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Morphometrical analysis of the tongue of adult white leghorn birds

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Abstract

Tongue specimens were collected from twenty-five White Leghorn hens, approximately one year of age. The tongue was located on the floor of the oropharyngeal cavity, specifically in a trench-like depression between the mandibular rami of the lower beak, directed downwards and backward. The tongue exhibited a triangular outline, resembling an arrowhead with a pointed tip. Various anatomical parts of the tongue, including the apex, body, caudal lingual papillae, and root, were measured and analyzed. The average weight and length of the tongue were 0.627 ± 0.03 gm and 26.84 ± 2.24 mm, respectively. The average widths and thicknesses of the tongue were as follows: apex (3.09 ± 0.20 mm, 1.31 ± 0.19 mm), body (7.10 ± 0.18 mm, 3.10 ± 0.12 mm), papillary crest (10.74 ± 0.38 mm, 4.55 ± 0.23 mm), and root (9.94 ± 0.38 mm, 3.84 ± 0.27 mm).

Keywords: Morphometry, white leghorn, tongue, statistical analysis

Introduction

The White Leghorn belongs to the superorder Galloanserae, specifically the order Galliformes. These medium-sized, chunky birds are known for their exceptional egg-laying ability and rapid growth. White Leghorn birds are highly productive in terms of egg production and are relatively easy to care for. The feeding mechanism plays a crucial role in the adaptation and survival of animals in their environment, and the tongue is an important component of the avian feeding apparatus. It works in coordination with the jaw and pharynx to generate precise movements during feeding and drinking behaviors (Homburger and Meyers, 1989) ^[10]. The gross morphology and microscopic structure of the avian tongue vary significantly based on the species' lifestyle (Erdogan and Iwasaki, 2014) ^[8]. The structural adaptations of this organ are influenced by the species' diet and feeding mode. While numerous studies have described the gross morphology of avian tongues and an abundance of literature is available on the topic, specific information regarding the morphometry of the tongue in White Leghorn birds is lacking. Understanding the anatomy of this organ is crucial for recognizing structural features that may affect food intake, nutrition, and ingestion. Additionally, it provides a foundation for identifying pathological alterations in this region, which is particularly important given the current interest in keeping this breed for various purposes. The present study aims to provide fundamental data on the morphometric features of the White Leghorn tongue, serving as a basis for further investigations into avian feeding mechanisms.

Materials and Methods

The study involved twenty-five adult White Leghorn hens, approximately one-year-old, obtained from the Poultry Farm at the College of Veterinary and Animal Science, RAJUVAS, Bikaner. Following the death of each bird, the oral cavity was opened, and the tongues were collected. Prior to examination, each tongue was rinsed with distilled water and excised for further analysis. The collected tongues were utilized to study and record various biometric parameters. Physical measurements, including weight, length, width, thickness, and volume, were conducted. The weight was determined using a physical balance, while the maximum length was measured from the apex to the root of the tongue using Vernier calipers. The breadth and thickness were measured at four distinct regions - the apex, body, caudal lingual papillae (papillary crest), and root - using Vernier calipers.

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The volume of the tongue was determined using the water displacement method.

Results

The weight, length, width, thickness, and volume of the tongues were recorded. The average weight and length of the tongue were 0.627 ± 0.03 g and 26.84 ± 2.24 mm, respectively. The width of the tongue was measured at four anatomical regions: apex, body, papillary crest, and root. The widest width was observed at the papillary crest. The average widths at the apex, body, papillary crest, and root were 3.09 ± 0.20 mm (W1), 7.10 ± 0.18 mm (W2), 10.74 ± 0.38 mm (W3), and 9.94 ± 0.38 mm (W4), respectively. The average thicknesses at the lingual apex, body, papillary crest, and root were 1.31 ± 0.19 mm (T1), 3.10 ± 0.12 mm (T2), 4.55 ± 0.23 mm (T3),

and 3.84 ± 0.27 mm (T4), respectively. The average volume of the tongue was 0.552 ml (Table).

Statistical analysis was performed on the collected data, and correlations between different parameters were calculated and presented in the table. A positive correlation of 0.503 was found between tongue weight (TWt) and bird weight (BWt). Additionally, a positive correlation of 0.553 was observed between tongue length (TL) and bird body weight (BWt). Among the four measured widths, the highest correlation (0.555) with bird body weight was found at the apex of the tongue (TW1). Similarly, there was a correlation between bird body weight and tongue thickness, with the highest correlation value (0.469) found at the papillary crest region (TT3). The volume of the tongue (TVol.) also showed a positive correlation of 0.374 with bird body weight (BWt).

Table 1: Showing Data collected for the present studies

Sr. No.	BWt (g)	TWt (g)	TL (mm)	TW1 (mm)	TW2 (mm)	TW3 (mm)	TW4 (mm)	TT1 (mm)	TT2 (mm)	TT3 (mm)	TT4 (mm)	TVol. (ml)
1	1500	0.72	28.72	3.69	7.73	11.24	10.56	0.7	3.22	4.26	3.75	0.6
2	1400	0.56	27.35	3.14	7.42	10.56	10.02	0.85	2.72	5.49	4.02	0.5
3	1300	0.58	26.45	2.73	7.17	10.22	9.53	0.95	3.21	4.3	3.7	0.5
4	1300	0.6	26.68	2.96	7.13	10.14	9.55	0.99	3.08	4.63	3.49	0.5
5	1300	0.57	27.23	3.09	6.67	9.81	9.07	1	2.98	3.88	2.96	0.5
6	1100	0.64	25.22	2.42	7.54	12.14	11.54	0.85	2.65	3.46	2.89	0.6
7	1300	0.8	27.57	2.66	7.34	11.69	10.88	0.68	2.95	4.16	3.78	0.7
8	1500	0.62	27.93	3.37	7.53	12.58	11.76	1.88	3	4.42	3.8	0.6
9	1400	0.6	27.13	3.48	7.39	12.67	11.69	1.72	2.88	4.09	3.62	0.5
10	1300	0.59	26.64	3.18	7.52	10.63	10.34	0.94	2.91	3.86	3.47	0.7
11	1300	0.52	27.31	2.92	7.22	10.24	9.68	1.76	2.95	4.28	3.94	0.5
12	1100	0.58	26.86	3.28	7.96	12.07	11.68	1.97	2.9	4.38	4.06	0.5
13	1200	0.75	27.24	2.76	6.81	10.03	9.6	1.31	2.87	4.24	3.83	0.5
14	1600	0.78	26.28	2.52	7	10.78	8.87	1.04	2.95	4.9	4.22	0.7
15	1000	0.54	25.17	2.26	6.45	11.76	8.8	0.97	2.86	4.36	3.98	0.5
16	1000	0.52	25.45	2.16	6.57	9.12	8.2	0.8	2.92	4.59	3.85	0.5
17	1400	0.57	25.47	3.19	7.16	10.02	9.13	1.17	3.22	5.18	4.62	0.6
18	1300	0.59	26.4	3.21	6.53	10.03	10.01	1.51	3.39	4.6	4.2	0.5
19	1300	0.62	25.93	2.63	6.76	10.54	9.57	1.13	3.31	5	4.55	0.6
20	1300	0.62	26.02	2.82	6.36	10.07	9.52	1.22	3.19	4.62	3.64	0.5
21	1500	0.72	26.66	3.64	7.4	11.44	10.05	2.22	3.97	5.82	5.49	0.5
22	1500	0.79	30.8	3.81	7.8	10.68	9.71	2.09	3.93	5.92	5.36	0.6
23	1400	0.67	26.88	3.96	6.68	9.98	9.4	1.72	3.33	4.76	3.16	0.5
24	1200	0.56	26.36	3.77	6.6	10.02	9.55	1.75	3.28	4.25	2.88	0.5
25	1400	0.58	27.67	3.83	6.87	10.03	9.98	1.63	2.97	4.32	2.92	0.6
Mean	1316	0.6276	26.8408	3.0992	7.1044	10.7408	9.9476	1.314	3.1056	4.5508	3.8472	0.552
SD	154.596	0.08447	5.49874	0.51351	0.45592	0.94911	0.94896	0.46714	0.31826	0.58352	0.67134	0.07141
SE	62.9977	0.03442	2.24073	0.20925	0.18578	0.38676	0.3867	0.19036	0.12969	0.23778	0.27357	0.0291
CC	-	0.50399	0.55338	0.55599	0.32824	0.09419	0.13092	0.27256	0.44015	0.46912	0.33367	0.37438

SD-Standard deviation, SE-Standard error, CC-Coefficient of correlation

Discussion

The morphometric analysis of the White Leghorn tongue revealed an average length of 26.84 ± 2.24 mm from the tip to the root. Comparing this to other avian species, Pasand *et al.* (2010) [20] and Jackowiak and Ludwig (2008) [12] reported an average tongue length of 1.92 ± 0.15 cm and 2.1-2.5 cm, respectively, in ostriches [20, 12]. The European kestrel and Hume's tawny owl had average tongue lengths of 2.3 cm and 2 cm, respectively (Abumandour and El-Bakary, 2017) [2]. Other studies have reported tongue lengths of 7 cm in domestic geese (Jackowiak *et al.*, 2011) [13], 6 mm in cattle egrets (Al-Ahmady, 2016) [3], 15.97 ± 0.1 mm in chukar partridges (Erdogan *et al.*, 2012), 2.5 cm in white storks (Jackowiak *et al.*, 2015) [14], 6 cm in white-tailed eagles (Jackowiak and Godynicki, 2005) [11], 8 mm in zebra finches (Dehkordi *et al.*, 2010) [5], 1.8 cm in white-throated kingfishers and 2 cm in common buzzards (El-Beltagy, 2013)

[7], 5 mm in budgerigars (Parchami and Salimi, 2017) [19], 28 mm in white-eared bulbuls (Parchami and Dehkordi, 2013) [18], 6.2 mm and 6.09 mm in male and female black-winged kites, respectively (Mohammed, 2017) [16], 1 cm in partridges (Rossi *et al.*, 2005) [22], 17 mm in laughing doves (Al-Nefei, 2015) [4], 2.4 cm in nutcrackers (Jackowiak *et al.*, 2010), 2.45 cm in American rheas (Santos *et al.*, 2011) [23], 39.33 ± 0.23 mm in seagulls and 21.75 ± 0.27 mm in common buzzards (Onuk *et al.*, 2015), 4.5 cm in common teals (El Bakary *et al.*, 2016), 1.2 cm in quails (Poullis, 2014), and 3 cm in fowl (Abou-Zaid, 2008) [13, 3, 9, 14, 11, 5, 7, 19, 18, 16, 22, 4, 15, 23, 17, 6, 21, 1].

The variations in tongue length among different bird species can be attributed to their specific adaptations to their respective diets and feeding behaviors. The White Leghorn hens, known for their egg-laying ability, may possess a tongue length suited to their feeding requirements and physiological characteristics. Further studies on the functional

implications of the tongue length in White Leghorns would provide valuable insights into their feeding mechanisms and behavior.

The average thickness of the White Leghorn tongue at the apex, body, papillary crest, and root were measured as 1.31±0.19 mm (T1), 3.1±0.12 mm (T2), 4.55±0.23 mm (T3), and 3.84±0.27 mm (T4), respectively. In comparison, Onuk *et al.* (2015) reported tongue thicknesses of 4.31±0.03 mm in seagulls and 3.2±0.04 mm in common buzzards [17]. Regarding the average width of the tongue at different regions, the measurements for the apex, body, papillary crest, and root were recorded as 3.09±0.20 mm (W1), 7.1±0.18 mm (W2), 10.74±0.38 mm (W3), and 9.94±0.38 mm (W4), respectively. In comparison, Jackowiak *et al.* (2011) [13] reported average widths of 1.3 cm, 2 cm, 1.1-2.1 cm, and 1.4 cm at the apex, body, lingual prominence, and root, respectively, in domestic geese [13]. Onuk *et al.* (2015) reported the width at the apex and radix in seagulls as 2.38±0.03 mm and 8.67±0.19 mm, respectively, and in common buzzards as 6.59±0.13 mm and 7.3±0.04 mm, respectively [17].

Comparing these findings to other bird species, the maximum width was reported as 2.92±0.29 cm in ostriches (Pasand *et al.*, 2010), 0.9 cm at the middle part in European kestrels, and 1 cm at the middle part in Hume's tawny owls (Abumandour and El-Bakary, 2017). Chukar partridges had a width of 5.57±0.04 mm (Erdogan *et al.*, 2012), cattle egrets had a width of 4 mm (Al-Ahmady, 2016) [3], and black-winged kites had widths of 3.8 mm in males and 3.4 mm in females (Mohammed, 2017) [16]. White-tailed eagles had a width of 1.8-2 cm (Jackowiak and Godynicki, 2005) [11], common teals had a width of 0.9 cm (El Bakary *et al.*, 2016), fowls had a width of 0.6 cm (Abou-Zaid, 2008), white storks had a width of 0.7-0.8 cm at the caudal part of the tongue (Jackowiak *et al.*, 2015) [14], and American rheas had a width of 2.60 cm at the caudal part (Santos *et al.*, 2011) [20, 2, 9, 3, 16, 11, 6, 1, 14, 23]. These variations in tongue thickness and width among different bird species can be attributed to their specific adaptations to their diets, feeding behaviors, and ecological niches. The White Leghorn's tongue dimensions reflect its own feeding requirements and physiological characteristics. Further studies on the functional significance of tongue thickness and width in White Leghorns would provide a deeper understanding of their feeding mechanisms and adaptations.

Conclusion

In conclusion, the study found positive correlations between tongue weight (TWt) and bird weight (BWt), as well as between tongue length (TL) and body weight (BWt) of the birds. The width of the tongue at the apex (TW1) showed the highest correlation with bird body weight (BWt) among the measured widths from different anatomical regions. Additionally, a positive correlation was observed between bird body weight and tongue thickness. Furthermore, there was a positive correlation between tongue volume (TVol.) and bird body weight (BWt).

These findings suggest that the size and dimensions of the tongue in White Leghorn hens are related to their overall body weight. Understanding the relationship between tongue characteristics and bird weight can provide insights into their feeding mechanisms, adaptation, and nutritional requirements. Further research on the functional significance of these correlations and the implications for feeding behavior in White Leghorns would be valuable for future studies on avian feeding mechanisms.

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