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Histological Study of Small Intestine in the Adult Guinea Fowl (Numida Meleagris)

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Abstract: Due to the importance of small intestine and its important role of the digestion and absorption process, as well as the economic importance of guinea fowl (Numida meleagris). The current investigate was conducted to study the segments of small intestine (Duodenum, Jejunum, and Ilium) histologically in guinea fowl. Samples were taken from the small intestine of (10) healthy adult males of guinea fowl after slaughtering them and separating the small intestinal from its appendages. All samples were subjected to histological techniques. In the current study, three kinds of stains were used when conducting the histological study, which are, Heamatoxylin and Eosin stain, the Masson trichrome stain and Periodic Acid-Schiff stain. From inner to outer, the wall of small intestine was lined with four tunicae: Mucosa, Submucosa, Muscularis, and Serosa. The small intestine's mucosa was flung into villi, which are protrusion. Columnar and goblet cells lined the various sections of the small intestine, which had varying small intestinal villi in terms of structure and arrangement. The intensity of Goblet cells were increment

from Duodenum to Ileum. The Lamina propria, which comprised cells and connective tissue fibers, made up the majority of the villus' core. It was nearly impossible to distinguish the thin, poorly developed submucosa from the muscularis externa underneath it, unless when there were big blood vessels present. There are no Brunner glands visible in the intestinal submucosa. Tunica muscularis appeared as longitudinal smooth muscle bundles on the outside and inner circular muscle bundles on the inside. Collagen fibers made up the majority of tunica serosa with blood vessels and adipose tissue.

Keywords: Guinea fowl, Small intestine, Duodenum, Jejunum, Ileum, Histology.

Introduction

The helmeted Guinea fowl (*Numida meleagris*) is a Galliformes order and Numididae family member and gets its name from the Guinea region of West Africa, where it originally appeared (Al-Shadeedi, 2020). Guinea fowls are highly prized for their meat and eggs, and they are also more disease-resistant than most birds (Zvakare *et al*, 2017). Guinea fowl makes a contribution significantly to rural households by providing a source of animal protein (egg and meat), income generation from the sale of birds and eggs, and so enhancing food security and, as a result, poverty reduction among rural communities (Kouassi *et al*., 2019). They are used for both revenue and protein. They have lower cholesterol levels and produce more edible meat than chicken. Both the eggs and the meat are delectable, and the thicker shells of the eggs allow for longer storage and handling with fewer breakage (Dei *et al*.,2007). The common guinea fowl diet includes seeds, grass, fruits, berries, insects, worms, frogs and molluscs (Moreky, 2009). The digestive system histology and anatomy of domestic birds are quite different from those of mammals. Furthermore, the feeding habits of different bird species result in a variety of anatomical changes (Karadağ and Nur, 2002; Elsheikh and Al-Zahaby, 2014). The small intestine of birds is crucial to much of digesting and absorption process (McLelland, 1979). Its contents are mixed with the pancreatic and bile juice, and the mucosal secretions of the mucosa (Ganong, 2003). The small intestine begins at the pylorus proventriculus and ends at the ileocaecal junction. As in mammal animals the small intestine composed of unequal three segments named duodenum, jejunum and ileum. There is no demarcation between them (Rahman *et al*., 2003). But, in carnivorous birds, the small intestine is shorter than that in herbivorous (Whittow, 2000). Anatomically and functionally of the small intestine are more variable than the anterior digestive organs probably due to the diverse physical nature of different foods (Klasing, 1999). The initiation of the small intestine was from the pyloric end of stomach to the junction with the large intestine. The small intestine is the

heaviest structure within the gastrointestinal tract and are located near the bird's center of gravity within the abdominal cavity (Nasrin *et al*, 2012). In mammals and birds, the small intestine is one organ and the main site of nutrient absorption (Lavin *et al*,2010). The ability of the animal to digest and absorb ingested macromolecules determines its growth, and any restriction of this is anticipated to limit growth (Liu *et al*, 2010).Therefore this present study aimed to explore histological of the small intestine of guinea fowl.

Material and Methods

In this study were used ten healthy adult male guinea fowl (*Numida meleagris*) specimens that collected from Al-Haay city market in Wasit and kept for a week under normal conditions and with healthy nutrition appropriate to the nature of these birds feeding to ensure that they are completely free of diseases. These birds were slaughtered and the small intestine was immediately eliminated from the bird's abdominal cavity after a longitudinal fissure. The parts of small intestine were detached and cleaned in 0.9% normal saline. These specimens were fixed in 10% formalin for 24 hours, then, these samples were washed and dried with an ethanol concentration gradient series. Following that, the specimens were rinsed with xylene, infiltrated, and embedded in paraffin wax. The specimens were then cut to 5m lengths. The samples were stained using Hematoxylin and Eosin (H&E) stain, Periodic Acid-Schiff stain, and Masson trichrome stain. A digital camera was then used to take microphotographs of the sections after the slides had been examined under a light microscope.

Result and Discussions

The small intestine extends from the pyloric end of the stomach to the junction of the small intestine, caeca and colon. It is long and consists of a coiled mass forming a series of loops and lies within the abdominal cavity. The histological investigation of the entire small intestine (duodenum, jejunum, ileum) of the male guinea fowl showed the existence of four basis layers in its wall arranged from inner to outer, Mucosa, Submucosa, Muscularis and Serosa or Adventitia, as seen in (Figure 1). The results of current study are similar to the finding to Hamdi *et al* (2013) in black winged kite, Zaher *et al*.(2012) and Al-Bideri and Jawad (2015) in rock dove. The tunica mucosa of duodenum presented in a finger like villi covered by a simple columnar epithelium with little of goblet cells followed by lamina propria. The lamina propria, which are longitudinal bundles of smooth muscle fibers and blood vessels, filled the core of the villi. as illustrate in (Figure 2, 3, 6). This finding agreement with Khaleel *et al*.(2017) in Duck, Singh *et al*.(2017) in guinea fowl and Kushch (2019)in Goose. The muscularis mucosa was consisted of longitudinal smooth muscle bundles, as shown in (Figure, 6). This result of the current study is consistent with Zaher *et al*.(2012), Al-Taee (2017) in brown falcon and Zghair *et al*.(2019) in guinea fowl. Tunica mucosa of the duodenum characterized by the presence of intestinal glands and villi. Some villi resembled tall finger-like mucosal projections, while others resembled leaves, as illustrate in (Figure 1, 6), This finding identical with Mohamed and Hassasn (2008) in broiler chicks.

Mucosa of the jejunum and ileum was distinguished by diverse size and shapes, such as a leaf-like projection, zigzag pattern, or blunt or pointy apical end with large basal part, as illustrate in (Figure, 9, 14) and they seem as a wider or shorter than that of that spotted in the duodenum as found by Al-Saffar and Al-Samawy (2016), Moreki (2009) in owl and ostrich and Zghair *et al*.(2019) in guinea fowl.

The mucosa of the small intestine displayed villi in whole segments that differed in size and shape as seen in (Figure, 4, 9, 14). This result agreement with Iji *et al*, (2001) in chicken. In all segments of the small intestine and glands, the epithelium of villi was lined by a single layer of columnar cells, each of which had an oval to elongated nucleus at the base of the cell. The free borders of these cells with brush border, as shown in (Figure 3, 11, 15). In between columnar cells, typical goblet cells were observed which increased in its density from the duodenum toward the ileum, as illustrate in (Figure 2, 11, 15). Because these cells had a brush border, their free borders were striated as stated in a previous study by Iji *et al* (2001) in broiler chicks, Ahmad *et al*, (2012) and

Zghair *et al*. (2019) in guinea fowl. The base of the villi had a small tubular intestinal gland that opened between the bases of the villi. Simple columnar cells and goblet cells made up the layer of epithelium that lined these glands and covered the villi, as seen in (Figure, 2 ,11 , 14), this result is in accordance with the finding of AL Sheshani, (2006) in Accipiter nisus Linnaeus. Lamina propria of all segments of the small intestine was composed of cellular connective tissue, smooth muscle fibers, abundant capillaries and with a few collagen fires, as shows in (Figure 6 , 12, 14), this finding agreement with Kalita and Singh(2010) in Kadakanath fowl and Singh *et al*.(2017) in guinea fowl. The muscularis mucosa was organized in single a longitudinal layer of smooth muscle fibers as seen in (Figure 6, 10, 12), this study is identical to a previous study by Fitzgerald, (1969) in quails, Dawood (2013) in duck and kadaknat fowl and Kalita *et al*. (2012) in fowl. Whereas, in contrary to Igwebuike and Eze, (2010) in African pied crow, as reported that the muscularis mucosa was absent. Beneath the mucosa, there was the tunica submucosa, which consisted of a thin layer of loose connective tissue contained blood vessels, as illustrates in (Figure 6, 10, 13), this result is similar to the result of Hodges (1974) in fowl, (Kachave, 2009) in broiler and (Al-Samawy, 2015) in pigeon, however, this layer emerged as a thick layer in the mallard and owl, which were different. The mean thickness of submucosa was lesser than that noticed by Al-Samawy (2015) in domestic pigeon, Al-Saffar and Al-Samawy (2016) in owl and higher than registered by Rici *et al* (2012) in Blue and Yallow macaws, Dawood (2013) in indigenous duck and AlTaee (2017) in Brown falcon. The duodenal submucosa lack of a Brunner gland attests to the presence of collagen fibers, fatty tissue, and mesothelium-covered blood vessels, the current study identical to Khaleel and Atiea (2017) in Duck(*Anas platyrhynchos*), Singh *et al*.(2017) and Zghair *et al*.(2019) in guinea fowl.

Tunica muscularis in every small intestine segments consisted of two layers of smooth muscle fibers with the outside, thin longitudinal layer seeming thinner than the well-developed inner circular layer, as seen in (Figure 7, 9, 14). Also observed the presence of blood and lymphatic vessels in addition to a nerve plexus between the two layers, as showed in (Figure, 8). This muscular coat was made up of smooth muscle bundles arranged thinly on the outside longitudinally and thickly on the inside circularly. From the duodenum through the ileum, the tunica muscularis thickness seemed to decrease. But in fowl noted (Hodges,1974), the duodenum seemed to have a thicker tunica muscularis than the jejunum and ileum. Wherease, Sivakumar and Vijayaragavan (1989) stated that Japanese quail had thicker tunica muscularis from the duodenum to the ileum.

Tunica serosa showed as a thin layer of loose connective tissue contains a blood vessels, adipose tissue and collagen fibers covered by a single layer of squamous epithelium (mesothelium) as seen in (Figure 5), this result agree with Khaleel and Atiea (2017) in Duck(*Anas platyrhynchos*) and Zghair *et al*.(2019)in guinea fowl.

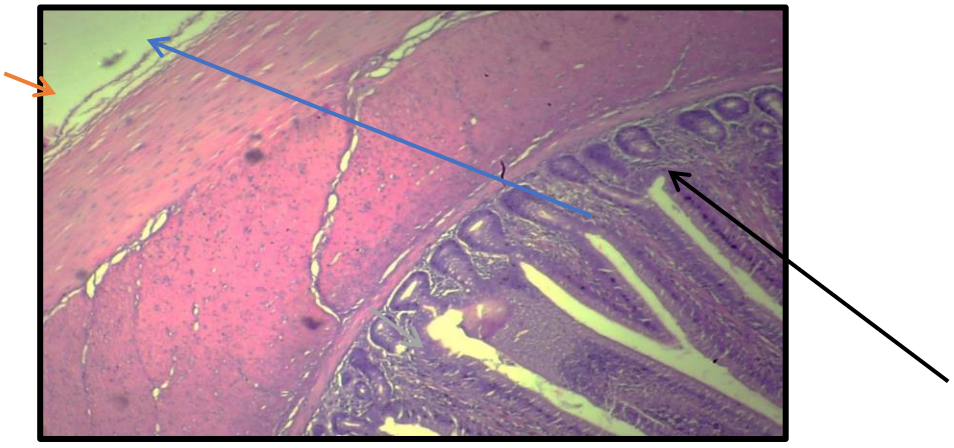


Fig. (1): Photomicroscope illustrates the segments of small Intestine in male guinea fowl: Tunica Mucosa (black arrow), Tunica Submucosa (green arrow),Tunica Muscularis(blue arrow) and Tunica serosa (red arrow). (H&E, X200)

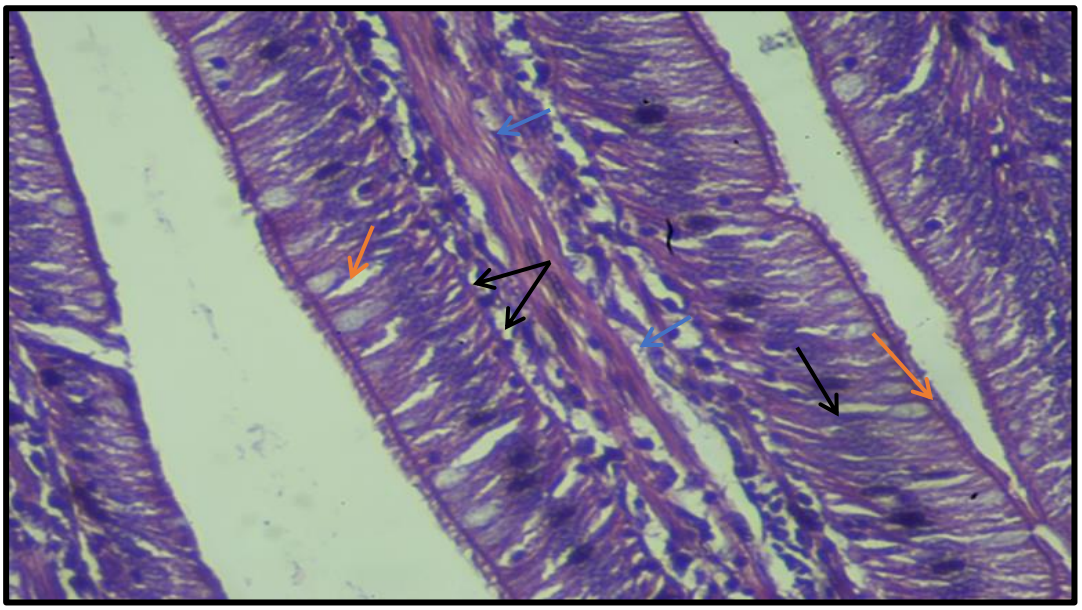


Fig. (2): Photomicroscope of the duodenum in male guinea fowl illustrates: Smooth muscle fibers (blue arrow), Simple Columnar Epithelium (black arrow) and Goblet cell(red arrow)(H& E, X 200)

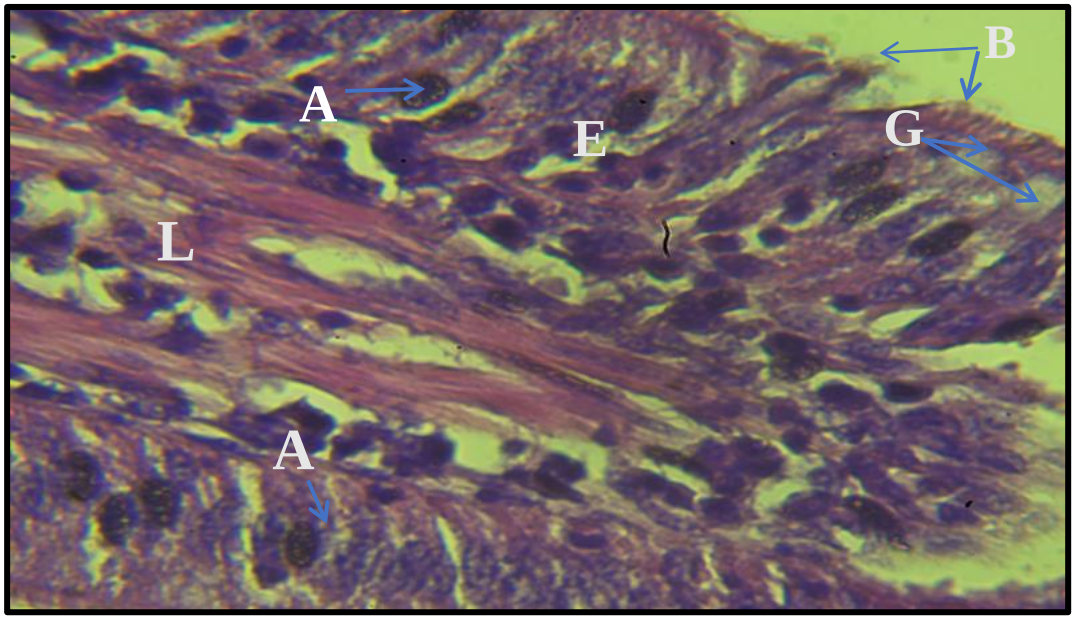


Fig. (3):Photomicroscope of duodenum illustrates: Simple Columnar epithelium I, Nucleus (A), Lamina propria (L), Goblet gland (G) and Brush border (B). (PAS, X400)

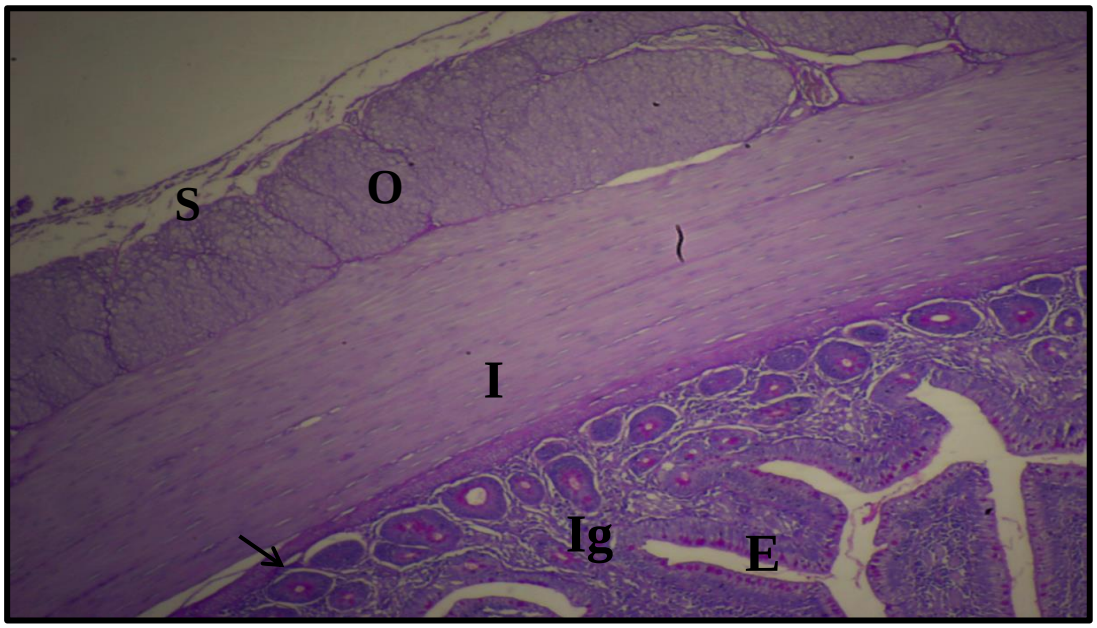


Fig. (4): Photomicroscope of cross section in duodenum illustrate: Inner circular(I), Outer Longitudinal(O), Serosa (S), Submucosa(black arrow), EpitheliumI and Intestinal glands(Ig). (PAS, X400)

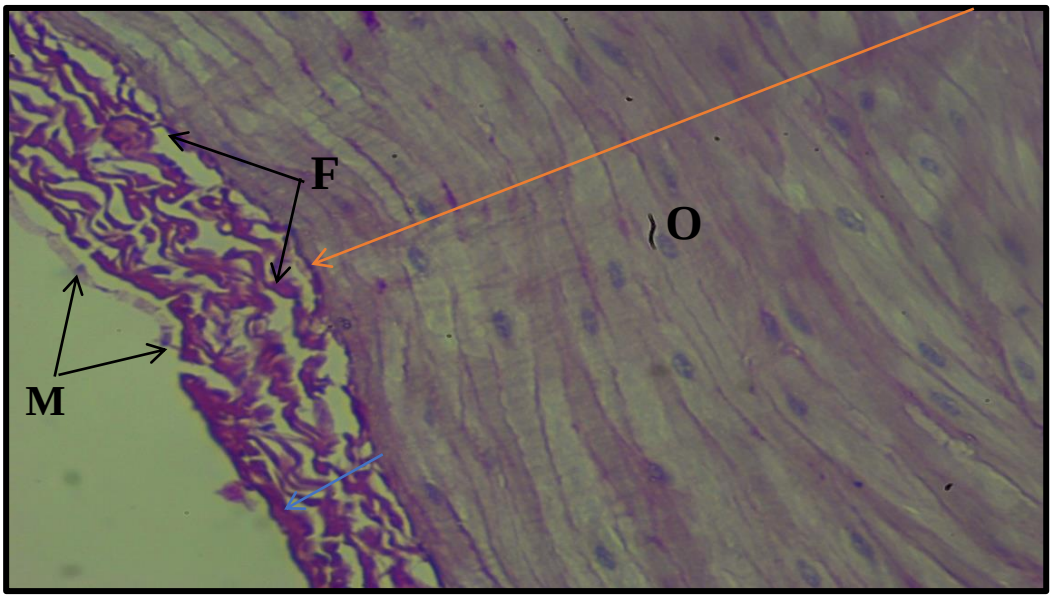


Fig. (5): Photomicroscope illustrate the structure of Serosa: M- Mesothelium, F- Collagen fibers, Serosa (blue arrow), Outer longitudinal (Muscularis extern). (H&E, X400)

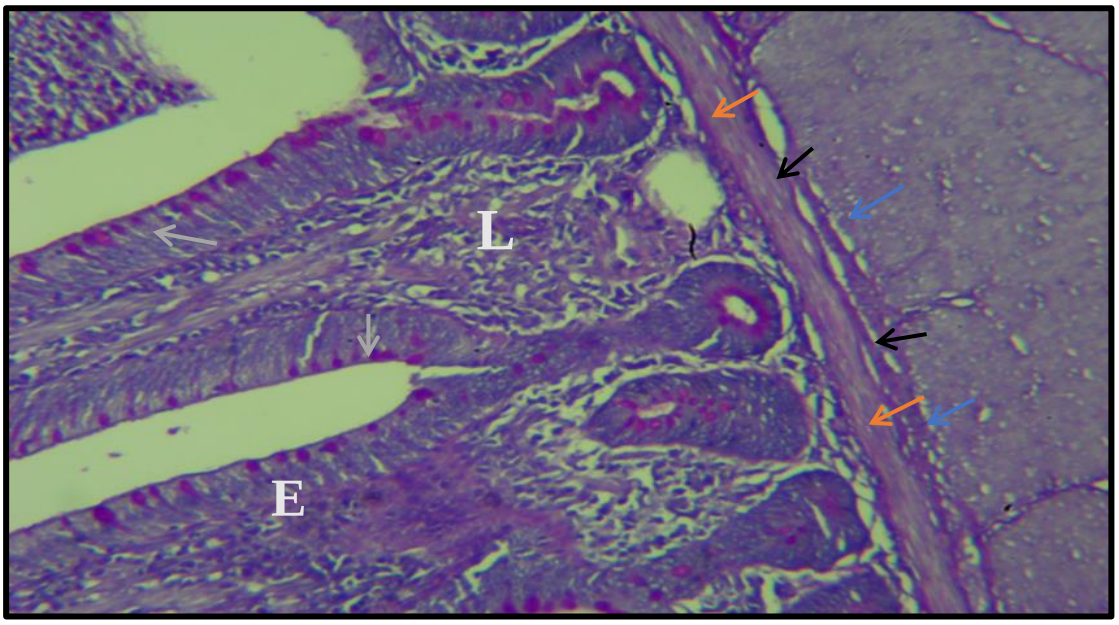


Fig. (6): Histological section of duodenum illustrates: Epithelium I , Lamina propria (L), Smooth muscle fibers (red arrow) , Muscularis mucosa (black arrow), Sub mucosa (blue arrow) and Goblet cell (green arrow). (PAS, X200)

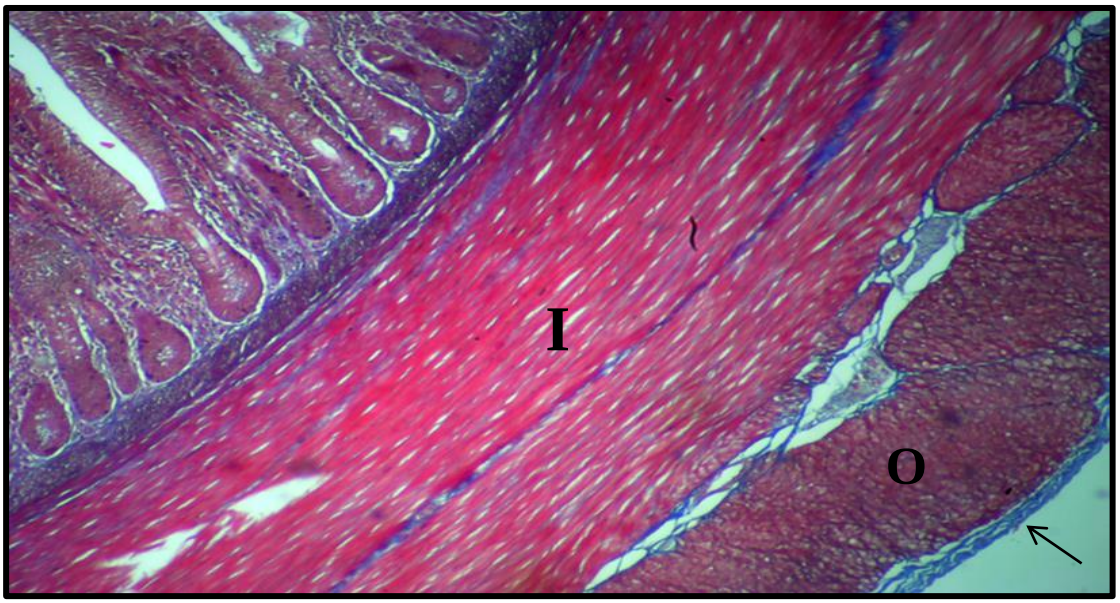


Fig. (7):Photomicroscope of cross section in duodenum illustrate: Serosa(black arrow), Inner circular(I), and Outer Longitudinal(O) (Masson,s Trichrom, X400)

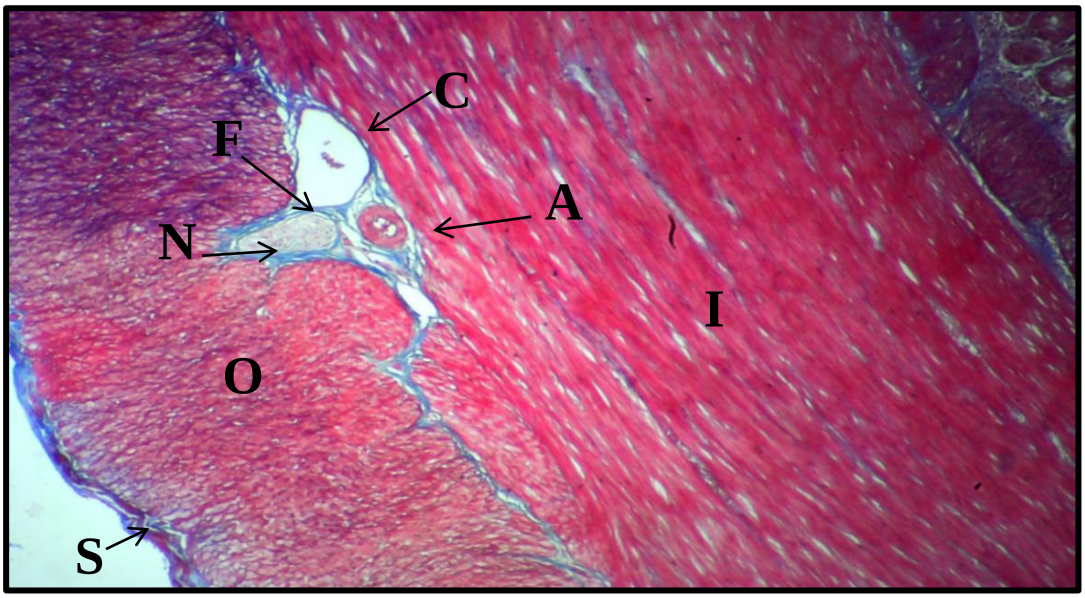


Fig.(8): Photomicroscope of cross section in duodenum: A-Blood vessels (artery), C- Blood vessels (vein), N- Nerve Plexus, F- Connective tissue fiber, I- Inner circular, O- Outer longitudinal and S- Serosa. (Masson,s Trichrom, X200)

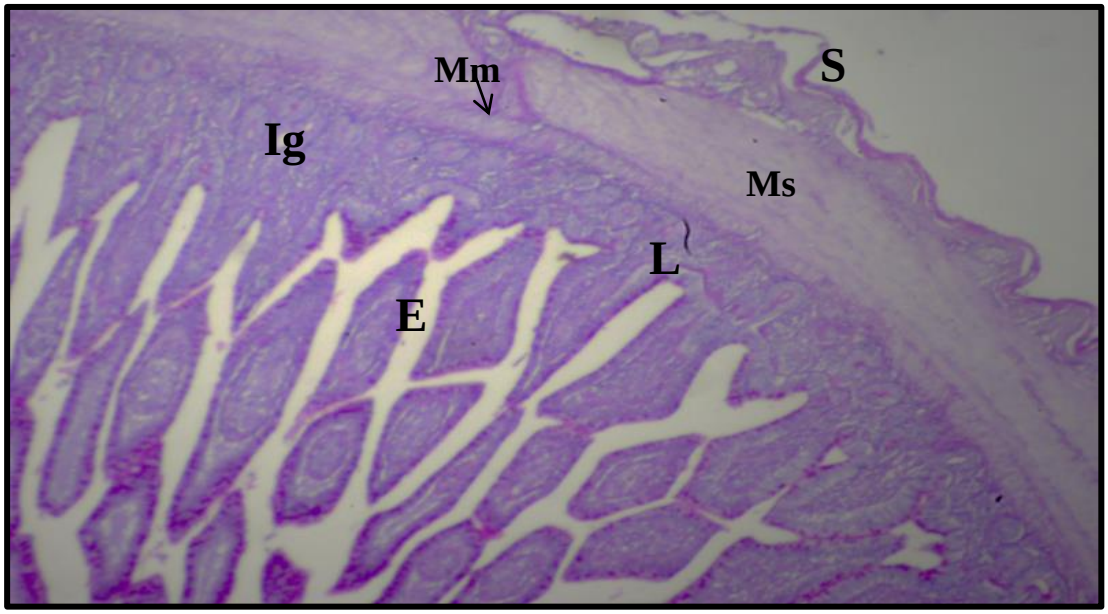


Fig. (9):Photomicroscope of jejunum illustrates section of leaf-like villi: Ig- Intestinal glands, E- Epithelium, L-Lamina propria, Mm- Muscularis mucosa, Ms-Muscularis,S-Serosa. (BAS, X100)

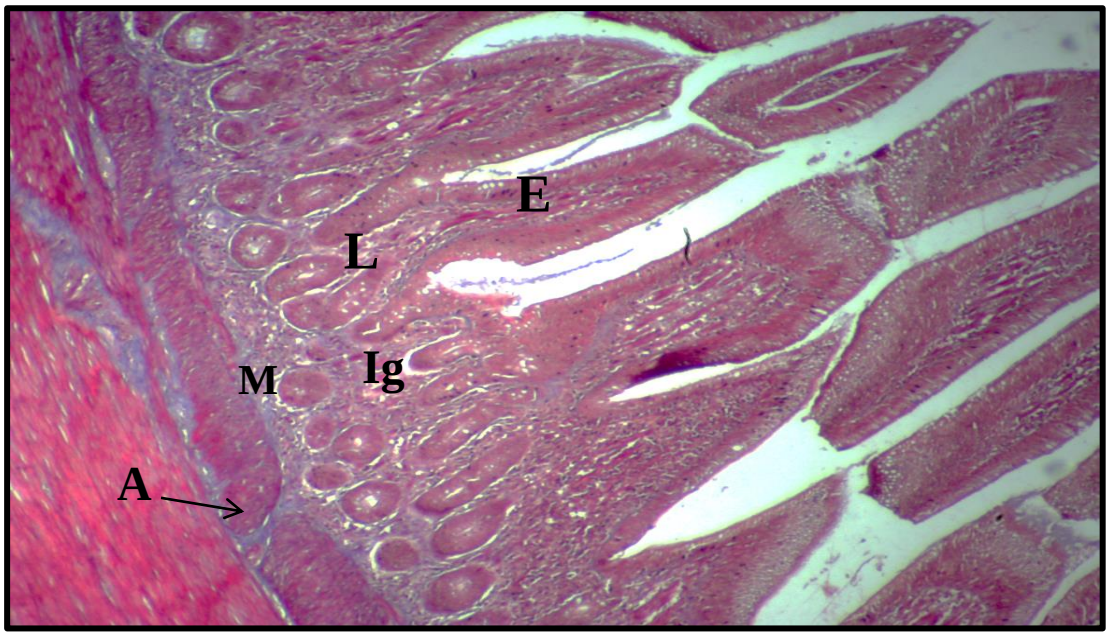


Fig. (10): Photomicroscope of jejunum illustrates: Epithelium I, Lamina propria (L), Intestinal glands (B), Musculsris mucosa (M) and Submucosa(A). (Masson,s Trichrom, X400)

Fig. (11):Photomicroscope of jejunum illustrates distribution of Goblet cell: Epithelium I, Lamina propria (L), Goblet glands (G), and N-Brush border. (PAS, X400)

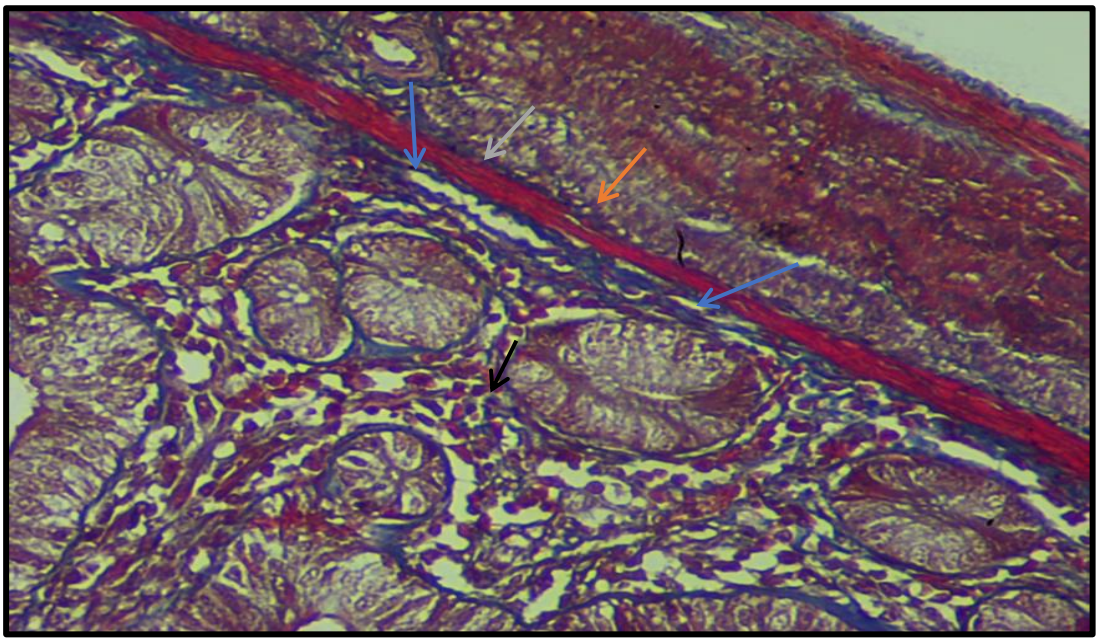


Fig. (12):Photomicroscope in ileum illustrate: Collagen fiber(blue arrow), Lamina propria (black arrow), Muscularis mucosa(green arrow) and Submucosa (red arrow). (Masson,s Trichrom, X200)

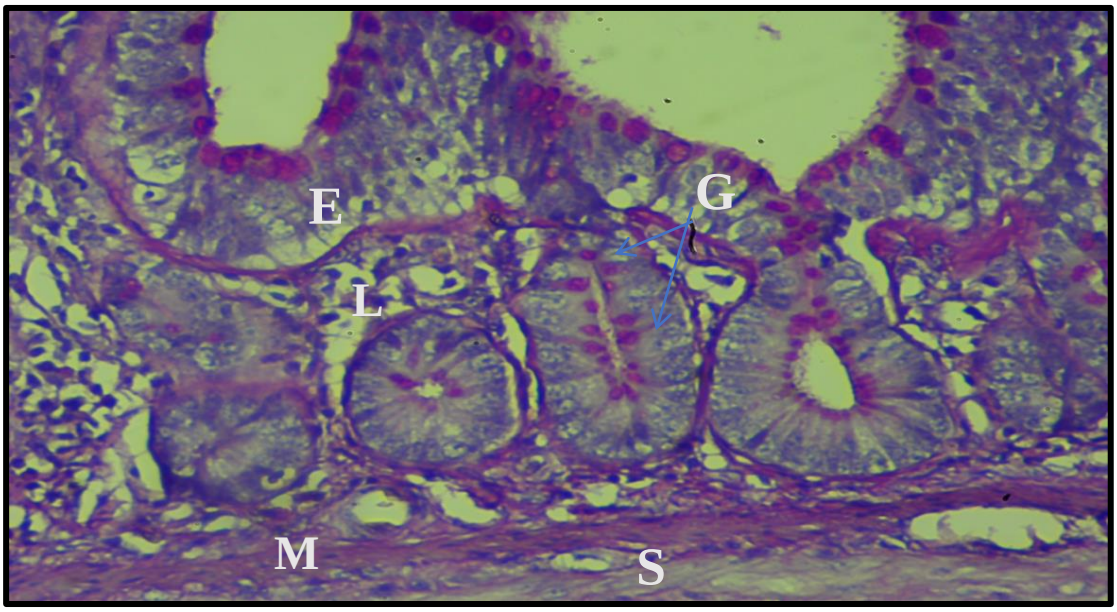
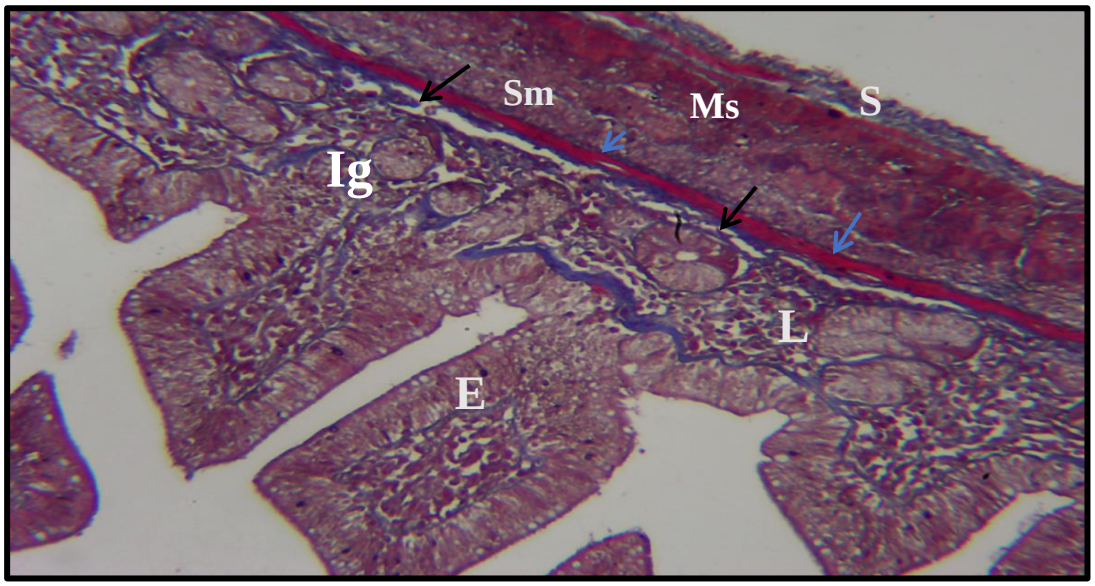


Fig. (13): Photomicroscope of ilium shows: E- Epithelium, L- Lamina propria, G- Goblet cells, M- Moscularis mucosa, S- Submucosa. (PAS, 200X)



Fig(14):Photomicroscope of ileum: E- Epithelium, L- Lamina propria, Collagen fibers (black arrow), Muscularis mucosa (blue arrow), Sm-Submucosa, Ms- Musculasis, S- Serosa and Ig- Intestinal glands. (Masson,s Trichram, X100)

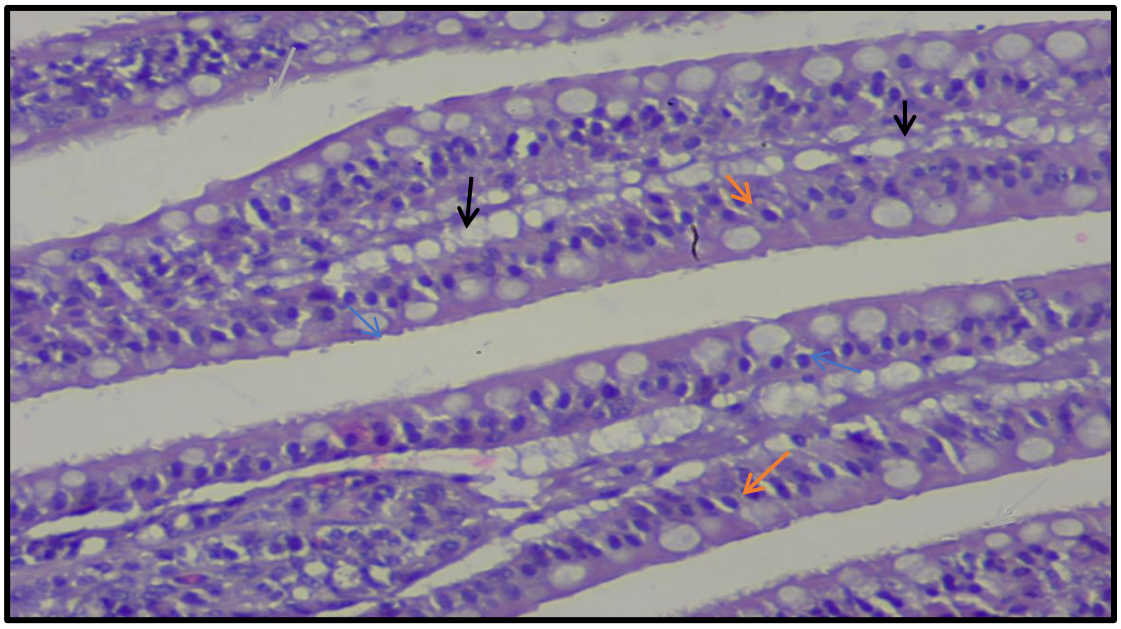


Figure (15):Photomicroscope of ileum: Simple Columnar epithelium(red arrow), Smooth muscle fibers(black arrow), Goblet cell(blue arrow), Brush border(green arrow). (H&E, X200)

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