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A comparative morphometric study of the tongue in white-eared bulbul (*Pycnonotus leucotis*) and bronze fallow cockatiel (*Nymphicus Hollandicus*)

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Abstract

The tongue of bulbul was don't fill the lower beak and divided in to apex, body, root. The apex was composed of two sharp ending that's appear as v shape and yellow in color. While the tongue of cockatiel was pink in color and divided into three part like in bulbul, the apex was pointed with present multi groove that make the apex appear as spatula like in structure. Frenulum linguae in bulbul started from the middle of the ventral surface of the body, in cockatiel the frenulum ligue started from the start of the body at ventral surface. The body in both birds have shallow median groove that divided the conical papillae in to two side. The root of bulbul tongue was larger area from that in cockatiel. In all morphological parameter there is significant differences between the tongue of bulbul and cockatiel.

Keywords: Bulbul, cockatiel, tongue, birds, conical papillae

Introduction

The (*Pycnonotus leucotis*) which commonly named white-eared bulbul belongs to passeriformes order, class: aves, that is the most popular garden birds.it is feed on fruits, grass and small lizards occasionally (Wang, 2011) ^[26]. The cockatiel (*Nymphicushollandicus*) is an australian bird belonging to the order psittaciformes; family psittacidae, 2012). The tongue is divided into apex (Tip), body and root. The bird's tongue is covered by keratinize or non-keratinize stratified squamous epithelia, according to their food intake habits (S.M. Al-Kafagy, *et al.*, 2022) ^[22].

Morphological and ecological investigations strongly indicated a close relationship of the lingual form, histological structure of the lingual mucosa and skeletal apparatus of the tongue with the feeding habitats including the food-intake and the type of foods. The avian tongue generally showed the triangular form and filled the whole lower part of the bill most of the avian tongues area divided into as three parts, the apex, the body and the root (Emura, *et al.*, 2009; Parchami, *et al.*, 2010; Koeing and Liebig, 2001) ^[9, 20, 19]. The number of rows of papillae forming the papillary crest shows little variation among avian species. There is only one well-developed transverse papillary crest with large mechanical caudally directed papillae (Erdogan and Perez, 2015; Erdogan and Alan, 2012; Iwasaki, 1992) ^[11, 12, 16].

Materials and Methods

The present study was designed to investigate the morphometrical study of the tongue in local White-Eared Bulbul (*Pycnonotus leucotis*) and Bronze Fallow Cockatiel (*Nymphicus Hollandicus*).

A samples are collected from al-Gazel bird market in of year (2023). To find out the form, each bird was weighted by sensitive balance, then anesthetized using Ketamine 15 mg/ k.g of body weight injected in thoracic or femoral muscles by using syringe (50ml). Then the bird was left for about five minutes for complete anesthesia (Schindala, 1999) ^[23]. After that the bird was fixed on anatomy board and fixed by pins. The bird dissection was conducted by making a small cleft at the midline of head, the tongue of the birds Gross photographic picture were captured using Nikon digital camera12 mega pixel. Length of body of the studied birds was determined by measuring tape by centimeter, starting from the head to the cloaca of the bird. While the total length of tongue was measuring from the apex to the end of the root by using electronic balance).

The body weight for each bird was measured by using sensitive balance, while the weight of tongue was calculated after removing it from the oral cavity emptying its contents and slow thorough washing with a normal saline. The relative weight was calculated as in the following equation: $\text{ratio} = \text{weight of tongue} / \text{weight of bird} * 100$.

Results and Discussion

The morphological results revealed that there is different in shape and color between tongue of white-eared bulbul (*Pycnonotus leucotus*) and bronze fallow cockatiel (*Nymphicus hollandicus*), the tongue of two species divides into three regions (apex, body, root), the tongue of white-eared bulbul was don't fill the lower beak and don't reach to the tip of beak. While the tongue of cockatiel extend to fill the limit of the lower beak and reach to the tip (Fig. 1, 2). This result was agreement with bulbul and disagree with cockatiel Most of the avian species have the common triangular shape of the tongue as in the galliform and passerine birds (Jackowiak, *et al.*, 2010; Erdogan and Alan, 2012) [17, 10], house sparrow, and Eurasian hoopoe (Abumandour, 2018; Abumandour and Gewaily, 2019) [18, 19]. The finding of (Reda, 2019) [21] in Muscovy ducks, (Igwebuikie and Anagor, 2013) [15] in Muscovy duck, (Abdalla, *et al.*, 2011) [2] in the duck, (Abd El-Fatah, *et al.*, 2000) [20] in turkey, (Skieresz-Szewczyk, *et al.*, 2021) [25] in domestic turkey and Koch (Koch, 1973) [18] in fish eaters birds was agree Results of bulbul and disagree with that finding in cockatiel that mention The tongue was filled the oropharyngeal floor, except for the free space in the rostral part of the bill.

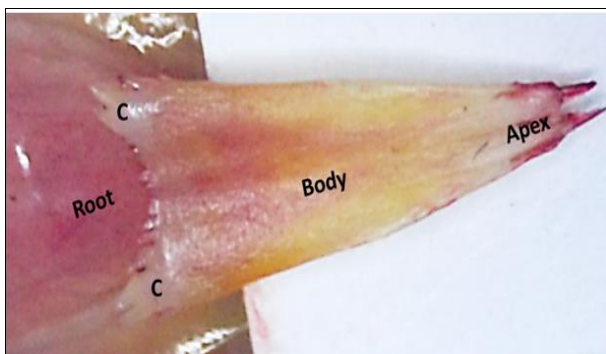


Fig 1: Photo macrograph of the tongue in bulbul show: the apex, body, root, conical papillae (C).

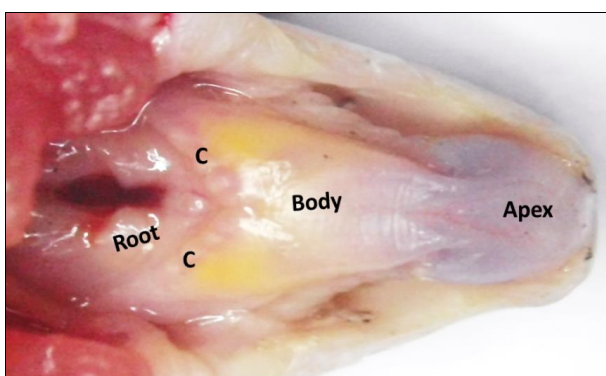


Fig 2: Photo macrograph of the tongue in cockatiel show: the apex,

body, root, conical papillae (C).

In bulbul the apex of bulbul tongue was pale yellow in color with two sharp pointed that take (v) shape the median shallow groove that start from the base of (v) shape of the apex that extend toward the body and root. While in cockatiel the apex was pinkish in color and have spatula like structure in shape at dorsal surface with present of several groove that direct toward the body of the tongue and give demarcation line between apex and body. The ventral surface of the apex was take abadminton ball shape. (fig.3). The finding of (Tawfiek and Mahmoud, 2021) [7] in geese, was disagree Results of bulbul and cockatiel. Who mention the smooth dorsal surface of the lingual apex had no lingual papillae. The finding of (El-Bakary, 2011) [8] in hoopoe bird, was disagree Results of bulbul and cockatiel. Who mention 3+4 large conical papillae are located at the rear end of the lingual apex in the form of letter "w".

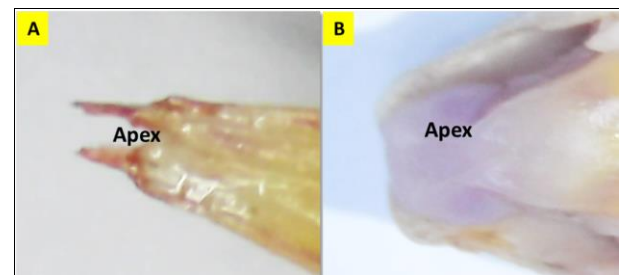


Fig 3: Photo macrograph (A) apex of bulbul tongue, (B) apex of cockatiel tongue show: the two sharp pointed end in bulbul as the shape and spatula like in shape in cockatiel.

Body of bulbul tongue was very thin and have yellow in color at beginning and then take pinkish color at the caudal end. The width was increased gradually toward the root, at the midline of the body present shallow median groove that extend from apex toward the root. the conical papilla was arranged at the caudal end of the body and composed of long and short papilla the long conical papilla was increased in number at two lateral side of caudal end of the body the frenulum linguae was present at ventral surfers of the body that start from the caudal third and extend to the root. (Fig. 1, 2). In cockatiel the body of the tongue that take pale pinkish color with triangular shape. the median shallow groove divided the body into two half's that start from the apex and extend through the body the width of the body was increased toward the root present of shallow torus linguae that start from the middle part of the body and extend to the caudal end the conical papilla was present at caudal end of the body that arranged as a single crest in shape that take pointed tip the median groove was divided the conical papillae into two half. The finding of (Reda, 2019) [21] in Muscovy ducks was similar Results of bulbul and cockatiel who mention The body of the tongue was attached to the lower bill by the wide frenulum linguae similar It had a prominent median groove on its dorsal surface.(Reda Mohamed, 2019) [21]. The finding of (Skieresz-Szewczyk *et al.*, 2021) [25] in geese bird, was similar Results of bulbul and disagree with that finding in cockatiel. Who mention the height of the conical papillae increases toward the lateral.

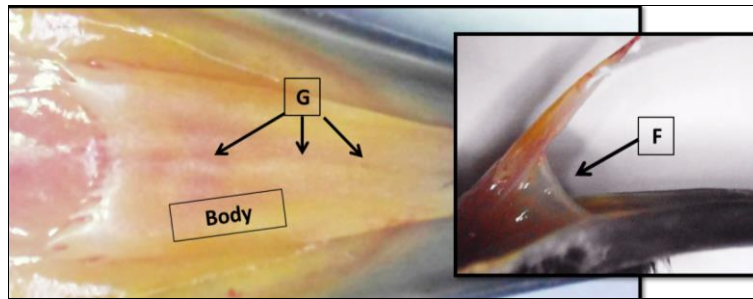


Fig 4: Photo macrograph of body of the tongue in bulbul show: the shallow median groove (G), frenulum linguae (F).

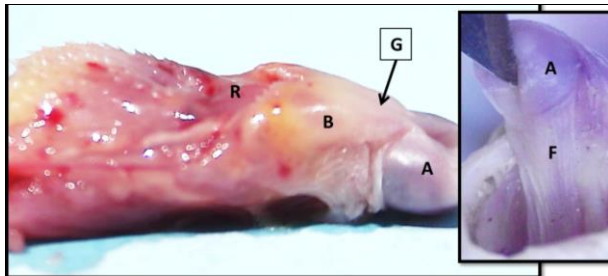


Fig 5: Photo macrograph of body of the tongue in cockatiel show: the shallow median groove (G), frenulum linguae (F), apex (A), body (B), root (R).

The root of bulbul tongue was appear below than the body and more than that appear in root of cockatiel tongue. the conical papilla was separated between the body of the tongue and the root the root in tongue of bulbul was larger in size from that in cockatiel the root of tongue have a pale pinkish color. While in cockatiel the conical papilla was separated the body from the root the root was below the height of the conical papilla the less at level from the body the root of tongue have same color of bulbul. (Fig. 1, 2). The finding of (Reda, 2019) [21] in Muscovy ducks, was similar Results of bulbul and cockatiel that mention the smallest part of the tongue was its root which was situated just caudally and below the base of the tongue with its laryngeal prominence. The finding of (Jackowiak, *et al.*, 2010) [17] in the Nutcracker bird, was similar Results of bulbul and cockatiel that mention The root of the tongue is located at a lower level than its body.

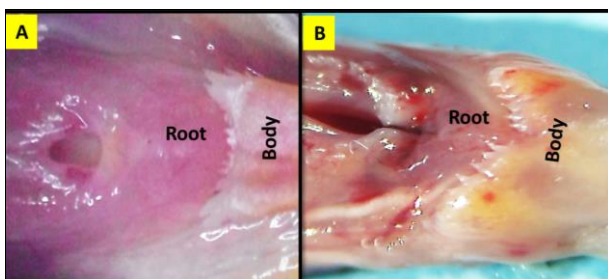


Fig 6: Photo macrograph (A) root of bulbul tongue, (B) root of cockatiel tongue show: the conical papillae was separated between the root and body and the body was located lower than the body in level.

The result of this study revealed that the weight of cockatiel was (48.753g), while the tongue weight was (0.414 g). The ratio between body weight and tongue weight (0.849) the weight of bulbul was (25.945g),while the tongue weight was (0.033g) and the ratio between body weight and tongue weight was (0.1272), (Table. 1) The length of the cockatiel body was (12.24±0.92) while the

tongue length was (0.95+0.167), the ratio between body length and tongue length of cockatiel was (7.76), (Table. 2) While the body length of bulbul was (10.54± 0.65) and the length of bulbul tongue was (1.12+0.173), the ratio between body length and tongue length of bulbul was (9.60). The morphological result, revealed that the width of the cockatiel tongue in three part was higher than that in bulbul tongue, the width of apex in cockatiel was (4.012+0.066) while in apex of the bulbul was (1.502+0.057). The width of body of the cockatiel tongue was (3.820+0.208) and in bulbul was (2.632+0.073) this result show that the body tongue in cockatiel was more thickness than that in bulbul. The width of the ratio of the tongue in cockatiel was (6.226+0.067) and in bulbul was (3.364+0.158). This result revealed that the root of the tongue in the cockatiel was very wide than that in bulbul and there is significant differences between then (Table. 3, 4).

Table 1: Show the weight of tongue (gm), weight of the bird (gm), ratio of body weight to tongue weight in bulbul and cockatiel.

Birds	Tongue weight (gm) Men ± SE	Body of bird (gm) Men ± SE	Ratio
Bulbul	0.033+0.007	25.945±0.92	0.1272*
Cockatiel	0.414+0.005	48.753±0.34	0.849*

Table 2: Show the length of tongue (cm), length of the bird (cm), ratio of body length to tongue length in bulbul and cockatiel.

Birds	Tongue length (cm) Men ± SE	Bird length (cm) Men ± SE	Ratio
Bulbul	1.12+0.173	10.54± 0.65	9.60*
Cockatiel	0.95+0.167	12.24±0.92	7.76*

Table 3: Show the width of three part of the tongue (apex, body, root) in bulbul and cockatiel.

Width	Bulbul (mm) Men ± SE	Cockatiel (mm) Men ± SE
Apex of tongue	1.502+0.057	4.012+0.066*
Body of tongue	2.632+0.073	3.820+0.208*
Root of tongue	3.364+0.158	6.226+0.076*

Table 4: Show the thickness of three part of the tongue (apex, body, root) in bulbul and cockatiel.

Thickness	Bulbul (mm) Men ± SE	Cockatiel (mm) Men ± SE
Apex of tongue	0.895 ± 0.027	3.014+0.038*
Body of tongue	1.640+0.335	3.394+0.127*
Root of tongue	2.242+0.188	3.966+0.041*

Conclusion

In conclusion, this study revealed significant morphological differences between the tongues of the white-eared bulbul (*Pycnonotus leucotus*) and the bronze fallow cockatiel (*Nymphicus hollandicus*). The bulbul's tongue, which is pale

yellow and V-shaped at the apex, does not fill the lower beak and falls short of the tip. In contrast, the cockatiel's tongue is pinkish, spatula-shaped, extends to the beak's tip, and fills the lower beak.

The body of the bulbul's tongue is thin, transitioning from yellow to pink, with a shallow median groove and conical papillae at the caudal end. The cockatiel's tongue body is pale pink, triangular, and has a pronounced median groove and torus linguae. Both species have roots as the smallest tongue part, with conical papillae separating the body and root, but the bulbul's root is larger.

Quantitatively, the cockatiel's tongue is wider and thicker across all regions compared to the bulbul. Additionally, the cockatiel exhibits a higher body weight to tongue weight ratio. These findings highlight distinct morphological adaptations linked to their feeding behaviors and ecological niches, enriching our understanding of avian tongue diversity and functionality.

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