Comparative Histological Study of Exocrine Pancreas in Duck (*Anas platyrhnchos*) and Turkey (*Meleagris gallopavo*)

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ABSTRACT

Due to the importance of the pancreas and its secretion in the digestive tract of birds, this study was carried out to compare the histological structure of the exocrine pancreas in ducks and turkeys, these birds differ in their habitats and classification. The samples of the pancreas were taken from ten local male mature ducks and ten local male mature turkeys. This study found the pancreas in ducks and turkeys surrounded by a capsule and composed of exocrine and endocrine parts. The exocrine part in both birds consisted of the acini and ductal system in different diameters. The acini were varied in size and shape. The acini represented secretory unites of exocrine part, which in ducks were rounded, oval, or tubular, but turkey pancreatic acini had mainly tubular shapes. The pancreatic ductal system is started by centroacinar cells then drains to intercalated ducts, intralobular ducts, and interlobular ducts then to the main ducts, which open in the duodenum. The wall of the main ducts of the duck pancreas contained ductal glands, while these glands were not found in the main ducts of the turkey pancreas. The present study concluded that the capsules of the turkey pancreas were thicker than in the duck pancreas and the turkeys need a greater amount of digestive enzymes, which are related to bird food components. The digestive enzymes modified adaptively by the diet components and also modified by feeding ecology, which leads to an increase in the turkey acini size and the height of their acinar cells.

Keyword: Exocrine, Pancreas, Histology, Duck, Turkey.

1- INTRODUCTION

Due to various environments for avian food sources such as small rivers, ponds, mountains, fields, or seashores, birds usually adapted. Avian adaptations back to dissimilar birds' lifestyles and feeding habits may lead to differences in the digestive canal [1]. Ducks for example can be fastly and easily adapted to distinct and inverse environments [2]. Wild turkeys are also able to an excellent response by adaptation to insufficient circumstances of the surrounding environment [3]. The pancreas of birds is accountable for hydrolytic enzyme secretion to the intestinal lumen. Different sizes and masses of the pancreas are present among the species [4]. Many structural differ-

ences are found in the bird's pancreas among species such as lobes division, islets distribution in lobes, frequency, and shape of islet endocrine cells as well as ducts structural features [5]. In avian, the pancreatic capsule is a thin connective tissue that covers the parenchyma of the pancreas [6]. The pancreas of avians is a gland with exocrine and endocrine secretions. Digestive enzymes and basic electrolytes are secreted from the exocrine portion [7],[8]. The exocrine portion of the pancreas is a tubuloacinar gland constituted by serous acini. Low columnar epithelium tissue lines these acini that have a rounded, large, and basal nucleus [9]. Pancreatic acini products of vertebrates are drained into the duodenum by the pancreatic ducts in the subsequent order: centroacinar cells (appear as flat cells), intercalated ducts, intralobular ducts, and interlobular ducts, as well as pancreatic (main) ducts [10]. In poultry, the pancreatic duct wall contains three layers: the first called the mucosa layer, the second called the muscular layer, and the last called the adventitial layer. Two sublayers are present in the mucosa layer: lamina epithelial and lamina propria [11]. No histological investigation compares between exocrine pancreas of ducks and turkeys birds. Therefore, this investigation was carried out to achieve that.

2- MATERIALS AND METHODS

The pancreatic specimens were taken from ten local male mature ducks (*Anas platyranchos*) and ten local male mature turkeys (*Meleagris gallopavo*). The experimental birds were slaughtered. Immediately, a longitudinal incision was made in the abdominal cavity of these birds and the pancreas was removed from the right side of the abdominal cavity. The lobes of the pancreas were separated and washed in 0.9% normal saline. The pancreatic specimens were put in 10% formalin for 24 hours to fix then washed and subjected to dehydration by alcohol gradients and clearing by xylene. All specimens infiltration and then embedded with paraffin wax. After that, the specimens were cut to 5µm. These specimens were stained by H&E stain, PAS stain, Masson trichrome stain, and Gomori's method for Langerhans islets. The thickness of capsule, diameter of acini, and height of acinar cells were measured by using ocular micrometer. Then the slides were examined by light microscope and the microphotographs were taken to the sections by digital camera.

3- Results and Discussions

The microscopic examination of the pancreas in local male mature ducks and turkeys showed that the pancreas was composed of parenchyma and was surrounded by capsules, which consisted of several connective tissue fibers (collagen fibers, elastic fibers, and reticular fibers) as well as fibroblasts. The capsules in both birds were covered by a mesothelial layer, the connective tissue septa extend from capsules to parenchyma in both ducks and turkeys (Figure 1, and Figure 2) in ducks and turkeys respectively. The result of the present study of the capsule is in line with[12] in duck pancreas (*Anas boscas*), [13] in turkey, [14] in red jungle fowl, [15] in goose pancreas, [16] in pigeon pancreas, and [17] in falcon (*Falco peregrinus*). On the other hand, the result of the present study of pancreatic septa in agreement with the finding of [18] in rock dove and steppe

buzzard, [19] in golden eagle (*Aquila chrysaetos*), [20] in Guineafowl, and [21] in Kestrel (*Falco tinnunculus*), but the septa were not found in Common gull [20].
The histological results showed the average thickness of capsules in local male mature ducks and turkeys were (8.32 ± 0.81µm) and (16.53 ± 1.34µm) respectively. There were significant differences in capsule diameters between ducks and turkeys at ($p \leq 0.05$), as shown in (Table 1).

The present study found the exocrine portion of the pancreas in the local male mature ducks and turkeys consisted of a serous compound tubuloacinar gland, which occupied a larger region of the pancreatic parenchyma than the endocrine part. Histologically, the present study revealed the exocrine part consisted of acini, which represented secretory unites and excretory ducts with different diameters. This result agrees with previous studies such as [22] in Palam Dove (*Streptoplia selegalensis*), [11] in the pigeon (*Columba livia*), [23] in the goose (*Anser anser*), and [17] in falcon (*Falco peregrinus*).

3.1- The pancreatic acini

The histological result were showed the shape of the acini of male ducks varies, which were rounded, oval, or tubular, but turkey pancreatic acini had mainly tubular shapes. The acini in both birds were lined by a single layer of cells that rest on the basement membranes. These cells were observed as triangular, polyhedral, or tall columnar. The acinar cells contained one large, spherical, and basal nucleus with prominent nucleoli. The pancreatic acinar cells appeared basophilic (blue color) on their bases and acidophilic (red color) on their apical. The current study in both birds showed the acinar cells lined by flat cells (simple squamous epithelial cells), these cells were called centroacinar cells which were observed only in the lumen of acini. The centroacinar cells had prominent round nuclei with pale cytoplasm. The zymogen granules are absent in the cytoplasm of centroacinar cells. These cells were represented as the start cells of the intercalated duct, as illustrated in (Figure 3, and Figure 4) in ducks and turkeys respectively. The result of the present study of acini and acinar cells is in line with [12] in duck pancreas, [13] in the pancreas of turkey, [22] in the pancreas of Palam Dove, [16] in pigeon, and [20] in Guinea fowl and Common gull. On the other hand, the result of the present study of centroaciner cells is in agreement with [24] in duck, [15] in goose, [19] in the golden eagle, and [21] in Kestrel, which reported the centroacinar cells had one or two nuclei, but centroacinar cells were not found in some birds that reported by [20] in Common gull and Guineafowl, and [25] in Mynah. The reason the pancreatic acini cells appear basophilic on their bases and acidophilic on their apical, these cells have rich rough endoplasmic reticulum in the base of the acinar cells and contain zymogen granules, which fill the apical of acinar cells [26].

The average diameters of acini in ducks and turkeys were (23.55 ± 1.03µm), and (35.21 ± 2.21µm) respectively, as noted in (Table1). There was a significantly different in acini diameter between ducks and turkeys at ($p \leq 0.05$). Additionally, the aver-

age height of the acinar cells in both ducks and turkeys were (10.27 ± 1.35µm), and (13.85 ± 1.32 µm) respectively, as shown in (Table 1). There were significant differences in height of acinar cells between ducks and turkeys at ($p \leq 0.05$).

3.2- The pancreatic ductal system

The current study on the pancreas of duck and turkey birds observed the ductal system started from centroacinar cells. The intercalated ducts in both birds formed the extension to centroacinar cells, which were lined by one layer of squamous epithelium. The intralobular ducts extended from intercalated ducts which in ducks and turkeys were lined by one layer of cuboidal epithelium. These cells had spherical nuclei located in the basal of the cells. Histologically, in both birds in this study, the intralobular ducts drained into interlobular ducts. The interlobular ducts were larger than intralobular ducts, which were lined by simple columnar cells with oval to round nuclei located in the basal of the cells. There was connective tissue around the ducts in both birds containing connective tissue fibers, smooth muscle fibers, and fibroblasts, which were thicker in interlobular ducts than in the intercalated ducts and intralobular ducts, as noted in (Figur 5, and Figur 6) in ducks and turkeys respectively. The result of the present study of intercalated ducts agrees with [5] in the goose pancreas,[16] in the pancreas of pigeon, and [11] in pigeon, but in contrast with [27] in the common quail, reported the intercalated ducts lined by simple cuboidal cells. On other hand, [21] found the intercalated duct was not found in the pancreas of Kestrel. The result of the present observation of intralobular ducts is in concord with [28] in the pancreas of Japanese quail, [24] in duck, [10] in the pancreas of goose, and [26] in Japanese quail and cattle egret. Whereas in contrast to [20] in the Common gull and Guineafowl and [29] in the pancreas of a falcon, those researchers reported that the intralobular ducts contained simple squamous cells. Moreover, [5] in goose and [16] in the pancreas of pigeon found the intralobular ducts contained simple columnarcells. The result of the present study of the interlobular ducts agrees with [27] in the pancreas of common quail, and [19] in golden eagles, but disagrees with [30] in bulbul who were found the interlobular ducts had simple cuboidal epithelium.

The histological results detected the interlobular ducts in ducks and turkeys observed to run to the larger ducts, which were main ducts. The main ducts then drained to the duodenum. The main ducts in both birds in this study were lined by one row of columnar epithelium with a rounded nucleus and prominent nucleoli. The ductal glands were observed in the lamina propria of the main ducts of the ducks, while in turkeys were not found. The mucosa of a wall of the main ducts in both birds consisted of a thick layer of connective tissue.The wall of the main ducts contained a smooth muscle cells in the muscular layer of these ducts, as shown in (Figure 7, and Figure 8) in ducks and turkeys respectively. The observation of epithelium tissue that lined the main ducts in both birds is in line with the finding of [5] in geese, [31] in ducks, [28] in Japanese quail, [13] in the pancreas of turkey, [24] in ducks, [16] in the pancreas of pigeons, and [26] in Japanese Quail and Cattle Egret. Furthermore, this result disagrees with [32] reported the main ducts in geese were lined by single to stratified

layers of columnar epithelium, whereas [10] in the pancreas of geese found the main ducts were lined via stratified cuboidal to stratified columnar cells. The result of the present study of the main duct and ductal gland is correlated with [12] in ducks, [5] in the pancreas of geese, [29] in falcons, [10] in geese, and [26] in Cattle egret. Those researchers detected that the ductal gland is found in these birds. Also, this result is similar to [28] in Japanese quail, [13] in turkeys, and [11] in pigeons, who reported the ductal gland is not found in these birds.

Table (1): Measurements of the thickness of capsule, diameter of acini, and height of the acinar cells in local male mature ducks and turkeys.

Pancreatic Measurements (Mean ± SD)	Duck	Turkey
Thickness of capsules	A 8.32 ± 0.81µm	B 16.53 ± 1.34 µm
Diameter of acini	A 23.55 ± 1.03 µm	B 35.21 ± 2.21 µm
Height of acinar cells	A 10.27 ± 1.35 µm	B 13.85 ± 1.32 µm

* The different letters (A, B) in the same raw indicated that there were significant differences between local male mature ducks and turkeys at ($p \leq 0.05$).

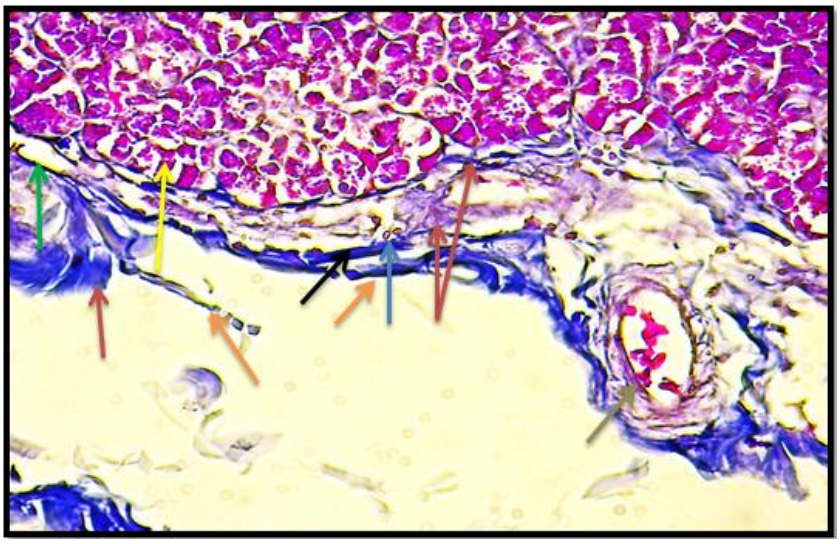

Figure (1): A cross-section of the duck pancreas shows connective tissue capsule and septa. Capsule (black arrow). Pancreatic parenchyma (yellow arrow). Mesothelial layer (orange arrow). Connective tissue septa (green arrow). Connective tissue fibers (red arrow). Fibroblast (blue arrow). Blood vessels (brown arrow). Masson trichrome stain. (200X).

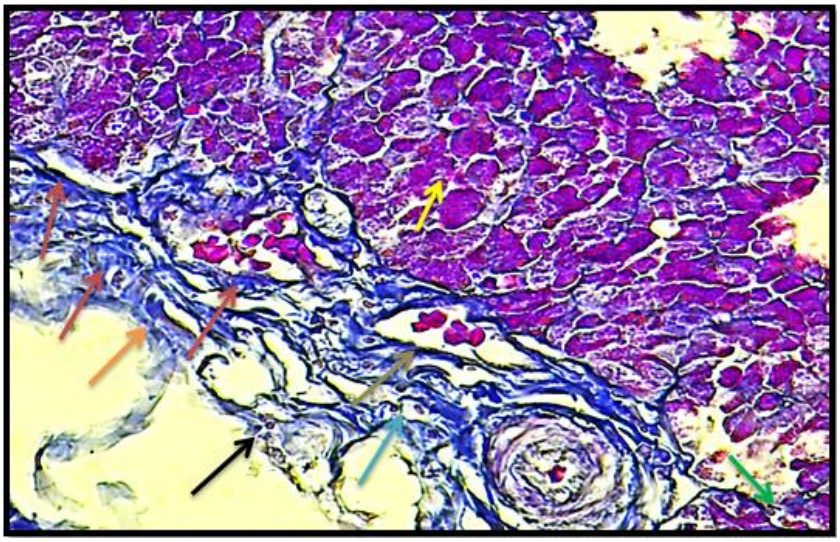

Figure (2): A cross-section of the turkey pancreas shows connective tissue capsule and septa. Capsule (black arrow). Pancreatic parenchyma (yellow arrow). Mesothelial layer (orange arrow). Connective tissue septa (green arrow). Connective tissue fibers (red arrow). Fibroblast (blue arrow). Blood vessels (brown arrow). Masson trichrome stain. (200X).

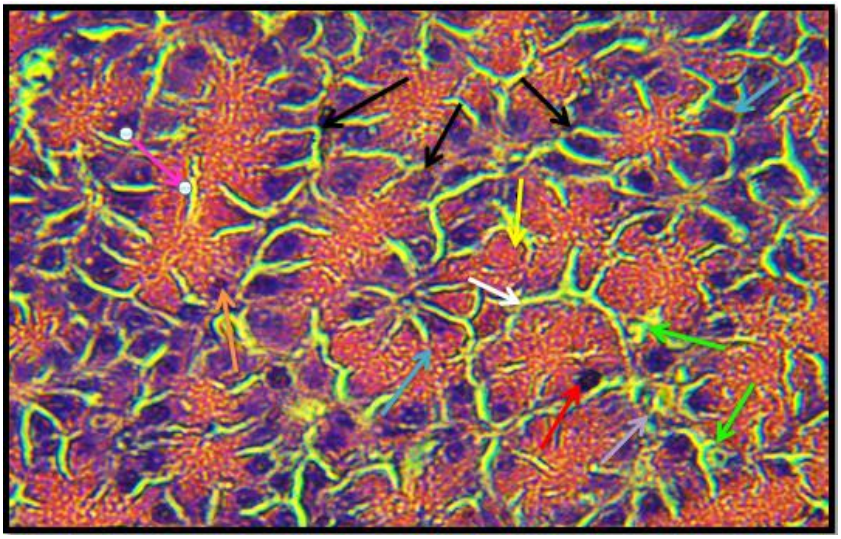

Figure (3): A cross-section of the duck pancreas shows the acini tissue. Acinus (black arrow). Acinar cell (blue arrow). Nucleus of acinar cells (red arrow). Nucleolus of acinar cells (orange arrow). Zymogen granules (yellow arrow). Basement membrane (white arrow). Centro aciner cells (green arrow). Acinus lumen (pink arrow). Intercalated duct (violet arrow). H&E stain. (400X).

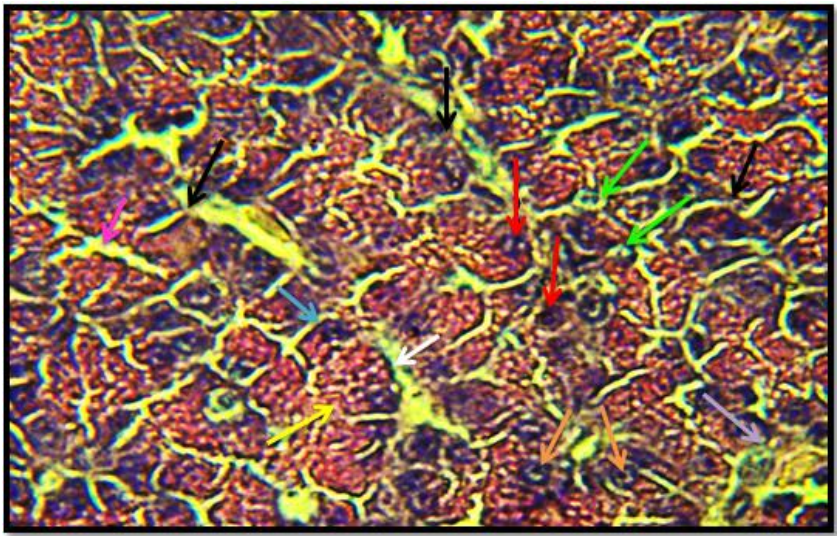

Figure (4): A cross-section of the turkey pancreas shows the acini tissue. Acinus (black arrow). Acinar cell (blue arrow). Nucleus of acinar cells (red arrow). Nucleolus of acinar cells (orange arrow). Zymogen granules (yellow arrow). Basement membrane (white arrow). Centro aciner cells (green arrow). Acinus lumen (pink arrow). Intercalated duct (violet arrow). H&E stain. (400X).

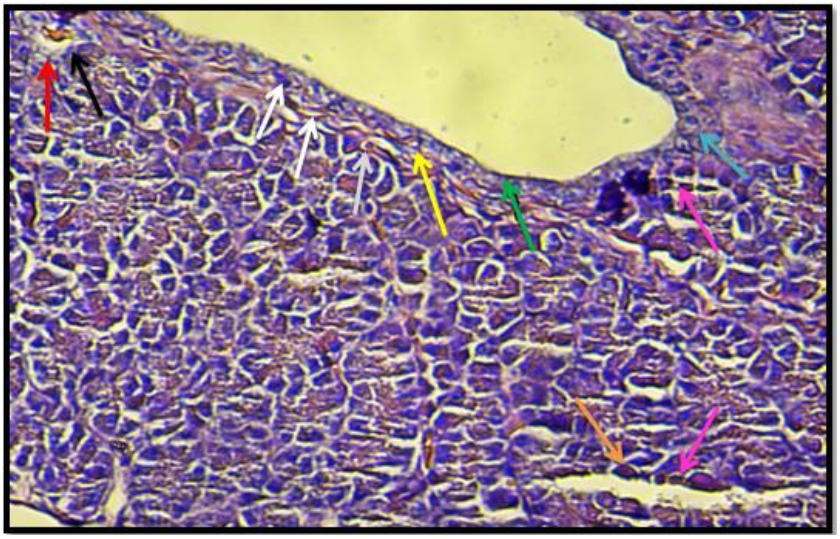

Figure (5): A cross-section of duck pancreas. Intercalated duct (black arrow). Simple squamous epithelium (red arrow). Intralobular duct (pink arrow). Simple cuboidal epithelium (orange arrow). Interlobular duct (green arrow). Simple columnar epithelium (blue arrow). Smooth muscle fiber (yellow arrow). Connective tissue fibers (white arrow). Fibroblast (gray arrow). PAS stain. (200X).

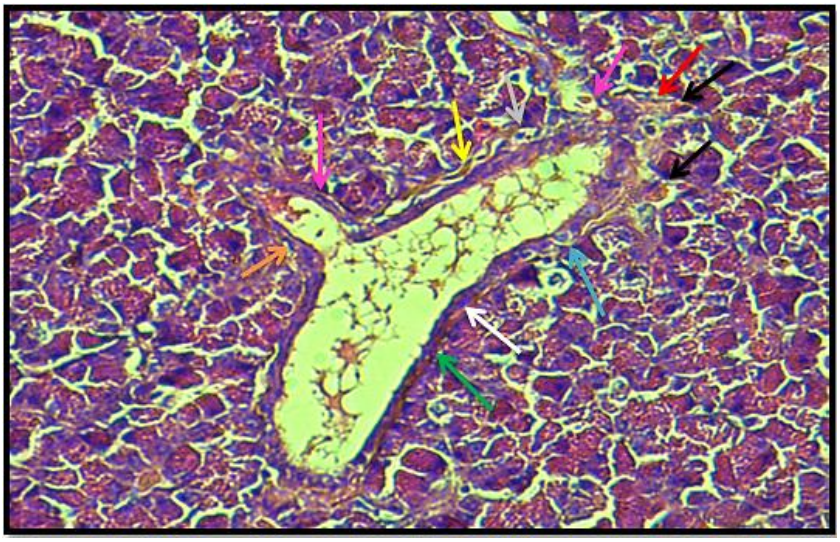

Figure (6): A cross-section of turkey pancreas. Intercalated duct (black arrow). Simple squamous epithelium (red arrow). Intralobular duct (pink arrow). Simple cuboidal epithelium (orange arrow). Interlobular duct (green arrow). Simple columnar epithelium (blue arrow). Smooth muscle fiber (yellow arrow). Connective tissue fibers (white arrow). Fibroblast (gray arrow). H&E stain. (200X).

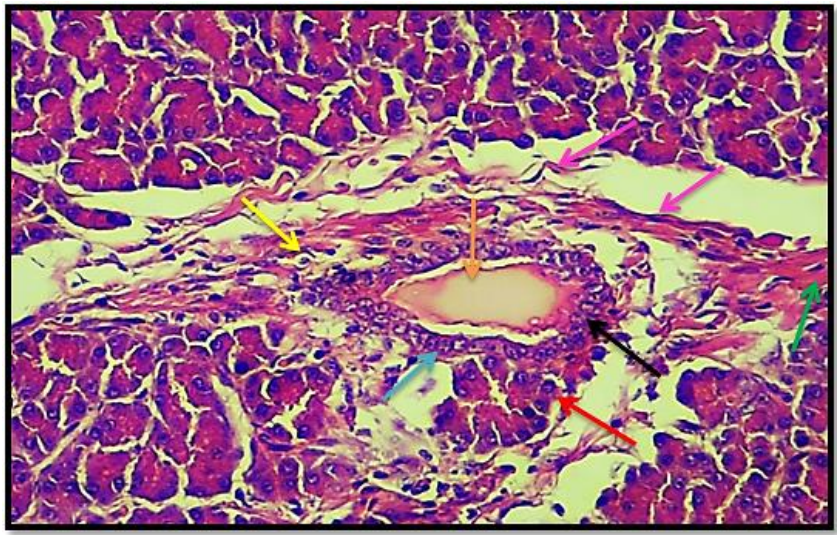

Figure (7): A cross-section of the main duct in duck pancreas. Main duct (black arrow). Simple columnar epithelium (blue arrow). Ductal gland (red arrow). Fibroblast (yellow arrow). Smooth muscle fibers (pink arrow). Connective tissue fibers (green arrow). Lumen of the main duct (orange arrow). H&E stain. (200X).

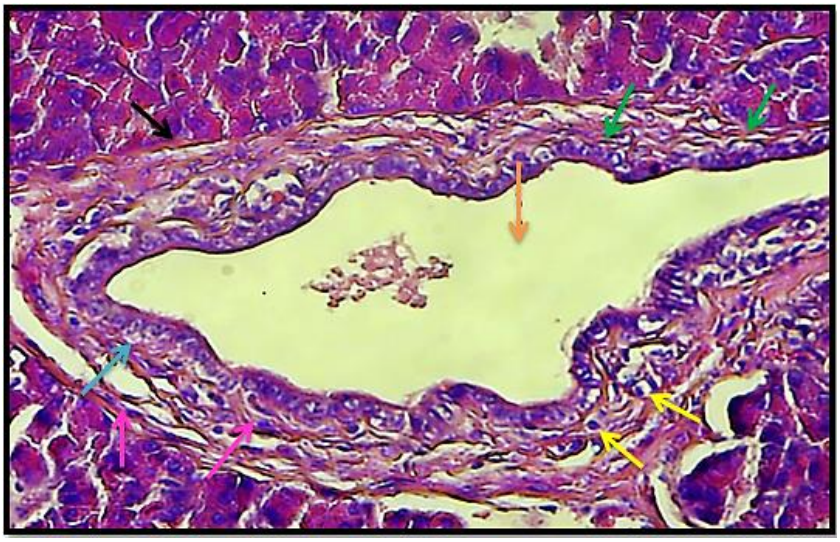

Figure (8): A cross-section of the main duct in the turkey pancreas. Main duct (black arrow). Simple columnar epithelium (blue arrow). Fibroblast (yellow arrow). Smooth muscle fibers (pink arrow). Connective tissue fibers (green arrow). Lumen of the main duct (orange arrow). H&E stain. (200X).

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