine showed a clear velvet-like appearance by long finger-like shaped villi, different in size and shape. Conclusion: The duodenum formed a U-shaped tube occupying the pancreas, the mucous membrane of the small intestine showed a clear velvet-like appearance by long finger-like shaped villi, different in size and shape to increase the surface area of absorption. The mucosal glands different in size and shape occupied most of the lamina propria. The goblet cells showed high density toward the end of the intestine. The duodenum showed the largest surface area of villi than other organs of the digestive tract.

Keyword: Morphology, Histology, Duodenum, swan geese.

Introduction

The avian digestive system is consisting of the mouth cavity, esophagus, crop, stomach (proventriculus and ventriculus), and small and large intestines. It is short compared to those of mammals (1,2). Most of this relative reduction is in the bird's intestines, which proposes that birds have less space for digestion and absorption than mammals, this makes the feedstuffs vacation in the gut for less time and makes it stiffer to get the nutrients from the feedstuffs, the duodenal loop and ileum make up the bird's small intestine, as the jejunum and ileum are not clearly distinguishable (2,3). The pancreas is between the duodenal loop and the bile and pancreatic ducts enter into the duodenum, which goes to the jejunoileal region and the colon (4). The large intestine consists of caeca followed by a straight segment of the intestine that is homologous to the mammalian rectum (5).Histologically, the basic constructional pattern of the digestive tract is beginning internally with mucosa and is subdivided into three sub-layers: superficial epithelium, connective tissue called lamina propria or tunica propria, and a thin layer of longitudinal muscle fibers, muscular mucosa and tunica submucosa, tunica muscularis, and serosa, while the large intestine does not differ from the other parts of the small intestine, it is composed of the four layers: mucosa, submucosa, muscular externa, and serosa (6).

Material and Methods

Ten apparently healthy adult males and females' swan. These birds were purchased from local suppliers in common markets in Al-Dwiynia province from Septembe2021 to March 2022. All studied birds were weighed, then euthanized by injecting ketamine and xylazine in pectoral muscle (7). Each bird was dissected by fixing it on a suitable dissecting board to view the thoracic and coelomic viscera including the small and large intestine. A mid-line incision in the thoracic-coelomic wall was made, after that, the duodenum, is identified and photographed in situ using a digital camera. Samples were extirpated and washed with normal saline to remove adhered debris and blood, then cleaned again with normal saline. Then, the weights of the studied organs were measured in grams by using a sensitive digital balance. The macroscopic measurements (length and diameters) of the collected segments were conducted in centimeters and millimeters by using the electronic Vernier caliber, while the volume was measured by the water displacement method (27). For the histological study Duodenal samples were washed using normal saline solution, then fixed with 10% neutral buffer saline for 48h Then proceed with a routine histological technique and periodic acid Schiff stain (26). statistically was carried out by employing a two-way ANOVA, and the level of significance for the mean difference was set at less than 0.05. In the process of using the T-test from the statistics package for social sciences (7).

Results

The duodenum shape was like the letter U, with its proximal portion resemble descending limb and its distal portion ascending. While the left side is related to the right aspect of the gizzard and it's covered dorsally by the jejunum, ileum, ceca, and colon and attached to the cloaca, the pancreas lies between the limbs (Fig.1,2). The pancreatic ducts opened into ascending loop of the duodenum; these ducts are opened near the two biliary ducts, the pancreas lies between the two limbs (Fig.5). The mean length of the duodenum was 18.69± 0.24 cm, the mean diameter was 7.35± 0.7 mm, and the mean volume was 8.88 0.18 ml. The mean weight of the duodenum was 10.8 g, with a standard deviation of 0.14 g.

Histologically the duodenum wall in Goose was subjected to a microscopic inspection, and the results revealed four tunicae: mucosae, submucosa, musculris and serosa (Fig.5). Between the bases of the duodenal villi interventions created crypts of Lieberkühn (Fig.6), and towards the base of villi, invaginations extend deeply as intestinal glands. The mucosa was structured into longitudinal villi finger-like projections, which vary in their shapes and sizes. The glands of the digestive tract had the appearance of simple tubular glands and were lined by the same surface of epithelium as the villi of the duodenum the epithelial surface was lined by simple columnar epithelium, which consisted of the main cells, which were also columnar cells and had oval nuclei located near the basement membrane with a brush border. Additionally, the goblet cells observed unicellular glands of varying sizes basally located nuclei scattered between the columnar cells covering the villi and lining the crypts (Fig.7).

There were no glands present in the tunicae of the submucosa, which was reported to be an interrupted thin layer of loose connective tissue that was abundant in collagen fibers (Fig 7, 8). The myenteric plexus was located between the muscularis mucosa and the muscularis inner layer. The muscular layer was made up of a dense inner circular arrangement of smooth muscle bundles and a sparse outer longitudinal arrangement of smooth muscle bundles. In between these bands was a fine connective tissue that was rich in elastic fibers, and there was also a presence of myenteric plexus, blood vessels, and nerve plexus (Fig.9, 10). The serosa was generated as a thin layer of loose connective tissue that was abundant with collagen fibers (Fig 13). This layer was then covered by a simple squamous mesothelium that was occupied by blood vessels and nerve plexus.

Discussion

The duodenum of the goose in this study looked to be the same as the one that (8) described, in that it began in the pyloric region of the gizzard and terminated at the Treitz ligaments, this distinctive U-shaped loop was produced by the duodenum; it has a descending leg and an ascending limb, and the pancreas was situated in the space created by the duodenum, Also found by (9) is that the

duodenum is a narrow U-shaped loop that lies on the right surface of the gizzard, with proximal descending and distal ascending parts that are held together by a narrow mesenteric fold, and that the pancreas lies between the two arms of the duodenum(Fig.1,2). Additionally, the pancreatic ducts and biliary ducts were opened into the ascending loop (10). Both the pancreatic and bile ducts open into the ascending portion of the duodenum, which is located on the opposite side of the gizzard from the cranial region (4).

The U shape of the duodenum in most birds and the placement of the pancreas in this bend is to stabilize the pancreas and protected it from torsion and thus obstruction of pancreatic ducts (Fig3,4). The duodenum is held in place by a thin ligament that attaches to the dorsal abdominal wall (11). It fused with the jejunum cranially, but there was no obvious distinction between the two in parallel with (12). There is not a clear transition between the end of the ascending duodenum and the jejunum, nor is there a clear transition between the jejunum and the ileum. Both of these transitions are not distinguishable, Whereas the duodenal loop is folded into a series of secondary folds (3). In some species, including the white-tailed sea eagle and the Jakass penguin, the duodenal loop is not folded in this way in macaws, The duodenal loops extend ventrally of the intestine, and they cover the loops that are found in the ileum (13).

In Turkey, the internal surface (mucous membrane) of the duodenum is characterized by white color thick mucus membrane which contains long, heavy projections, finger like which gives velvet appearance to the duodenum, In the same way, the duodenal wall appeared thick and the internal surface was lined by white color thick mucus membrane which contains finger like projections which gives velvet appearance to the duodenum (13). The morphometric measurements mean of (weight, length, and diameter) revealed values that were somewhat higher than those recorded for Mallard but lower than those recorded for Turkey and Guinea fowl correspondingly (13,14, 15).

This is in agreement with (16) in pigeon, (17) in black winged kite, (14) in quail, and (18) in rock dove. The duodenum wall in goose is made of tunicae; mucosa, submucosa, muscularis, and serosa. The mucosa was organized as longitudinal villi, which, comparable to (19) in brown falcon, (14) in broiler chickens, was helpful for analyzing the function of the duodenum since it increased the surface area. The crypt depth may be an important factor that determines the ability of the crypts to sustain the increase in the villus height as well as to maintain the villus structure (19). Increasing the villi height results in an increase in the intestinal surface area, which in turn speeds up the rate at which food is absorbed (20). The lamina propria was consistent with the findings of (21). In the African pied crow Corvus albus and (22), which found that the lamina propria of the intestinal villi in birds does not include lacteal arteries, contrary to

the findings of (23). The submucosa findings were agreed with (20,21), in the yellow macaw. Present of muscularis mucosa as recorded by (19), in upland buzzard different than that in African pied crow, the muscularis mucosa was absent, whereas composed of two layers as referred to in quai (24). In ducks (25) and poultry (20), the muscularis externa was made of an inner layer that was thick and circular, and an outer layer that was thin and longitudinal, both layers ran parallel to one another. The serosa layer of the ventriculus, which coincided with the findings of (22,25), in the majority of bird species. Previous research on birds found that these observations of the duodenum in peahens were consistent with their findings (18,20).

Table 1: Anatomical Measurements of Duodenum, Ileum and Colon of Goose (N = 10)

Anatomical Measurements	Duodenum Mean±SE	Ileum Mean±SE	Colon Mean±SE	T. test
Weight (g)	10.88± 0.14	5.8 ± 0.85	6.83 ± 0.12	0.002
Length (mm)	18.69 ± 0.24	5.2 ± 0.23	10 .73± 0.15	0.122
Diameter (mm)	7.35 ±0 .70	5.6 ±0 .61	8.29± 0.69	0.01
Volume (ml)	8.88 ± 0.18	7.85 ± *0*.14	8.85 ± 0.16	0.000

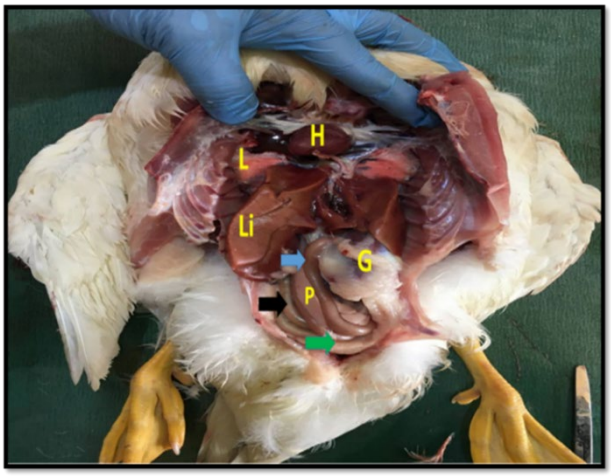

Figure 1: Photograph illustrate location and parts of small intestine in Male adult Goose: Heart(H), Lung (L), Liver (Li), Gazzird(G), Pancrase (P), Dudenum (blue arrow), Jejenum (black arrow),Elium (green arrow)

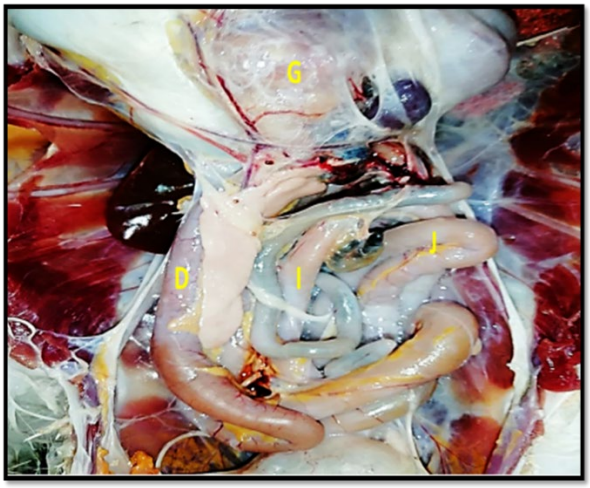

Figure 2: Photograph illustrate location and parts of small intestine in Male adult Goose Gazzird(G) Dudenum (D), Jejenum (J) ileum (I).

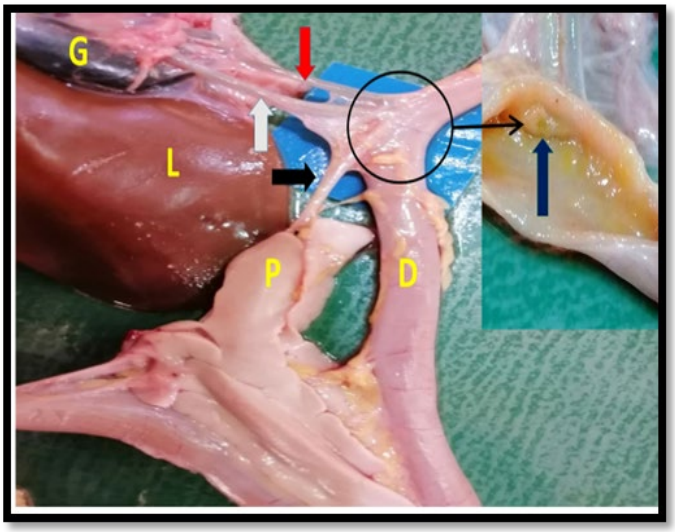

Figure.3. Gross anatomy shows gallbladder(G), Liver(L), Pancreas(P), Duodenum(D), duodenum papilla (blue arrow) Hepatoenteric duct (red arrow), Cysticoenteric duct (gray arrow) and pancreatic duct (black arrow).

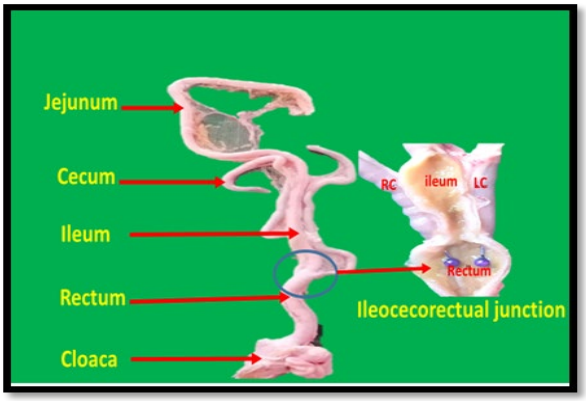

Figure.4. Grosse anatomy show location and relationship of ileum with anther parts of intestine and ileocecorectal junction

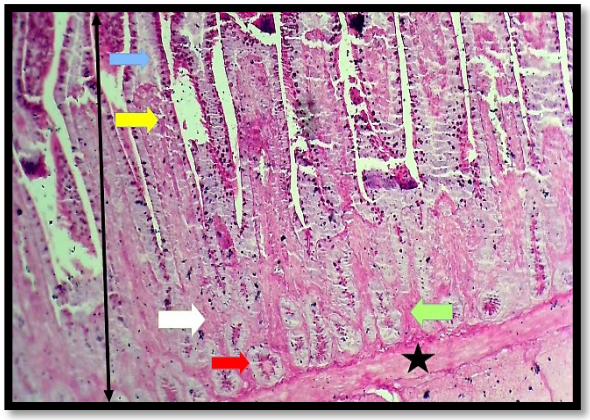

Fig.5: Histological section of the Duodenum walls of male goose. T mucosa, T Submucosa (A), T. Muscularis T. serosa (blue arrow) H & E, X100

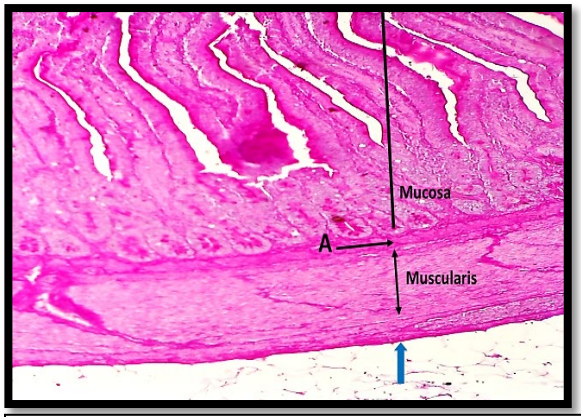

Fig.6. Histological section of the Duodenum mucosa of male goose. T mucosa, lamina epithelia (blue arrow), lamina propria (yellow arrow), lamina muscularis (white arrow), the Crypts of Lieberkühn, intestinal gland (red arrow) and submucosa (black star) H & E, X100

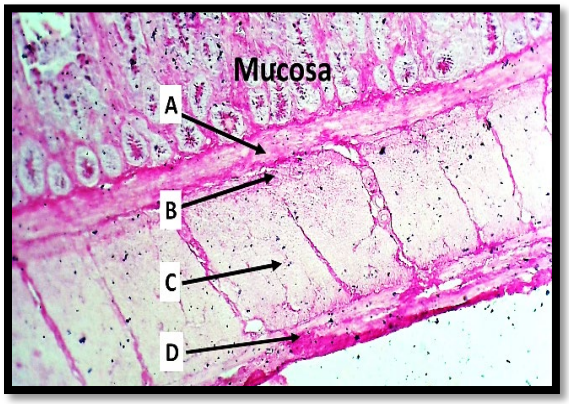

Figure7: Histological Section of the Duodenum in Swan goose shows Villi (V), Epithelium columnar cells (E), Brush border (B), Crypt of Lieberkühn (C), Goblet cells (G), Lamina propria (Lp), PAS Stain 400X.

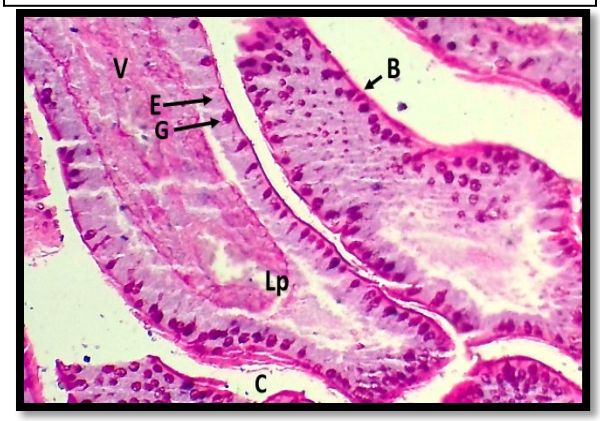

Fig.8. Histological section of the Duodenum walls of female goose. T mucosa, T Submucosa (A), T. Muscularis inner part(B) and outer part(C) T. serosa (D) H & E, X400

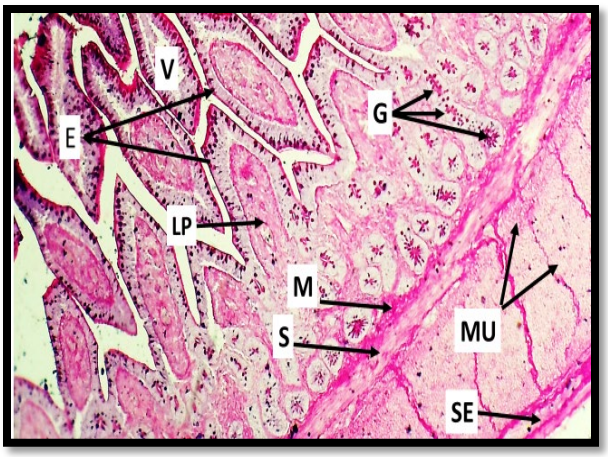

Fig.9. Histological section of the Duodenum walls of female goose. T mucosa, T Submucosa (A), T. Muscularis) T. serosa, loose connective tissue(B), collagen fibers(A), Blood vessels(C) PAS stain, X200

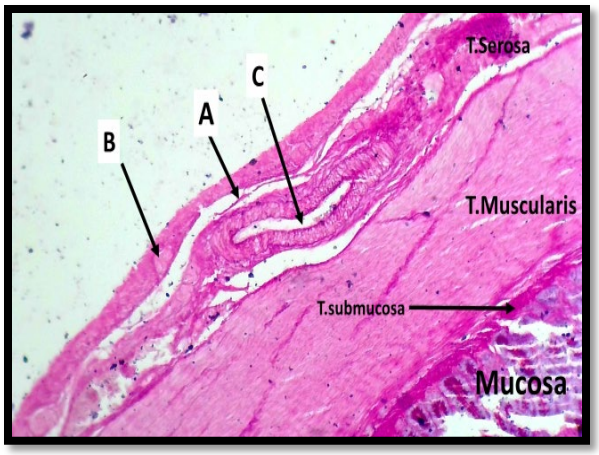

Figure 10: Histological Section of the Duodenum in goose shows villa (V), Epithelial, lamina (E) , ileal gland(G),Muscularis mucosa (M), Serosa (Se), Muscularis internal and external (Mu), Blood vessel (Bv), H&E stain X400

References:

1-Rebecca, K. (2002). The digestive system of birds. http://www. Page wise. com / disclaimer. Html.

2-Turk, D. E. (1982). The anatomy of the avian digestive tract as related to feed utilization. *J Poul. Scie, 61*(7), 1225-1244.

3-King, A. S. and Mclelland, J. (1984). Birds, Their Structure and function, 2nd edition, J.B.T. London 2:94-101.

4-Hodges, R. D. (1974). The histology of the fowl. Academic press. London., pp: 35–88- 101-112. 149

5-Mina, T., P. Paria, (2011). "Histological study of proventriculus of male adult ostrich. *" G.V.J. 7* (2), 108-112.

6-Saleem, G. (2012). Necrotic enteritis, disease induction, predisposing factors and novel biochemical markers in broilers chickens. PhD. Thesis, Scottish Agriculture Collage, University of Glasgow.

7-Adeola, O. (2006). Review of Research in Duck Nutrient Utilization. Int. *J. Poult. Sci. 5* (3): 201-218.

8-Grajal, A. (1995). Structure and function of the digestive tract of the hoatzin (*Opisthocomus hoatzin*): A folivorous bird with foregut fermentation. *The Auk, 112* (1): 20-28.

9 Hristov, H., Vladova, D., Kostov, D. and Dimitrov, R. (2017). Gross Anatomy of some Digestive organs of the Domestic canary (*Serinus canari*). *Trakia J. Scie, 15*(2), Pp: 33-42.

10-Salman, R. J. (2016). Anatomy and histological comparison of the large

intestine in adult common kestrel (*Falco tinnunculus*) and white –eared bulbul *Pycnonctus leucotis*) differ in their food type. M.Sc. Thesis in Anatomy and Histology. university of Baghdad.

11-Shanawany, M. (1996). Principles and practice of ostrich feeding.*J. Feed mix, 4*, : 44-46. 157

12-Cooper, R. G. and Mahroze, K. M. (2004). Anatomy and physiology of the gastro-intestinal tract and growth curves of the ostrich. *J.Anim. Scie: 75*: 491–498.

13- Deeming, D. C. (1999). The Ostrich Biology, Production and Health. CABI Publishing, Walingford Oxon and New York: pp 144-148.

14- Naser, R. A. (2021). Anatomical, Histological and Histochemical Study of the Intestinal Tract of Male Adult Turkey (*Meleagris gallopavo*). Ph.D. Thesis in veterinary Anatomy and Histology. Univ. of Baghdad, Baghdad-Iraq.

15 -Khaleal, I. M. and Salman, R. J. (2016). A comparative histological study of ceca and rectum in common kestrel (*Falco tinnunculus*) and white-eared bulbul (*Pycnonotus leucotis*) according to their food type. *Iraq J. Vete. Med., 40(*2):48-56.

16 -Duke, G.E.; Reynhout, J.; Tereick, A. L.; Place, A. E. and Bird, D. M. (1997). Gastrointestinal morphology and motility in American Kestrels receiving high low-fat diets. *Condor, 99*:123-131.

17-Batah Abbas Lafi, Hanan Ali Selman, Mustafa saddam., (2012). Histological study for stomach (proventiculus and gizzard) of Coot bird (*Fulica atra). J.Diyala Agricultural Sci. 4(*1) 9 – 16.

18-Ghosh. S. K; Ghosh, B. and Chakrabarti, P. (2011). Fine Anatomical Structures of the intestine in relation to respiratory function of an air breathing loach. *Lepidocephalichthys guntea* (Actinoterygii; Cypryiniformes; Cobitidae).J. Acta Ichhtyo. Pisca. 41, 1-5.

19-Indue, V. R., Lucy; K. M., Sreeranjini, A. R; Ashok, N., and Chungath, J. (2011). A comparative study on the histomorphology of ileum and colo-rectum in peafowl. *J. India Veter Associ, Kerala (JIVA), 9*(2):35-38.

20-Mohamed M. A.; Hassasn H. M. A.and El- Barkonky. EMA. (2008). Effect of characteristics of broiler chicks. *J. Agri. Soc. Sci; 4*: 13-17.

21-AL-Aredhi, J. A. (2013). Comparative Anatomical and Histological Studies of Gastrointestinal Tract for Three Wild Iraqi Birds Black-Shouldered Kite *Elanus caeruleus*, Green-Winged Teal *Anas crecca* and The Common Quail *Coturnix coturnix*, Ph.D. Thesis. University of Kufa, Iraq. Pp: 44-57.

22-AL-Nassiri, S. H. M. (2011). Comparative anatomical and histological study of digestive system in Broilers from first day after hatch to sexual maturity. M. Sc. Thesis. University of Tikrit. Iraq. Pp 33-50

23-Mohammad, F. S and AL-Samarrae A. (1994). Histoarchitecture of ceca of indigenous ducks in Iraq. *J.Iraq.vete.scie., 7*(3):129-135.

24-Bezuidenhout, A. J. and Van Aswegen, G. (1990). A light microscopic and immunocytochemical study of the gastrointestinal tract of the ostrich (*Struthio camelus L. J. Onderstepoort. Vet. Res. 57*, 37–48.

25-Rodrigues, M. N.; Abreu1, J. A. P.; Tivane, C., Wagner, P. G.; Campos, D. B.; Guerra, R. R.; Rici, R. E. G. and Miglino, M. A. (2012). Microscopical study of the digestive tract of blue and yellow macaws. *J.curre.microsc.contri.adva.scie &techno.28:* 414-421.

26-Luna, L.G., 1968. Manual of histologic staining methods of the Armed Forces Institute of Pathology.

27-Zghair, F. S. (2019). Histomorphological, Histochemical and Immunohistochemical Study of Small intestine in Adult Guinea Fowl (Numida meleagris). Ph.D. Thesis in veterinary Anatomy and Histology. Univ. of Baghdad, Baghdad-Iraq.

دراسة شكلية نسجيه عن الاثني عشر في أوزه البجعة (*Anser cygnoides*)

رائد كحط معجال ،سمير احمد عبد الرضا
فرع التشريح والأنسجة ،كلية الطب البيطري ،جامعة القادسية ،العراق.

الخلاصة

هدفت الدراسة الحالية إلى ملاحظة السمات التشريحية والنسجية للأمعاء الدقيقة (الاثني عشر) في ذكور وإناث إوز البجعة البالغة. أجريت الدراسة على 10 اوز بالغ تتراوح اعمارهم بين (سنة - سنتين). تم استخدام هذه الطيور للدراسة التشريحية والنسجية. تم وزن الطيور ثم الموت الرحيم بحقن الكيتامين والزيلازين في العضل في العضلة الصدرية. تم تشريح التجويف الجوفي وتصويره لتحديد الأمعاء تشريحيا وموقع الأعضاء. تم وصف وقياس الاثني عشر بشكل إجمالي (الوزن والوزن النسبي والطول والطول النسبي والقطر النسبي والحجم والحجم النسبي). من الناحية النسيجية، تم تثبيت العينات في 10٪ فورمالين مخزون محايد للدراسة النسيجية. تم تلوين المقاطع باستخدام صبغة (هيماتوكسيلين - ايوسيين) وPAS. أظهرت الدراسة التشريحية أن الأمعاء الدقيقة تتكون من ثلاثة أقسام (الاثني عشر، الصائم، اللفائفي). يحتل الاثنى عشر المكون من أنبوب على شكل حرف U البنكرياس، وظهر الدقاق جزءًا أقصر من الأمعاء الدقيقة، وأظهر الغشاء المخاطي للأمعاء الدقيقة مظهرًا مخمليًا واضحًا عن طريق الزغابات الطويلة التي تشبه الإصبع، مختلفة في الحجم والشكل. الخلاصة: شكل الاثني عشر أنبوبًا على شكل حرف U يشغل البنكرياس، وأظهر الغشاء المخاطي للأمعاء الدقيقة مظهرًا مخمليًا واضحًا عن طريق الزغابات الطويلة التي تشبه الإصبع، والتي تختلف في الحجم والشكل لزيادة مساحة الامتصاص السطحية. احتلت الغدد المخاطية المختلفة في الحجم والشكل معظم الصفيحة المخصوصة. أظهرت الخلايا الكأسية كثافة عالية في اتجاه نهاية الأمعاء. أظهر الاثني عشر أكبر مساحة سطحية للزغابات من الأعضاء الأخرى في الجهاز الهضمي.

الكلمات المفتاحية: علم التشريح، علم الأنسجة، الاثني عشر، أوز البجعة.