Global Veterinaria 9 (2): 192-195, 2012
ISSN 1992-6197

DOI: 10.5829/idosi.gv.2012.9.2.6460

Scanning Electron Microscope Study of the Dorsal Lingual Surface of *Halcyon smyrnensis* (White Breasted Kingfisher)

Neveen E.R. El-Bakary

Department of Zoology, Faculty of Science, New Damietta, Egypt

Abstract: The aim of this study is to examine the dorsal lingual surface of species of the order Coraciiformes; the white breasted kingfisher belongs to family Alcedinidae using scanning electron microscopy and compare the previous reports on other birds. Three parts are recognized in the dorsal surface of the tongue of the investigated species: the apex, the body and the root of the tongue. In the dorsal surface of the tongue of the white breasted king fisher, many pointed processes directed backwards and from the anterior to the posterior end of the tongue. The lingual glands opening in the white breasted kingfisher are found as one raw around the larynx opening and as four longitudinal rows in front of the larynx opening. Therefore, the differences in the structures of the tongue in the investigated species may be reason of the differences in its feeding habits.

Key words: Scanning Electron Microscope Study · Dorsal Lingual Surface · Birds

INTRODUCTION

Morphological studies on the structure of the tongue in birds have been conducted on a small number of species, i.e. chickens, parrot, geese, eagle, cormorant, owl, peregrine falcon, common kestrel, oriental scops owl and hoopoe [1-9].

The previous studies indicate that the tongue of birds is a triangular organ fills the whole lower part of the bill. The tongue of birds is divided into the apex, the body and the root. Morphological studies on birds indicated a close correlation of the form of the tongue, the structure of the epithelium of the mucosa and its skeletal apparatus with the method of food intake and the type of food and habitat [7, 8, 10-13].

Generally, there are no extensive microscopic studies concerning birds living in the wild. Emphasis should be put in this respect on a study on the African grey parrot [1], studies describing the morphology of the tongue in penguins [14] and a study on the white tailed eagle [4].

No anatomical, histological and scanning electron microscopic studies of the tongues of *Halcyon smyrnensis* (white breasted kingfisher) have been carried out. The purpose of this study is therefore, to examine the dorsal lingual surface of one species of the order Coraciiformes using scanning electron microscopy and compare the previous reports on other birds.

MATERIALS AND METHODS

The tongues of the family Alcedinidae (kingfishers) includes *Halcyon smyrnensis* were used in this study were collected besides the Mediterranean Sea near Damietta-Egypt. The tongues were fixed in 10% formalin, post fixed with 1% osmium tetroxide for 1h. Thereafter, the specimens were dehydrated through graded series of ethanol and critical point dried. To show the three dimensional connective tissue structure of the lamina propria of the mucosa, some samples were washed in distilled water after fixation and macerated in 10% NaOH at room temperature for 4days. After maceration tissues were washed in several changes of the distilled water and post fixed in 1% osmium tetroxide in cacodylate buffer at room temperature for 1h and once again washed three times in distilled water, dehydrated in a series of ethanol and critical point dried [6]. All specimens were mounted on aluminum stubs covered with carbon tabs, sputtered with gold and observed under JEOL scanning electron microscopy (JSM-5300) at an accelerating voltage of 15kv in Alexandria University.

RESULTS

The tongue of the white breasted king fisher is about 2.5 cm long. Three parts are recognized in the dorsal surface of the tongue of the investigated species: the

Corresponding Author: Neveen E.R. El-Bakary, Department of Zoology, Faculty of Science, Damietta Branch Mansoura University, New Damietta, Egypt.

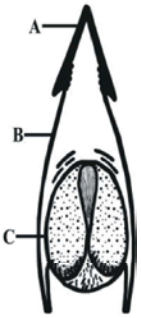

Fig. 1: Diagram showing macroscopic view from the dorsal side of the tongue of *Halcyon smyrnensis* (A: apex, B: body and C: root of the tongue

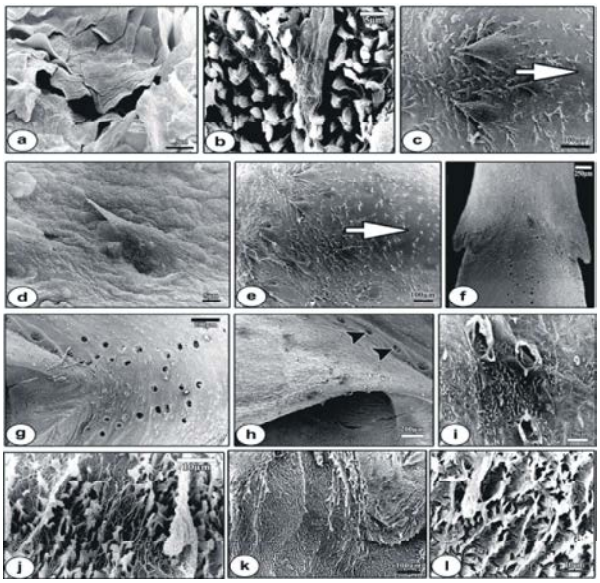

Fig. 2: Scanning electron micrograph of the dorsal lingual surface of *Halcyon smyrnensis* (white breasted kingfisher) a- the apex of the tongue showing a pattern of microridges on the keratinized cells of the lingual apex b- fibers of the connective tissue of the lamina propria of the lingual apex have tubule shaped and directed backwards (sodium hydroxide macerated sample). c,d- many epithelial processes directed backwards in the apex of the tongue e-epithelial processes directed backwards in the root of the tonue. Arrow (c,e)- indicates anterior direction of the tongue. f,g - esveral raws of lingual glands in front of the larynx opening. h- opening of lingual glands (head arrows) around opening of the larynx. i-openings of lingual glands partially filled with mucous. j- dorsal subepithelial surface of the lamina propria of the lingual body mucosa. k, 1-dorsal lingual surface back to the larynx opening (sodium hydroxid macerated sample)

apex, the body and the root of the tongue (Fig. 1). The tip of the tongue of the white breasted king fisher is pointed (Fig. 1) and ended in two conical papillae (Fig. 1). The dorsal lingual surface of the tip of white breasted kingfisher is keratinized but in different degree (Fig. 2a). The lingual apex of white breasted king fisher showing that the fibers of the connective tissue of the lamina propria have tubules shaped and directed backwards (Fig. 2b).

In the dorsal surface of the tongue of the white breasted king fisher, many pointed processes directed backwards and from the anterior to the posterior end of the tongue (Fig. 2c, 2d, 2e).

The openings of the lingual glands in the white breasted king fisher are found in front of the larynx in four longitudinal rows (Fig. 2 f-i) and around the larynx opening in one raw.

The fibers of the connective tissue of the lamina propria of the lingual body and root of the white breasted king fisher have tubule shaped and densely distributed in the lingual apex (Fig.2b), body (Fig. 2j) and in the posterior part of the root (Fig. 2 k, l).

DISCUSSION

All birds are adapted to their habitats; in the air, on land and on and around fresh water and sea water with respect to food sources. Birds have different feeding habits, with corresponding differences in the structure of their bills and tongues. The structure of the tongue of birds frequently gives some clue to the principal diet and manner of feeding of the species. The tongue of the bird is intimately related with the birds most important problem, that of obtaining food and for this function it must serve as a probe or spear (e.g., woodpecker), a seieve (e.g., ducks), a capillary tube (e.g. sunbirds), a brush (e.g., Trichglossidae), a rasp (e.g.vulture), a barbed organ (e.g. penguin).

In the present study, the tips of the tongues of white breasted kingfisher were pointed and not bified. Different structures were showed on the Peregrine Falcon and Common Kestrel tongue where they were bified [7].

In the marginal region between the anterior and posterior parts of the tongue of the chicken, a close array of giant conical papillae was observed, arranged transversely in a row [2]. On the tongue of the goose, giant conical papillae were located in a transverse row between the lingual body and the lingual radix [3]. At a point approximately 2/3 of the length of tongue in the white tailed eagle, between the body and the root of the

tongue there were large conical papillae, the apices of which were pointed towards the posterior part of the tongue [4]. In the dorsal surface of the Hoopoe tongue, a large conical papillae are found at the posterior border of the lingual apex and small and large conical papillae are found between the body and the root of the tongue. The presence of papillae in these region facilitate pushing food to the lingual glands which are found in the region posterior to the conical papillae directly [9]. Furthermore, in the white tailed eagle, the crest of the conical papillae found in the lingual body was sites aiding in the transfer of the swallowed food towards the esophagus and at the same time preventing its regurgitatioin [4]. In the peregrine falcon and common kestrel [7], there were observed not only the crest but also the many conical papillae on the lingual body. In this study, the tip of the tongue of the white breasted king fisher is pointed and ended in two large conical papillae which help in pushing food to the numerous lingual glands found in front of the larynx before swallowing.

Distribution of lingual glands on a few bird species make it possible to distinguish anterior and posterior lingual glands [12, 15, 16]. The orifices of the anterior lingual glands of the birds are located on the edges of the lingual body or occasionally on the lateral surfaces of the tongue, whereas the orifices of the posterior lingual glands are located on the dorsal surface of the root of the tongue.

A different distribution of glands was found in Hoopoe where the anterior lingual glands are located on the entire part of the body of the tongue and the posterior lingual glands are located on the entire part of the root of the tongue and numerous than that of the anterior one. These glands may help in lubrication of food before pushing it to the esophagus [9]. In this study, the distribution of the numerous lingual glands in the white breasted kingfisher is around and in four longitudinal rows in front of the larynx opening which may indicate the food of the white breasted king fisher needs more lubrication.

The secretion of these glands may be collected in the subepithelial chamber, whereas wide orifices of the glands, provide effective evacuation of the produced glutinous mucus which may act as inhibitors of some bacterial enzymes [17].

In mammals, some openings of the glandular ducts at the dorsal surfaces of the conical papillae of the lingual radix were observed in the tiger [18], fox [19] and mole [20]. However, the openings of the lingual glands in mammals are a small number than that of the eagle, owl and hoopoe.

The white tailed eagle feeds mostly on fish and the peregrine falcon and common kestrel feeds on small animal. The hoopoe feeds on large insects, their larvae and pupae, also small vertebrates: lizards and geckos. The white breasted kingfisher feeds on fish and invertebrates. Therefore, the differences in the structures of the tongues in the white tailed eagle, peregrine and common kestrel, hoopoe and white breasted king fisher may be reason of the differences in the feeding habits.

REFERENCES

1. Homberger, D.G. and A.H. Brush, 1986. Functional morphological and biochemical correlations of the keratinized structure in the African Grey parrot, *Psittaccus erithacus* (aves). Zoomorphology, 106: 103-114.
2. Iwasaki, S. and K. Kobayashi, 1986. Scanning and transmission electron microscopical studies on the lingual dorsal epithelium of chickens. Acta Anatomica Nippon., 61: 83-96.
3. Iwasaki, S., T. Asami and T. Chiba, 1997. Ultrastructural study of the keratinisation of the dorsal epithelium of the tongue of Middendorff s bean goose, Anser fabalis middedorfii (Anseres, Antidae). Anatomical Records, 247: 147-4.
4. Jackowiak, H. and S. Godynicki, 2005. Light and scanning electron microscopic study of the tongue in the white tailed eagle (Haliaeetus allbicilla, Accipitridae, Aves). Annals of Anatomy, 187: 197-205.163.
5. Jackowiak, H., W. Andrzejewski and S. Godynicki, 2006. Light and Scanning electron microscopic study of the tongue in the cormorant *Phalacrocorax carbo* (Phalacrocoracidae, Aves) Zoological Science, 23: 161-167.
6. Emura, S. and H. Chen, 2008. Scanning electron microscopic study of the tongue in the owl (*Strix uralensis*). Anatomia Histologia Embryologia, 37: 475-478.
7. Emura, S., T. Okumura and H. Chen, 2008. Scanning electron microscopic study of the tongue in the peregrine falcon and common Kestrel. Okajimas Folia Anatomica. Jpn., 85(1): 11-15.
8. Emura, S., T. Okumura and H. Chen, 2009. Scanning electron microscopic study of the tongue in the Japanese pygmy woodpecker (*Dendrocopes kizuki*). Okajimas Folia Anatomica. Jpn., 86(1): 31-35.
9. El Bakary, N.E.R., 2011. Surface morphology of the hoopoe tongue. Journal of American Science, 7(1): 394-399.

10. Campbell, B. and E. Lack, 1985. A dictionary of Birds. Calton T. AD. Poyser.
11. McLelland, J., 1990. A colour atlas of avian anatomy, Wolfe Publishing Ltd.
12. Vollmerhaus, B. and F. Sinowatz, 1992. Verdauungsapparat. In: R. Nickel, E. Schummer and E. Seiferle, (Eds.) Anatomie der Vogel Bd. 5. Lehrbuch Der Anatomie Der Haustiere, Parey, Berlin.
13. Koeing, H.E. and H.G. Liebig, 2001. Anatomie und Propadeutik des Geflugels. Lehrbuch and Farbatlas fur Studium und Praxis. Schattauer stuttgart, New York.
14. Kobayashi, K., M. Kumakura, K. Yoshimura, M. Inatomi and T. Asami, 1998. Fine structure of the tongue and lingual papillae of the penguin. Archives Histol Cytol., 61: 37-46.
15. McLelland, J., 1975. Aves digestive system, In: R. Getty, (Ed.) Sisson and Grossmans. The anatomy of the domestic animals, fifth ed. Saunders Company, Philadelphia, London, Toronto, 2: 1857-1882.
16. Homberger, D.G. and R. Meyers, 1989. Morphology of the lingual apparatus of the domestic chicken Gallus gallus, with special attention to the structure of the fasciae. American Journal Anatomy, 186: 217-257.
17. Gargiulo, A.M., S. Lorvik, P. Ceccarelli and V. Pedini, 1991. Histological and histochemical studies on the chicken lingual glands. British Poultry Science, 32: 693-702.
18. Emura, S., D. Hayakawa, H. Chen and S. Shoumura, 2004: Morphology of the lingual papillae in the tiger. Okajimas folia Anatomica. Jpn., 81: 39-44.
19. Jackowiak, H. and S. Godynicki, 2004. The scanning electron microscopic study of lingual papillae in the silver fox (*Vulpes Vulpes fulva*, Desmarest, 1820). Annals of Anatomy, 186: 179-183.
20. Jackowiak, H., 2006. Scanning electron microscopic study of the lingual papillae in the European mole (*Talpa europea*, L., Talpidae). Anatomia Histologia Embryologia, 35: 190-195.