Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/6269
DOI URL: http://dx.doi.org/10.21474/IJAR01/6269

RESEARCH ARTICLE

GROSS ANATOMY AND HISTO-ARCHITECTURE OF RABBIT STOMACH.

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Manuscript Info

Manuscript History

Received: 10 November 2017
Final Accepted: 12 December 2017
Published: January 2018

Key words:-
Gross, Histo-morphology, Rabbit, Stomach.

Abstract

The present study was undertaken to explore the gross and histomorphological details of stomach of rabbit. Stomach was a J-shaped dilatation of the digestive tract and was located on the left side of the median plane transversally in the abdominal cavity just caudal to the liver. It had three distinct glandular regions viz; cardiac, fundic and pyloric gland region. The principle cell types in the fundic gland regions were the chief and parietal cells with a unique arrangement. The upper 1/3rd area had numerous parietal cells and the lower 2/3rd region had predominantly chief cells with parietal cells arranged on the periphery. The tunica muscularis in the pyloric gland region was significantly thick than other two regions. The tunica serosa had abundant of elastic fibers which aided in elasticity of this organ.

Introduction:-

Among mammals there exists very considerable diversity in the form and structure of the stomach. Much of this diversity is clearly adaptive and reflects the habitual diet of various groups (Dyce *et. al*., 1996). Hence, the present study was undertaken to explore structure of rabbit stomach since little information is available regarding its digestive capability.

Materials and methods:-

All the animal experiments complied with the guidelines promulgated by the Institutional Animal Ethics Committee (IAEC) of West Bengal University of Animal and Fishery Sciences, Kolkata. The present study was carried out on twelve adult rabbits between body weights of 1.0 to 1.5 Kg. Before collection of organ, the gross disposition was studied in situ. Tissue specimens were taken from cardia, fundus and pyloric regions of the stomach and fixed in 10% NBF and Bouin's fixatives. The samples were processed by acetone-benzene schedule and the sections of 5-6 µm thickness were obtained on clean, grease free glass slides. These paraffin sections were stained with Haematoxylin and eosin (H&E) for routine morphology, Masson's trichrome method for Collagen fibers and Weigert's method for elastic fibers and (Luna, 1968). Micrometry was done by using Leica Qwin Image Analyzer software in Leica DM 2000 microscope. The data collected were analyzed statistically (Snedecor and Cochran, 1994).

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Results and discussion:-

Gross Anatomy:-

In the present study, the stomach was observed to be a J- shaped dilatation of the digestive tract and was located on the left side of the median plane transversally in the abdominal cavity just caudal to the liver (Fig.1) which was in accordance with the reports of O'Malley (2008); however, some authors had described it to be C-shaped (Elnagy and Osman, 2010). The greater curvature of stomach was convex in outline with an average measurement of 17.33±0.558 cm. The lesser curvature was short, slightly concave and extended from cardia to pylorus and was approximately 5.833±0.401 cm in length. The esophagus opened at the centre of the lesser curvature of stomach. The present findings were in conformity with the reports of Prasad (1971). The cardiac end of stomach was much wider and highly rounded as compared to the pyloric end from where the duodenum originated. The pylorus was located on the right side of the median plane and directed dorso-laterally. The fundus was located at the left of the cardia as a sac like bulge (Fig.1). Similar observations were reported by Hristov *et. al.* (2006).

The stomach was related cranially to the visceral surface of the liver and caudally it was adjacent to the jejunal loops. Dorsally it was in contact with the diaphragm and the proximal parts of the ribs and ventrally with the caecum and colon (Fig.1). Jordan and Verma (1983) reported similar observations in rabbit.

Histology:-

The wall of the stomach was observed to be comprised of all the four basic layers viz., tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa.

The lining epithelium was simple columnar throughout the area of stomach. The gastric furrow was distinct in the pyloric regions as compared to the other two regions and was lined by simple columnar epithelium. The gastric pits were found distinctly in the pyloric region whereas in the other two regions the continuation of the duct of the gastric glands resembled the existence of pit. These gastric pits were shallow in cardiac gland region, short in fundic region and relatively long in pyloric gland region (Fig.2 &3). These findings were in accordance with the reports of Ghoshal and Bal (1989) and Khalel and Ghafi (2012) in rabbits. The lamina propria was distributed with numerous gastric glands. Serial sections from the gastro-esophageal junction revealed no non-glandular region in the stomach which was in accordance with Ghoshal and Bal (1989) in rabbits, however, other laboratory mammals show a well defined non-glandular. The glands in different regions of stomach opened at the bottom of these gastric pits (Fig.2). Apart from gastric glands, the lamina propria had loosely arranged collagen fibers showing wavy appearance, reticular fibers and numerous small blood capillaries. The lamina muscularis was well developed and consisted of smooth muscle fibers arranged in inner circular and outer longitudinal layers. Ghoshal and Bal (1989) and Khalel and Ghafi (2012) also reported similar findings in rabbit.

The tunica submucosa was composed of loose connective tissue containing abundant of collagen fibers, fibrocytes, adipocytes and large blood vessels. Elastic fibers were found prominently in the wall of blood vessels (Fig.4). The tunica muscularis consisted of two layers of smooth muscle fibers, the thick inner circular and thin outer longitudinal layers (Fig.3). The similar observations were reported by Ghoshal and Bal (1989) and Khalel and Ghafi (2012) in rabbits. Ganglionic cells and plexus were present in between the two muscle layers which were in accordance with the reports of Khalel and Ghafi (2012). Delicate tunica serosa had enormous distribution of elastic fibers which aid in elasticity of this organ in order to accommodate large amount of food materials as these animals have the tendency to eat frequently (Fig.4).

Cardiac gland region:-

The cardiac gland region appeared as a narrow area at the gastro-esophageal junction (Fig.2). The cardiac glands were short, branched tubular glands. These glands were predominantly mucous secreting. The mucous cells were observed near the surface in the lining epithelium and in the neck region of the glands that lined the gastric pits. These cells were cuboidal to low columnar with basophilic cytoplasm but the staining intensity was less than that of the chief cells (Fig.2). A few parietal cells were present either singly or mixed with mucous neck cells along the periphery of the gland. The present findings were in accordance with the reports of Khalel and Ghafi (2012) in rabbits who also observed that the mucous cells were predominant cell type in this region with few parietal cells

Fundic gland region:-

The serial histological sections revealed a region between the cardiac and pyloric regions with a typical glandular distribution pattern which differed from both the ends. These glands were long straight tubular that was arranged

straight almost parallel to one another towards lamina muscularis and at the base the cross-section of the gland revealed typical coiling character of the gland (Fig.3). Similar observations had been reported by Ghoshal and Bal (1989) and Khalel and Ghafi (2012) in rabbits, Berghes *et. al.* (2011) in guinea pig and Chandana *et. al*. (2013) in albino rat.

Apart from mucous secreting cells, the other two main cell types observed were parietal and chief cells (Fig.3;inset). Mucous cells were similar to that of the cardiac gland region. Towards the neck of the gastric gland, the mucous cells were mixed with the parietal cells. Parietal cells were found scattered along the entire length of the gland but were more numerous in the upper 1/3rd of the gland. The number was less in the lower 2/3rd region and arranged at the periphery of the gland but the frequency of parietal cell was less as compared to chief cell (Fig.3). Similar observations were reported by Ghoshal and Bal (1989).

The parietal cells were largest polymorphic and present either singly or along the periphery of the gland with a centrally placed spherical nucleus and highly eosinophilic granulated cytoplasm. The base of the cell bulged outward from the external surface of the gland (Fig.3;inset). Eurell and Frappier (2006) reported the same in case of domestic animals. Chandana *et. al*. (2013) also reported that in albino rats, the parietal cells were pyramidal and largest cell type in gastric glands.

On the contrary, Chief cells were more numerous in the lower 2/3rd area of the fundic gland region and were squeezed between the parietal cells. The chief cells were pyramidal shaped with basally located spherical nuclei and intense basophilic cytoplasm. The area between the nucleus and free apical surface appeared vacuolated or clear that might be filled with zymogen granules in living state, since the lipid granules dissolves during tissue processing for paraffin sections (Fig.3;inset). Ghoshal and Bal (1989) also stated that in rabbit the lower three-quarters of the lamina propria of stomach consisted predominantly of chief cells. The chief cells had an average diameter of 9.675±0.23 μm and were smaller in size than the parietal cells. Chandana *et. al.* (2013) also reported that in rat the chief cells were comparatively smaller than the parietal cells.

Pyloric gland region:-
The pyloric gland region consisted of simple, branched tubular glands that were coiled at its base. These glands were short as compared to cardiac and fundic glands. The predominant cell types were typical mucous secreting cells with flat basal located nuclei and basophilic cytoplasm. Similar observations had been reported by Eurell and Frappier (2006) in domestic animals and Khalel and Ghafi (2012) in rabbits.

Micrometrical observations:-
The mean thickness of all the tunics had been tabulated (Table 1). The fundic gland region showed a significant increase in thickness of tunica mucosa from that of the cardiac and pyloric gland region. Similar observations had been reported by Khalel and Ghafi (2012) in rabbits. This might be due to the presence of more amounts of fundic glands in the lamina propria as compared to the other two regions. The tunica submucosa of pyloric gland region showed a significant increase in thickness from that of the other two glandular regions. Khalel and Ghafi (2012) also reported the micrometrical observations of rabbit stomach and mentioned similar value for the pyloric region but the values for cardiac and fundic regions were slightly higher than the present findings. It might be due to the breed character and body weight of the animal. The tunica muscularis of pyloric gland region showed a significant increase in thickness from that of the other two glandular regions which were similar with the reports of Neogy (2000). The tunica muscularis of cardiac gland region also increased significantly than that of the fundic region but was less thick as compared to the pyloric region. This might be the because of the need of higher muscular contraction at the pyloric region for propulsion of food particles towards the intestine. Similarly, the thickness was minimum at the fundic region where the food had to be retained for longer time for digestion. Likewise the thickness was more in the cardiac region than that of the fundic region to receive the food from the esophageal end.

Table 1:- Mean ± S.E. of micrometrical observations of different regions of stomach (μm).

Stomach	Tunica mucosa	Tunica submucosa	Tunica muscularis	Tunica serosa
Cardiac region	475.41 ± 23.024^{b}	55.11 ± 7.576^{a}	1049.73 ± 23.057^{b}	32.39 ± 4.564^{a}
Fundic region	629.56 ± 13.213^{c}	69.16 ± 4.555^{a}	207.8 ± 11.081^{a}	28.36 ± 2.414^{a}
Pyloric region	367.95 ± 37.102^{a}	172.06 ± 30.853^{b}	2304.96 ± 34.224^{c}	37.61 ± 8.376^{a}

N.B. – Mean Values bearing different superscripts in a column differ significantly, where $P<0.05$

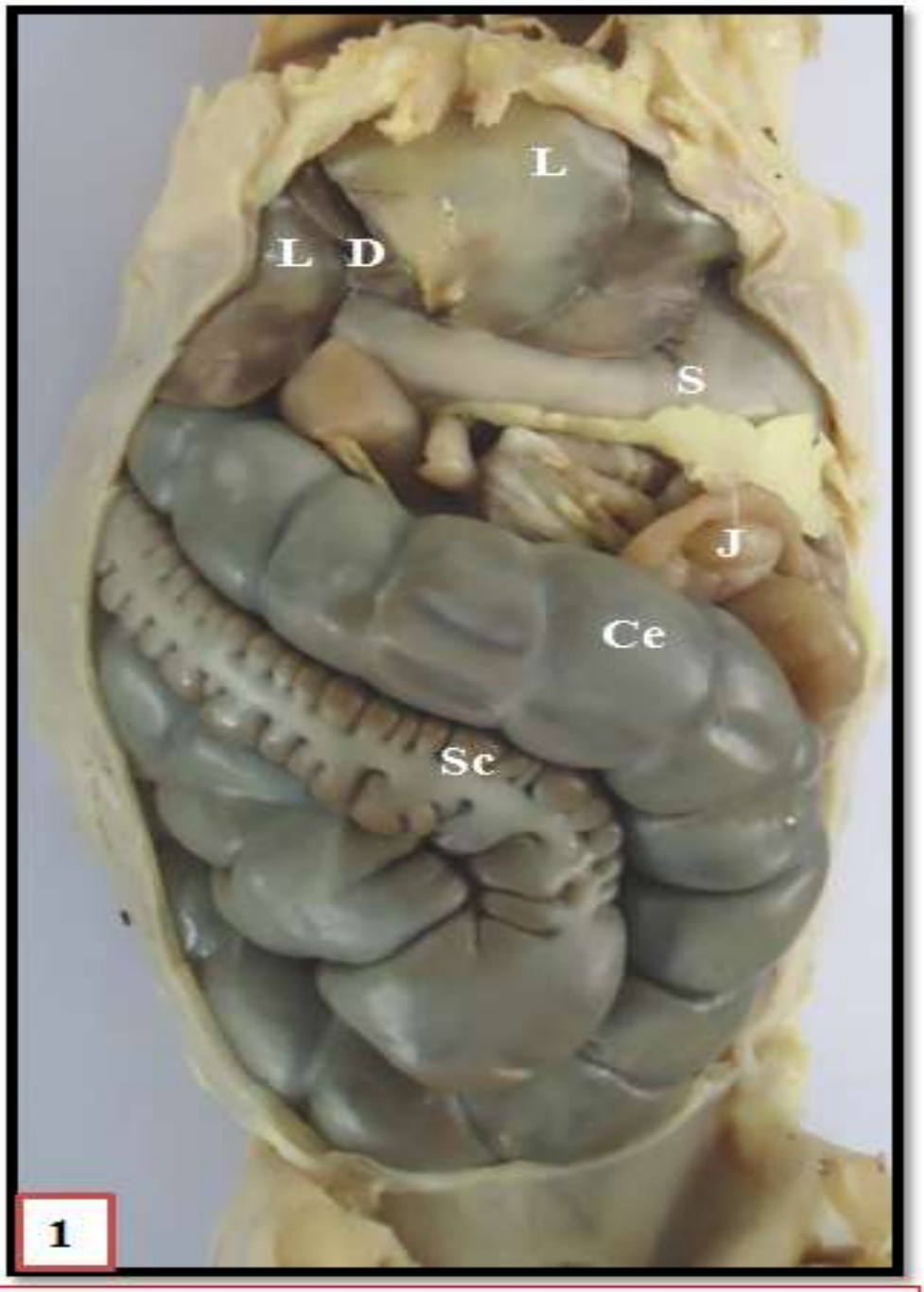

Fig. 1 Photograph showing the anatomical location of J-shaped stomach (S) after removing the ventral abdominal wall and relation with other organs like Duodenum (D), Jejunum (J), Caecum (Ce), Sacculated Colon (Sc) and Liver (L).

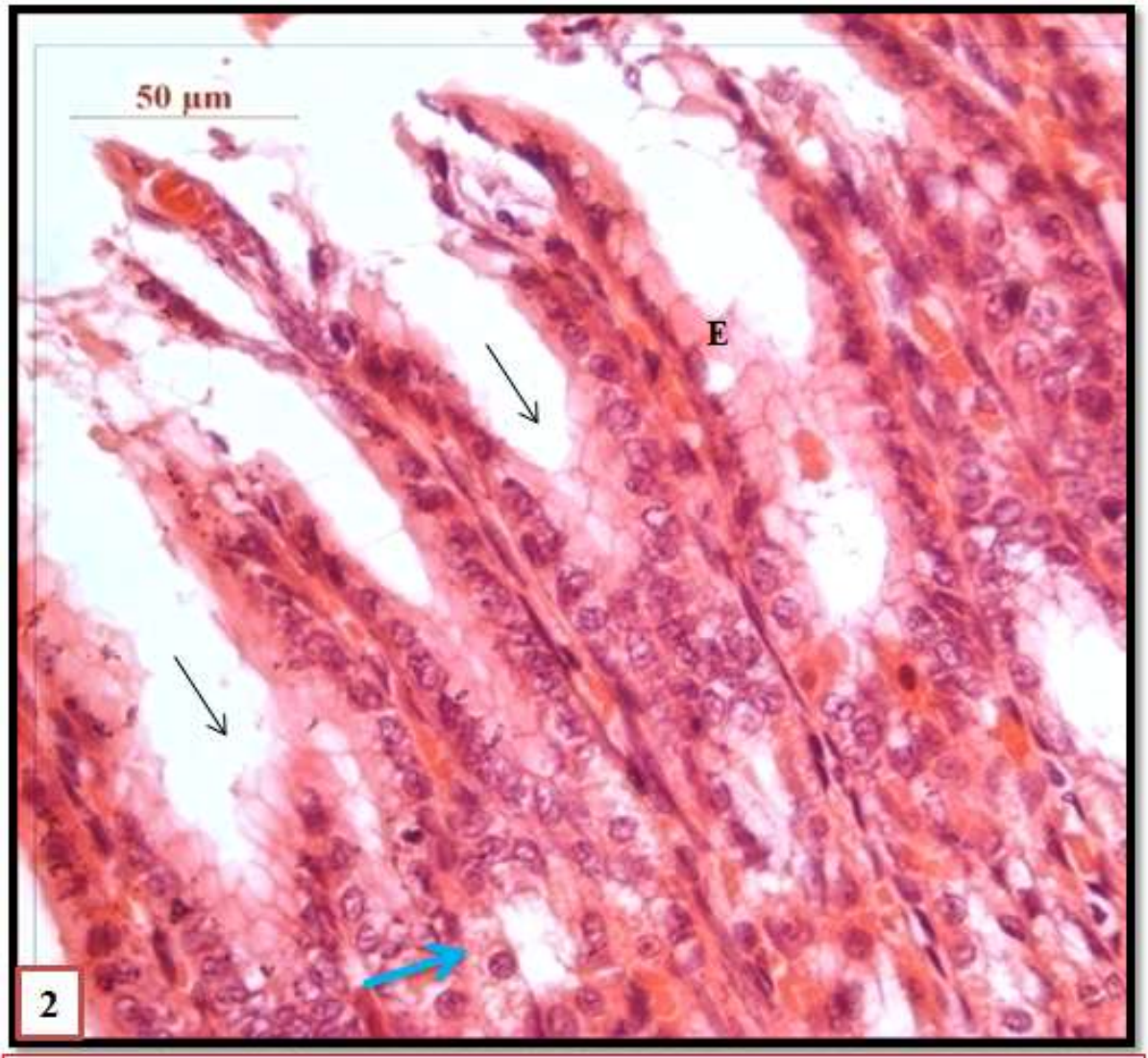

Fig. 2 Photomicrograph showing simple columnar epithelium (E), mucous neck cells (blue arrow) and shallow gastric furrows (black arrow) in cardiac region of stomach. H & E 40X

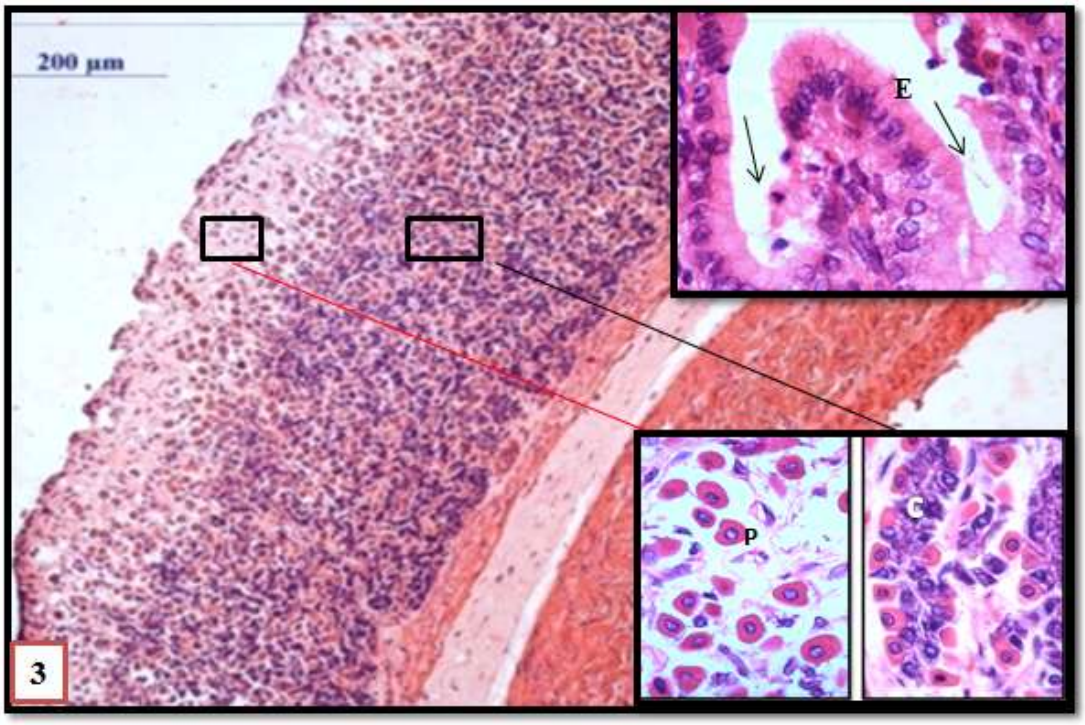

Fig. 3 Photomicrograph showing fundic gland region of stomach . H & E 10 X. [Inset 1: simple columnar epithelium (E) and shallow gastric furrow (arrow) H & E 40 X. Inset 2: Showing distribution of parietal (P) (upper 1/3rd ; red arrow) and chief cells (C) with peripheral parietal cells (lower 2/3rd; black arrow) in gland region. H & E 108 X.]

Fig.4 Photomicrograph showing elastic fibers (arrow) in the blood vessels and tunica serosa of stomach. Weigert's 20X.

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