Scanning electron microscopic study of the tongue in the rainbow lorikeet (Trichoglossus haematodus)

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Summary: The dorsal lingual surfaces of rainbow lorikeet (Trichoglossus haematodus) were examined by scanning electron microscopy. Macroscopically, the tongue of the rainbow lorikeet has a finger-like shape. Three parts are distinguished in the dorsal surface of the tongue: the apex, body, and root of the tongue. The apex of the tongue has numerous processes inclined toward medial side from lateral side. These processes are rod-like structure and smooth surfaces. Many grooves are observed in both lateral sides of the lingual body. A large opening of the lingual gland exists in central part of the lingual root and some large openings of the lingual glands exist in both lateral sides of the lingual root.

Introduction

Studies on the structure of the tongue in birds have been conducted on some species, i.e., chicken, African grey parrot, Middendorff’s bean goose, common kestrel, Ural owl, Oriental scops owl, Japanese white-eye and nutcracker (Iwasaki and Kobayashi, 1986; Homberger and Brush, 1986; Iwasaki et al., 1997; Jackowiak and Godynicki, 2005; Jackowiak et al., 2006; Jackowiak and Ludwig, 2008; Emura et al., 2008a; Emura and Chen, 2008; Emura et al., 2009a,b; Emura et al., 2010; Jackowiak et al., 2010). Results of morphological studies conducted until date indicate a close correlation between the shape of the tongue and the method of food intake, the type of food, and bird’s habitat.

However, a scanning electron microscopic (SEM) study on the tongues of the rainbow lorikeet has not been carried out. Therefore, the purpose of this study is to examine three-dimensionally the dorsal lingual surface of the rainbow lorikeet in order to compare results with those from previous reports on other birds.

Materials and Methods

The tongues of two adult rainbow lorikeets (Trichoglossus haematodus) of the family Psittacidae were used in this study. The tongues were fixed in 10% formalin. The specimens were washed in distilled water and post-fixed in 1% osmium tetroxide for 1 h, dehydrated in a series of acetone dilutions, and then critical-point dried. The specimens were sputtered with Pt-Pd alloy before being examined under SEM (Hitachi S-3000N, Tokyo, Japan) at an accelerating voltage of 10 kV.

Results

Macroscopically, the tongue of the rainbow lorikeet has a finger-like shape (Fig. 1). Three parts are distinguished in the dorsal surface of the tongue: the apex, body, and root of the tongue (Fig. 1). The apex of the tongue has numerous processes inclined toward medial side from lateral side (Fig. 2a,b). These processes are rod-like structure and smooth surfaces (Fig. 3a,b). Many grooves are observed in both lateral sides of the lingual body (Fig. 4a). A large opening of the lingual gland exists in central part of the lingual root (Fig. 4b) and some large openings of the lingual glands exist in both lateral sides of the lingual root (Fig. 5).
Discussion

All birds adapted to their environment with respect to food sources. Corresponding to their lifestyles they have different feeding habits, with corresponding differences in the structures of their bills and tongues.

The tongues of the white-tailed eagle, black kite, and northern goshawk which feed on fish or small animals were elongated with a sharp-ended apex (Jackowiak and Godynicki, 2005; Emura 2008a; Emura et al., 2008b). The characteristic morphological features observed on the tongue included a distinct median groove dividing the mucosa into two symmetrical, convex lateral parts and a single crest of large conical papillae in the posterior part of the lingual body, extending over the surface of the flat root of the tongue (Jackowiak and Godynicki, 2005; Emura, 2008a; Emura et al., 2008b).

The tongues of the Middendorff’s bean goose, swans and spot-billed duck which feed on seeds of water plants or water plants were elongated with a sharp-ended apex (Iwasaki et al., 1997; Emura, 2008c; Emura, 2009a). Those tongues were elongated in the anteroposterior direction, and the apical regions of the tongues were round (Iwasaki et al., 1997; Emura, 2008c; Emura, 2009a). The lingual body had a distinct median groove. On both the lateral sides of the lingual body lingual hairs were compactly distributed and small numbers of cylindrical papillae were arranged between these hairs (Iwasaki et al., 1997; Emura, 2008c; Emura, 2009a).

The tongues of the chicken and common pheasant which feed on grains appeared as an elongated triangle with a pointed tip (Iwasaki and Kobayashi, 1986; Emura, 2008b). The dorsal surfaces of the tongues were flat, but differences in structure were distinguishable between the anterior tongue and posterior tongue, and a median groove was not observed in the tongue (Iwasaki and Kobayashi, 1986; Emura, 2008b).

Fig. 1. Macrograph of rainbow lorikeet tongue. The tongue shows a finger-like shape. A = lingual apex. B = lingual body. R = lingual root. Arrow = lower bill. Scale = 1 mm.

Fig. 2. Macrographs of the surfaces of the lingual apex. (a,b) The apex of the tongue has numerous processes inclined toward medial side from lateral side.
Fig. 3. Scanning electron micrographs of the surfaces of the lingual apex. (a,b) The processes are rod-like structure and smooth surfaces.
The tongue of the brown-eared bulbul which feeds on nectar and fruit had a spear-like shape (Emura, 2009b). The characteristic morphological features observed on the tongue included many conical processes in the tip of the tongue (Emura, 2009b).

The tongue of the Japanese pygmy woodpecker which feeds on insects had a toothpick-like shape (Emura et al., 2009b). On both the lateral sides of the anterior lingual apex, some conical processes were observed (Emura et al., 2009b).

The tongues of the little egret, black-crowned night heron, and green-backed heron which feed on fish and frog were needle-like or had a spearhead-like shape (Emura, 2009c). The surfaces of the lingual apex and body were smooth in adult little egret, but exfoliation of several epithelial cells was observed in the lingual surfaces of infant back-crowned night heron and young green-blacked heron. A pair of mantle-shaped giant conical papillae was inclined toward the posterior of the tongue on the lateral side of the lingual body (Emura, 2009c).

In this study, the tongue of the rainbow lorikeet which feeds on nectars showed a finger-like shape. Furthermore, the apex of the tongue had numerous processes inclined toward medial side from lateral side. Many processes were observed in the tips of the lingual apexes of the brown-eared bulbul and Japanese white-eye (Emura 2009, Emura et al., 2010). Thus, numerous processes of the lingual apex in the rainbow lorikeet are relation to the style of food intake.

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References


