



Analytical Study of Lingual Morphology of Tongue of Bat (*Rousettus leschenaulti*)

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ABSTRACT

In frugivorous bats, variation in the distribution and types of lingual papillae are related to manner of food uptake. These lingual papillae are categorized into mechanical (i.e. Filiform and Conical) and gustatory papillae (i.e. Fungiform and Vallate). Distribution, microstructure, location and number of gustatory papillae in mammalian tongue are specific according to their specific adapted feeding habits. Diversity of feeding habits directly reflects on the morphological structure of tongue and arrangement of mechanical and gustatory papillae. The tongue of Megachiropteran bat, *Rousettus leschenaultia* are elongated with keratinized epithelium and different types of papillae at their respective locations on the dorsum of tongue. Frugivorous bats show tremendous range of variation in their lingual morphology. Close relationship is found between microstructure of tongue with varieties of food consumed by frugivorous bats. Many species of nectar or fruit-eating bats annually migrates between a series of landscapes. These movements are driven by seasonal fluctuations in the availability of flowers or fruit resources for feeding purposes. Frugivorous bats are thus, well-equipped to disperse tree-seeds throughout the man-made and natural ecosystems during their movement for feeding.

Keywords: *Rousettus leschenaultia*; Megachiroptera; Tongue; Microstructure; Lingual Papillae.

INTRODUCTION

Bats are very vulnerable and most beneficial creature of ecosystem. Bats are well-equipped to disperse tree seeds far and wide through a forest (Allen 1996). Fruit and nectar-eating bats play a vital role in survival, preservation, maintenance and stability of rain forests and world climates.

Tongue is a muscular, sensitive taste organ have important role in digestion of food. Most important feature of the mammalian tongue is presence of taste buds in gustatory papillae i.e. circumvallate and fungiform papillae. Unique design and arrangement of papillae on tongue of megachiropteran bats plays an effective role in reception of gustatory sensation of variety of food and the structure of mechanical papillae is helpful for ingestion of foods and its grinding in oral cavity.

Megachiropteran bat, *Rousettus leschenaulti* belong to the order of Chiroptera and family Pteropodidae. They are diversely roosts in fruit trees, roof of old houses and underground dilapidated mines. Flying foxes of the genus *Pteropus* (Pteropodidae) are important pollinators and seed dispersers in Oceanic-island ecosystem (Cox *et al.*; 1991, 1992). Phyllostomidae contain a diverse array of feeding adaptations, but over one half of its species are Plant-visitors.

Rousettus leschenaultia shows the frugivorous feeding habit. Birt *et al.*; (1997) noticed the tongue of six species of Australian bats like, *Syconycteris australis*, *Nyctimene robinsoni*, *Pteropus poliocephalus*, *P. alecto*, *P. conscipicillatus* and *P. scapulata* are adapted according to their habits. Singh and Bhatti, (1993) and Jackowiak *et al.*; (2009), noticed *Pteropus giganteus giganteus* had

longer and well muscular tongue for rasping and possess filiform, fungiform and circumvallate papillae for grinding the fruit pulp during consumption of variety of food.

In present study, describes the analysis of morphology of the tongue of frugivorous bat, *Rousettus leschenaultia* in terms of distribution, microstructure and the number of lingual papillae on antero-dorsal surface of the tongue in its adapted diet habits..

MATERIAL AND METHODS

Preserved material was used for this work. For histological study, the tongue was fixed in different fixative. Alcoholic Bouins, Aqueous Bouins and 10% formalin for 24 hours, then washed overnight in running tap water and dehydrated by passing through different grades of ethyl alcohol, cleared in xylene and embedded in paraffin. The sections were cut at 5-7µm with the help of rotary microtome. For routine histological observations were stained with Haematoxyline-Eosin method.

RESULT

Collected preserved material of tongue of adult male of *Rousettus leschenaultia* having a body mass 120g. The tongue measures 28mm long, 9mm in breadth and 0.64g in weight. The tongue of *Rousettus leschenaultia* shows that the anterior tip of tongue surrounded by scale-like filiform papillae directed laterally towards the posterior region. These scale-like filiform papillae are flat and lie close to the surface of the tongue. Numerous fungiform are distributed between larger tricuspid papillae, these tricuspid papillae with a thick squamous epithelial coating. The large sized mechanical tricuspid papillae covered

the extreme anterodorsal surface of tongue having a thin parakeratotic layer over a thick central prickle cell layer. The scale like filiform papillae is observed around the tricuspid papillae. Presence of mechanical tricuspid filiform papillae which covers most of the anterodorsal surface of tongue was adapted for the frugivorous feeding habits of the species. The tricuspid papillae are covered by thick keratinized stratified squamous epithelium. The singly pointed hook-like papillae is observed towards the posterior region. These papillae stand upright, almost perpendicular to the surface epithelium and had a highly keratinized parakeratotic layer. The hook-like and bifid mechanical papillae are located next to each other along the midline of the tongue. These bifid mechanical papillae are extremely numerous and covered the large area of dorsal surface of tongue. At the posterior region a large number of salivary gland and a dense network of blood capillaries are observed, embedded in the connective tissue beneath the smooth layer of stratified squamous epithelium. The horny papillae densely cover the dorso-lateral region of the tongue and extended further anteriorly along the lateral margins.

The round shaped fungiform papillae were observed on the anterior two-third part of the tongue. Numerous large sized fungiform papillae were present on the region in between anterior tricuspid filiform papillae and posterior circumvallate papillae. Smaller fungiform papillae were observed surrounding the anterior tricuspid as well as larger fungiform papillae, (Ramteke *et. al*; 2012c). The taste buds are present at the lateral epithelial wall of fungiform papillae.

The characteristic inverted cup-shaped circumvallate papillae are present at the base of the tongue along with well developed taste buds in the lateral epithelium as well as in the walls of the circular furrow around them. The circumvallate papillae are bounded by mucous membrane, i.e. smooth epithelium of the tongue. The large posterior lingual glands consists numerous ducts are generally located among the muscle bundles just in front of the medial circumvallate papillae, along the margins of the tongue near its root and under the mucosa of the lymphatic area.



FIGURE 1

FIGURE 2

Fig. 1. Photograph showing the dorsal view of the tongue of *R. leschenaultia* (with a body mass 120gms). The tongue measures 28mm in length, 9mm in breadth and 0.64 gm in weight. Dorsal view of tongue consist three types of foliate papilla, viz, Filiform, Fungiform and Vallate papillae.

Fig. 2. Photograph showing the ventral view of the tongue of *R. leschenaultia* devoid of papillae, but with presence of the lateral margins lined with filiform papillae.

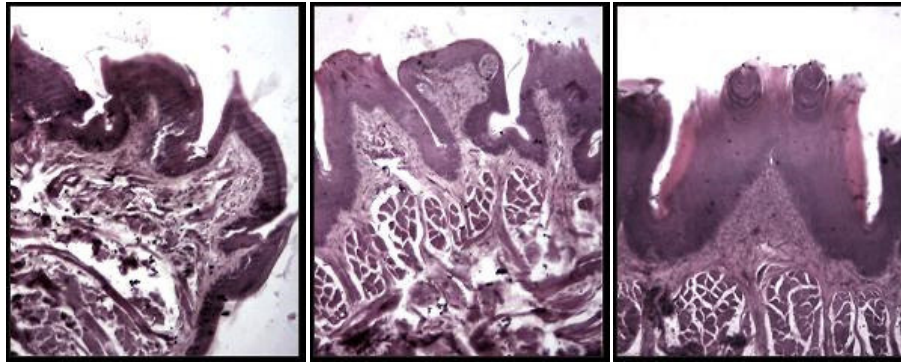


FIGURE 2

FIGURE 3

FIGURE 4

Fig.2. Photograph showing anterior tip of tongue surrounded by scale-like papillae directed towards posterior surface.

Fig.3. Round shaped fungiform papillae were distributed over most part of the dorsum. The fungiform papillae consist of taste buds at the lateral epithelium.

Fig. 4. Cluster of large size mechanical papillae covered most of the antero-dorsal surface of tongue and is composed of thick orthokeratotic core of central prickle cell layer covered by thin parakeratotic layer.

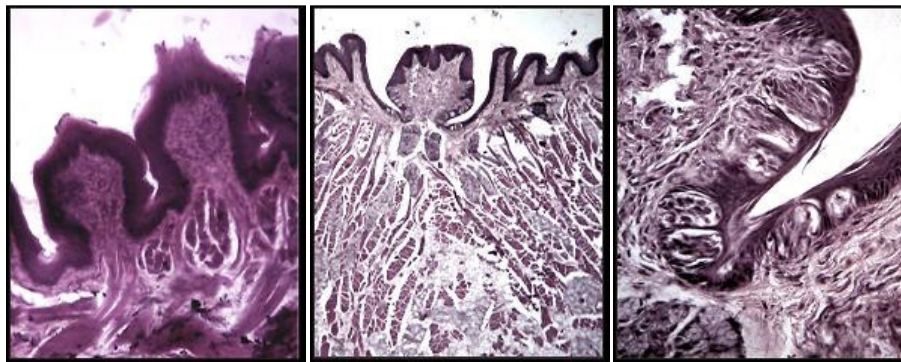


FIGURE 5

FIGURE 6

FIGURE 7

Fig. 5. Small sized tricuspid papillae are present at the surrounded area of large size of mechanical papillae. The tricuspid papillae enveloped by thick, keratinized stratified squamous epithelium.

Fig. 6. Part of the posterior region of tongue to show inverted cup shaped circumvallate papilla with well developed taste buds.

Fig.7. Taste bud is abundant on the lateral epithelium of circumvallate papilla and the wall of circular furrow. The taste buds are ovoid, ellipsoidal or spheroidal in shape and occupied the entire depth of the epithelial layer.

DISCUSSION

The research study emphasized on the distribution, microstructure and number of lingual papillae as well as gustatory papillae on the tongue of *Rousettus leschenaultia* affected by its feeding of varieties of food. Elongated and movable tongue with keratinized epithelium and different location of different types of papillae on the tongue shows frugivory type of diet of *Rousettus leschenaultia*.

In fruit eater bats, considerable length of the anterior free part of the tongue facilitates the movement of tongue (Greenbaum and Phillips,1974). Different types of filiform papillae according to their location, participate in aid of

eating fruit seed and leaf (Emura *et. al*; 2001). Shape and distribution of the lingual papillae by making a rough surface in the front of tongue are effective in touching and taking of the food particles and posterior papilla participate in transportation of food. So, structural characteristic of papilla are exactly appropriate for their function.

Generally, fruit eater bats has high number of fungiform papillae and large tongue size, which enable them to take a wide range of food in relation with seasonal fluctuations (Emura *et. al*; 2001). Availability of food specially changes according to the seasonal changes. Seasonality of fruit availability causes dietary shifts by

frugivorous bats. Different factors like seasonal cycle change, physiological condition and the environmental features, megachiropteran bats consume tremendous range of food like soft and hard fruit, leaves and flowers. So, according to their different variety of food consumption habits, the number of fungiform papillae are developed more in megachiropteran bat for taste sensation of different quality of food, (Marshall 1983). Mechanical tricuspid filiform papillae are very abundant in frugivorous bats for grasping mechanism and numerous fungiform and large sized circumvallate papillae for sensation of taste. Gustatory papilla like fungiform and circumvallate papillae contains taste buds for taste sensor. Taste sensitivity is different at the different locations of tongue. Distribution of fungiform papillae on the antero-dorsal surface of tongue had a more density of taste buds than the lateral border of tongue.

Number of circumvallate papillae in bats is different and depends on food habit. Insectivorous bats have two circumvallate papillae (Son *et. al*; 2000) but in frugivorous bats, three vallate papillae are located at the posterior region (Emura *et. al*; 2002). Fungiform and vallate papillae were covered by a very thin keratinized layer because they have taste buds (Hwang and Lee 2007).

Frugivorous bats, eats both hard and soft fruit which categories based on structural properties of outer skin and physical properties of food and its size, (Freeman 1988 and Dumont 1999). *Platyrrhinus lineatus* and *Artibeus jamaicensis* were eating mostly hard fruits (i.e. Figs). *Stumira lilium* and *Corollia perspicillata* on the other hand were found to eat only solanum and piper fruits. Flying foxes of the genus *Pteropus* in both mainland and island group of frugivorous bats eat taxonomically non-random subset of fruit. Among bats, only Pteropodids (Old World Bats) and Phyllostomids (New World Bats) can be considered largely frugivorous and many of these bats pollinate a broad variety of commercially valuable plant, (Gardner, 1977; Marshall 1983; Fleming, 1986). Large important angiosperm group of plant are pollinated by the frugivorous bats.

Thus, structural and functional characteristic of papilla of tongue participates in its efficient and appropriate function during feeding of tremendous range and variety of food. So, frugivorous bats play a vital role in the maintenance of species-rich tropical forests because of their unique lifestyle and most-effective long distance dispersers of tropical seeds.

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