Morphology of the Lingual Papillae in the Japanese Marten

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Summary: The dorsal lingual surfaces of two adult Japanese marten (Martes melampus) were examined by scanning electron microscopy (SEM). Filiform, fungiform, vallate and foliate papillae were observed. A small filiform papilla on the apical surface of the tongue had several pointed processes. A small filiform papilla contained the connective tissue core consisting of several small processes. A large filiform papilla of the lingual body consisted of a main papilla and some secondary papillae. A large filiform papilla contained the connective tissue core consisting of processes of various size. The fungiform papillae are round in shape. The connective tissue core of the fungiform papilla had a top with several round depressions. The four vallate papillae were located on both sides of the posterior end of the lingual body and each papilla was surrounded by groove and crescent pad. A zigzag surface structure appeared on the connective tissue core of the vallate papilla. The foliate papillae were seen on the dorsolateral aspect of the tongue and some ridges and grooves were exposed reciprocally. A zigzag surface structures appeared on the connective tissue cores of the ridges of the foliate papillae.

Much work has been published on the structures of the lingual surfaces in various animals. In the order Carnivora, there have been many SEM studies of the tongues of cat (Boshell et al., 1982; Kobayashi et al., 1988), dog (Iwasaki and Sakata, 1985; Kobayashi et al., 1987), mongoose (Iwasaki et al., 1987), Japanese weasel (Furubayashi et al., 1989), sea otter (Shimoda et al., 1996), Asian black bear (Inatomi and Kobayashi, 1999), bush dog (Emura et al., 2000), panther and Asian black bear (Emura et al., 2001), lion (Emura et al., 2003), tiger (Emura et al., 2004), silver fox (Jackowiak and Godynicki, 2004) and raccoon dog and fox (Emura et al., 2006). Such studies reveal variations in morphology and distribution of papillae on the dorsal lingual surface among animal species.

The purpose of this study is to observe both the three-dimensional structures on the dorsal lingual surfaces of the Japanese marten, and their connective tissue cores after exfoliation of the epithelium on the dorsal surface of the tongue.

Materials and Methods

The tongues of two adult Japanese martens (Martes melampus) of the family Mustelidae were used in this study. The tongues were fixed in 10% formalin. Small blocks containing papillae were cut with a razor blade, post-fixed with 1% osmium tetroxide for 1 h. Thereafter, the specimens were dehydrated through graded series of acetone and critical-point-dried. To show the three-dimensional connective tissue structure of the lamina propria of the mucosa, some of the samples were washed in distilled water after fixation and macerated in 3.5 N HCl at room temperature for 6 days. After maceration tissues were washed in the distilled water and post-fixed in 1% osmium tetroxide for 1 h, and dehydrated in a series of acetone and critical-point-dried.

All specimens were sputtered with Pt-Pd before being examined under SEM (Hitachi S-3500N, Tokyo, Japan) at an accelerating voltage of 15 kV.

Results

The filiform papillae are distributed over the entire dorsal surface of the tongue. A small filiform papilla on the apical surface of the tongue has several pointed processes (Fig. 1). A small filiform papilla contains the connective tissue core consisting of several small processes (Fig. 2). A large fili-
form papilla of the lingual body consists of a main papilla and some secondary papillae (Fig. 3). A large filiform papilla contains the connective tissue core consisting of processes of various size (Fig. 4). The fungiform papillae are round in shape (Figs. 1, 3). The connective tissue core of the fungiform papilla has a top with several round depressions (Figs. 2, 4). The four vallate papillae are located on both sides of the posterior end of the lingual body and each papilla is surrounded by groove and crescent pad (Fig. 5). A zigzag surface structure appears on the connective tissue core of the vallate papilla (Fig. 6). The foliate papillae are seen on the dorso-lateral aspect of the tongue and some ridges and grooves are exposed reciprocally (Figs. 7, 8). A zigzag surface structures appear on the connective tissue cores of the ridges of the foliate papillae (Fig. 8).

Fig. 1. The filiform papillae (Fi) on the apical surface of the tongue show several pointed processes. Fu = fungiform papillae.

Fig. 2. A small filiform papilla (Fi) contains the connective tissue core consisting of several small processes. Fu = fungiform papilla.

Fig. 3. A large filiform papilla (Fi) of the lingual body consists of a main papilla and some secondary papillae. Fu = fungiform papilla.

Fig. 4. A large filiform papilla (Fi) contains the connective tissue core consisting of processes of various size. Fu = fungiform papilla.
Shimoda et al. (1996) reported that the filiform papillae on margin of the tongue of the newborn sea otter were divided into two shapes which were horny or club-shaped papillae, and the fungiform papillae also were divided into two shapes which were hemispherical or club-shaped papillae. Emura et al. (2001, 2003) described that the large papillae were observed on margins of the lingual apexes of the newborn panther, newborn asian black bear and lion. In the cat (Boshell et al., 1982), newborn panther (Emura et al., 2001), lion (Emura et al., 2003) and tiger (Emura et al., 2004), a marked

**Discussion**

Shimoda et al. (1996) reported that the filiform papillae on margin of the tongue of the newborn sea otter were divided into two shapes which were horny or club-shaped papillae, and the fungiform papillae also were divided into two shapes which were hemispherical or club-shaped papillae. Emura et al. (2001, 2003) described that the large papillae were observed on margins of the lingual apexes of the newborn panther, newborn asian black bear and lion. In the cat (Boshell et al., 1982), newborn panther (Emura et al., 2001), lion (Emura et al., 2003) and tiger (Emura et al., 2004), a marked
transition occurred between the tip and midportion of the dorsum of the tongue. The transition was characterized by an increase in size of the projection of the filiform papillae. In the midportion of the tongue, the projections were very prominent. In the silver fox, *Vulpes vulpes fulva* (Jackowiak and Godynicki, 2004), the filiform papillae on the anterior part of the tongue were divided into 1 main and 10~12 accessory processes. In the posterior part of the body of the tongue the number of accessory processes was reduced. In the raccoon dog, each filiform papilla on the apical surface of the tongue had several pointed processes, and the filiform papillae of the lingual body consisted of a main papilla and some secondary papillae. In the present study, the filiform papillae of the Japanese marten were similar to those of the silver fox and raccoon dog.

In the present study, there were dome-shaped fungiform papillae scattered among the filiform papillae, especially at the lingual apex. Similar SEM studies have been reported on the dorsal lingual surface of the other mammals (Emura et al., 2000, 2003, 2004, 2006; Jackowiak and Godynicki, 2004).

In the cat (Kobayashi et al., 1988), a large filiform papilla contained the connective tissue core consisting of one large posterior process (main process) and several small processes (accessory processes) arranged in a circle at anterior basal margin of the primary connective tissue core, and a small filiform papilla contained a short tubular connective tissue core. In the treeshrew (Kobayashi and Wanichanon, 1992), the connective tissue core of the filiform papilla looks like a human hand raised with the palm facing towards the tongue tip. In the California sea lion (Yoshimura K et al., 2002), the connective tissue cores of the filiform papillae of a main protrusion (primary core) and many small cores (secondary cores). The connective tissue core of the fungiform papilla in the cat has a cup-like top with several round depressions (Kobayashi et al., 1988). The fungiform connective tissue core in the treeshrew is columnar in shape (Kobayashi and Wanichanon, 1992). The morphological characteristics of the connective tissue cores of the filiform and fungiform in the Japanese marten were similar to those of the cat. However, a small filiform papilla of the Japanese marten contains the connective tissue core consisting of several small processes.

Many works have been published on the three-dimensional structure of the vallate papillae in the mammalian tongue. The vallate papillae of the cat, dog and flying squirrel were encircled by the filiform papillae in the posterior body (Boshell et al., 1982; Iwasaki and Sakata, 1985; Emura et al., 1999).

The vallate papillae of the bush dog were surrounded by a groove and crescent pad, and in the dorsal surfaces of the papillae small conical papillae were observed (Emura et al., 2000). Some vallate papillae of the asian black bear were composed by a primary papillae which was divided into several secondary papillae by intermediate grooves (Emura et al., 2001). The dorsal surfaces of the vallate papillae in the tiger, raccoon dog and fox were irregular (Emura et al., 2004, 2006). The surfaces of the vallate papillae in the silver fox were smooth (Jackowiak and Godynicki, 2004). In this study on Japanese marten, the surfaces of the vallate papillae were smooth as well as those of the silver fox (Jackowiak and Godynicki, 2004). After removal of the epithelium in the threesrew, pine-cone-like structures with numerous small thorns were revealed under the epithelium of the central papillla of the vallate (Kobayashi and Wanichanon, 1992). In the California sea lion (Yoshimura K et al., 2002), numerous small rod cores were seen densely distributed on the surface of each core. In this study, a zigzag surface structure appeared on the connective tissue core of the vallate papilla.

Krause and Cutts (1982) reported that the foliate papillae in the opossum were not observed, and that elongated mucosal folds with numerous, irregular, finger-like projections were present on the posterolateral borders where the foliate papillae were normally found in other species. Emura et al. (2002) described that the foliate papillae in the monkey, which had some ridges separated by deep grooves, were found on the dorsolateral aspect of the posterior part of the tongue. In this study, the foliate papillae are seen on the dorsolateral aspect of the tongue, and some ridges and grooves are exposed reciprocally. After removal of the epithelium, the plate-like folds of the connective tissue cores which run parallel to each other appeared in the rabbit (Kobayashi, 1992). The connective tissue cores of the foliate papillae on the Japanese marten were different from that of the rabbit.

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References
