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Histomorphological and histochemical study of small intestine of adult age of local pigeon *Columba livia*

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Abstract
Our study was aimed to morphological and histological results, so the study was included some special stains for histochemical study of adult age of local pigeon *Columba livia*. Six pigeons were sacrificed. The morphological study had three parts of the small intestine duodenum, jejunum and ileum. The duodenum was U-like to connect between gizzard and jejunum. Ascending and descending duodenum includes the pancreas. The jejunum was characterized coil tube and anastomosed at anteriorly with duodenum and caudally with ileum. Ileum was the last part of small intestine. Generally, the histological sections were included entire the small intestine. Light microscope showed histological structures to mucosa, submucosa, musculais and serosa. Mucosa was included long finger project is called villi. These finger structures were different in length during duodenum, jejunum and ileum. Where lengths of the duodenum were taller. So it's lined by simple columnar epithelia with basal nuclei. Either lamina properia was located under epithelia which it's characterized loose connective tissue and included intestinal glands with crypts of Lieberkuhn is lined by simple columnar cells. Muscularis layer was last tunica in mucosa, it's composed from longitudinal smooth muscles. Others tunica, submucosa was thin layer of dense connective tissue almost no obvious during histological sections. So tunica musculais was consisted of two orientations smooth bundles, first longitudinal orientation is outer while inner layer had been circular smooth fibers. Final tunica was serosa. The present study showed histochemical reaction between goblet cells, where it's appeared the periodic acid Schiff the mucin secretion of their cells is neutral positive reaction while alcian blue stain showed acidic positive reaction of the secreted goblet cells.

Keywords: Local pigeon, morphology, histochemical, small intestine

Introduction
The pigeon *Columba livia* are wide pervasion around the world. There are more than 8000 species [1]. The digestive and others systems are considered a sensitive parts to play role in birds life, where it's affected by have diet, if was treated by some chemical materials [2]. The birds have high metabolism therefor consume a lot of diet. These variations are occurred between the birds species according to the environmental changes [3]. The small intestine is composed from three portions, duodenum, jejunum and ileum. The duodenum is first part which it's connected anterior with gizzard and posterior extend to jejunum [4]. The small intestine is different between other birds species of the formation such as black-winged kite haveonly duodenum and ileum [5]. The parts of the small intestine are separated by diverticulum called vitellin (Meckel's) which spilt jejunum and ileum, the longest part of small intestine [6]. The duodenum has U-shaped loop in indigenous duck, and divided into descending and ascending limb [7]. The jejunum is the second part after the duodenum, it has a spiral coils structure (cone) in African pied crow. The cone is appeared centripetal and centrifugal parts from apex of cone [8]. Ileum is last part, it's started from end diverticulum toward the cecum. Histological features are included four tunics, mucosa, submucosa, muscularis and serosa. Light microscope showed that layers, so they are included epithelium, lamina properia and muscularis within mucosa layer. However, the mucosa of intestine glands are characterized extensive project know villi. These villi processes are varied during three segments of small intestine (duodenum, jejunum and ileum), [9]. The intestinal glands are situate in lamina properia with crypts.

It's called Lieberkuhn's crypt which covered by simple columnar epithelium [10]. The submucosa is located under the mucosa layer, included dense connective tissue [7]. Third layer is called muscularis which has circular and longitudinal muscle fibers. Either serosa layer is last part of tunics represented by loose connective tissue with cover mesothelium. The study is aimed to describe the morphological and histochemical sections of entire the small intestine of adult age of local pigeons.

Materials and methods

Experimental design: Six adult local birds were used. These birds were bought from central market in Baghdad. Then the birds were put on dissected board for the sacrificed after dislocated neck region. Later the pigeons were done –midline incision in ventral region. Three parts of small intestine (duodenum, jejunum and ileum) were put inside container fill 10% formalin during 72 hour. The samples were cleaned carefully by syringe carry the buffer solution to remove of material residues. The histological techniques were included dehydration across processing of specimens to alcohol through 2 hour (70, 80, 90, 100%), these specimens were passing to clearing and later embedded inside paraffin wax for their cutting by microtome machine. The slides were stained by hematoxine and eosin for general structure, masson's trichrom for describe collagen fiber. For histochemical technique were used periodic acid shift PAS and Alcian blue AB [11].

Results

Morphological study

The small intestine of adult age of local pigeon *Columba livia* were composed from three segments, duodenum, jejunum and ileum. Generally the study showed that the duodenum U-shape, formed from descending (ventral) and ascending (dorsal) segments lead to duodenal tube, where the pancreas located inside upper and lower parts of duodenum (Figure 1, 2, 3). The duodenum was anastomosed to the jejunum at ascending limb (Figure 3). The jejunum located at ending part of ascending duodenum. The jejunum was characteristics features cone-like of spiral coils, this forming centripetal coils. The jejunum is occupied almost the caudal part of coelomic cavity (Figure 1, 3). The dorsal part of jejunum was beneath right lobe of liver with impression on it (figure 1b). The last part of small intestine was called ileum, the present study were observed that ileum a long portion of other two segments. Which it's extended to straight part, located between the caeca (figure 1, 3).

Histological study

Histological study appeared the three segments, duodenum, jejunum and ileum were formed from mucosa, submucosa, muscularis and serosa. Histologically, the light microscope showed the duodenum mucosa had epithelium, lamina properia and muscularis. The epithelia is simple columnar with basal nuclei. In addition to villi is projected finger extensive processes which extended from base of lamina properia to free part of epithelia. The histological structures showed villi differences of lengths between entire the small intestine. Where the villi length of duodenum was longer than jejunum and ileum villi (figure 4, 9). The present study showed crypts of Lieberkuhn, it's located between villi and lining by simple columnar epithelium (figure 5). Submucosa of duodenum has no Brunner's glands in local pigeon (figure 6). The intestine glands were distributed along lamina properia during duodenum, jejunum and ileum (figure 6, 7, 9). Tunica muscularis were well developed during the entire three segments, represented by longitudinal smooth muscle fibers (figure 7, 9). Submucosa were less developed in local pigeon, seem thin layer or lost in some histological sections (figure 6). Generally, third tunica is called musculais, this layer had longitudinal outer layer, while inner layer was circular (figure 7). Serosa is final layer which included loose connective tissue with simple squamous epithelium (figure 9).

Histochemical study

Third target of this study represented in the histochemical study, where it's showed the stains by periodic acid schiff (PAS) and alcian blue (AB) stains, where appeared that stains were positive reaction with secretion of mucous (goblet cell) mucin. Hence the PAS stain appeared neutral activity with mucin secretion (figure 5, 8b), while Alcian blue showed acidic reaction with mucin of the goblet cell (figure 8a).

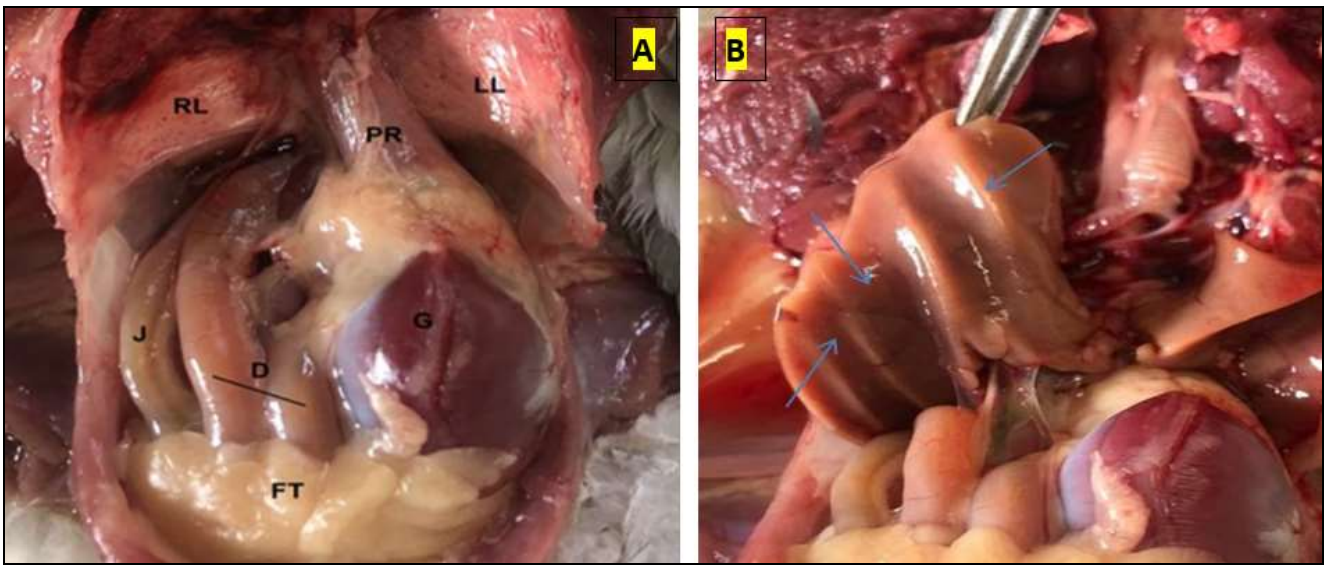

Fig 1: A Macrophotograph of adult pigeon showing: Gizzard (G), Proventriculus (Pr), left lung (LL), right lung (RL), duodenum (D), jejunum (J) and fatty tissue (FT). B. Liver impressions (blue arrow)

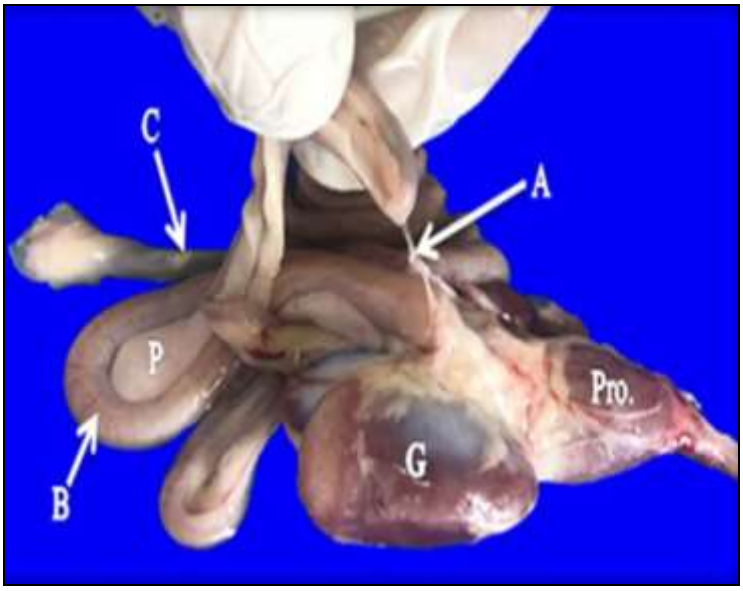

Fig 2: Macrophotograph Viscera of adult pigeon showing: Gizzard (G), Proventriculus (Pro), Pancreas (P), Small fold of peritoneum (A), Duodenum (B), Ceca (C)

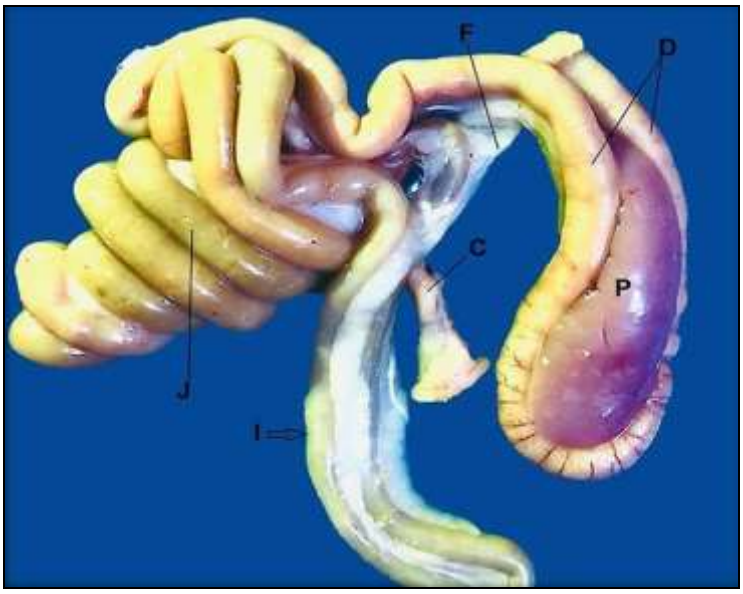

Fig 3: Macrophotograph of adult local pigeon showing: Duodenum (D), Jejunum (J), Ileum (I), cecum (C), pancreas (P), peritoneal fold (F)

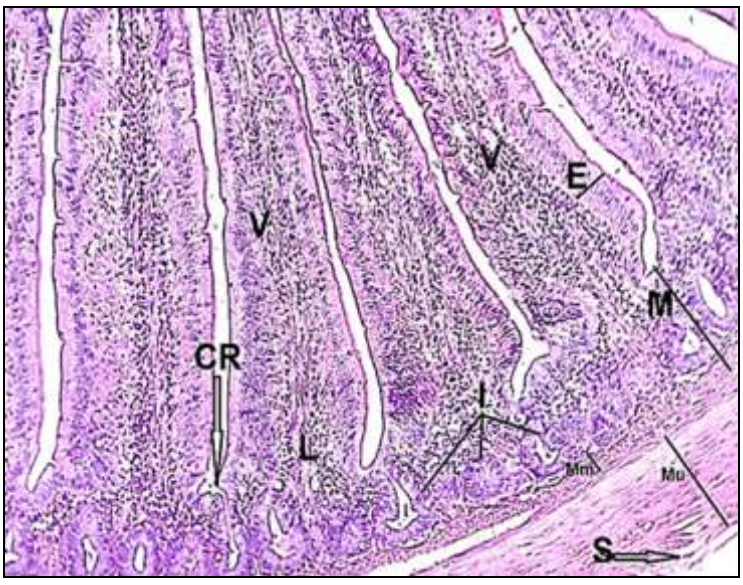

Fig 4: Cross histological section of the duodenum of adult Local pigeon showing: Villi (V), Lamina propria (L), Intestinal glands (I), leiberkuhn's crypt (CR), Tunica Muscularis (Mu), Tunica Serosa (S). H&E stain, 100X

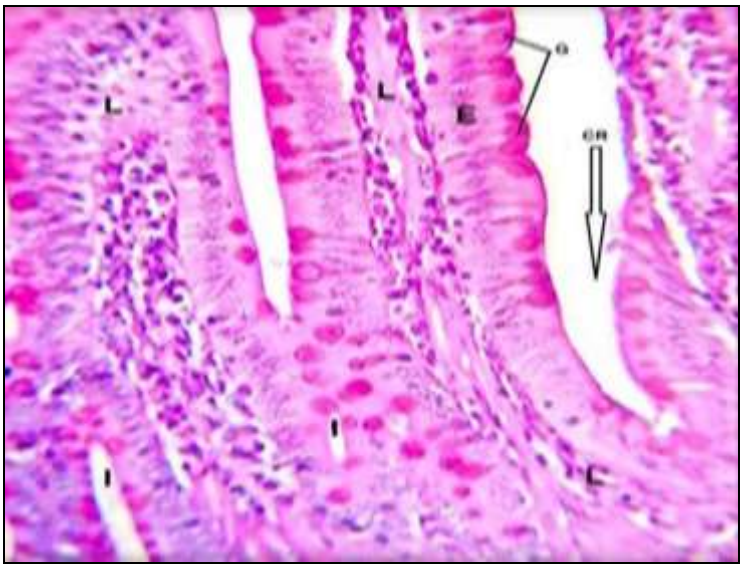

Fig 5: Cross histological Section of duodenum of adult Local pigeon showing: Goblet cells (G) magenta color, Simple columnar epithelia (E), Lamina propria (L), Intestinal glands (I), Crypts of Lieberkun (CR). PAS stain, 400X

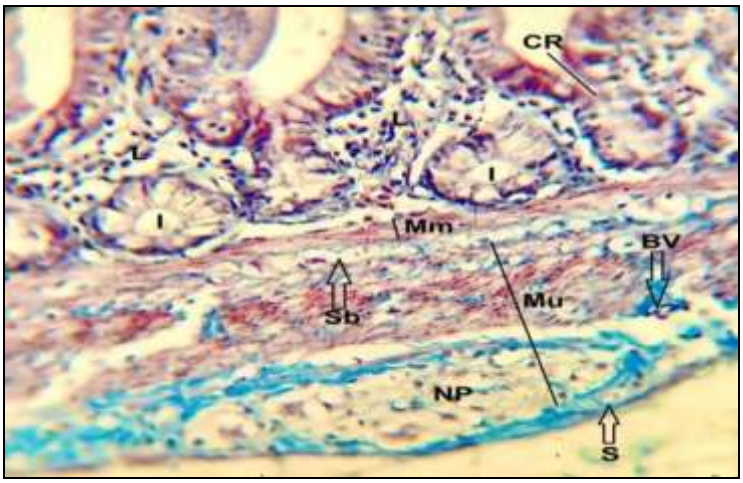

Fig 6: Cross histological Section of duodenum of adult Local pigeon showing: Intestinal glands (I), Crypts of Lieberkuhn (CR), Muscularis mucosa (Mm), submucosa (Sb), Tunica muscularis (Mu), Blood vessels (BV), Tunica serosa (S), Nerve plexus (NB). Masson's Trichrome, 400X

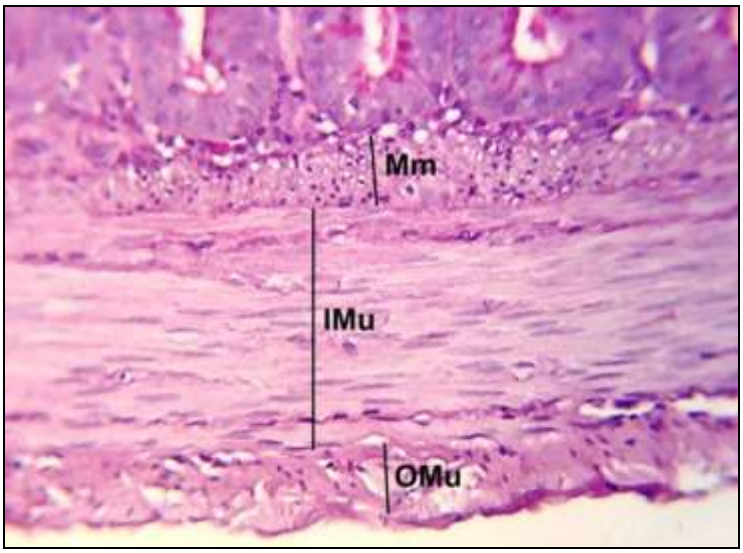

Fig 7: Cross histological section of duodenum of adult Local pigeon showing: Intestinal gland (I), Muscularis mucosa (Mm), Inner tunica muscularis (IMu), Outer tunica muscularis (OMu), Myenteric plexuses (NP), Serosa (S). H&E stain, 400X

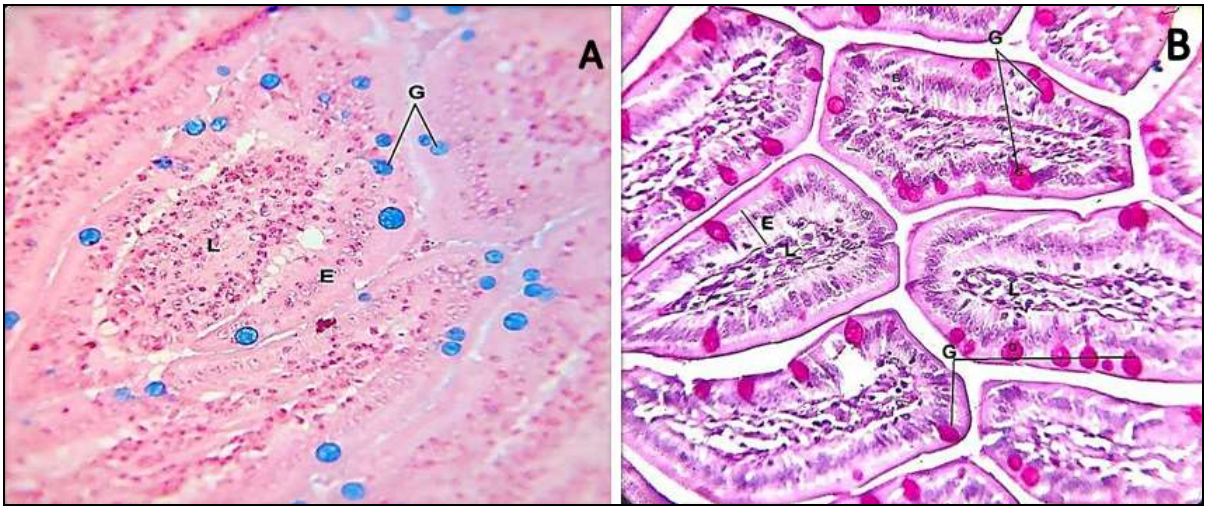

Fig 8: Longitudinal histological section of jejunum of adult Local pigeon showed positive reaction of histochemical special stain between goblet cells secretion (mucin), A. Alcian blue (AB) stain B. Perodic acid Schiff stain (PAS), 400x

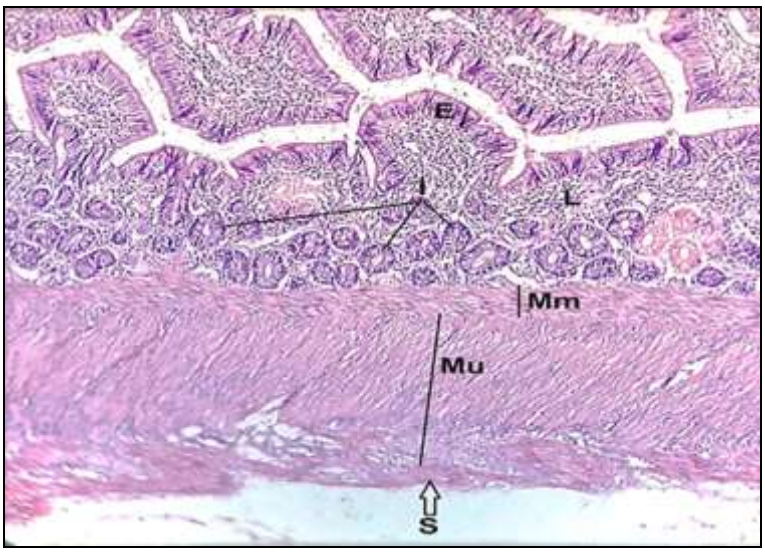

Fig 9: Longitudinal histological section of ileum of adult Local pigeon showing: Intestinal glands (I), Muscularis mucosa (Mm), Epithelia (E), Tunica muscularis (Mu), Tunica serosa (S). H&E stain, 400X

Discussion

The small intestine of adult age of local pigeon *C. Livia* were included duodenum, jejunum and ileum in order. Morphology study showed the duodenum U-like, anastomosing with lower part of gizzard, formed from lower (descending) and upper (ascending) parts, these parts were taken shape duodenal tube. The pancreas is situated between two parts of duodenum. These results of gross findings were accepted with some previously studies of avian species such as adult kestrel *Falco tinnunculus* [12] and in starling and pigeons [13] whom stated the duodenum was formed from two segments (upper and lower parts), then the upper parts of duodenum anastomosed with jejunum. The jejunum was began at ending part of ascending duodenum. The jejunum was characterized cone-like of spiral coils, and which it's consisted of centripetal coils. The jejunum is occupied almost the caudal part of coelomic cavity, so the study appeared liver impressions. These results no corresponding with [14] in human and domestic rabbit whom said the dorsal part of jejunum was beneath right lobe of liver which it's appeared impression on it. The last part of small intestine was called ileum, the present study were observed that ileum a long portion of duodenum and ileum. Which it's extended to straight part, located between the caeca. These observations disagreement with [15] Coturnix coturnix japonica and [16] whom showed the ileum was continuous with the colorectum and no caeca in yellow and blue macaw. Histological study was proved the small intestine it's formed from three segments, duodenum, jejunum and ileum. The histological structure was included mucosa, submucosa, muscularis and serosa. The current results parallel with observations [5]. In black winged kite and accepted with [17] in rock dove. Also in adult rock dove. The light microscope showed the duodenum mucosa, it's consisted of simple columnar cells called epithelia, eitherlamina properia and muscularis were located underlying the epithelia. These results accepted with said [18] as well as villi is projected finger extensive processes which extended from base of lamina properia, it's longer in duodenum from rest other two segments. Either Submucosa of *C. livia* was thin layer may see or absent, and has no Brunner's glands. This result conflict with said [18] in Guinea pig. Either [19] in 20 day age in pigeon. The present study showed crypts of Lieberkuhn, it's located between villi and lining by simple columnar epithelium. The intestine glands were distributed along lamina properia during duodenum, jejunum and ileum. These findings were corresponding with said [20] in chicken. And [16], in yellow and blue macaws, and accepted with [21] in Uttar fowl. Tunica muscularis were well developed during the entire three segments, represented by longitudinal smooth muscle fibers. These results accepted with said [7, 22] in

mallard, in and owl and kadaknath fowl respectively. The histochemical sections were stained by periodic acid schiff (PAS) and alcian blue (AB) stains, where appeared that stains were positive reaction with secretion of mucous (goblet cell) mucin secretion. Hence the PAS stain appeared neutral activity with mucin secretion, while Alcian blue showed acidic reaction with mucin of the goblet cell. These results accepted with [23]. Turkey and Cockatiel whom proved that goblet mucin were positive reaction with some special stains. Muscularis tunica was third in order and had longitudinal outer layer, while inner layer was circular. Serosa is final layer which included loose connective tissue with simple squamous epithelium. These results accepted with [24, 25] in pigeon and esophagus of squirrels [26].

Conclusions

The small intestine of adult age of local pigeons were appeared a similar with other birds species. There are some varies during arrangement of the shape and size villi in entire the small intestine. The histochemical techniques showed positive reaction of mucin secretion during periodic acid Schiff and alcian blue stain.

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Conflict of interest

The authors declare that there is no conflict of interest regarding publishing or funding of this article.

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