# MORPHOLOGY OF THE CAECA OF THE AFRICAN PIED CROW (*Corvus albus*)

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## ABSTRACT

***The objective of the present study was to provide basic information on the gross and histomorphology of the caeca of the African pied crow, a corvid found in close association with human settlements in many African countries. The caeca of the African pied crow appeared as small blind-ended sacs of approximately the same size, which extend from the junction between the small and large intestines. Each caecum was positioned at an acute angle with the ileum. Histology of the caeca revealed the presence of many lymphoid aggregations and glandular acini in the lamina propria mucosae and submucosa. It was concluded that the morphological features of the caeca of the African pied crow may represent structural specializations to support the role of the caeca in digestion of small food particles and more importantly, in the response of the African pied crow to invasion by antigens.***

**Keywords:** African pied crow, Avian caeca, Gut-associated lymphoid tissues

## INTRODUCTION

The African pied crow, a member of the family *Corvidae* is characterized by a glossy black plumage interrupted by a large area of white feathering from the shoulder down to the lower breast, and is commonly found in close association with human settlements in many African countries (Hartwig and Morel, 1997). The African pied crow is omnivorous and feeds by scavenging for food in garbage dumps and by foraging on the ground for diet of invertebrates, fruits, vegetables, reptiles, amphibians, small birds and mammals. Management of African pied crows in captivity is handicapped by paucity of biomedical data. As a consequence, the present study was designed as part of a comprehensive research programme including anatomical and pharmacological studies on the African pied crow. An understanding of the anatomy of components of the digestive tract of the African pied crow would prove useful in relation to medical, surgical and nutritional management of these birds, especially in captivity. This is particularly important in the present time when there is increased interest in keeping African pied crows as pets.

The digestive tract of most birds contains a pair of fingerlike out-pocketing that project from the proximal colon at its junction with the small intestine. These avian caeca are blind-ended sacs that may serve as sites for several different functions, especially digestion of small food particles, absorption of nutrients, production of antibodies, microbial action of beneficial and pathogenic organisms, utilization and absorption of water, and metabolism of uric acid into amino acids (Clench, 1999). The two caeca are situated opposite each other and

open into the lateral colon opposite one another (Mclelland, 1989). Among birds, the caeca may range in size from very large to very small or may be entirely absent (Clench and Mathias, 1995). The purpose of our study was to provide basic information on the morphology of the caeca of the African pied crow.

## MATERIALS AND METHODS

**Experimental Animals:** Ten adult African pied crows used for this study were obtained from the Zoological Garden, University of Nigeria, Nsukka. The birds were sacrificed by euthanasia. Euthanasia was achieved by administering 500 mg/kg body weight of phenobarbitone to each bird via the intravenous route.

**Gross Anatomy:** Following death, the digestive tract was dissected and the caeca were studied in terms of their shape, physical appearance and in-situ topographical relationships. Gross photographs of the caeca were captured with a Yashica 7.1 mega pixels digital camera.

**Histological Preparations:** Specimens of the caeca were cut and fixed by immersion in Bouin's fluid for 48h. Later, these specimens were dehydrated in graded concentrations of ethanol, cleared in xylene and embedded in paraffin wax. The 5 µm thick sections were cut, mounted on glass slides, and stained with hematoxylin and eosin for light microscopy. Photomicrographs were captured using Moticam Images Plus 2.0 digital camera.

## RESULTS

**Gross Anatomical Features:** The digestive tract of the African pied crow included two caeca. These appeared as blind-ended sacs of approximately 5 cm in size, which extend from the junction between the small and large intestines (Figure 1). Each caecum was positioned at an acute angle with the ileum, and the tip of the caecum was directed cranially. These caeca were rather very small in size in comparison to other components of the digestive tract of the African pied crow.


**Figure 1: The ventral surface of the digestive tract of the African pied crow showing two very small caeca (arrow). Note the jeunum (J), ileum (L) and large intestine (asterisk)**

The two caeca opened via separate orifices into the ventro-lateral aspects of the junction between the ileum and the colon.

**Histological Features:** The tunica mucosa of the caecum of the African pied crow was lined by simple columnar epithelium. The connective tissue of the lamina propria mucosae under this epithelium was continuous with the tunica submucosa. Both the lamina propria mucosae and the submucosa were filled with very many lymphoid aggregations (Figure 2).

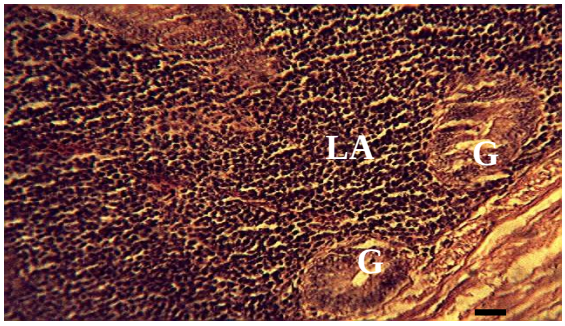


**Figure 2: Photomicrograph of the tunica submucosa of the caecum of the African pied crow showing lymphocytic aggregations (LA) and acini of glands (G). Scale bar = 15 µm**

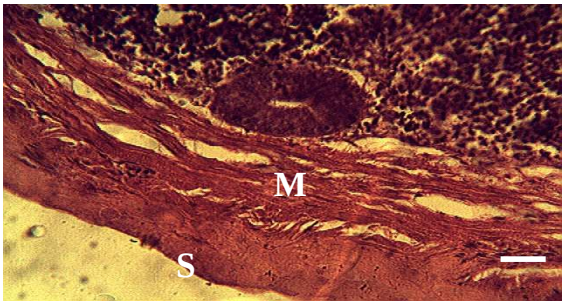


**Figure 3: Photomicrograph of the tunica muscularis and tunica serosa of the caecum of the African pied crow showing layers of smooth muscle fibres (M) and connective tissue of the serosa (S). Scale bar = 15 µm**

Intermingled among these lymphoid aggregates were some glandular acini. The tunica muscularis was composed of few layers of circularly arranged smooth muscle fibres (Figure 3). This layer contained blood vessels. The tunica serosa appeared as a layer of connective tissue lined by mesothelium, a simple squamous epithelium.

## DISCUSSION

The caeca of the African pied crow are very small in size. This may be related to the diet of these birds. The avian caeca are presumed to be sites into which indigested food may be directed for microbial fermentation of cellulose and other constituents of the diet (Miller, 1976). Thus, many authors (Fenna and Boag, 1974; Gasaway, 1976; Kehoe *et al*., 1988) suggested a distinct relationship between the size of the caeca and the kind of diet consumed by the particular species of birds. A positive correlation of length of caecum with the number of raw fibre in diet has been demonstrated with particular reference to representatives of the order Galliformes (Miller, 1976; Pulliainen, 1976). This interrelationship is a result of already well-known digestion function of the caeca in this group of birds. On the other hand, Barnes and Thomas (1987) showed that predatory species of birds, with no indigestible carbohydrates in their diet, were characterized with poor caeca development. It follows therefore, that the function played by the small-sized caeca of the African pied crow in the digestion process may not be large. Furthermore, the position of the caeca of the African pied crow, which are at acute angles with the ileum, may serve to ensure that only very little amount of food particles enter the caeca. Apparently, most of the free mono- and disaccharides and amino acids are completely digested and absorbed in the small intestine (Riesenfeld *et al*., 1980; Southgate, 1995). However, the presence of glands in the submucosa of the caeca of the African pied crow suggests that some degree of enzymatic breakdown of food particles may take place in the caeca.

The occurrence of aggregates of lymphoid cells in the lamina propria mucosae and submucosa of the caeca of the African pied crow was observed in this study. This is an indication that the caeca may play very important roles in immune responses in this species of birds. The occurrence of lymphoid cells in association with the avian caeca has been previously reported (Gómez del Moral *et al*., 1997; Kitagawa *et al*., 1998). Lymphoid cells present in the caeca are important components of gut-associated lymphoid tissues (GALT), which are comprised of several types of cells including specialized inducer, immunoregulatory and effector cell types distinct from their counterparts in the systemic immune system (Friedman *et al*., 1994). Development of lymphoid follicles in the avian gut has been associated with gut colonization by microflora (Honjo *et al*., 1993). In most birds, contact with microflora occurs in the distal intestine due to the fermentative nature of the caeca (Kitagawa *et al*., 1996). Lymphoid follicles present in the caeca of the African pied crow may be the centre for generation of primary immune responses. Such primary responses may become systemic insofar as the locally produced antibodies are found in the plasma. In addition, effector cells from the caeca may migrate to other parts of the gut and be responsible for the protection of the gut. This is important because the digestive tract is very much in contact with the external environment. Retrograde peristalsis of the colon has been attributed to the need to improve water reabsorption from urine (Clench, 1999). It has been suggested that this retrograde peristalsis may also serve an immunological purpose, to sample antigen material from the exterior and present the rectally-derived external material to the immunologically active caeca (Bar-Shira and Friedman, 2005). The wall of the caeca of the African pied crow contains a tunica muscularis of smooth muscle fibres. Contraction of these smooth muscles may serve to propel immunoglobulins (antibodies) and other materials from the caecal lumen into other segments of the gut.

In conclusion, the morphological features of the caeca of the African pied crow

may represent structural specializations to support the role of the caeca in digestion of small food particles and more importantly, in the response of the African pied crow to invasion by antigens.

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