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Scanning electron microscopic study on the dorsal lingual surface of the Egyptian little owl, *Athene noctua*

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KEY WORDS

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Little owl,
Light microscope,
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ABSTRACT

Tongue in birds has a significant role in feeding mechanism as it greatly differs in the shape and size to help in obtaining, manipulating, swallowing and processing food. However, many details about some species are still missing. Therefore, the present study was designed to investigate the morphological appearance of the dorsal lingual surface of the little owl, *Athene noctua* using scanning electron microscope. The tongue of the little owl, *Athene noctua* appears elongated in the antero-posterior direction. The tongue is distinguished into an anterior lingual body and a posterior lingual radix. Lingual body surface is devoid from any type of the lingual papillae which are observed only on the dorsal surface of the lingual radix. The tip of the tongue appeared to be bifurcated. Irregular scaly protrusions of deciduous epithelial outgrowths were observed on the lingual body surface. Several rows of lingual papillae of different sizes were observed on the dorsal surface of the lingual radix. The results showed that the morphological features of the tongue of the little owl, *Athene noctua* is matched with its feeding habit.

1. Introduction

Feeding mechanism is important to determine the adaptation of vertebrates to their environment. In vertebrates and especially in birds, tongue has a significant role in the feeding mechanism. Differences in the shape and size of the tongue allow it to work as a specialized tool for obtaining, manipulating, swallowing and processing food **(Al-Nefeiy, 2015)**. Many authors studied the morphology of the tongue in birds and they reported that tongue's shape and structure differ according to the type of food and method of food intake **(Al-Zahaby and Elsheikh, 2014)**. Difference in the shape of the tongue reflects their lifestyle and feeding habits as birds are spread out through the different habitats such as the air, the land and the water **(Skieresz-Szewczyk and Jackowiak, 2014)**. Iwasaki (2002) studied the structure of the oral cavity in

birds and concluded that its structure is related to the adaptation to the methods of feeding and climate conditions. For example, El-Bakary (2011) studied the Morphological characters of the dorsal lingual Surface of little green bee eater, *Meropes orientalis* and the European bee eater, *Merops apiaster*, and found that the tongue in both species is similar to most of the majority of avian tongue and consisted of three parts; the apex, the body and the root. **El-Beltagy (2013)** studied the tongue of white-throated Kingfisher, *Halcyon smyrnensis* and Common buzzard, *Buteo buteo* and reported numerous fine hard processes on dorsal lingual surface of *H.smyrnensis* tongue while such processes were apparently absent in the tongue of the common buzzard. The dorsal surface of common buzzard tongue was keratinized. **EMURA et al. (2009)** reported considerable variations in the morphology, histology and the fine structure of the avian tongue in relation to the feeding habits such as in Scops Owl, *Otus scops*. Recently, some investigators were interested in studying the functional morphology of the tongue in Relation to Feeding Habit **(Iwasaki, 1992; Iwasaki et al., 1997; Al-Nefeiy, 2015; Alm-Eldeen, 2005; Al-Zahaby and Elsheikh, 2014)**. Therefore, the present study aimed to investigate the relation between the structure of the dorsal lingual epithelium of the little owl, *Athene noctua* and the feeding habit.

2. Materials and Methods

The experiment adhered to the guidelines of the ethical committee of Tanta University, Tanta, Egypt. Three male little owls, *Athene noctua* were captured from Abou Rawash, El-Giza Governorate, Egypt in June 2016. After anaesthetizing the birds with diethyl ether, the tongues were quickly dissected out and processed as follow:

Scanning electron microscopy (SEM)

Tongues were immediately fixed in modified Karnovsky solution overnight at 4°C (2% paraformaldehyde and 2.5% glutraldehyde containing 0.1 M phosphate-buffered solution, pH 7.4 **(Karnovsky, 1965)**. After rinsing in 0.1 M phosphate buffer (pH 7.4) the samples were post-fixed in phosphate-buffered solution (pH 7.4) of 1% osmium tetroxide at 4°C for 2 hours. The specimens were then washed in 0.1M phosphate buffer solution for several times before treating with 3N hydrochloric acid for 20 min at 60°C to remove extra cellular mucus from the lingual surface **(Alm-Eldeen, 2005)**. The specimens were then washed in phosphate buffer and dehydrated in a graded ethanol series to the critical-point of drying and gold coated. The specimens were then examined in a JEOL-JSM 5300 scanning electron microscope at the faculty of Science, Alexandria University, Alexandria Governorate, Egypt.

3. Results

3.1.Morphological appearance

The tongue of the little owl, *Athene noctua* is about 1.3 cm long and 0.5 cm width. Although the tongue appears elongated in the antero-posterior direction with almost a constant width, it has a wide fleshy base and somewhat rounded and narrower apex. The tongue is distinguished into an anterior lingual body and a posterior lingual radix. The body is almost equal to 2/3 of the tongue length which is almost equal to 0.8 cm length while the radix is equal to 1/3 of the tongue length which is almost equal to 0.5cm length. The dorsal surface of the lingual body appeared as a smooth surface free from any type of papillae. However, posterior protrusions like lingual papillae of different sizes were "obviously observed on the dorsal surface of the lingual radix (Fig. 1).

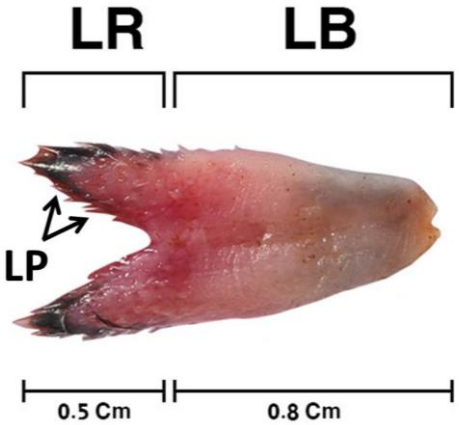

Figure (1): Macrograph of the owl tongue showed that it is distinguished into an anterior lingual body (LB) and a posterior lingual radix (LR). Note the lingual papillae (LP).

3.2.SEM observations

Observation of the dorsal lingual surface of the little owl using scanning electron microscope revealed that the tip of the lingual apex was bifurcated in which a mid-dorsal furrow was observed (Fig. 2& 3). At low magnification, the lingual body surface appeared to be devoid from any type of the lingual papillae which are observed only on the dorsal surface of the lingual radix. However, at higher magnification, smaller regular scaly protrusions of deciduous epithelial outgrowths were observed surrounding the mid dorsal furrow on the anterior tip of the tongue (Fig. 3). Behind the tip, the deciduous epithelial outgrowths appear very few in number and larger in size (Fig. 4). Furthermore, at the posterior part of the lingual body in the direction of the lingual root, the deciduous epithelium appears to be numerous in number and smaller in size (Fig.5).

In addition, openings of the lingual glands were randomly detected between these deciduous epithelial outgrowths on the posterior part of the dorsal lingual surface (root) (Fig 5.). Observation of the owl dorsal surface of the lingual radix using scanning electron microscope revealed several rows of well-arranged lingual papillae of different sizes. Smallest papillae are located just between the lingual body and the lingual radix while these papillae appeared to be increased in their size posteriorly until reach the biggest at the end of the tongue (Fig. 6). The papillae of the lingual root are conical in shape with somewhat pointed ends. They are inclined toward the posterior direction of the tongue and showing flat surfaces (Fig. 6). At high magnification, scaly protrusions of deciduous epithelial outgrowths were observed on both the dorsal surface of the lingual radix and their papillae (Fig.7). Furthermore, openings of the lingual glands were randomly detected between these deciduous epithelial outgrowths on the anterior part of the dorsal lingual root (Fig. 5).

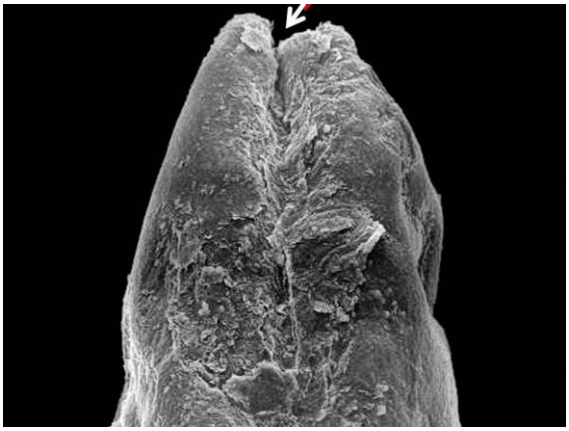

Figure (2): Scanning electron micrograph of the owl dorsal lingual surface. Note the bifurcated tip (arrow).

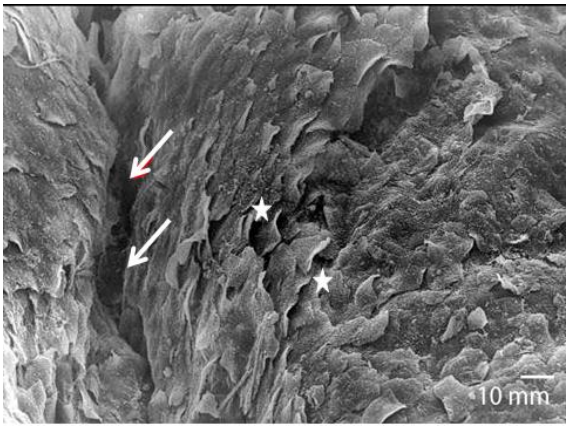

Figure (3): Higher magnification of Fig. (2) Showing the furrow (arrows) that is detected at the lingual tip and surrounded by irregular scaly protrusions of deciduous epithelial outgrowths (stars).

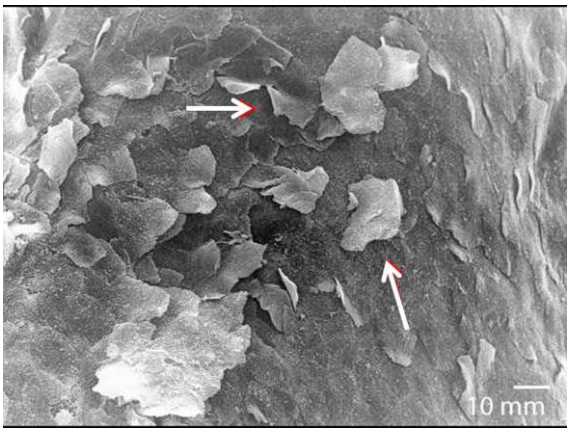

Figure (4): Scanning electron micrograph of the owl dorsal lingual surface showing the anterior part of the lingual body. Note the few and large deciduous epithelial cells (arrows).

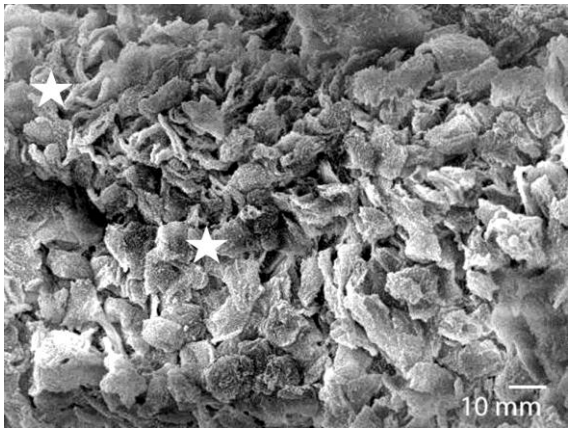

Figure (5): Scanning electron micrograph of the owl dorsal lingual surface showing the posterior part of the lingual body. Note the presence of numerous deciduous epithelial cells (stars).

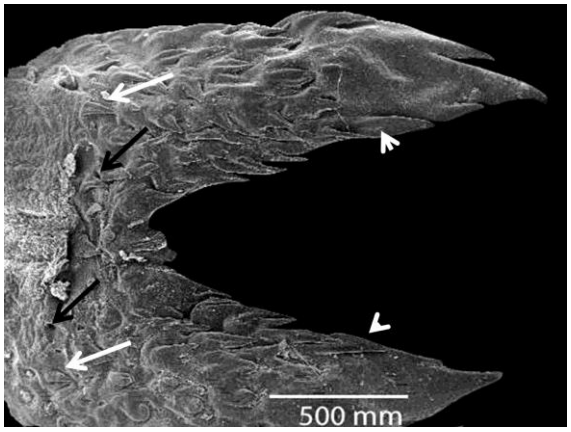

Figure (6): Scanning electron micrograph of the owl dorsal lingual surface showing the lingual radix. Note small (white arrows) and large (arrowheads) papillae and glands opening (black arrows).

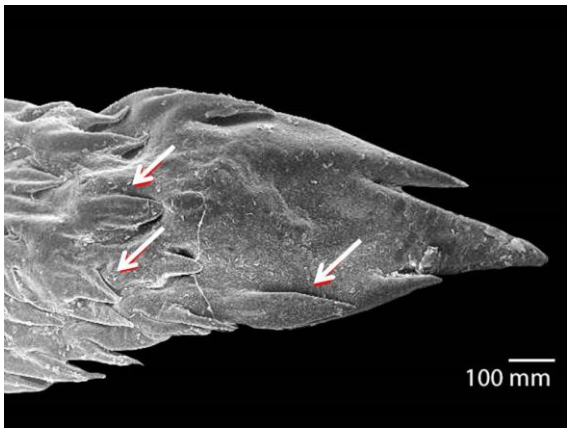

Fig. (7): Higher magnification of Fig. (6) Showing scaly protrusions of deciduous epithelial outgrowths (arrows) on the dorsal surface of the lingual radix and their papillae.

4. Discussion

The present study aimed to investigate the relation between the morphological structure of the dorsal lingual epithelium of the little owl, *Athene noctua* and the feeding habit. The results showed that the shape of the tongue of the little owl appeared elongated in the antero-posterior direction with almost a constant width with wide fleshy base and somewhat rounded and a narrower apex. The tip of the tongue appeared to be bifurcated and a median furrow was observed dorsally on the anterior part of the lingual apex. The present results are similar to what observed in the common kestrel and the peregrine falcon which feed on small bird and animal **(EMURA et al.,2009)**. However, these results vary with El-Bakary (2012) who reported that the tip of the tongue of the white breasted king fisher is pointed and not bifid in spite of it feeds on fish and invertebrates. On the other side, in the chicken and pigeon which are grains-feeder, the tongues appeared triangular in shape with a pointed tip with no bifurcation **(Iwasaki and Kobayashi, 1986)**. Therefore, the morphological features of the owl's tongue which we obtained in the present study showed that it may be suitable with its food as it feed son skink, small bird and animal.

The tongue of the little owls differentiated morphologically into lingual body and lingual radix. The lingual body surface is devoid from any type of lingual papillae. Instead mall irregular scaly protrusions of deciduous epithelial outgrowths were observed surrounding the mid dorsal furrow in the anterior part of the tongue. The lingual papillae were observed only on the dorsal surface of the lingual radix. The presence of deciduous epithelial outgrowths on the lingual body in the present study is similar to what observed in the tongue of the peregrine falcon and common kestrel **(Emura et al. 2008)**. They reported that there was carpet-shaped epithelium on the lingual body in both birds. Similarly, Emura et al. (2008 and 2009) observed the tongue of the Oriental Scops Owl and the Owl, *Strix uralensis* and reported desquamated cells of the non-keratinized epithelium on the surface of the lingual body.

Regarding the presence of lingual papillae on the lingual radix in the present study, it is similar to what observed on the tongue of white tailed eagle which feeds mostly on fish and birds **(Jackowiak and Godynicki, 2005)**. They reported that the conical papillae found in the dorsal surface of the lingual radix helping to transport swallowed food towards the esophagus and at the same time working on non- returning food to the beak again. Similarly, **Emura et al. (2008)** observed the tongue of the peregrine falcon and common kestrel and reported that there are many conical papillae which are inclined toward the posterior of the tongue. However, the present results are varied with what observed in the tongue of goose which feeds mostly on greater variety of food like saltwater mollusks, green plants and seeds **(Skieresz-Szewczyk and Jackowiak 2014).** They noticed 11 pairs of small and 4 pairs of large conical papillae surrounded by filiform papillae; both located on the lateral side of the lingual body. In the same direction, **Parchami et al. (2010)** recorded two types of lingual papillae on the dorsal surface of the tongue of the golden eagle, *Aquila chrysaetos*; first type is slim filiform papillae that located in lateral area of dorsal surface of the lingual body and the second type is circumvallate papillae that located in the posterior part of the lingual body. On the other side, **Emura et al. (2011)** reported that tongue of rainbow lorikeet, *Trichoglossus haematodus* which feeds on nectars showed a finger-like shape with no papillae.

Lingual glands openings were randomly detected between the deciduous epithelial outgrowths on the posterior part of the lingual body. **Emura et al. (2009)** recorded same phenomena in the dorsal lingual surface of thetongue of the oriental Scops Owl, *Otus scops*. Consistently, **Emura et al. (2012)** detected pair lingual glands opening in the posterolateral area of the lingual body in scarlet macaw, *Ara macao* which feeds on seed and fruit.

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