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Histomorphological and histochemical studies on the pancreatic duct in guinea fowl (*Numida meleagris*)

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Abstract
The aim of this study was to characterise the pancreatic ducts of twelve guinea fowl (*Numida meliagris*) birds in terms of their histological structure and histochemical characteristics. *Tunica mucosa* of pancreatic duct has simple cuboidal epithelium and got altered as simple columnar epithelium from caudal to cranial course. *Lamina propria* was surrounded by equally proportionate inner longitudinal and outer circular muscle fibers. *Tunica adventitia* was also observed. The collagen fibers were observed at mucus and *Tunica adventitia*. Histochemically the pancreatic duct was shown the mild activity of PAS for glycogen at epithelium and *Tunica adventitia*. Pancreatic duct has not shown any activity for acid phosphatases at any regional morphological component. The mucous and *Tunica mucosa* were showing mild positive activity for alkaline phosphatases.

Keywords: Pancreatic duct, histology, histochemistry, guinea fowl

Introduction
The guinea fowl (*Numida meliagris*) is a domesticated bird that got its name from the West African region of Guinea where it first appeared. The pancreas of vertebrates is generally understood to be divided into two regions: an exocrine portion, and an endocrine portion. In all birds the pancreas is positioned on the right side of the abdominal cavity (Hamodi *et al.* 2013) [2]. The Pancreatic ducts are conduit between pancreas and duodenum. There are two types of pancreatic ducts: the major pancreatic duct and the minor pancreatic duct. At the ascending duodenum, these ducts were open close to the cystic duct and common hepatic duct of the biliary apparatus. When viewed from the side, the opening of the major pancreatic duct, or duct of Wirsung, was found directly above the opening of the common hepatic duct. Just below the opening of the cystic duct on the lateral side, the minor pancreatic duct was also visible. (Purushottam *et al.* 2020) [5]. The sphincter of Oddi (SO), which varies depending on the species, facilitates the flow of bile produced in the hepatocytes of the liver and pancreatic juice into the duodenum. The cystic duct and common hepatic duct is the part of biliary apparatus, which served as a conduit between the liver and duodenum (Purushottam *et al.* 2020) [5]. Therefore, this important role performing but somewhat neglected *viz*. pancreatic duct requires to be studied for its different components on histomorphological and histochemical parameter which are being undertaken in guinea fowl (*Numida meleagris*).

Materials and Methods
The samples were collected from a poultry farm, which is located in Udaipur, Rajasthan. Twelve samples of pancreatic duct have been collected from guinea fowl (*Numida meleagris*) birds. After routine desired investigative process different tissues of pancreatic duct were collected and processed for further studies. Different fixatives and processes for light microscopy were used as per Singh and Sulochana (1996) [6]. Paraffin sections were stained by haematoxylin and eosin method, and elastic fibres by Weigert's method (Singh and Sulochana, 1996) [6]. For Histochemical study, fresh and paraffin processed samples were studied as per Luna (1960) [3], and Bancroft and Cook (1994) [1]. The samples were fixed in 10% buffered neutral formalin or 80% Alcohol or Acetone. McManus's method for glycogen (PAS), Gomori's method for acid phosphatise and Gomori's Cobalt method for alkaline phosphatise were used.

Results and Discussion

Pancreatic duct is to carry pancreatic juice into duodenum which produces by the pancreas. It supports the process of digestion. The pancreas is generally situated into duodenal loop and as the longitudinal strip it is located maximum upto the level of caudal end of fundus of gall bladder. But in the rare scene it was observed upto the level of cranial end of body of gall bladder. The *Lumen* of pancreatic duct is seen like star shaped.

Number of pancreatic ducts was also observed with varied number. Their serial sections were studied which has shown simple cuboidal epithelium and got altered as simple columnar epithelium from caudal to cranial course. *Lamina propria* has also seen which was surrounded by equally proportionate inner longitudinal and outer circular muscle fibers. *Tunica adventitia* was also noticed there (Fig. 1, 2 and 3). The collagen fibers were observed at mucus and *Tunica adventitia* while both the fibers were discovered intermixed at other structural components (Fig. 4).

The microscopical findings in present studies pertaining to pancreatic duct were in conformity with the findings of McMinn and Kugler (1961) [4] who had studied pancreatic ducts in mouse, hamster, rat, guinea-pig, cat, dog and Rhesus monkey. The present studies were showing epithelial cells altering from simple cuboidal to simple columnar during its course from caudal to cranial. These findings were shown the support towards functional ability and morphological requirement of pancreatic duct from its caudal to cranial course.

Histochemically the pancreatic duct has shown the mild activity at epithelium and *Tunica adventitia* while stained with PAS for glycogen (Fig. 5). The observations were cohesive with the functional aspect and the source of energy necessitated during performance of pancreatic duct. The mild positive activity for alkaline phosphatases was located at mucous and *Tunica mucosa* but the pancreatic duct has not shown any activity for acid phosphatases at any regional morphological component (Fig. 6 and 7). These findings were encouraging when illustration being thought for the functional continuance of pancreatic duct for digestion.

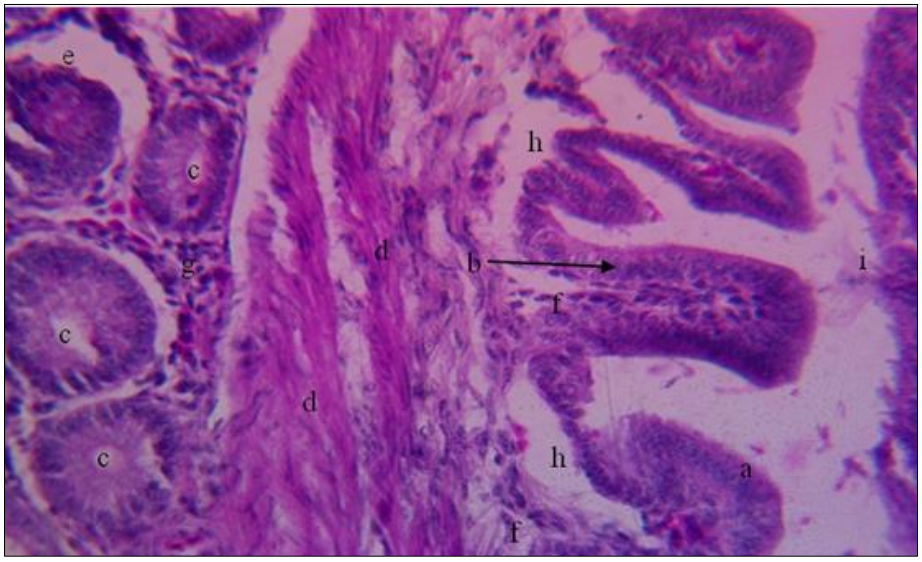

Fig 1: Photomicrograph is showing wall of pancreatic duct at intramural portion. a. *Tunica mucosa*, b. Columnar cells, c. Duodenal glands, d. Smooth muscle, e. Duodenum, f. *Lamina propria*, g. *Lamina propria*, h. Lymphatic vessels and i. Pancreatic duct *Lumen*. Haematoxylin and Eosin 400X

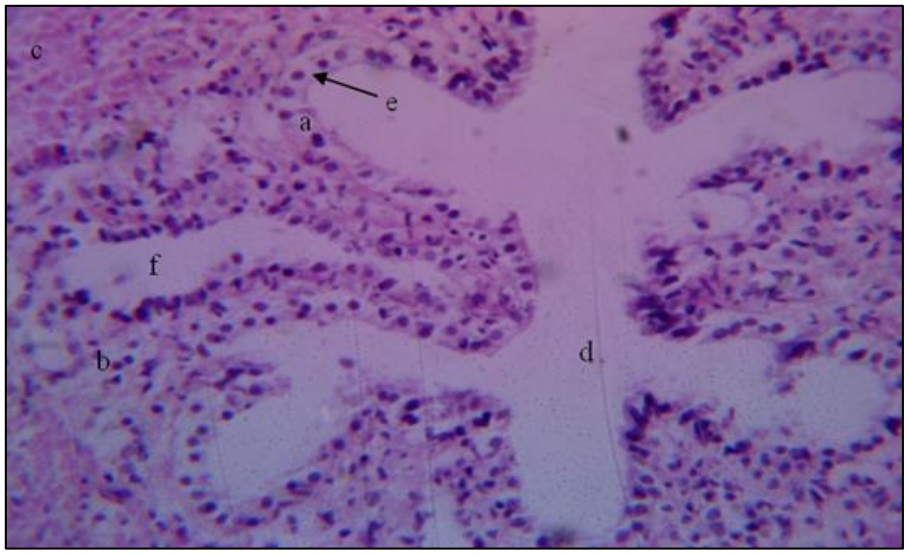

Fig 2: Photomicrograph is showing wall of the pancreatic duct. a. *Tunica mucosa*, b. *Lamina propria*, c. *Tunica muscularis*, d. *Lumen*, e. Simple cuboidal epithelium and f. Diverticulum or Crypt. Haematoxylin and Eosin 400X

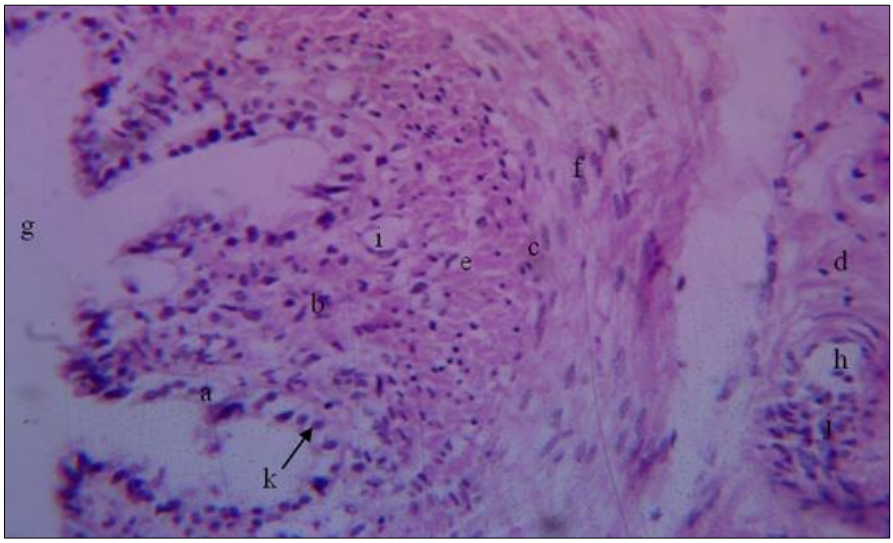

Fig 3: Photomicrograph is showing wall of the pancreatic duct. a. *Tunica mucosa*, b. *Lamina propria*, c. *Tunica muscularis*, d. *Tunica adventitia*, e. Inner longitudinal f. Outer circular, g. *Lumen*, h. Blood vessel, i. Lymph vessel, J. Lymphoid aggregation and k. Simple cuboidal epithelium. Haematoxylin and Eosin 400X

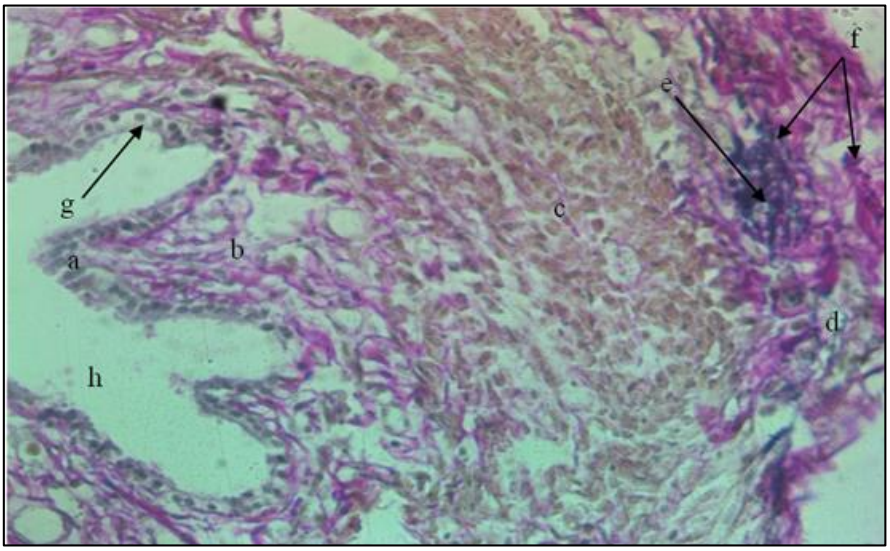

Fig 4: Photomicrograph is showing elastic and collagen fibers in the wall of pancreatic duct. a. *Tunica mucosa*, b. *Lamina propria*, c. *Tunica muscularis*, d. *Tunica adventitia*, e. Capillary, f. Collagen and Elastic fibers, g. Simple cuboidal epithelium and h. *Lumen*. Weigert's Method 400X

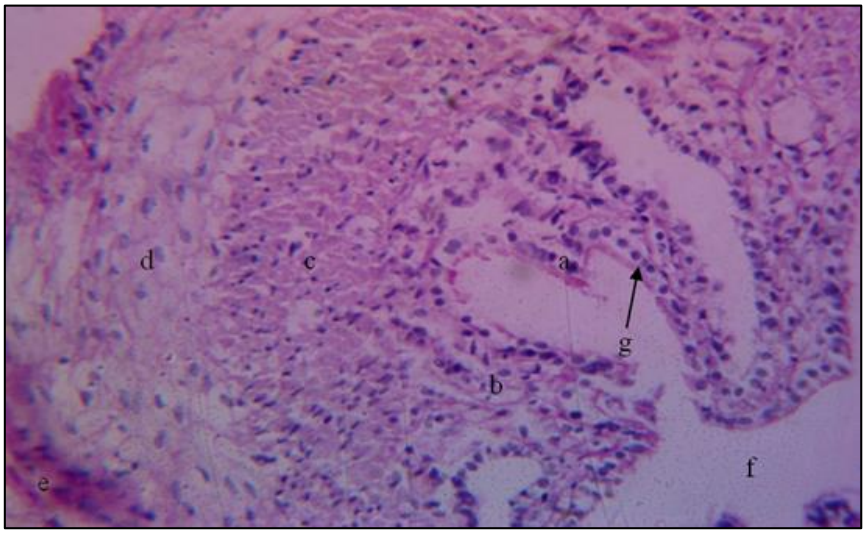

Fig 5: Photomicrograph is showing the PAS activity in the wall pancreatic duct at the caudal end of biliary apparatus. a. *Tunica mucosa*, b. *Lamina propria*, c. Inner longitudinal, d. Outer circular, e. *Tunica adventitia*, f. *Lumen* and g. Simple cuboidal epithelium. Periodic Acid Schiff 400X

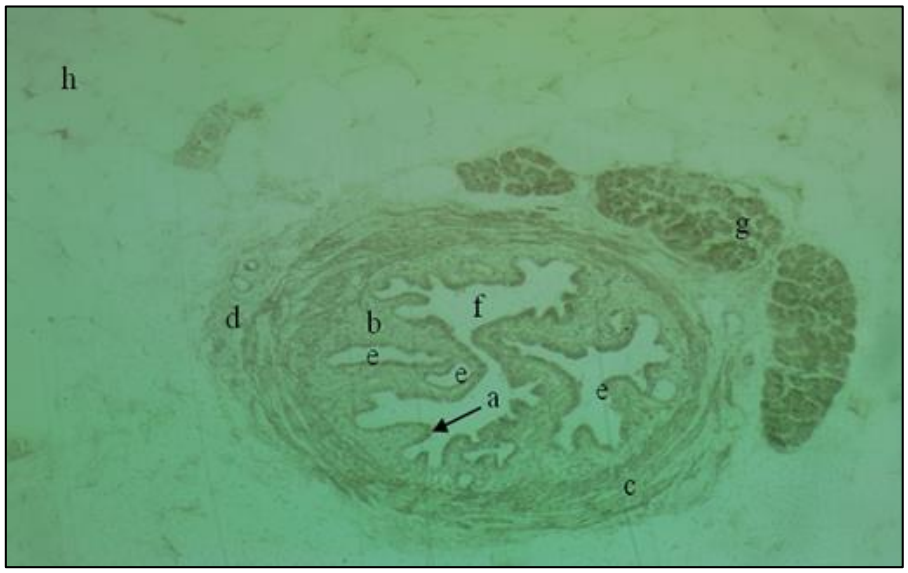

Fig 6: Photomicrograph is showing alkaline phosphates activity at the wall of pancreatic duct. a. *Tunica mucosa* or mucous, b. *Lamina propria*, c. *Tunica muscularis*, d. *Tunica adventitia*, e. Diverticulum or Crypt, f. *Lumen*, g. Pancreas and h. Adipose tissue. Alkaline Phosphates 100X

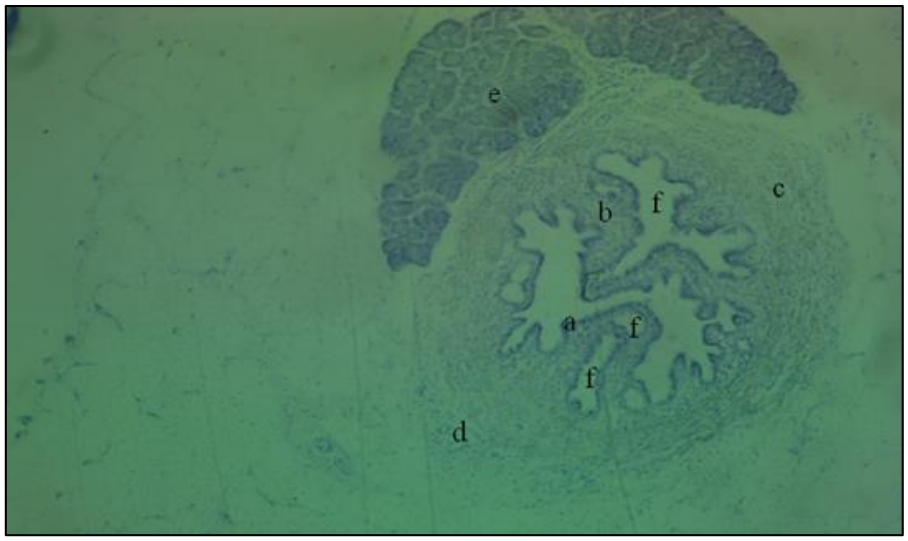

Fig 7: Photomicrograph is showing acid phosphates activity in the wall pancreatic duct at the caudal end of biliary apparatus. a. *Tunica mucosa*, b. *Lamina propria*, c. *Tunica muscularis*, d. *Tunica adventitia*, e. Pancreas and f. Diverticulum or crypt. Acid Phosphates 100X

Conclusion

Pancreatic duct has shown simple cuboidal epithelium which is altered as simple columnar epithelium from caudal to cranial course. The *Lamina propria* of pancreatic duct has also seen surrounded by equally proportionate inner longitudinal and outer circular muscle fibers. *Tunica adventitia* is also noticed there. The collagen fibers are observed at mucous and *Tunica adventitia* while both the fibers are discovered intermixed at other structural components. The mild positive activity for glycogen is noticed at epithelium and *Tunica adventitia*. The mild positive activity of alkaline phosphatases is located at mucous and *Tunica mucosa* while no activity is noticed by acid phosphatases.

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