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Histomorphological studies on the gizzard of Kadaknath fowl

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Abstract

The study was conducted in Kadaknath breed of fowl. The histomorphological studies of gizzard of kadaknath fowl revealed that kaolin was the innermost layer, protecting the luminal surface and secreted by the gizzard glands. The tunica mucosa was composed of various long mucosal folds like rodlets which was lined by low columnar epithelium. Lamina muscularis mucosae was absent. Three different types of cells were found in gizzard mucosa viz. chief cell, basal cells and surface epithelium. Gizzard glands were characteristically composed of a neck body and fundus. Chief cells were predominant in the gizzard gland. Basal cells were very few located at the fundus region of the glands. The propria submucosa was made up of mainly collagen and reticular fibers and less elastic fibers. The connective tissue septa extended between the glandular tubules and tunica muscularism giving a crisscross appearance. Tunica muscularis was composed of outer longitudinal, middle circular and inner oblique layer. The tunica serosa was consisted of connective tissue sheath, which was lined by mesothelial cells.

Keywords: Kadaknath fowl, gizzard, histomorphology

Introduction

The avian stomach is formed of two distinct parts; the glandular portion, gastric proventriculus or true stomach (ventricular glandularis) which is caudal to the esophagus and the muscular portion, gastric ventriculus or gizzard (ventriculus muscularis) which is located caudal to the proventriculus. The avian stomach is currently used as an indicator for a bird performance in many nutritional experiments (Aderolu *et al.* 2007; and Esuga *et al.* 2008) [2, 13]. The Kadaknath or Kali Masi is an Indian breed of chicken local to Jhabua and Dhar districts of eastern Madhya Pradesh, where it is known as "Kali masi" ("fowl having black flesh"). Due to its high protein and very low fat and cholesterol levels, it is in high demand. Its fat content is 0.73-1.03% compared to 13 to 25% in most other chicken breeds. Being a local variety it has lot of importance so a detail scientific inputs are essential to explore the basic information. Digestive system is a vital which need to be explored starting from its basic structural peculiarities and as there is paucity of literature pertaining to the study of non-glandular stomach of Kadaknath breed of fowl.

Materials and Methods

The present study was conducted in Kadaknath breed of fowl in the Department of Veterinary Anatomy, College of Veterinary & Animal Sciences, G.B. Pant University of Agriculture & Technology, Pantnagar. The birds were sacrificed by severing the carotid artery and jugular veins. Feathers were removed manually and the gizzard was carefully dissected out. Tissue samples were collected from the proximal, middle and distal part. Soon after collecting the tissue samples were fixed in 10% neutral buffered formalin. Tissue samples were processed for paraffin embedding and tissue sections (5-7 μ) were stained with H&E technique (Luna, 1968). Masson-tri-chrome, Gomori's, and Verhoeff's staining was done for the demonstration of collagen, reticular and elastic fibers respectively.

Results and Discussion

The gizzard of kadaknath fowl found to be consisted of inner cornified layer, tunica mucosa, very thin tunica submucosa, thick tunica muscularis and tunica serosa. The inner cornified layer was an amorphous thick keratinized layer lining the lumen of the gizzard, produced by the straight tubular gizzard glands (Fig. 1, 2, 7). These observations are in agreement with the observations recorded by Hodges (1974) [5]; Kind and McLelland (1975) [7]; Dellmann

(1993) ^[4]; McLelland, 1979 and Prasad and Kakade (1990, 1992) ^[16]; Rocha and De Lima, (1998) ^[17]; Ahmed, YAEG *et al.* (2011) ^[18] and Kausar, R. *et al.* (2016) ^[19] in Japanese Quail. Though Bradley and Grahame (1960) ^[9] stated that kaolin layer was made up of the keratohy line material. Lei Zhu, 2015 ^[15] also reported the presence of kaolin layer at inner most lining of gizzard of black tailed crane. The secretions of the gizzard glands showed a pattern of parallel striations (Fig. 1, 5). These observations are in accordance with the observations reported by Bradely and Grahame (1960) ^[9]; Dellmann (1993) ^[4]; McLelland, 1979; and Prasad and Kakade (1992). In the present investigation the wavy mucosa was characterized by straight tubular gizzard glands. Secretions of the glands mostly shed in the crypt between the folds and fell into the koilin (Fig. 5). Lei Zhu, 2015 ^[15] reported the presence of sulci in the mucosal folds and which were the opening of the glandular secretion in black tailed crane. The gizzard mucosa in the investigation was lined by the low columnar epithelium with basal nucleus. (Fig. 2). Similar observations were also recorded by Abbas Lafi Batah 2012 ^[3] in coot bird. Ahmed, *et al.* (2011) ^[18] reported glands were lined with columnar epithelium with rounded vesicular basal nucleus and lightly acidophilic cytoplasm. Muscularis mucosa was formed of circularly arranged smooth muscle fibers. Lei Zhu in black tailed crane reported high-columnar cells with basal nuclei. The lamina propria mucosae was composed of round gizzard glands which were simple tubular and arranged in groups separated by collagen and reticular fibers (Fig. 3). These observations were in agreement with the observations recorded by Bradely and Grahame (1960) ^[9]; Bank (1993); Hodges (1974) ^[5]; Kind and McLelland (1975) ^[7]; Dellmann (1993) ^[4]; McLelland (1979); Prasad and Kakade (1992). The distinct lamina muscularis mucosae was not observed in the present study which was in agreement with Lei Zhu, 2015 ^[15] and Yasser Abd El-Galil Ahmed 2011 ^[18] in Japanese quail. In the present investigation the tunica mucosa and tunica muscularis were blended together and so the tunica submucosa was not distinct in which was supported by Abbas Lafi Batah (2012) ^[3] in coot bird. In the present study the apical surface of the epithelium tends to bulge into the lumen. The large round nucleus of the epithelium was located towards the base (Fig. 2). These observations were in agreement with the observations and conclusions of Toner (1964) ^[6]. In the present investigation gizzard glands showed fragmented translucent, material into the lumen which was also accumulated on the mucosal surface of the gizzard. (Fig. 3). These observation were in accordance with the observations reported by Bradley and Grahame (1960) ^[9] in fowl. The gizzard glands were consisting of neck, body and an expanded fundus (Fig. 4). The gland epithelium was composed of chief cells, basal cells and surface epithelium in the present study. The chief cells were cuboidal in shape and their nucleus was more or less rounded in shape (Fig. 4). Toner (1964) ^[6] discussed four types of cells i.e. basal cells, chief cells surface cells and intermediate cells. Basal cells were present at the fundus of the glands and were few in number found mostly in pairs. The basal cell had pale cytoplasm and large round nucleus (Fig. 4). The observations about the chief cells and basal cells were consistent with the observations and conclusions drawn by Hodges (1964); Toner (1964) ^[6] and Aitken, (1958) ^[1]. The propria submucosa was mainly composed of connective tissue fibers such as collagen

fibers, reticular fibers and few elastic fibers. While Rocha and De Lima, (1998) ^[17] reported the absence of tela submucosa in burrowing owl. The connective tissue septa extended between the glandular tubules and tunica muscularis (Fig. 5, 6). These observations were in agreement with the observations reported by Prasad and Kakade (1992) in duck and McLelland (1979). Das and Biswal (1967) reported that this type of arrangement might be useful for firm attachment with muscular tunic and the mucous membrane, which provide a firm basis for grinding action of the gizzard. The tunica muscularis was made up of smooth muscles arranged in three planes as outer longitudinal, middle circular and inner oblique layer (Fig. 7). Similar observations were reported by Hodges, (1974) ^[5]. Bradley and Grahame (1960) ^[9]; Hodges (1974) ^[5]. Dellmann (1976) reported a single thick layer of parallel muscle fibers that spreads from two aponeurosis at the centre of the gizzard. Trautmann (1957) reported that the wall of the gizzard was composed of bundles of smooth muscle fibers. King and McLelland (1975) ^[7] noticed that the wall of the gizzard was made up of smooth muscle fibers arranged in four distinct semitononomous masses, while Prasad and Kakade (1992) reported that it consisted mainly of circularly oriented smooth muscle fibers with intensive connective tissue septa between the muscle bundles. whereas Rocha and De Lima, (1998) ^[17] reported There was well developed tunica muscularis gastris with thick inner and outer layer. Abbas Lafi Batah (2012) ^[3] reported internal circular and external longitudinal muscle layers of gizzard in coot bird. Ahmed, *et al.* (2011) ^[18] reported Muscularis mucosa was formed of circularly arranged smooth muscle fibers in Japanese quail. The tunica serosa was external to the tunica muscularis. It was consisted of mesothelial lining and connective tissue with blood vessels and nerve fibers (Fig. 8). These observations are consistent with the findings of Dellmann (1976) and Prasad and Kakade (1992); Banks (1993) ^[8] and McLelland (1975) ^[7] Abbas Lafi Batah (2012) ^[3] in coot bird.

Photographs

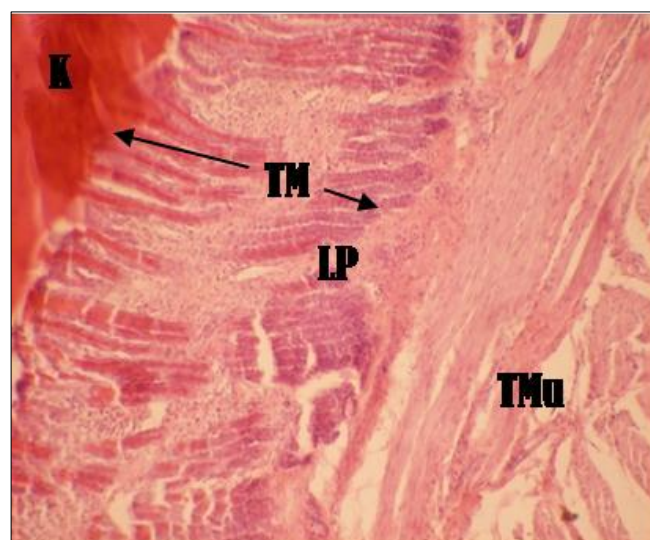


Fig 1: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing kaolin layer (K), tunica mucosa (TM), lamina propria (LP) and tunica muscularis (TMu) and gastric pits (P) accumulating the secretion (H&E X200)

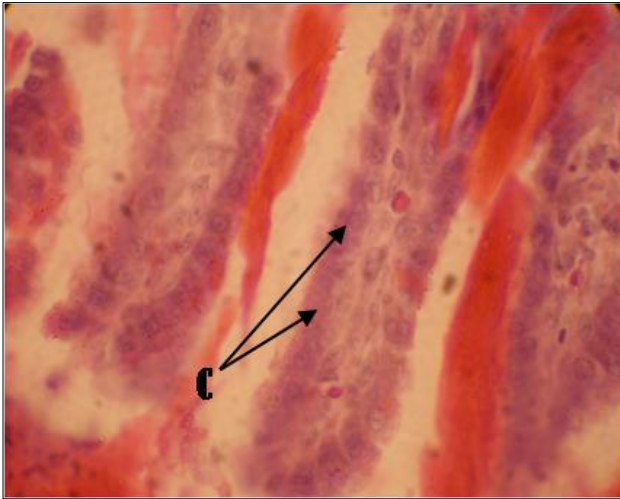


Fig 2: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing low columnar surface epithelium (C) (H&E X1000).

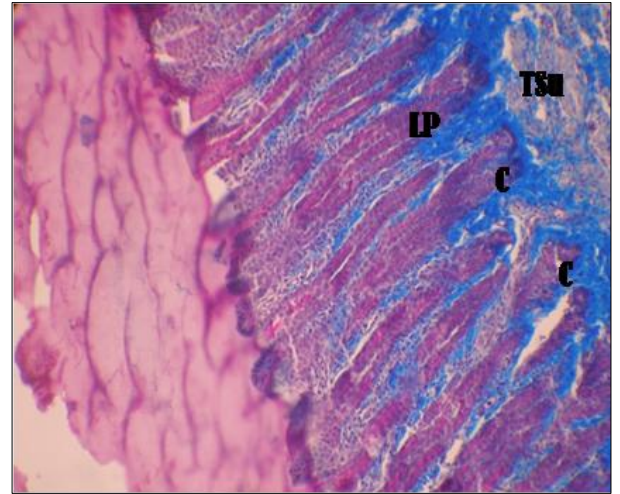


Fig 5: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing collagen fibers (C) in the lamina propria(LP) and propria submucosa (TSu)(Masson's Trichrome Stain X200)

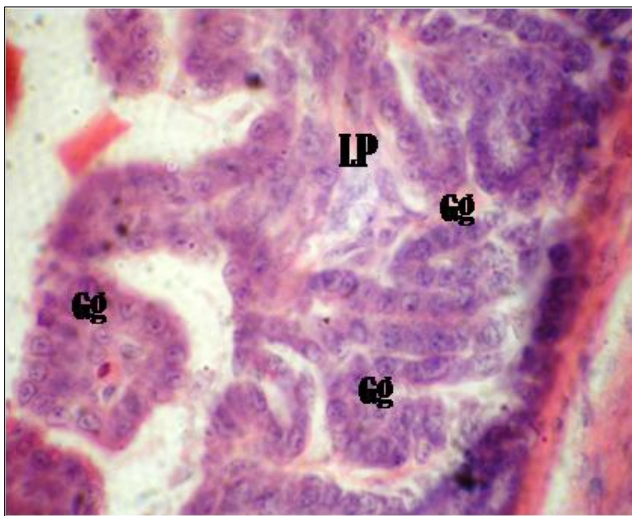


Fig 3: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing gizzard glands (Gg) in the lamina propria (LP) (H&E X1000).

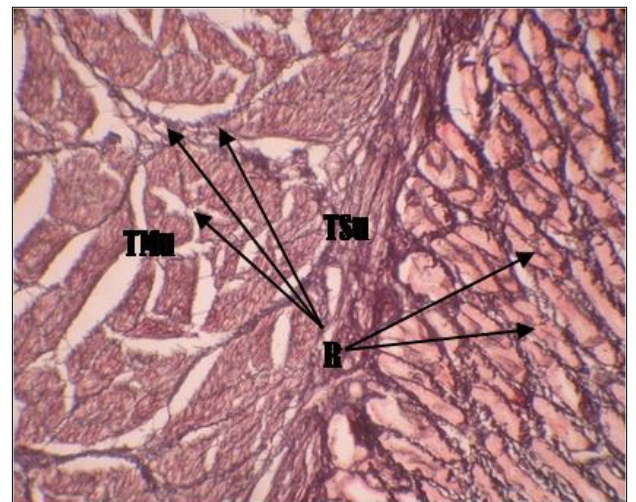


Fig 6: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing reticular fibers(R) in the lamina propria(LP) , propria submucosa (TSu)and tunica muscularis (TMu) forming criss cross pattern(Gomori's Stain X200).

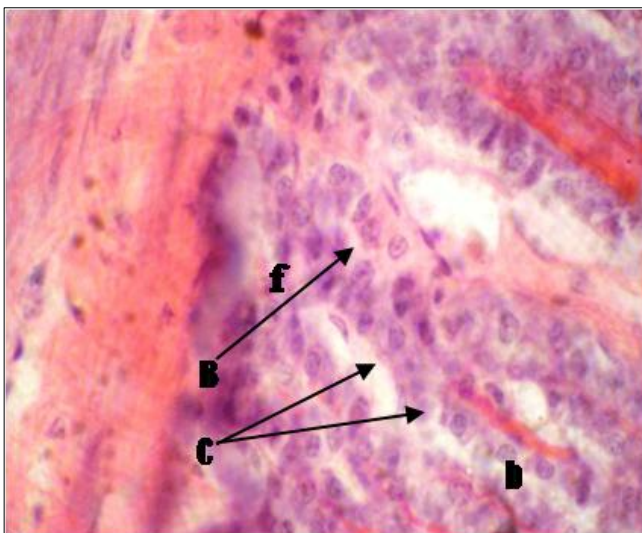


Fig 4: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing body (b), fundus (f) of gizzard gland , chief cells (c) with rounded nucleus and basal cells (B) with pale cytoplasm (H&E X1000)

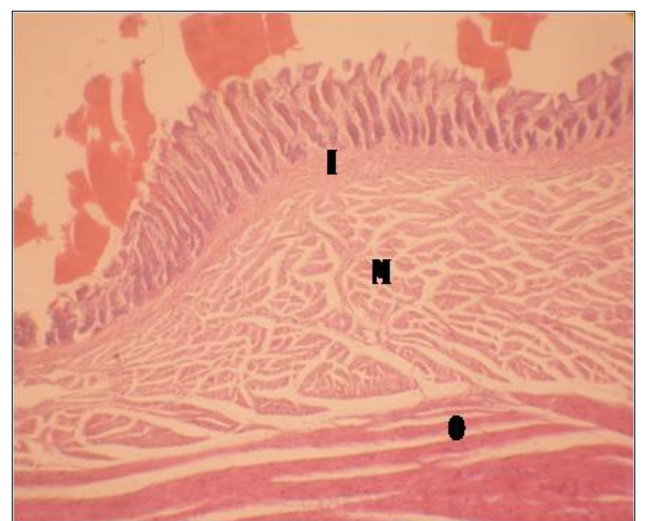


Fig 7: Photomicrograph of gizzard of 7 days old Kadaknath fowl showing inner oblique (I), middle thick circular (M) and outer longitudinal (O) muscle layers of tunica muscularis (TMu) (H&E X100).

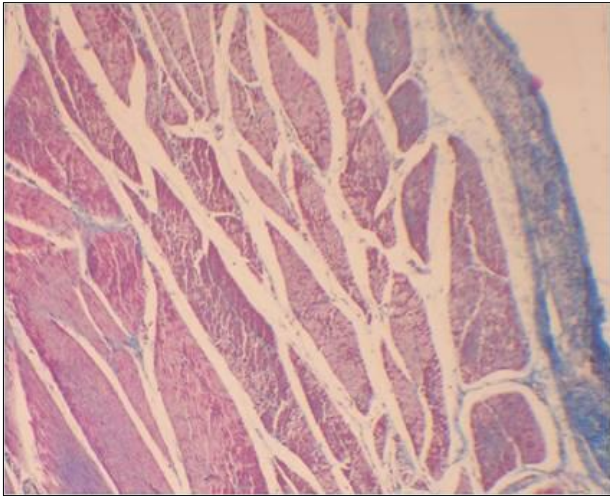


Fig 8: Photomicrograph of gizzard of 112 days old Kadaknath fowl showing tunica serosa (TS) containing collagen fibers (Masson's Trichrome Stain X100).

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