Tikrit Journal of Veterinary Sciences (2026) 5(1): 173-180
DOI : 10.25130/tjvs.5.1.18

IRAQI Academic Scientific Journals

TJVS Tikrit Journal of Veterinary Sciences

Tikrit Journal of Veterinary Science

A Comparative Morphological and Histological Study of the Tongue between African grey parrot and the black crow (Corvus capensis)

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ARTICLE INFO.

Article history:
-Received:1/10/2025
-Received In Revised Form: 20/11/2025
-Accepted: 22/11/2025
-Available online: 30/6/2026

Keywords:
Tongue, African grey parrot, Black crow, Morphology, Histology.

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Background and Objective: Studying the anatomy and histology of bird tongues is very important for figuring out how different birds feed and how their bodies change. This study aimed to investigate and compare the morphological and histological changes associated with the distinct ecological roles and dietary preferences of two avian species: The African grey parrot and the black crow (Corvus capensis).

Methods: This study included a comparative analysis including ten parrots and ten black crows.

Results: After death, the tongues of both species were carefully collected and examined for anatomical and histological purposes. From an anatomical point of view, the tongues had different shapes. The tongue of a parrot is short, thick, and strong, and it is formed of keratin. The tongues of crows were not as keratinized, wider, or narrower than normal. The histology study says that the parrot's tongue contains a lot of diverse taste buds, a complicated and flexible internal musculature, elastic connective tissue, and a strong, keratinized mucosal epithelium. The tongues of crows have a more delicate epithelium, a simpler muscle structure, thinner and more flexible connective tissue, and no taste buds.

Conclusions: The study shows that the structural changes found in both groups are in line with how they eat and what they like to consume.

Introduction

Because of their adaptability to a wide range of environments, birds are among the most diverse groups of vertebrates. These feathered friends have worked out what's best for their diet. They have quite different digestive systems because of the way they eat [1]. One of the most important parts of a bird's body, the tongue performs a wide variety of critical functions. Among these functions include the ability to make noises, consume, and move food around in the mouth, among others. There are a lot of other food-related problems it helps with as well [2]. The tongues of many bird species are easily distinguishable from one another, highlighting the unique physical characteristics of each bird. These variations are made possible by the particular circumstances of the birds' environment and their food source. In order to understand the evolutionary changes and behavioral differences between the species, it is essential to make this distinction [3]. The beak, jaws, and tongue of each bird species varies in structure, appearance, and function [4,5] The shape of the beak is modified according to function, as the movements of the mandible and tongue, which, in conjunction with the beak, are responsible for sound production, feeding: pretension, transport, bolus formation, and swallowing in birds [6,7]. Birds' shallow tongue takes grabbing and Fear actions, while the long tongue plays an essential role in gathering dew as a water source in nectar feeder birds [8]. So tongue shape varies between species. Understanding the anatomical structure and histology condition of the tongue in birds collectively and individually are scarce [9]. The birds tongue is modified to the route and type of food intake [10]. Parrots possess a powerful, muscular tongue enclosed with prominent horny papillae, enabling them to grasp seeds and assist in peeling and manipulating them during feeding, a characteristic of herbivorous species [11]. While the tongue of black crow has a longer, thinner with a relatively smooth surface, reflecting a more diverse and omnivorous feeding pattern that includes the consumption of insects, seeds, and carrion, without the need for shelling or complex manipulation of the seeds within the oral cavity [12,13]. The aimed of the study to highlight the Morphological and functional differences between two different bird species belonging to contrasting nutritional and behavioral environments, contributing to an understanding of the relationship between tongue anatomies and associated ecological and nutritional adaptations. This comparison also provides a basis for understanding the mechanisms of the functional evolution of avian feeding auxiliary organs.

Materials and method

Ethical Approval:

"The Scientific Ethical Committee of the College of Veterinary Medicine, University of Diyala, Iraq, approved this study (Approval no: Vet Medicine (212); July 2025 M and R".

Sample Collection

Twenty birds were purchased for the study from local markets in Baghdad and Diyala governorates. The samples were divided into 10 parrot samples and 10 black crow samples. The weights of each bird were recorded before slaughter.

Morphology study

After the birds were sacrificed (slaughtered), a morphology examination was performed. The tongue was completely removed from the tip to the larynx using anatomical tools. After that tongue washed in distilled water to remove any food or blood adhering to it, and its weight was taken. Then the tongue was divided into three parts: the tip, the body, and the root [14]. The measurement was taken via the vernia.

Histological study

To prepare tongue tissue specimens for microscopic analysis, the samples were initially cut and washed with water. They were then preserved by immersing them in a 10% formalin solution for 48 hours. The samples then departed through a dehydration process utilizing an order of graded ethanol concentrations for two hours each, moving forward through 70%, 80%, 90%, and finally 100% ethanol. After dehydration, the samples were cleared with xylene for 1 hour. Lastly, the specimens had been embedded in paraffin wax, permitting for the preparation of blocks from which serial sections, 5 micrometers thick, were cut using a microtome. The ribbon Sections were stained after being placed on glass slides using hematoxylin and eosin (H&E) for enhanced visibility under light microscopy. These prepared slides were then inspected and captured on camera with a microscope, equipped with a digital camera, ensuring high-quality imaging [15].

Statistical analysis

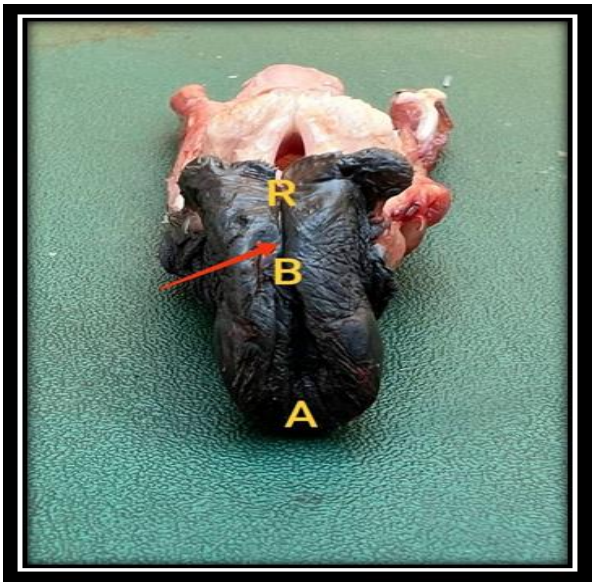
"The Statistical Packages of Social Sciences-SPSS (2019) program was used to detect the effect of difference groups in study parameters. T-

test was used to significant compare between means in this study"[16].

Result and Discussion

Anatomical Result

The results in the current study showed that the tongue in both species consists of three parts: the (apex, the body, and the base), The dorsal surface of the tongue body is divided into two symmetrical segments by the medial groove that extends along the length of the body from the lingual elevation posteriorly to the tip of the tongue anteriorly. The median lingual groove in a parrot is relatively deep, while in a black crow the tongue is shallow and extends along the length of the tongue (Fig.1 A and B). Our study agrees in this description with the study by [17] on the tongue of the hooded crow and [18] on the tongue of the domestic turkey. In terms of shape, there were clear differences, as the parrot's tongue appeared longer, thick, and very muscular with a keratinous surface (Fig.1 A), while the crow's tongue was shorter, thinner, and less keratinous (Fig.1 B). In the parrot's tongue, the root region occupies the area between the lingual and larynx elevations. These elevations, the smallest part of the tongue, lie below the lingual elevation. On both sides of the root is a pair of prominent bulges. These rounded bulges bear conical papillae with spiny borders (Fig. 2 A). The smooth, triangular surface forming up the base of the crow's tongue is encircled by a raised surface. The cylindrical papillae, which are pointing backwards towards the throat, are the components that make up this elevated surface (see Figure 2b). The findings that were obtained pertaining to the tongues of both parrots and crows serve to illustrate that the smooth root of the tongue, which is the smallest of all the segments that make up the tongue, is situated between the pharyngeal aperture, which is located posteriorly, and the lingual elevation, which is found anteriorly. The results of our investigation provide support for the conclusions that were reached by the researchers [19,20]. The measures of the tongues of the black crow and the African grey parrot are substantially different from one another in terms of their thickness, length, and breadth, as can be seen in Table 1. The tongues of parrots are longer than those of crows by a statistically significant amount ($P = 0.0412$), with the average length of a parrot's tongue being 83.69 ± 5.21 mm, and the average length of a crow's tongue being 69.00 ± 4.32 mm. As a consequence of this, the parrot's tongue becomes elongated and more developed since it is used to ingest food and manage the nutrients that it ingests. According to the conclusions that were drawn from prior study, the tongues of parrots are both long and muscular in nature. Due to these qualities, the degradation of food and the generation of sounds are both made simpler [21, 22]. The parrot's tongue has a thicker tip (3.87 ± 0.19 mm) compared to the crow's tongue (2.65 ± 0.13 millimeters). There is a difference that is statistically significant ($p = 0.0040$). This is an example of how the wide tongue tip of the crow, which is used for the purposes of tearing apart and grabbing food, is well suited to its diet, which is comprised of a wide array of different foods. Crows have tongues that are shorter in length and have a keratin point at the end [23]. The results of previous research are supported by the differentiation that has been seen in this investigation. Because the thicknesses of the body and the root were identical ($P > 0.05$), the two species need an equal amount of muscle assistance in order to chew and swallow their food. The root of the tongue of the parrot became larger and wider because of the existence of intrinsic tongue muscles and a more flexible tongue apparatus, which aid the parrot in creating sounds and feeding itself. A significance level of 0.0496 along with 0.0008, respectively, were obtained, indicating that there were notable changes in breadth between the body and root regions. The parrot's tongue was broader, particularly at the base, which was a necessary feature that enabled it to manoeuvre accurately while it consumed food. The investigators previously got comparable outcomes [24] stated that the tongues of parrots are broader and more flexible than those of crows due to the manner in which the muscles in their tongues function.



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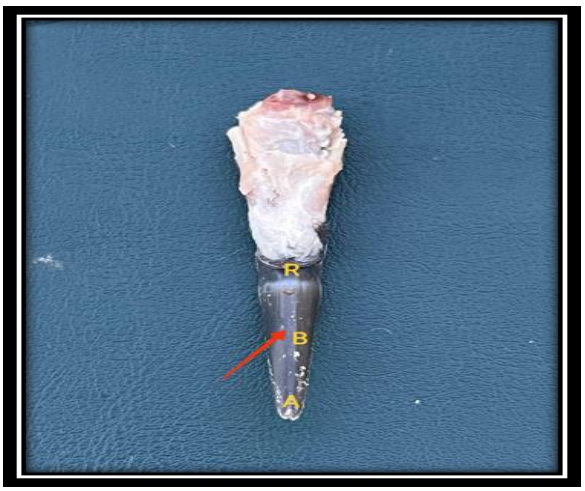

Figure (1): A gross morphology of the tongue in (A) African grey parrot, (B) Black crow showing the shape and divisions of the tongue: apex (A), body (B), root (R), Medial groove (red arrow).

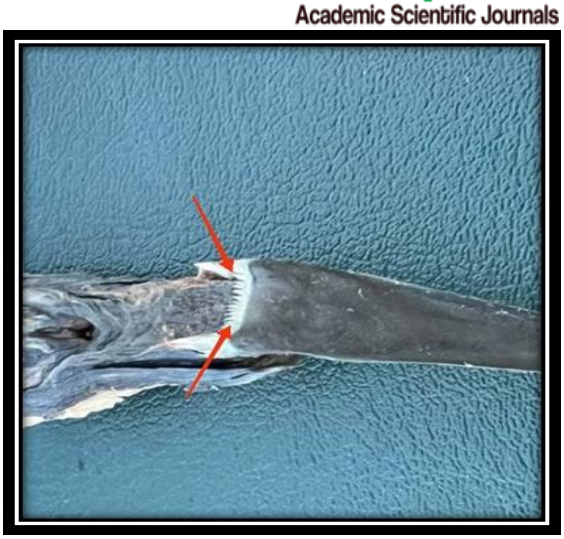

Figure (2): A gross morphology of the area at the root of the tongue in (A) African grey parrot, (B) Black crow. Is where the conical papillae appear (red arrow), Medial groove (blue arrow).

Table1: shows the average length, thickness, width, and Total of each part of the tongue.

Measurement	Apex (mm)	Body (mm)	Root (mm)	Total (mm)
Length: Crow **Parrot**	6.09 ±0.24 9.74 ± 1.60 (+)*	46.85 ±3.74 55.30±8.20 (+)*	16.04 ±2.80 18.65 ± 0.68 (+)*	69.00 ± 4.32 83.69 ± 5.21 (+)*
P-Values	0.1347	0.9690	0.2374	0.0412
Thickness: Crow **Parrot**	2.65 ± 0.13 (-) * 3.87 ± 0.19 (+)	8.79 ± 0.33 8.50 ± 0.12	10.69 ± 0.60 11.27 ± 0.27 (+)	8.98 ± 0.64 (-) * 10.85 ± 0.29 (+)
P-Values	0.0040	0.5129	0.0035	0.0042
Width: Crow **Parrot**	10.08 ± 0.18 9.65 ± 0.52 (-)	14.01 ± 0.46 14.69 ± 0.36 (+)	12.71 ± 0.42 (-) 15.36 ± 0.42 (+)*	36.80 ± 0.69 39.70 ± 0.81 (+)*
P-Values	0.5771	0.0496	0.0008	0.0024

Histological Results:

Our histological study showed that the mucous membrane covering the tongue of Parrot and Black Crow is composed of epithelium and lamina. The type of epithelium is stratified squamous keratinized epithelium composed of four layers (stratum Basale, stratum spinosum, stratum granulosum, stratum corundum) (Fig.3).

The results of the current study showed that the parrot tongue is lined with a thick stratified squamous epithelium with a distinct keratinized layer (Fig.3). The average thickness of this epithelial layer in the parrot was 261.46 ± 67.95 µm, while in the black crow it was 84.24 ± 4.14 µm, thinner than in the parrot (Table 2). The

thickness of the keratinized layer in the parrot was measured at an average of 29.20 ± 4.36 µm, while in the black crow it was 10 ± 3.43 µm (Table 2). The specialized lamina propria consists of dense connective tissue, skeletal muscle, taste buds, and blood vessels (Fig.4). The current result is consistent with [26]. In the black crow, collagen is moderate in the connective tissue, while in the parrot it is dense and thick collagen bundles. As for blood vessels in the black crow, they were moderate in the lamina propria, while in the parrot they had a rich vascular supply due to high metabolic activity (Fig.5, 6). Our study is consistent with [27] in birds. In the black crow, the muscles are moderately developed and well-developed for coordinating pecking and flight, while in the parrot, thick and strong muscle fibers are shown for beak movements (Fig.5, 6). Our study is consistent with [28] in birds. The results showed that the lamina propria also contains lingual glands, which were more developed and larger in the parrot compared to the crow (Fig.5, 6). The tongues of crows and parrots were found to have significantly different diameters ($P < 0.01$), suggesting that these birds had different secretory activities and lubricating requirements. In line with previous research, this study shows that there is a strong correlation between the thickness of the epithelium, the development of glandular structures in birds, and how these organisms adapt to their environments through feeding and other means.

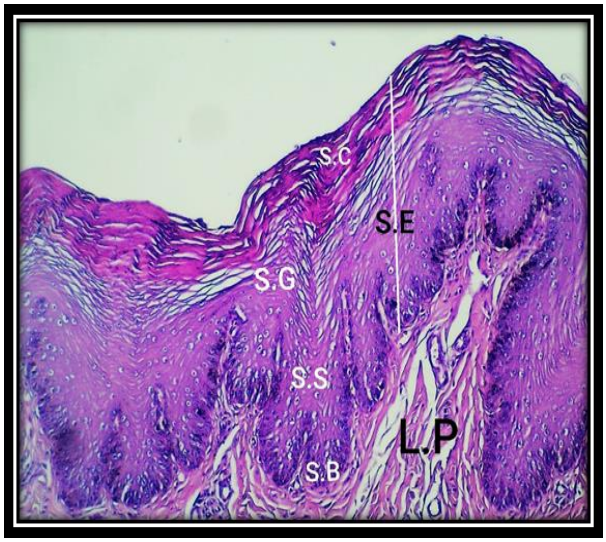

Figure (3): Photomicrograph of the Parrot tongue showing, epithelium composed of four layers' stratum Basale (S.B), stratum spinosum (S.S), stratum granulosum (S.G), stratum corundum (S.C), lamina proprea (L.P). (H&E stain, X 100).

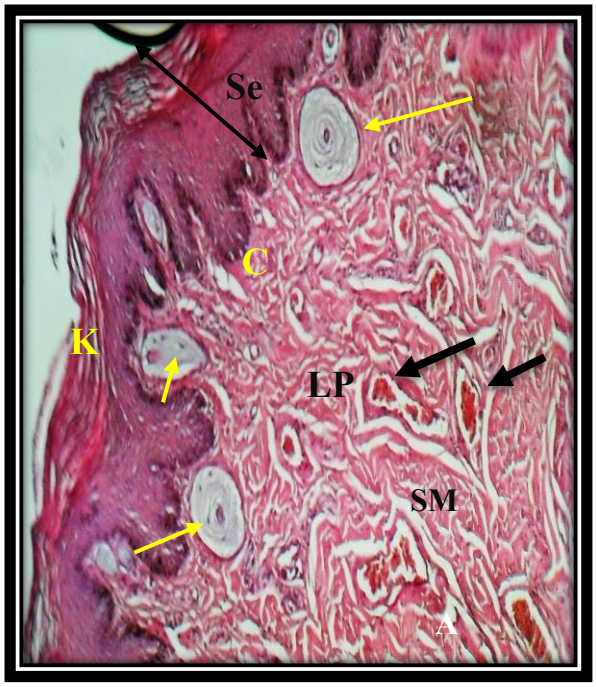

Figure 4: illustrates the parrot's tongue as viewed under a microscope, highlighting the dorsal lingual surface and taste buds (indicated by yellow arrows). The keratin layer (K) is positioned above the stratified squamous epithelium (Se), accompanied by the skeletal muscle layer (SM), blood vessels (marked by black arrows), and connective tissue (C) (H&E stain, magnification X 200).

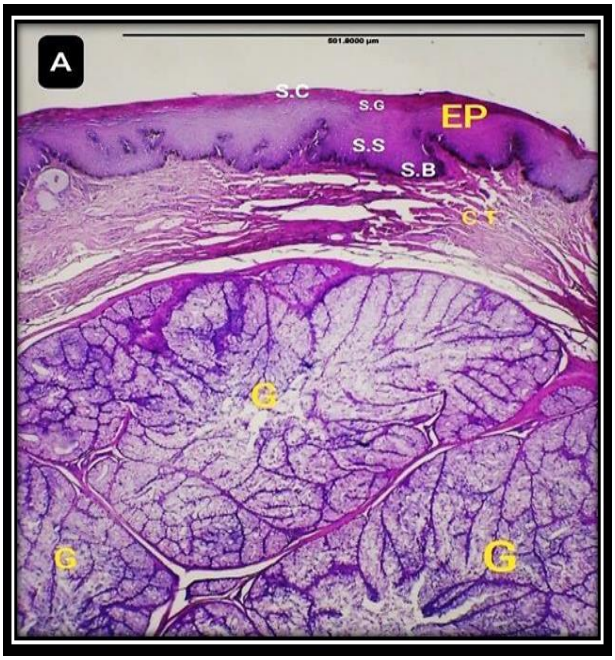

Figure (5): Photomicrograph of the African grey parrot tongue showing, epithelium composed of four layers' stratum Basale (S.B), stratum spinosum (S.S), stratum granulosum (S.G), stratum corundum (S.C), salivary gland (G), lamina proprea (Ct). (H&E stain, X 100).

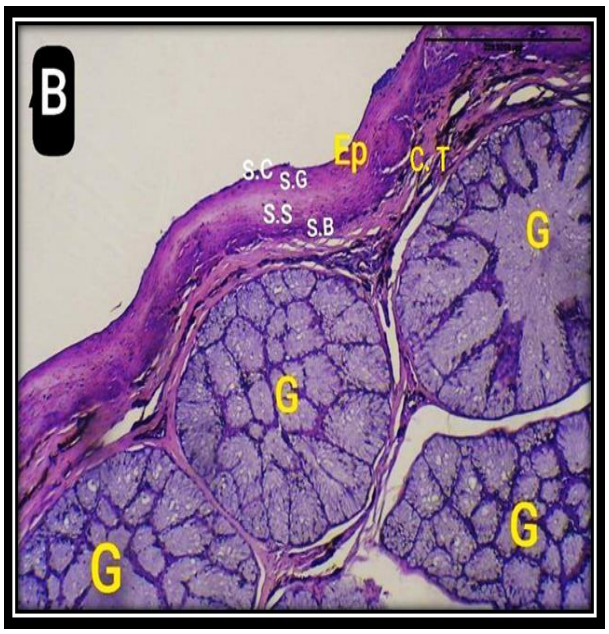

Figure (6): Photomicrograph of the tongue of black crow showing, epithelium composed of four layers stratum Basale (S.B), stratum spinosum (S.S), stratum granulosum (S.G), stratum corundum (S.C), salivary gland (G), lamina proprea (Ct). (H&E stain, X 100).

Parameter	Parrot	Black crow	(P-value)
Thickness of lingual epithelium (µm)	261.46 ± 67.95	84.24 ± 4.14	P < 0.01
Thickness of keratinized layer (µm)	29.20 ± 4.36	10.43 ± 3.43	P < 0.05
Diameter of salivary glands (µm)	123.9 ± 3.90	68.73 ± 5.07	P < 0.01

Conclusion

According to the outcomes of the current investigation, the tongue of the parrot appears to have a significant amount of muscular strength and is additionally capable of being maneuvered. On the other hand, the tongue of the black crow demonstrated a greater number of characteristics particularly in terms of rigidity and elevated keratinization when performing pecking and gripping behavior.

Acknowledgments

The authors extend their sincere thanks to the Dean of the College of Veterinary Medicine and the Head of the Anatomy and Histology Department at Diyala University. They also wish to thank the staff of the Anatomy and Histology Laboratory at the college for their cooperation.

Declaration of interests

The authors declare that they have no conflicts of interest.

Funding sources

The authorship and publication of this work were the result of an independent investigation without funding from elsewhere.

Data and material availability

All data generated and analyzed during this study are included in this published article.

Author contribution

Muhannad A. M.: Sample collection, laboratory techniques, manuscript writing, and revising. Raad S.I.: Suggested the title of the research, manuscript writing, and revising.

Reference

[1] Farhan, N. A., & Hussein, A. A. 2024. Morphometric comparative study of the pancreas between the owl bird and the moorhen bird. Diyala Journal for Veterinary Sciences, 2(3), 75-83.
[2] Gussekloo, S. W. S., & Bout, R. G. 2005. The kinematics of feeding in birds. Biological Reviews, 80(3), 515–525.
[3] Cuban, D., Hewes, A. E., Sargent, A. J., Groom, D. J., & Rico-Guevara, A. 2022. On the feeding biomechanics of nectarivorous birds. Journal of Experimental Biology, 225(2).
[4] El-Mansi, A. A., El-Bealy, E. A., Al-Kahtani, M. A., Al-Zailaie, K. A., Rady, A. M., Abumandour, M. A., & El-Badry, D. A. 2021. Biological aspects of the tongue and oropharyngeal cavity of the Eurasian Collared Dove (Streptopelia decaocto, Columbiformes, Columbidae): Anatomical, histochemical, and ultrastructure study. Microscopy and Microanalysis, 27(5), 1234-1250.
[5] Schneider, R. A. 2024. Cellular, Molecular, and Genetic Mechanisms of Avian Beak Development and Evolution. Annual review of genetics.
[6] Kamil Kadhim, K., Hameed, A. L. T., & A. Abass, T. 2013. Histomorphological and Histochemical Observations of the Common Myna (Acridotheres tristis) Tongue.

[7] Cheng, Y., Miller, M. J., & Lei, F. 2024. Molecular Innovations Shaping Beak Morphology in Birds. Annual Review of Animal Biosciences, 13.
[8] Ritchison, G. 2023. Locating, Obtaining, Ingesting, and Digesting Food. In In a Class of Their Own: A Detailed Examination of Avian Forms and Functions (pp. 687-884). Cham: Springer International Publishing.
[9] Kuo, P. C., Navalón, G., Benson, R. B., & Field, D. J. 2024. Macroevolutionary drivers of morphological disparity in the avian quadrate. Proceedings of the Royal Society B, 291(2017), 20232250.
[10] Niknafs, S., Navarro, M., Schneider, E. R., & Roura, E. 2023. The avian taste system. Frontiers in Physiology, 14, 1235377.
[11] Homberger, D. G., & Brush, A. H. 1986. Functional and structural significance of the complex tongue and lingual papillae in parrots, with special reference to the African Grey Parrot (Psittacus erithacus). Zoomorphology, 106(2), 103–114.
[12] Goodwin, D. 1986. Crows of the World. British Museum (Natural History).
[13] Marzluff, J. M., & Angell, T. 2005. In the Company of Crows and Ravens. Yale University Press.
[14] Bello A, Onu, JE, Jimoh MI. & Olushola O, 2015. Morphometric observations of the tongue of the domestic duck (Anas Platyrhynchos Domestica). Res J Phytomed, 1(1), 30-2.
[15] Bancroft, J. D., & Gamble, M. (Eds.). 2008. Theory and practice of histological techniques.6th ed. Elsevier health sciences.
[16] Statistical Packages of Social Sciences-SPSS/ IBM Statistics 26 step by step. 16th Edition. SPSS 2019.
[17] Elsheikh, E. H., & Al-Zahaby, S. A. 2014. Light and scanning electron microscopical studies of the tongue in the hooded crow (Aves: Corvus corone cornix). The Journal of Basic & Applied Zoology, 67(3), 83-90.
[18] Skieresz-Szewczyk K, Plewa B. & Jackowiak H, 2021. Functional morphology of the tongue in the domestic turkey (Meleagris gallopavo gallopavo var. domesticus). Poultry Science, 100(5), 101038.
[19] Hassan SF, Moussa EA, & Cartwright AL. 2010. Variations by sex in anatomical and morphological features of the tongue of Egyptian goose (Alopochen aegyptiacus). Cells Tissue Organs 191:161–165.
[20] Ragab S, Farag F, Tolba A, Saleh A, & El-Karmoty A. 2014. Gross morphological and angioarchitectural study of the oral cavity in the Egyptian domesticated ducks (Anas platy rhynchos domesticus). Suez Canal Vet Med J. 9(2): 137-148.
[21] Iwasaki, S. 2002. Evolution of the structure and function of the vertebrate tongue. Journal of Anatomy, 201(1), 1–13.
[22] Jackowiak, H., & Godynicki, S. 2005. Light and scanning electron microscopic study of the tongue in the zebra finch (Taeniopygia guttata). Annals of Anatomy, 187(3), 197–205.
[23] McLelland, J. 1990. A Colour Atlas of Avian Anatomy. Wolfe Publishing Ltd., London, UK.
[24] Emura, S., & Chen, H. 2008. Scanning electron microscopic study of the tongue in birds. Anatomia, Histologia, Embryologia, 37(6), 459–463.
[25] Romanoff, A. L., & Romanoff, A. J. 1972. The avian embryo: Structural and functional development. New York: Macmillan.
[26] Kooloos, J. G. M., Kraaijeveld, A. R., Langenbach, G. E. J., & Zweers, G. A. 1989. Comparative mechanics of filter feeding in Anseriformes. Acta Biotheoretica, 38(1-2), 51–64.
[27] Mescher, A. L. 2024. Junqueira's Basic Histology: Text and Atlas (17th ed.). McGraw-Hill Education.
[28] King, A. S., & McLelland, J. 1984. Birds: Their structure and function. Baillière Tindall.

Tikrit Journal of Veterinary Sciences (2026) 5(1): 173-180
DOI : 10.25130/tjvs.5.1.18

دراسة شكلية ونسيجية مقارنة للسان الببغاء الرمادي والغراب الأسود

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الملخص

الخلفية والهدف: تُعد دراسة التشريح والأنسجة لألسنة الطيور أمراً بالغ الأهمية لفهم آليات التغذية والتغيرات الجسدية لدى الأنواع المختلفة منها. هدفت هذه الدراسة إلى فحص ومقارنة التغيرات الشكلية (المورفولوجية) والنسيجية المرتبطة بالأدوار البيئية المتباينة والتفضيلات الغذائية لنوعين من الطيور: الببغاء الرمادي الأفريقي والغراب الأسود.

المواد وطرق العمل : تضمنت الدراسة تحليلاً مقارناً شمل عشرة طيور من الببغاء الرمادي الأفريقي وعشرة طيور من الغراب الأسود .

النتائج: بعد النفوق، جُمعت ألسنة كلا النوعين وفُحصت بعناية لأغراض تشريحية ونسيجية. ومن الناحية التشريحية، تبين وجود اختلافات في شكل الألسنة؛ إذ يتميز لسان الببغاء بكونه طويلا وسميكاً وقوياً ومكوناً من مادة الكيراتين، في حين كانت ألسنة الغربان أقل تكرتناً، وتفاوتت في عرضها (بين العريض والضيق). وأظهرت الدراسة النسيجية أن لسان الببغاء يحتوي على تشكيلة متنوعة من براعم التذوق، وبنية عضلية داخلية معقدة ومرنة، ونسيج ضام مرن، وظهارة مخاطية قوية ومكرتنة. وفي المقابل، تميزت ألسنة الغربان بظهارة أكثر رقة، وبنية عضلية أبسط، ونسيج ضام أكثر رقة ومرونة، مع خلوها تماماً من براعم التذوق.

الاستنتاجات: تشير الدراسة إلى أن التغيرات التركيبية الملحوظة لدى كلا المجموعتين تتوافق مع أنماط التغذية والتفضيلات الغذائية الخاصة بكل منهما.

الكلمات المفتاحية: اللسان, الببغاء، الغراب الأسود، التشريح، الأنسجة.