



■ Author(s)

Baygeldi SB¹  <https://orcid.org/0000-0002-4403-8663>
Güzel BC¹  <https://orcid.org/0000-0002-2504-120X>
Ilgın R²  <https://orcid.org/0000-0003-0150-3008>
Özkan E¹  <https://orcid.org/0000-0001-5213-958X>

¹ Firat University, Faculty of veterinary, Department of anatomy, Elazığ, Turkey.

² Aksaray University, Faculty of veterinary, Department of anatomy, Aksaray, Turkey.

■ Mail Address

Corresponding author e-mail address
Barış Can Güzel
Firat University, Faculty of veterinary,
Department of anatomy, Elazığ - 23100 -
Turkey.
Phone: +90 5331375393
Email: bcguzel@hotmail.com

■ Keywords

Anatomy, Digestive system, Embden goose, SEM.



Macroanatomy of Cecum in German Mast Geese (*Anser Anser*) and Investigation with Scanning Electron Microscope (Sem)

ABSTRACT

Our study aimed to compare the cecum of German mast geese with other poultry species through macroanatomy and scanning electron microscope (SEM). Adult German geese were used as research material, which were obtained from its breeders and died of various causes. In the study, after determining the macroanatomical features of the German mast goose cecum, it was examined with a scanning electron microscope (JEOL JSM-5600LV) and the general structures were photographed. The craniodorsal of the rectum of German mast geese was shaped with two ceca, giving right and left arms to the cranial symmetrical to each other near the end of the ileum. The macroanatomy of the apex, corpus, and basis cecum parts was examined in the cecum divided into two. In the study, it was determined that villus extensions were sparse in the right and left apex ceci parts in the cecum SEM images of the German mast geese, while the number of the corpus and basis ceci parts was higher.

As a result, the macroanatomy and scanning electron microscopic findings of German mast geese cecum were examined in detail and its differences from other poultry species were revealed.

INTRODUCTION

Goose is a large bird species that forms the genus *Anser* from the Anatidae family of the goose (*Anseriformes*) order (Tan & Özdemir, 2020; Tan, 2015). Due to different needs and consumption purposes, such as goose farming meat, liver, and feathers, the importance of this bird has increased among poultry in different regions of the world. German mast geese are a breed belonging to Germany, also known as Embden (Emden) goose (Evcil kaz, 2021). It is a goose breed with white feathers, upright posture, orange-colored beak and legs (Tan, 2015; Al-Sharoot, 2016). Since the Embden goose is very valuable in terms of meat production in recent years, it is cultivated in many parts of the world (Tan, 2015; Evcil kaz, 2021). The digestive system anatomy of domestic birds is quite different from other mammals. Moreover, it has been reported that there are many structural differences among poultry according to their species and feeding habits (Getty, 1975; Elsheikh *et al.*, 2014). Many studies on macroanatomical and SEM studies of different poultry species cecum can be encountered in the literature (Ilgun *et al.*, 2017; Li *et al.*, 2018). The cecum has the characteristics of digesting cellulose and being the organ from which immune system cells are produced in the poultry digestive system (Karadağ & Nur, 2002; Potter *et al.*, 2006). Although the shape and location of the cecum differ anatomically according to the poultry species, it has been reported that cecum is not present in poultry families such as apodiformes, columbiformes, cuculiformes, piciformes, and psittaciformes (Doğuer & Erençin, 1964;



Nomenclature, 1993; Ilgun *et al.*, 2017). Cecum in poultry lies between the ileum and the colon, curved to the left and right. Its form is that of a closed tube with its length and dark green appearance. (Abas, 2013). The cecum consists of three parts: apex, corpus, and basis (McLelland, 1990; Karadağ & Nur, 2002; Haligür, 2008). Apex ceci tilts to the right and left depending on the species.

The head is in the form of a blind pouch. (Tasbas, 1978; McLelland, 1989; Karadağ & Nur, 2002). While the corpus ceci is a short median part, it has a weak and thin lumen (Nickel *et al.*, 1977; Karadağ and Nur, 2002). The basis ceci part forms the long part of the cecum, with its thick wall and narrow lumen appearance (Chen *et al.*, 2002; Abas *et al.*, 2013; Karadağ & Nur, 20021). The cecum is connected to ileum by the ligamentum ileocecale (Nickel *et al.*, 1977; Haligür, 2008). There are various studies in the literature (McLelland, 1989; Chen *et al.*, 2002; Ilgun *et al.*, 2018) with SEM findings of the cecum.

The main purpose of the study is to make a scientific contribution to activities such as research, crossbreeding, and breeding for geese of various species in light of findings to be obtained from the macroanatomical and SEM images of the German mast goose cecum.

MATERIALS AND METHODS

The ceca of geese with an unknown cause of death were examined. Morphological examination of the cecum was performed after dissection of the research material. Cecum tissue samples taken for scanning electron microscope (SEM) images were modified by the methods of Chen, Hsu, & Hsu, (Chen *et al.*, 2002) and Erdoğan & Alan (Erdogan & Alan, 2012). Parts of apex, corpus, and basis ceca were kept in 10% formaldehyde for 24 hours. After washing with 0.1 M PBS (Phosphate buffer solution) 2 times for 10 minutes, they were kept in 2.5% glutaraldehyde for 6 hours and washed 5 times in 0.1 M buffered buffer solution. They were left to stand for 10 minutes in 25%, 50%, 75% and 100% Ethyl Alcohol series. After drying and coating process in the incubator, their images were taken with a SEM (JEOL JSM 5600 LV) located at the Eskişehir Osmangazi University Central Research Laboratory Application and Research Center. Nomina Anatomica Veterinaria (ICVGAN, 2017) and Nomina Anatomica Avium (Baumel *et al.*, 1993) were used for writing terminological expressions.

ETHICAL APPROVAL

This study was carried out in accordance with the ethical rules set forth by decision numbered 2020/14, which was taken by Firat University Animal Experiments Local Ethics Committee. Geese were obtained from German Mast goose breeders in Elazığ province.

RESULTS

Macroanatomical result

The cecum of the German mast goose was between the craniodorsal of the gray rectum and the end of the ileum, and was located in two curved extensions on the right and left. These two folds were closed at the ends and there were two ceca towards the cranial. It is anatomically located in the ventral of Cavum abdominis. It was determined that it is connected to the ileum through the ligamentum ileocecale. Apex, corpus, basis ceci bodies were present in both ceca. Right and left apex ceci were determined to be long and flat. The cecum formed a common path with the last part of the ileum and opened to the rectum with a short colon course after the ostium cecum opening. (Figure 1).

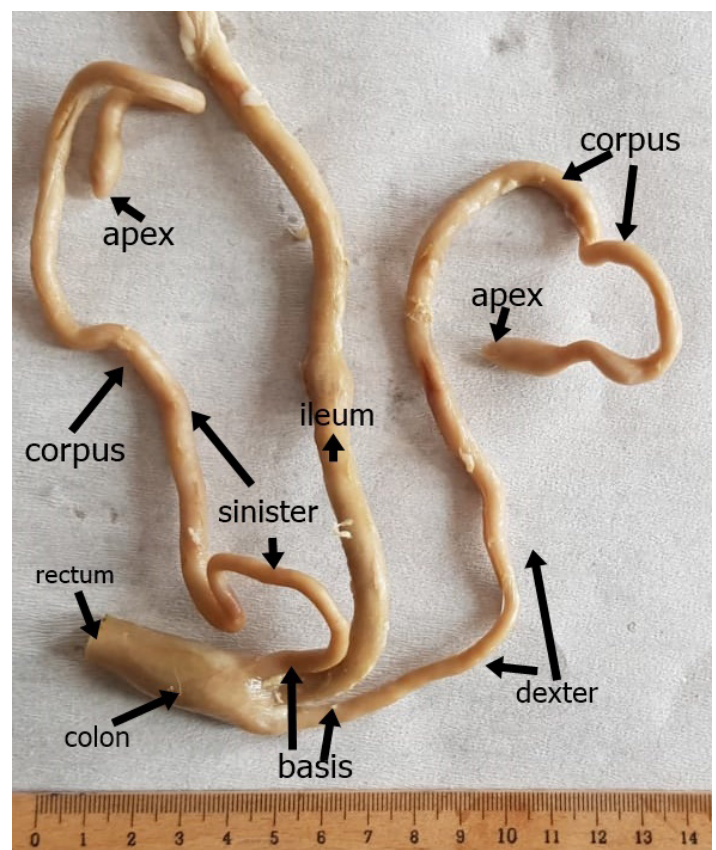


Figure 1 – Macroanatomical view of Cecum.



Scanning electron microscope (SEM) result

SEM images of the apex, corpus, and basis ceci parts of the German mast excavation right and left cecum were examined. The villi in the cecum formed finger-shaped extensions towards the lumen. While these extensions were sparse in the right and left apex ceci parts, it was determined that there were more in the corpus and basis ceci parts. The serous and muscular layers were evident in all parts. Epithelium was densely detected on the corpus ceci.

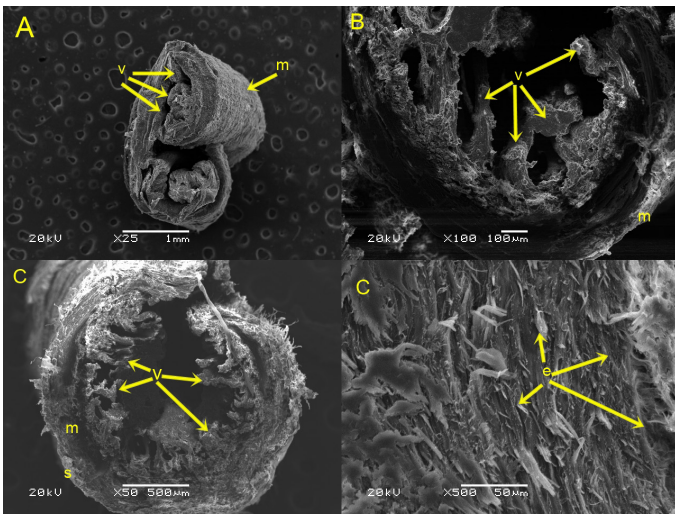


Figure 2 – SEM views of Cecum. A. Apex ceci, B. Basis ceci, C. Corpus ceci. v.villi, e. Epithelial tissue, m. Tunica muscularis, p. Serosa layer.

DISCUSSION AND CONCLUSION

It has been reported that the cecum in poultry is dark green, and its right and left ends are closed as a tube, between the ileum and the colon (Abas *et al.*, 2013). The research material was also found in the cecum gray, cavum abdominis in German mast geese and showed other similar findings.

Ilgün *et al.* (Ilgun *et al.*, 2018) reports that the cecum of the guinea fowl has a more pointed left apex ceci, while the right apex ceci is longer and flattened. No difference was observed in the right and left apex ceci in German mast geese.

Doğuer & Erençin, (Doguer & erencin, 1964), Nickel, *et al.* (Nickel *et al.*, 1977) and Karadağ & Nur, (Karadağ & Nur, 2002); reported that the cecum is attached to the ileum by the ligamentum ileocecale in poultry. Studies show that there is a similar connection in the German mast goose, they reported that the cecum consisted of three main parts: apex, corpus, and basis. Cecum, apex, corpus reported that it consists of three parts on a basis (Mclelland, 1989; Karadağ & Nur, 2002; Haligur, 2008). In German mast goose, the cecum similarly consisted of three parts.

Nickel *et al.* (Nickel *et al.*, 1977) and Mclelland, (Mclelland, 1989) reported that the basis cecum in parrots, swallows, and pigeons followed a short course to the caudal and opened to the rectum. Barnes & Thomas (26) reported that in owls, the cecum expands towards the caudal rectum.

Gosomji *et al.* (Gosomji *et al.*, 2015) reported that the 12-13-day-old guinea fowl cecum was opened to the rectum without forming a colon, and the coloproctum was opened to the cloaca by reaching out to the ileum in the distal region in a small way. In the German mast goose, both ceca formed a common path attached to the last part of the ileum. After the ostium ceci opening, it opens to the rectum with a short colon course.

Chen *et al.* (Chen *et al.*, 2002), when analyzing SEM images of the cecum in White Roman geese, reported that the villi are finger-shaped extensions in the filamentous shape and structures. Moreover, it was determined that the length of the villi in the apex ceci part decreased. It was observed that the surface epithelium in the corpus ceci had a circular structure.

Ilgün *et al.* (Ilgun *et al.*, 2018) reported that in SEM images of guinea fowl cecum, the extensions of the villi in the lumen surround the lumen in a tight and circular manner. The SEM findings of the German Mast goose cecum were also similar to those of White Roman geese and Bec chicken cecum.

AUTHORS' CONTRIBUTION

RI and BB conceived and designed the research. BCG and BB performed the material preparation and experiments. BCG and BB performed the data collection and analysis. RI and BB drafted the manuscript. All authors read and approved the final manuscript.

FINANCIAL SUPPORT

This research received no grant from any funding agency/sector.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

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