

Morphology of the Dorsal Lingual Papillae in the Black Rhinoceros (*Diceros Bicornis*)

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With 3 figures

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Summary

The dorsal lingual surface of a black rhinoceros (*Diceros bicornis*) was examined by scanning electron microscopy. The tongue was about 30 cm in length. There were about 60 vallate papillae on both sides. Filiform, fungiform and vallate papillae were found. The filiform papillae were distributed over the entire dorsal surface of the tongue. The papillae had a hair-like shape. The fungiform papillae were round in shape, and more densely distributed on the lingual apex. No foliate papillae were seen on the dorsal surface. The vallate papillae were located on both sides of the posterior end of the lingual body. Each papilla was surrounded by a groove.

Introduction

Much work has been published on the three-dimensional structures of the lingual surfaces of various animals. In the order Artiodactyla, there have been many scanning electron microscopy (SEM) studies of the tongues of the cow (Steflik et al., 1983; Chamorro et al., 1986; de Paz Cabello et al., 1988), serow (Funato et al., 1985; Atoji et al., 1998), pig (Kullaa-Mikkonen et al., 1987), one-humped camel (Qayyum et al., 1988), buffalo (Scala et al., 1993), lesser mouse deer (Agungpriyono et al., 1995) and saiga (Frey and Hofmann, 1995). Such studies have revealed variations in the morphology and distribution of papillae on the dorsal lingual surface among animal species.

In the order Perissodactyla, there have been SEM studies of the tongues of horses (Chamorro et al., 1986; de Paz Cabello et al., 1988). However, no SEM studies of the tongue of the black rhinoceros have been carried out. The purpose of this study was therefore to examine in three-dimensions the dorsal lingual surface of the black rhinoceros, in order to compare the results with those of previous studies on other mammals.

Materials and Methods

The tongue of one female black rhinoceros (body weight 640 kg) of the order Perissodactyla was used in this study. The tongue was fixed in 10% formalin. Small blocks containing papillae were cut with a razor blade, and post-fixed with 1% osmium tetroxide for 2 h. Thereafter, the specimens were dehydrated through a graded series of acetone, critical-point-dried and plasma-coated with OsO₄ before being examined under SEM (Hitachi S-3500N) at an accelerating voltage of 10 kV.

Thick sections from each block were stained with 0.1% azur II for light microscope studies.

Results

Macroscopically, the tongue of the black rhinoceros is about 30 cm long, and the apex is conical in shape (Fig. 1a). Filiform papillae are distributed over the entire dorsal surface of the lingual body (Fig. 1a,b). Fungiform papillae are round in shape and more densely distributed on the tip of the lingual apex (Fig. 1a). The papillae are also found on the dorsolateral aspect of the posterior part of the tongue (Fig. 1c). They are larger than those located on the apex (Fig. 1a,c). There are no foliate papillae. Vallate papillae are located on both sides of the posterior end of the lingual body (Fig. 1c,d). The papillae have a molar-like shape, and each papilla is surrounded by a groove (Fig. 1c,d). The vallate papillae are sometimes fused with adjacent vallate papilla (Fig. 1c,d). There are about 60 vallate papillae in total.

Under SEM, the filiform papillae on the lateral side of the lingual apex have a hair-like shape, and consist of main papillae and some smaller secondary papillae (Fig. 2a: SEM image of 1 in Fig. 1a). The fungiform papillae are scattered among the hair-like papillae (Fig. 2b: SEM image of 2 in Fig. 1a). The filiform papillae in the lingual body also consist of main papillae and some smaller secondary papillae (Fig. 3: SEM image of 3 in Fig. 1b). However, the papillae of the lingual body are larger than those of the lingual apex (Figs 2a,b and 3). Taste buds are not found in the hair-like papillae (Fig. 3, inset)

Discussion

Agungpriyono et al. (1995) reported that, in the lesser mouse deer, filiform papillae consist of main papillae and smaller secondary papillae, and that the secondary papillae have a relatively restricted distribution, being present in the anterior and middle thirds of the tongue but rare or absent in the posterior third. Atoji et al. (1998) observed filiform papillae and conical papillae, and reported that the filiform papillae have secondary papillae in the Formosan serow. In the present study on the black rhinoceros, secondary papillae were observed in the filiform papillae. However, the papillae of the black rhinoceros (order Perissodactyla) were found to be long and thin, with a hair-like shape, while those of the lesser mouse deer and For-

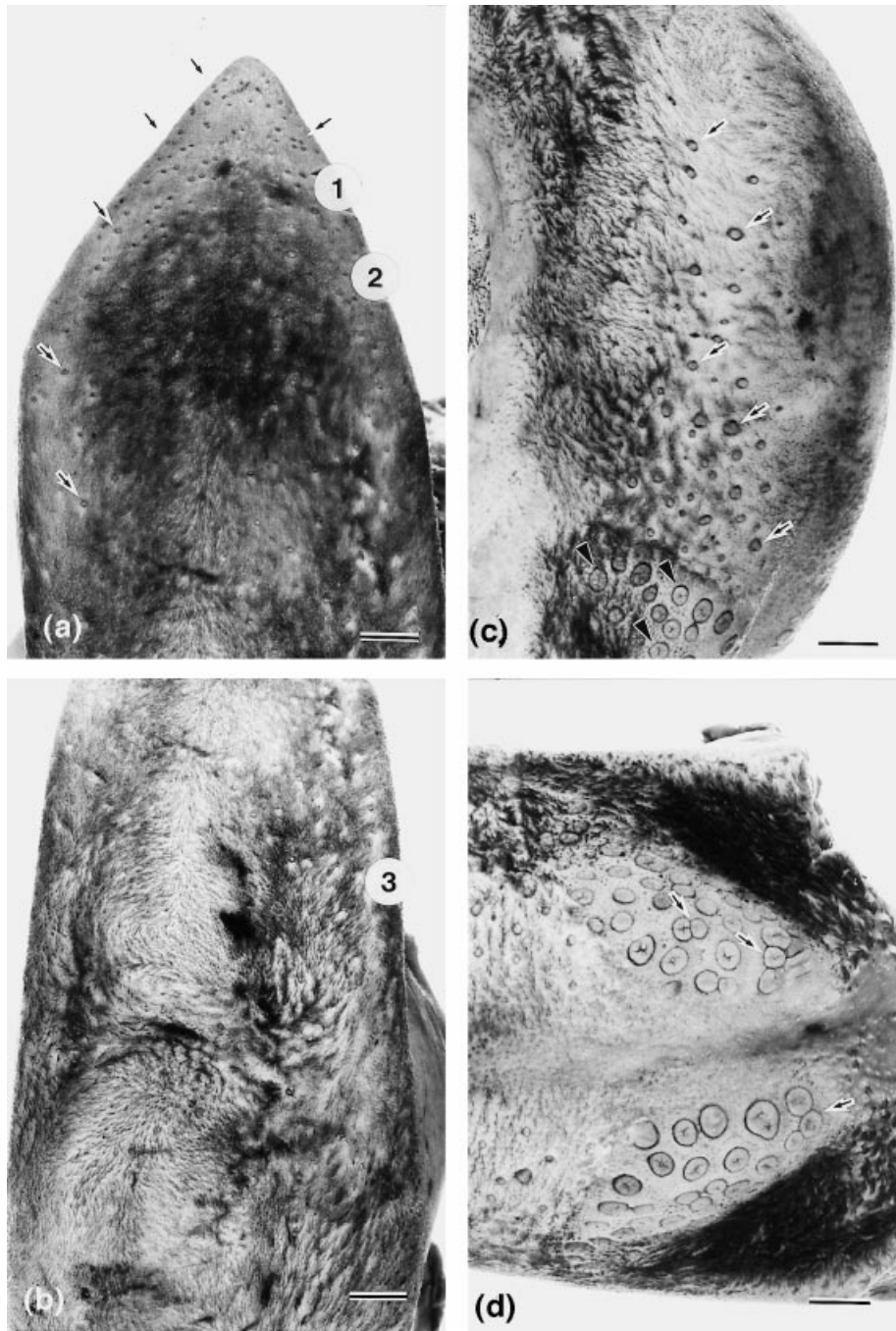


Fig. 1. (a) Dorsal surface of the lingual apex. Note more numerous fungiform papillae (arrows) than on the lingual body. 1 and 2 show the parts prepared for SEM observations. Bar = 1 cm. (b) Dorsal surface of the lingual body. There are fewer fungiform papillae than on the lingual apex. 3 shows the part prepared for SEM observations. Bar = 1 cm. (c) Posterolateral side of the lingual body. Note the larger fungiform papillae (arrows) than on the lingual apex. Arrow heads = vallate papillae. Bar = 1 cm. (d) Posterior end of the lingual body. The vallate papillae are fused with adjacent vallate papilla (arrows). Bar = 1 cm.

mosan serow (order Artiodactyla) are robust and conical in shape. This finding is consistent with observations on the tongue of the cow (de Paz Cabello et al., 1988).

The fungiform papillae were more densely distributed than those located on the body at the tip and on the ventral surface of the lingual apex in Japanese and Formosan serows, and the

papillae located on the lingual torus were larger than those located on the apex and body (Funato et al., 1985; Atoji et al., 1998). In the lesser mouse deer, the fungiform papillae were larger and more abundant than those located on the body at the tip of the tongue (Agungpriyono et al., 1995). In bovines, the fungiform papillae had a clear groove surrounding their base

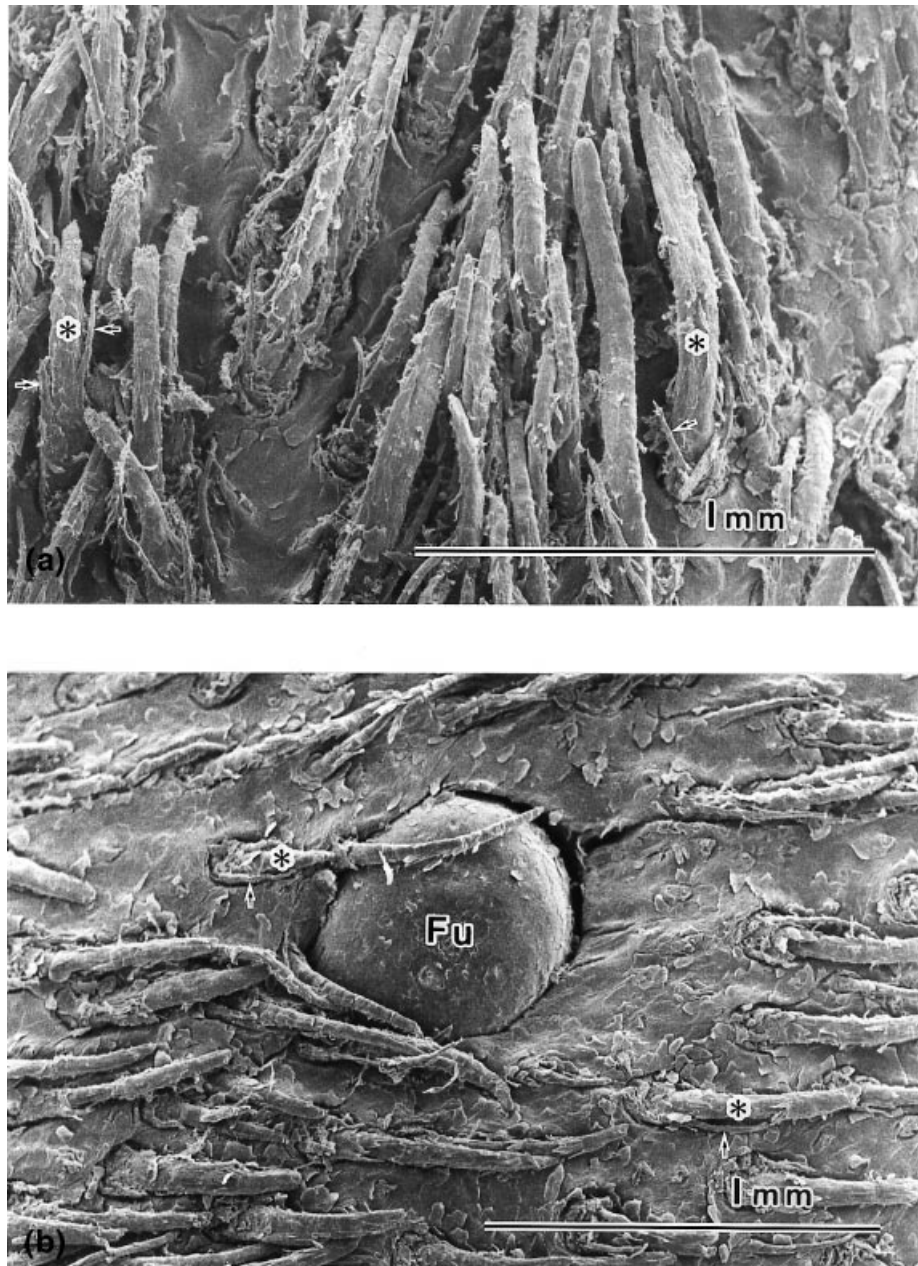


Fig. 2. (a) SEM micrograph of 1 in Fig. 1. The filiform papillae have a hair-like shape. * = main filiform papillae; arrows = secondary filiform papillae. (b) SEM micrograph of 2 in Fig. 1. Fu = fungiform papilla; * = main filiform papillae; arrows = secondary filiform papillae.

and separating them from the rest of the lingual surface (de Paz Cabello et al., 1988). In the present study on the black rhinoceros, the fungiform papillae were more densely distributed than those located on the body on the tip of lingual apex. The papillae on the tip of lingual apex were smaller than those on the posterolateral sides of the lingual body.

The vallate papillae surrounded by a groove were round or oval in shape, and there were about 24 in total in the Japanese and Formosan serows (Funato et al., 1985; Atoji et al., 1998). On the tongue of a lesser mouse deer, Agungpriyono et al. (1995) observed a pair of long, flat vallate papillae and five

round, flat vallate papillae. Nine to twelve circumvallate papillae were found about two-thirds of the way, anterior to posterior, along the tongue of the one-humped camel (Qayyum et al., 1988). Equine vallate papillae were composed of a primary papilla which was divided into several secondary papillae by intermediate grooves (Chamorro et al., 1986). In bovine vallate papillae, twin papillae were sometimes surrounded only by a primary papillary groove (Chamorro et al., 1986). The present study found about 60 vallate papillae in total, and demonstrated that the vallate papillae are sometimes fused with adjacent vallate papillae.

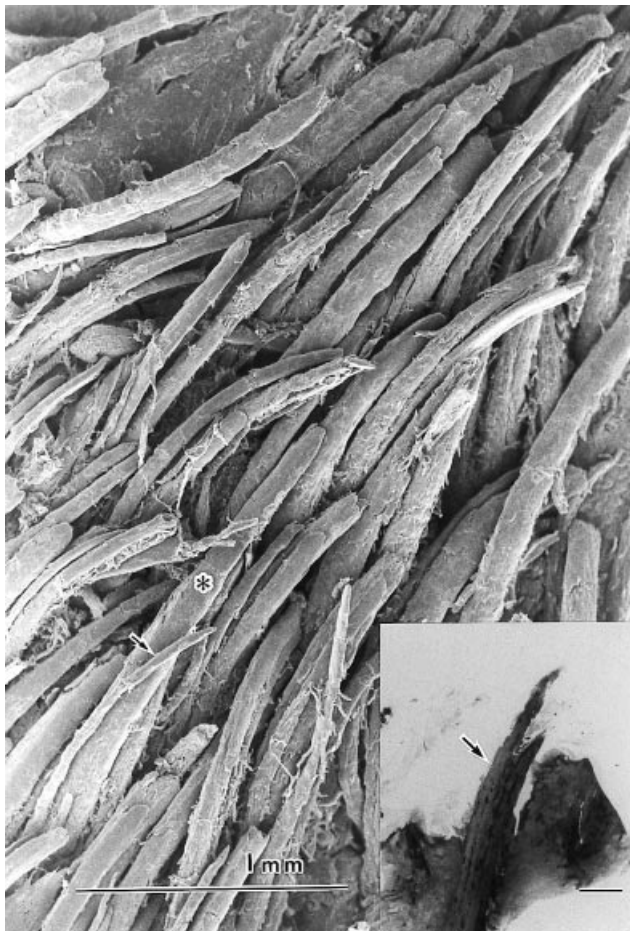


Fig. 3. SEM micrograph of 3 in Fig. 1. * = main filiform papillae; arrow = secondary filiform papilla. The filiform papillae of the lingual body are larger than those of the lingual apex. Inset = light microscope photograph of the filiform papilla (arrow). Bar = 0.25 mm.

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