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Original Research Article

Morphological and Histochemical Study of Jejunum and Ilium in Post Hatching of (Columba Livia) and Adult

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Abstract: These results found differences in the jejunum and ilium of post hatching and adult *Columba Livia* in terms of morphological and histochemical aspects. the jejunum is longest part of small intestine and it was cone shape, it is starting at the proximal end of ascending duodenum to the ileum, it was consisted of centripetal, centrifugal coli and central flexure called spiral loop and suspended by mesentery called mesojejunum. It reddish- brown color. the ileum is third and short part of small intestine reddish color and it is continuing with jejunum to the end of ileo-cecal junction. Histological, the jejunum and ilium was consisting of four layer mucosa, sub-mucosa, muscularis, serosa. The tunica mucosa consisted from of villi, lamina propria and muscularis mucosa, the villi was finger like and not-branched, each villus was covered by simple columnar epithelium with goblet cells. The crypt of lieberkuhn also called intestinal gland were located in the basal of each villus. The thickness of tunica mucosa of jejunum in post and adult was high at level $P<0.05$ vs thickness of tunica mucosa of ilium in post and adult. The tunica sub-mucosa was thin layer that form connective tissue and collagen fiber. The tunica muscularis was thick layer made from inner circular layer and outer longitudinal layer, the thickness of muscular of jejunum in post was high at level $P<0.05$ vs adult. While the thickness of ilium in adult was high at the level $P<0.05$ Vs post hatching. The serosa layer was thin of simple epithelium layer which contain blood vessels, nerve and adipose tissue.

Keywords: Post hatching, Columba Livia, jejunum, ilium, adult, Histochemical and Morphological.

INTRODUCTION

The intestine is play an important role of converting food of avian, it's provided nourishment essential for the growth maintenance and absorption food of life birds (Lavin *et al.*, 2008; Jacob *et al.*, 2011). The jejunum of adult in columba livia the jejunum has been starting at the proximal end of the ascending duodenum and has been connected to the ileum by a mesenteric fold, forming a large spiral loop. This loop has been cone-shaped and located on the right side of the abdomen, consisting of centripetal and centrifugal and a central sigmoid flexure (Al-Khakani, 2013).The jejunum indigenous ducks (anasplayrhynchos) has been extend from duodenl loop to meckle diverticulum, it has been coils like, it have weight in female 13.67±0.56gm and in male the weight was 11.59±0.33gm and it have been length in female 53.31±0.34cm and male 50.35±0.63cm(Khaleel and Atiea, 2017). The jejunum in geese has been the second and longest section of the small intestine extending from the distal portion of the duodenum loop to the ileum-jejunum junction the inner surface has a rough mucous membrane, the mickel diverticulum has been found wall appeared as small pouch about 1 cm in length, the jejunum has been made up of many loops with a thin mesentery and has attached by long mesenteric folds carrying the jejunum arteries and average length and weight was 109.166±2.688cm with ratio3.001% and 36.833±0.703 with ratio 0.030% respectively (Zeena and Taha, 2023).The jejunum in the female pekin ducks (Anas platyrhnchos) it's started after the entrance of the bile and pancreatic ducts, arranged in several U-shape coils the number of jejunal coils and flexures were 12 with 11respectively which located on the right side that being displaced by the enlarged reproductive organ that were located on the left side (Elsabbgh *et al.*, 2024). the ileum in the African pied

crow (Corvus albus) has been a shorted tube that continued from the jejunum to the origin of the ceca and demarcation between jejunum and ileum has marked by the cranial mesenteric artery (Igwebuike and Eze,2010).

Histological, The mucosal layer has been consisting of villi was cylindrical, unbranched, thick, and pointed at the ends. The villi have been containing lacteal vessels and have been covered by a single layer of columnar cells, with oval-shaped nuclei located near the basal membrane and lamina propria was consisted of connective tissue containing collagen fiber, smooth muscle fiber representing the mucosal muscle and the crypts of lieberkuhn was extended at the base of villi and it have characterized by being less deep. Also the thickness (463±5.55 µm). (Al-Khakani, 2013; Al-Muhammadi and Al-Taai, 2020). The sub-mucosa in the broiler ross (7,14 and 21days), the layer was composed of connective tissue containing blood vessels and nerves, with a thickness of 11.96 ± 1.095 µm, 11.3±1.377µm and 12.66±1.711µm respectively (Ali, 2022). In the turkey (meleagris gallopavo) (18th, 16th and 24th weeks), the tunica muscularis was thickness 212.30±9.79 µm, 169.08±5.57µm and 297.02±17.28µm (Masyitha *et al.*, 2023). The tunica serosa is covered the outer surface and composed of simple squamous epithelium and loose connective tissue (Parisa *et al.*, 2019) and there are between the muscularis layer and serosa blood vessels and Auerbach's plexus (Taha and abed, 2022).

Aims of the study: To describe and compare the morphological, histological and histochemical difference of jejunum and ilium, between the post hatching of Columba livia and adult depending on the nature of the nutrition.

MATERIAL AND METHOD

Twenty eight birds (Coiumba livia) we use fourteen post hatching at age (4 days) and fourteen adult at age (7 month) of Columba livia in this study for examine the small intestine morphology and histochemical study, sample were obtained from bird owners in local markets (Babylon Market).

We stop earing the birds for 24 hours, then anesthetized injection in the pectoral muscle. Leave the bird for five minutes to allow the anesthesia to spread throughout the body. After that the bird was putting on anatomy board, make opening in made at caudal end of chest muscle and a longitudinal incision is made on both sides at the caudal area. then the small intestine of birds was gross photographic picture. The thickness and width of jejunum and ilium measuring, the jejunum from the centrifugal by vernia digintal. The sample were labeled and immerse in 10% formalin solution for 24 hours then the fixation has been replaced. For histological study using Haematoxylin and Eosin (H&E) stain, Periodic acid Schiff (P.A.S), Alcian blue (PH 2.5) And Masson's trichrome stain (M.T.S).

RESULT AND DISCUSSION

Morphologically, In the post at the age (4 days) and adult at the age (7 month) the jejunum is longest part of small intestine and it was cone shape or coils like, it is starting at the proximal end of ascending duodenum to the ileum, it was consisted of centripetal, centrifugal coli and central flexure called spiral loop and suspended by mesentry called mesojejunum. It reddish- brown color (figure 1, 2) and the internal surfers is smooth, these result accept with reported (Igwebuike and Ez.,2010), in African pied crow (Corvus albus) and (Khaleel and Atiea,2017) in the ducks and dissent with (Zeena and Taha,2023) that found in it's results the inner surface is rough in geese. the thickness of jejunum in post and adult was 1.34±0.008mm and 1.32±0.008 mm (table1) which no significant difference at P>0.05 and width in post and adult was 5.32±0.007 mm and 8.19±0.008 mm which increased at the significance level P<0.05 (table1). The relative increase thickness of jejunum wall in post may be to need for a thicker muscular layer to propel viscous contents and higher density of absorptive, this result concur with (Karasov and Douglas,2019). The reason for the increased of width jejunum in adult due conversion from milk crop to solids food and increased wall elasticity. These adaptations indicate a remarkable tissue elasticity in the Columba livia digestive system during different stage of growth. The ilium in post and adult is third and short part of small intestine reddish color (figure 1, 2) and it is continues with jejunum to the end of ileo-cecal junction, the external surface was smooth and inner surface have contains long folds these result agree with reported (Al-khakani,2013) in Columba livia. The thickness of ilium in post and adult 0.93±0.008 mm and 1.31±0.008 mm which increased at the significance level P<0.05 and the width of ilium in post and adult was 5.74±0.008 mm and 9.66±0.046mm which a highly significant difference at the level P<0.05 (table 1).

Table 1: Showing the thickness (mean±SE), width (mean±SE) of jejunum and ileum in the post hatching of Columba livia and adult

Organ	Post hatching	Adult of *CL*	T-value
Thickness of jejunum (mm)	1.34±0.008	1.32±0.008	1.73
Width of jejunum(mm)	5.32±0.007	8.19±0.008	35.83
Thickness of ileum (mm)	0.93±0.008	1.31±0.008	32.90
Width of ileum (mm)	5.74±0.008	9.66±0.046	82.59

- The number represent the mean± standard error.
- Statistical significant different.
- P<0.05

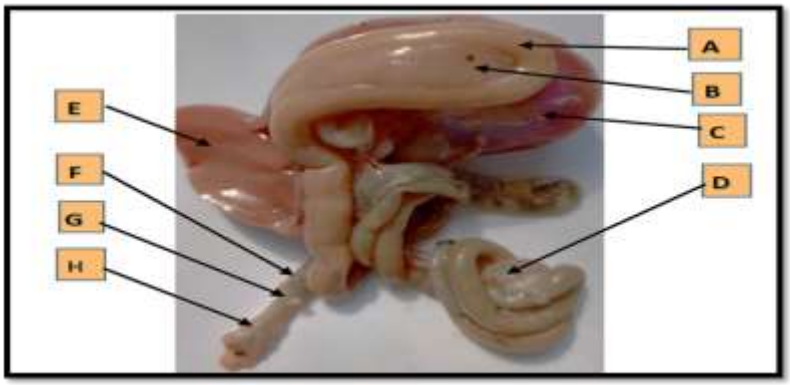

Figure 1: Post hatching of Columba Livia (4 days old) (A) duodenum, (B) Pancreas, (C) Gizzard, (D) Jejunum, (E) Liver, (F) Ilium, (G) cacal, (H) Rectum

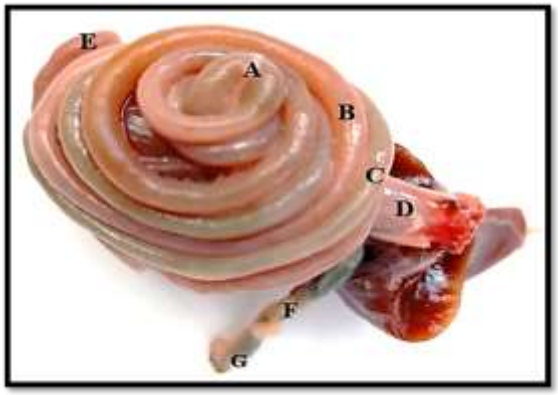

Figure 2: Adult Columba Livia (A) central flexure (jejunum), (B) centripetal loop (jejunum), (C) centrifugal loop (jejunum), (D) proventriculus, (E) duodenum, (F) ilium, (G) Rectum

Histologically, The jejunum in post hatching and adult was second parts of the small intestine histologically structure was composed of four tunicas which are mucosa, sub-mucosa, muscularis and serosa. The tunica mucosa of jejunum was consisted of lamina propria, villi and muscularis mucosa The current study was accede with (Al-Saffar and Al-Samawy,2016) in the otus scors brucei. The villi were appeared finger- like projection, cylindrical shape, long and not branched(figure 3,7). Each villus were covered by epithelial tissue consisted of absorbed cells and goblet cells, the absorbed cells appear single layer from columnar cells called simple columnar epithelium contain oval nucleus(figure3,7), the height of epithelial in post and adult was 0.025±0.012µm and 0.027±0.0012µm (table 2) at the apical surface of epithelium cells found brushes border called microvilli that increasing the absorbing surface area of the intestine. This result agree with (Kadhim, 2017) in goose. The height villi in post and adult was 0.0649±0.041µm and 0.0518±0.0045µm, the width of villi in post hatching and adult was 0.0518±0.0045µm and 0.0292±0.0026µm (table 2) which a significant difference at level of $P<0.05$. The thickness of tunica mucosa in post and adult was 0.213±0.0051 and 0.154±0.0141µm (table 2) the thickness of mucosa layer in post is higher at significant level $P<0.05$ because they feed on crop milk which is rich in proteins and the secreted mucin also helps the growth of beneficial bacterial in the intestines. In addition, the immune system is not complete so the mucin protects it from germs. In the adult the need for this thickness decreases due to the maturity of the immune system and change in food to grains. This result concur with (Felix *et al.*, 2023) broiler chicks.

The goblet cells are interspersed among the absorptive cells characterized by a slightly expanded shape at the a apical surface long cup -shaped with pale cytoplasm due to production of the mucus and nucleus of goblet cells is located near their basal pole. This study unite with (Dyshliuk *et al.*, 2024) in the common Blackbird (Turdus merula). The number of goblet cells in post and adult was 24.28±3.913µm and 42.4±6.531µm (table 2). The increase in goblet cells in adult is attributed to the higher required for mucin production which facilitates intestinal motility due to their diet solid food that contained rich mount of fiber and carbohydrate. In contrast, the post hatching was feed on crop milk which easily digestible there by reducing the need for extensive mucin secretion. The crypt of lieberkuhn also called intestinal gland were located in the basal of each villus and extend in the lamina propria of mucosa which lined by simple columnar epithelial cells with oval nucleus in the lower half (figure3,8) This study result concur with (Jaya *et al.*, 2024) in the Cemani Chicken (Gallus gallus domesticus). The depth of crypts in post and adult was 0.039±0.0028 and 0.033±0.0027µm(table2). In the glands are found goblet cells, paneth cells and

enteroendocrine cells which secreted digestive enzymes, mucus to lubricate, product the intestine wall and produce cells that replace surface-membrane cells shed from the tip villi. The lamina porpria was formed of loose connective tissue rich in blood vessels, muscle fibers which supporting mucosal membrane. Each villus contains a core of lamina propria that extend upward into the villi from mucosae and a centeral lymphatic vessel called the lacteal that support the villi. This result accept with (Majeed *et al.*,2009). The thickness of lamina porpria in post and adult was 0.00102±0.0183µm and 0.0013±0.016µm (table 2). the tunica sub-mucosa was poorly developed, thin layer of loose fibrous connective tissue which contain of vessels, collagen and elastic fibers(figure4,8). This result in harmony with (Hizewska *et al.*, 2023) in the geese. The thickness of sub-mucosa in post and adult was 0.0105±0.00126µm and 0.0101±0.0105µm. The tunica musclaris in post and adult was made of two layers of smooth muscle fibers inner circular and outer longitudinal layers and between them a narrow connective layer contained blood and lymphatic vessels as well as a nerve plexus(figure4,8). This result assent with (Zaher *et al.*, 2012). The thickness of muscularis in post and adult was 0.042±0.0052µm and 0.031±0.0025µm (table 2). the tunica serosa was thin layer of loose connective tissue contain of dipose tissue and blood vessels covered by mesothelium(figure4,8). This study was agree (Khaleel and Atiea,2017) in ducks (anasplayrhnchos). The thickness of serosa in post and adult was 0.0095±0.00085µm and 0.0058±0.00053µm (table 2).

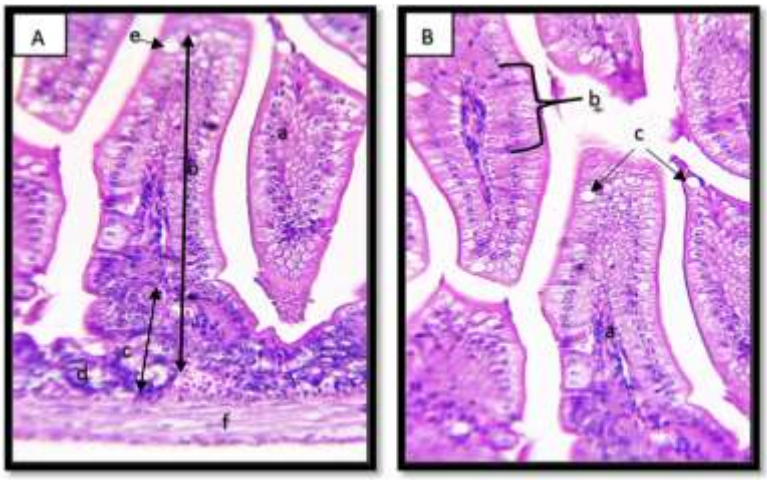

Figure 3: Transvers section of jejunum in post hatching (A) a-villi, b-tunica mucosa, c-lamina propria, d- crypt of Lieberkühn, e-goblet cells, f-tunica muscularis (B) a-core, b- simple columnar epithelium, c-goblet cells H&E (A)40x (B)100x

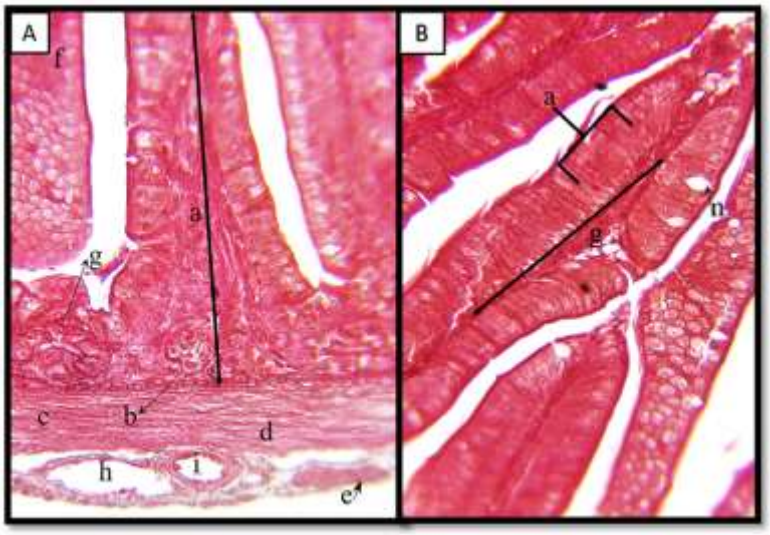

Figure 4: Jejunum in the post hatching (A) a-tunica mucosa, b-tunica sub-mucosa, c-inner circular layer, d-outer longitudinal, e- tunica serosa, f-villi, g-crypt of Lieberkühn, h-nerve plexus, i-blood vessels (B) a-simple columnar epithelium, g- core, n-goblet cells Masson Trichrome (A)40x (B)100x

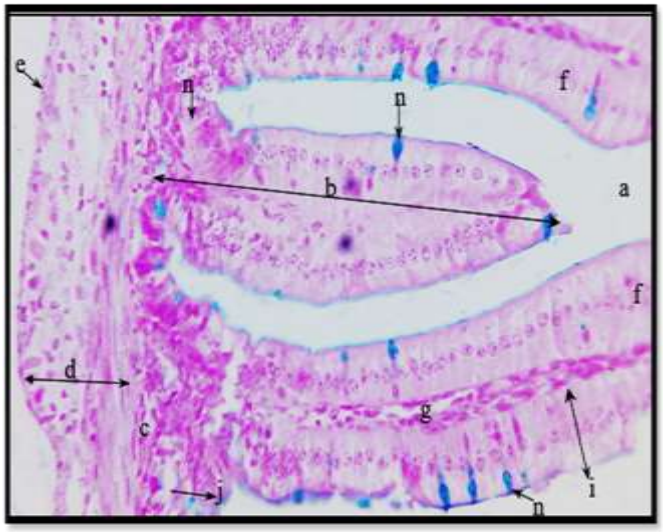

Figure 5: Transvers section of the jejunum in post-hatching Columba Livia. Indicator: a-Intestinal lumen b-Mucosa. c-Submucosa. d-Muscularis externa. e-Serosa. f-Villus. g-core. i-Simple columnar Epi. j-Crypt of Lieberkuhn. n-Goblet cell. Alcian blue stain. 20X

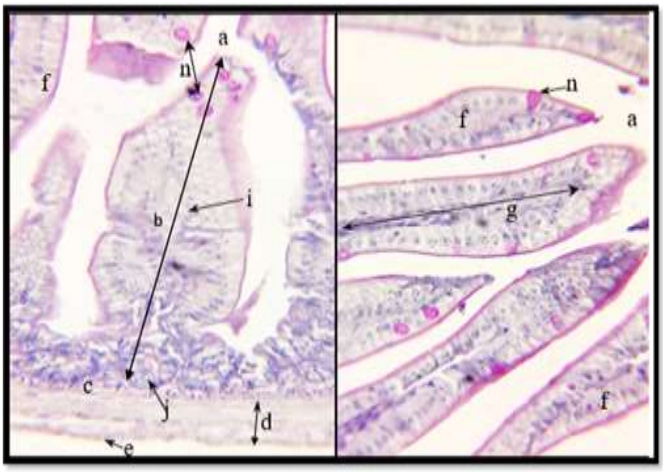

Figure 6: Transvers section of the jejunum in post-hatching Columba Livia. Indicator: a-Intestinal lumen b-mucosa c-Submucosa. d-Muscularis externa. e-Serosa. f-Villus. g-Lamina propria. i-Simple columnar Epi. j-Crypt of Lieberkuhn. n-Goblet cell PAS stain. 40X

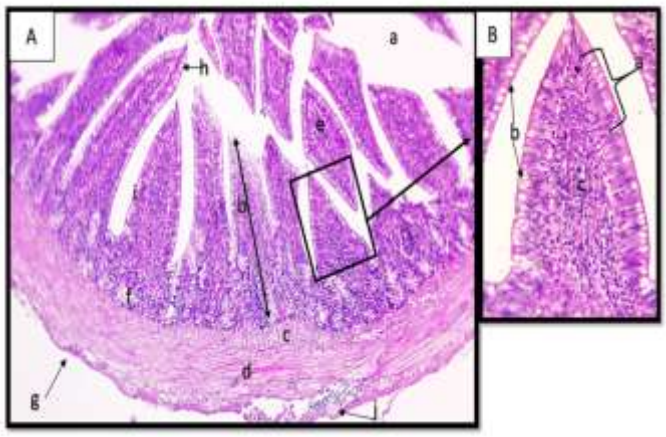

Figure 7: Transvers section of the jejunum in adult (A) a-intestinal lumen, b-tunica mucosa, c-tunica sub-mucosa, d-tunica muscularis, e-villi, f-epithelia, g- tunica serosa, h-goblet cells, j-Auerbach's plexus (B) a- simple columnar epithelia, c- core H&E (A)20x (B)100x

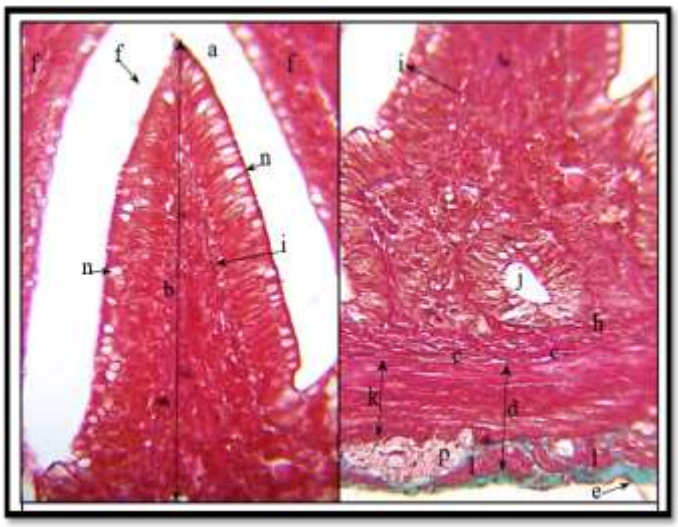

Figure 8: Transvers section of the jejunum in adult Columba Livia. Indicator: a-Intestinal lumen b-tunica Mucosa. c-tunica Submucosa, d-tunica muscularis, e-Serosa, f-Villus. h-Muscularis mucosae, i-Simple columnar Epi, k-Inner circular muscular, l-Outer longitudinal muscular, J-Crypt of Lieberkühn, n-Goblet cell, p-Auerbach's plexus. Masson's trichrome stain. 100X

Table 2: Showing the height and width of villi, depth of crypt, height of epithelium, lamina propria and thickness of tunica mucosa sub-mucosa, muscularis, serosa and number of goblet cells of jejunum in post and adult *Columba Livia*

Parameter (µm)	Post (mean±SE)	Adult (mean±SE)	T-test
Height of villi	0.0649±0.041	0.0518±0.0045	2.169
Width of villi	0.0302±0.00219	0.0292±0.0026	0.294
Depth of crypt	0.039±0.0028	0.033±0.0027	1.451
Height of epithelium	0.027±0.0012	0.025±0.012	1.170
Lamina propria	0.0013±0.016	0.00102±0.0183	1.433
Thickness of mucosa	0.213±0.0051	0.154±0.0141	3.93
Thick of sub-mucosa	0.0105±0.00126	0.0111±0.0105	0.374
Thick of muscularis	0.042±0.0052	0.031±0.0025	1.811
Thick of serosa	0.0095±0.00085	0.0058±0.00053	3.67
Number of goblet cells per 100	24.28±3.913	42.4±6.531	2.424

- The numbers represent the mean ± standard error.
- Statistical significant difference.
- $P<0.05$.

The ilium in post hatching and adult, The tunica mucosa of ilium was consisted of villi which finger-like projection, lamina propria and muscular mucosa. The current study was accede with (Ali,2022). The villi was appeared finger- like projection, cylindrical shape, long and not branched(figure11,15) the height in post and adult of villi was 0.0712±0.0118µm and 0.0910±0.0052µm, the width of villi in post and adult was 0.018±0.00096µm and 0.025±0.0017µm (table 3). This result agreement with (Al-Ghakany,2013) in (*colimba livia*). Each villus was covered by single layer of epithelial tissue contain of absorbed cells (columnar cells) called simple columnar epithelium which contain oval nucleus(figure 11,15) the height of epithelium in post and adult were 0.0198±0.0011µm and 0.0228±0.0012µm (table 3), In dorsal surface of the cells brushes border called microvilli that increasing the absorbing surface area of the intestine. thickness of tunica mucosa in post and adult was 0.0886±0.0079µm and 0.1242±0.0098µm(table3). This result accept with (Taki-El-Deen,2017) in spur-winged lapwing vanellus spinosus. the reason for the increased thickness of the mucosa layer in adult is due to their feeding on grains and fibers that cause mechanical friction with the intestinal wall. Therefore, the layer needs to be thick to isolate the epithelium and thus friction. The goblet cells are interspersed among the absorptive cells in the adult characterized by a slightly expanded shape at the a apical pole long cup -shaped and pale cytoplasm due to production of the mucus and nucleus of goblet cells is located near their basal pole. This study concur with (Dyshliuk *et al.*, 2024) in the common Blackbird (Turdus merula). The number of goblet cells in post and adult was 32.6±3.1814 and 47.12±6.324µm (table 3). The crypt of lieberkuhn also called intestinal gland were located in the basal of each villus and extend in the lamina propria which lined by simple columnar epithelial cells with oval nucleus in the lower half. The depth of cryptsin post and

adult were 0.0338±0.0019µm and 0.049±0.0029µm (table 3). This study result agree with (Jaya *et al.*, 2024) in the Cemani Chicken (Gallus gallus domesticus). In the glands are found goblet cells, paneth cells and enteroendocrine cells which secreted digestive enzymes, mucus to lubricate, product the intestine wall and produce cells that replace surface-membrane cells shed from the tip villi. The lamina propria was consisted of a loose connective tissue, fibers and blood vascular which supporting the mucosal membrane. This result agree with (Michael,2000). The thickness of lamina porpria in post and adult was 0.0013±0.0148µm and 0.00089±0.0118µm (table3). Each villus contains a core of lamina propria that extend upward into the villi from mucosae and a centeral lymphatic vessel called the lacteal that support the villi. the sub-mucosa layer was thin which composed of connective tissue including blood vessels, collagen and elastic fiber(figure12,16). This result was acord with (Khaleel and Atiea, 2017) in mallard. The thickness of sub-mucosa in post and adult was 0.0133±0.0013µm and 0.0188±0.0011µm. the tunica musclaris was made of two layers of smooth muscle fibers inner circular layer which was appeared thicker than outer thin longitudinal layer (figure12,16) and between them a narrow connective layer contained blood and lymphatic vessels as well as a nerve plexus. This result unite with (Zaher *et al.*, 2012). The thickness of muscularis in post and adult was0.0303±0.00236µm and 0.0429±0.0028µm (table 3). the tunica serosa was thin layer of loose connective tissue contain of dipose tissue and blood vessels covered by mesothelium (figure12,16). This study was concur (Khaleel and Atiea,2017) in ducks (anasplayrhnchos). The thickness of serosa in post and adult was 0.0075±0.00096µm and 0.0093±0.00117µm (table 3). **Histochemical**, the jejunum in the post goblet cells reacted good positive of AB and PAS and appeared blue and pink color respectively, simple columnar cells showed a weak reaction with the PAS and AB stain, the lamina propria, sub mucosa, tunica serosa and smooth muscle fibers of muscularis mucosa and tunica muscularis were weak reacted for both stain (Fig 5,6).In adult the jejunum Alcian blue stain that is used to visualize acidic epithelial and mucus that will blue color that give strong reaction and PAS which stains the neutral mucus magenta give moderate positive reaction(figure9,10). the ilium in post and adult was goblet cell of villi and crypts of liberkühn, strong positive reaction with AB and PAS stain (fig 13,14,17,18).

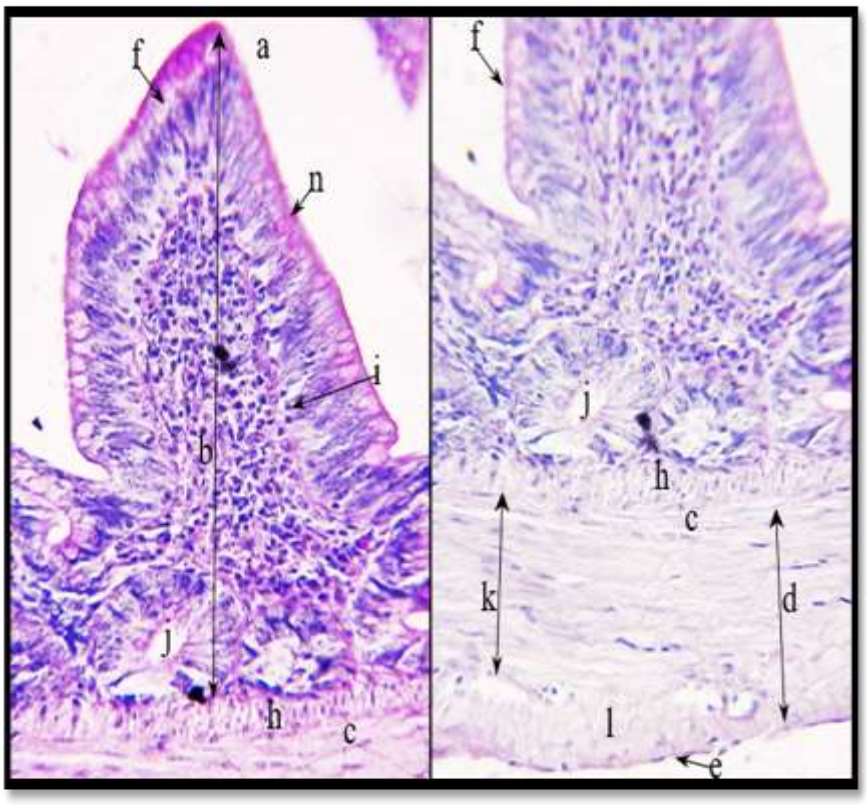

Figure 9: Transvers section of the jejunum in adult Columba Livia a-Intestinal lumen b-Mucosa. c-Submucosa. d-Muscularis externa. e-Serosa. f-Villus. h-Muscularis mucosae. i-Simple columnar Epi. k-Inner circular muscular. l-Outer longitudinal muscular. J-Crypt of Lieberkuhn. n-Goblet cell. PAS stain. 40X

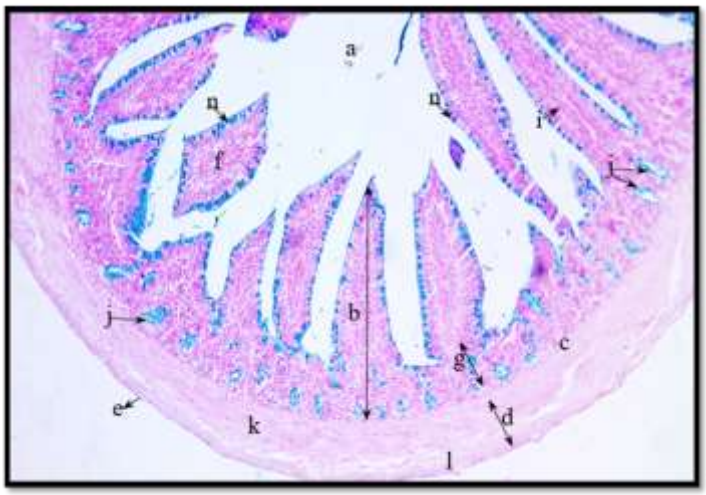

Figure 10: Transvers section of the jejunum in adult Columba Livia a-Intestinal lumen b-Mucosa. c-Submucosa. d-Muscularis externa. e-Serosa. f- Villus. g-Lamina propria. i-Simple columnar Epi. j-Crypt of Lieberkuhn. k-Inner circular muscular. l-Outer longitudinal muscular. n-Goblet cell. Alcian blue stain. 20X

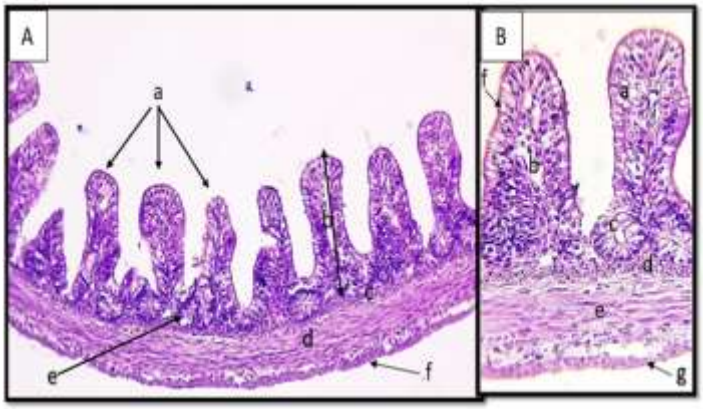

Figure 11: Transvers section ilium of post hatching (A) a-villi, b-tunica mucosa, c-tunica sub-mucosa, d-tunica muscularis, e-crypt of Lieberkühn (B) a-simple columnar epithelium, b-tunica sub-mucosa, c-crypt of Lieberkühn, d-core, e-tunica muscular, f-goblet cells, g-tunica serosa H&E (A) 40x (B) 100x

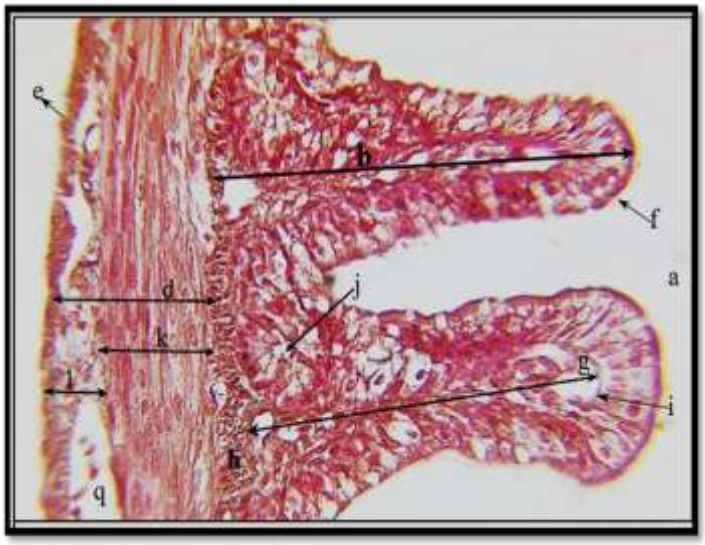

Figure 12: Transvers section of ilium in post a-intestinal lumen, b-tunica mucosa, d-tunica muscularis consisted from k-inner circular layer, l-outer longitudinal layer, h- tunica submucosa, e- tunica serosa, f-villi, g-lamina propria, i-simple columnar epithelium, j-crypt of Lieberkühn, q-blood vessels Masson Trichrome 40x

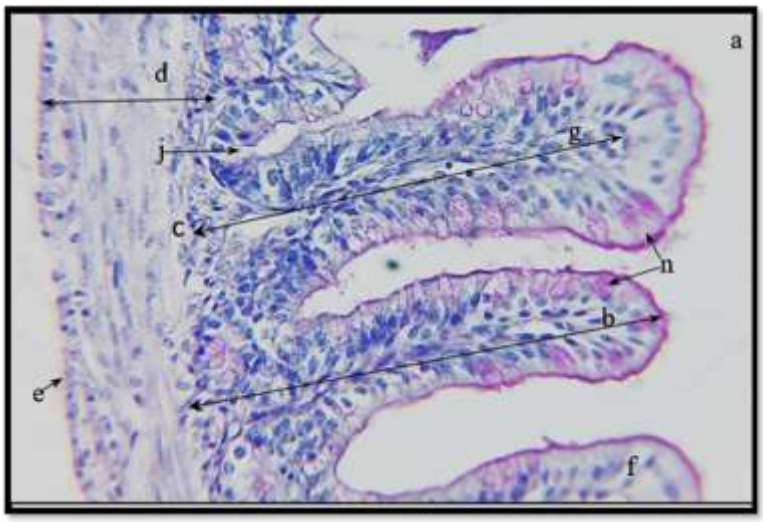

Figure 13: Transvers section of the ilium in post-hatching Columba Livia a-Intestinal lumen b-Mucosa. C-sub-mucosa d-Muscularis externa. e-Serosa. f-Villus. g-core. j-Crypt of Lieberkuhn. n-Goblet cell. PAS stain. 40X

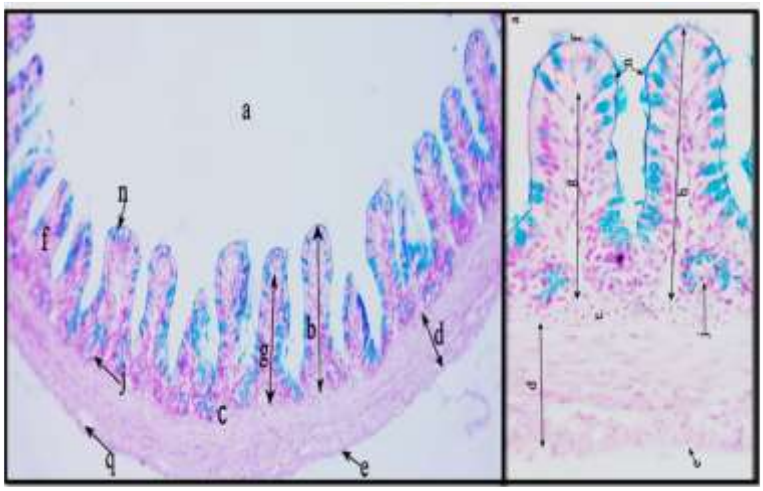

Figure 14: Transvers section of the ilium in post-hatching Columba Livia. a-Intestinal lumen b-Mucosa. C-sub-mucosa d-Muscularis externa. e-Serosa. f-Villus. g-core. j-Crypt of Lieberkuhn. n-Goblet cell. q-Blood vessels Alcian blue stain. 40x.100X

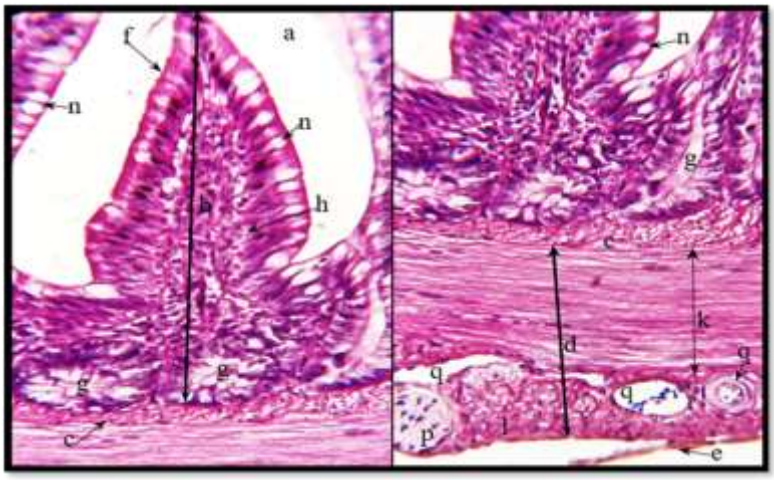

Figure 15: Transvers section of ilium in adult a-intestinal lumen, b-tunica mucosa, c-tunica sub-mucosa, d-tunica muscularis, e-tunica serosa, f-villi, g-crypt of lieberkuhn, h-simple columnar epithelium, k- inner circular layer, l-outer longitudinal layer, q-blood vessels, p- Auerbach's plexus H&E 40X

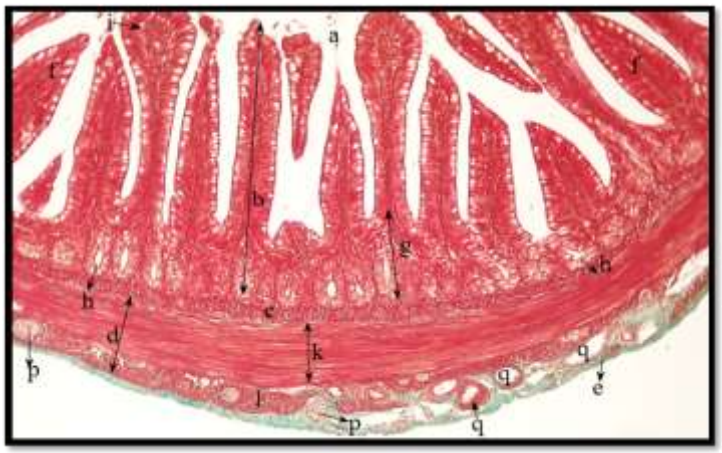

Figure 16: Transvers section of ilium in adult a-intestinal lumen, b-tunica mucosa, c-tunica sub-mucosa, d-tunica muscularis, e- tunica serosa, f- villi, g- lamina propria, h-crypt of Lieberkühn, k-inner circular layer, i-simple columnar epithelium, l-outer longitudinal layer, p-Auerbach's plexus, q-blood vessels Masson trichrome 20x

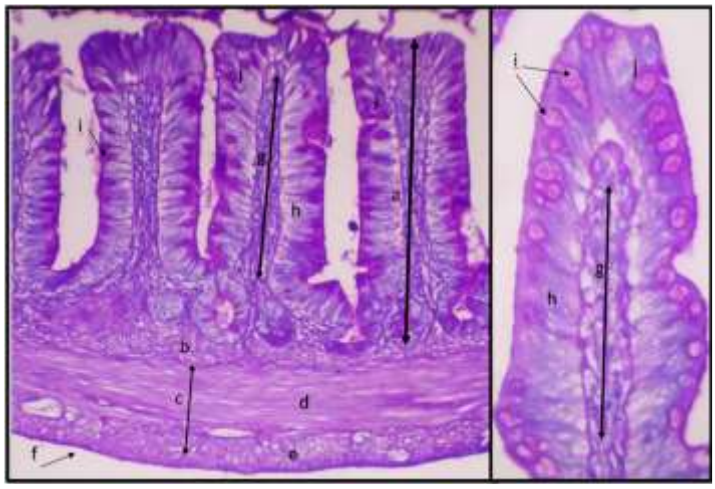

Figure 17: Transvers section of ilium in adult of Columba livia a-tunica mucosa, b-tunica sub-mucosa, c- tunica muscularis, d- inner circular layer, e-outer longitudinal layer, f-tunica serosa, g-core, h-simple columnar epithelium, i-goblet cells, j-villi. PAS (20X) (40X)

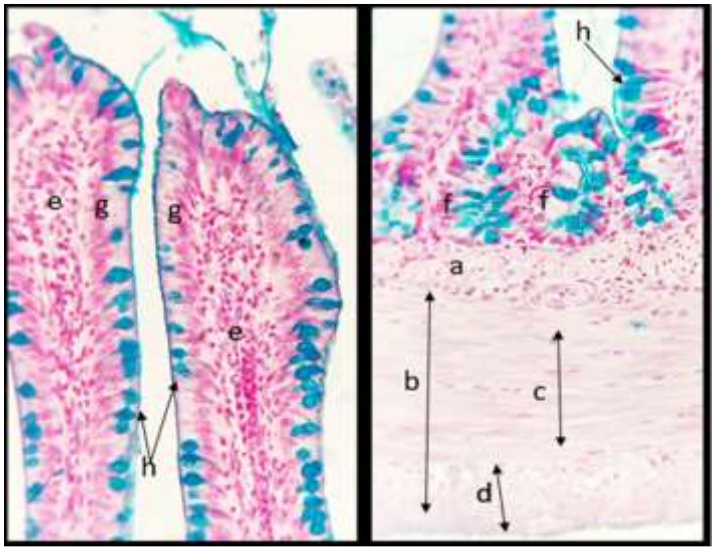

Figure 18: Transvers section of the ilium in adult Columba livia a- sub-mucosa layer, b-muscularis layer, c-inner circular layer, d-outer longitudinal layer, e-core, f-crypt of Lieberkühn, g-simple columnar epithelium, h-goblet cells. Alcian blue stain 100x

Table 3: showing the height and width of villi, depth of crypt, height of epithelium, lamina propria and thickness of tunica mucosa, sub-mucosa, muscularis, serosa and number of goblet cells of ilium in post and adult *Columba Livia*

Parameter (µm)	Post (mean±SE)	Adult (mean±SE)	T-test
Height of villi	0.0712±0.0118	0.0910±0.0052	1.54
Width of villi	0.018±0.00096	0.025±0.0017	3.56
Depth of crypt	0.0338±0.0019	0.0494±0.0029	4.548
Height of epithelium	0.0198±0.0011	0.0228±0.0012	1.89
Lamina propria	0.00113±0.0148	0.00089±0.0118	2.142
Thickness of mucosa	0.0886±0.0079	0.1242±0.0098	2.816
Thick of sub-mucosa	0.0133±0.0013	0.0188±0.0011	3.19
Thick of muscularis	0.0303±0.00236	0.0429±0.0028	3.43
Thick of serosa	0.0075±0.00096	0.0093±0.00117	1.17
Number of goblet cells per 100	32.6±3.1814	47.12±6.324	2.058

- The numbers represent the mean ± standard error.
- Statistical significant difference.
- P<0.05.

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