NTU Journal of Agricultural and Veterinary Sciences (2023) 3 (3) : 90-96
DOI: https://doi.org/10.56286/ntujavs.v2i2

IRAQI Academic Scientific Journals

P-ISSN: 2788-9890 E-ISSN: 2788-9904
NTU Journal of Agricultural and Veterinary Sciences
Available online at: https://journals.ntu.edu.iq/index.php/NTU-JAVS/index

A Comparative Histological & Histochemical Study of the Tongue between the Local Adult Ducks & Geese

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Article Informations

Received: 09-08- 2023,
Accepted: 20-08-2023,
Published online: 18-10-2023

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Key Words:
ducks,
geese,
tongue,
keratinization,
papillae.

A B S T R A C T

Our study aimed at determining the histological and histochemical composition of the tongue of both ducks (*Anas Platyrhynchos*) and geese (*Anserini*). Our histological study showed that the mucous membrane covering the tongue in local ducks and geese consists of a multi-layered epithelium covering the lamina propria, which differs in the degree of keratinization according to its location in the tongue, and that the thickness of the epithelium of the dorsal surface of the tongue gradually decreases from the front towards the root, while the epithelium increases in thickness towards the root. The ossified epithelium is located at the top and beginning of the body of the tongue forming what is known as the nail of the tongue in both ducks and geese. The small and large conical papillae in various parts of the tongue, as well as the filiform papillae, are covered with erosive ossified epithelium

Introduction

Most birds are very important to humans from an economic point of view as poultry are among the main sources of meat, eggs and feathers. Also, some of them, such as songbirds and parrots are nice domestic animals (Alonso *et al*., 2004).

Birds are spread all over the world, and their sizes greatly vary. The smallest species at all is the bee hummingbird and the largest is the ostrich (Brown and Van Tuinen, 2011).

Birds are classified according to the relationship of the diet to the tongue of the bird, as they found five functions provided by the tongue of the bird (collecting food, eating, swallowing, tasting, touching and building the nest). They found that the tongue has great adaptations to the diet as it can eat a variety of foods, including insects, small seeds, herbs, grains, etc., and this varies according to the species and the shape of the tongue, as it has thick or thin tongues, narrow or wide, rounded or pointed at the tip or split at the tip, etc. (El-Bakary, 2011)

The scientifically named duck (*Anas Platyrhynchos*) is a medium-sized waterfowl. Ducks are well adapted to life on water along with their water filter system in their mouths (Kabita and Anil, 2015). The geese with the scientific name (*Anserinae*) follow the duck family of the geese order, as the former are closely related to ducks, swans and other waterfowl that belong to the Anatidae family. They are relatively medium-sized birds, and their diet consists of papyrus plants, grasses, grains, seeds and aquatic plants. Sometimes, they resorts to insects and fish (Hassan and Moussa, 2010).The goose has a beak used to eat food, and is characterized by its very sensitive inner part that plays a major role in facilitating the process of obtaining food. (del Hoyo, 2011).internal structure of the tongue tissue contains many glands, muscles, nerves, blood vessels, and various internal connective tissues, In most birds, the tongue is covered with epithelium, which may be partially keratinized or not, and papillae of different types and shapes are scattered on the surface of the tongue. In some birds, the ventral surface of the tongue is keratinized and has a special nail-like shape that helps the bird in feeding and picking up food. Some birds have tactile receptors that help to locate and place food before swallowing (Olsen, 2011).

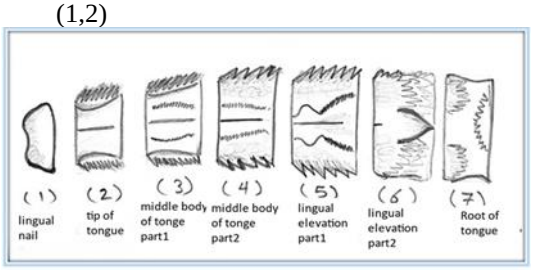
Materials & Methods:

Sampling:

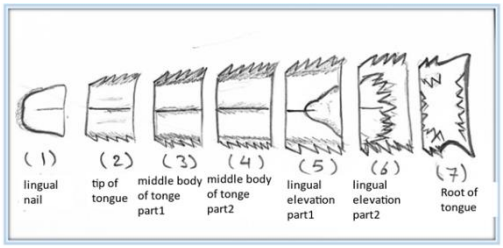
Twelve samples were collected for the study, consisting of (6) Birds of geese and the same number of ducks from the local market of the city of Mosul, and the birds were adults, clinically healthded, regardless of sex.

Histological Study:

a) For the histological study and better observation of tongue structures, the tongue, in this study, was divided for each type of birds into seven parts, as shown in Figure (1,2)



Figuer 1: Divisions of parts of the duck's tongue for the purpose of histological study.



Figuer 2: Divisions of goose tongue parts for the purpose of histological study

b) Making tissue sections for the aforementioned seven areas of the tongue, and this is done by the following:

A representative sample of $1cm^3$ for each segment was fixed in 10% neutral buffered formalin solution for 48 hrs. Then processed by routine histological processing method to obtain hisological sections of 5-6 micrometer in thickness (Bancroft *et al*, 2019).

Staining: Histological slides were examined after staining them with the following stains:

a. Hematoxylin and eosin (H&E) stains were to show the general histological structure of all parts of the tongue and to take microscopic measurements (Luna, 1968; Layton *et al*., 2019). B. Masson's Trichrome stain was to differentiate between collagen and muscle fibers in the tongue. (Luna, 1968; Culling *et al*., 1985; Layton *et al*., 2019) c. A drop of distrene-plasticizer-xylene (DPX) adhesive substance was placed on the tissue slide, then the slide cover glass was placed and the slides were left for 24 hours to dry before examination

Results:

Histological Study:

Description of the Epithelium:

Our histological study showed that the mucous membrane covering the tongue in domestic ducks and geese consists of a multi-layered epithelium covering the lamina propria, connective tissue, mucous glands and all subepithelial structures. It

consists of distinct layers of cells: basal layer, (stratum basale), stratum spinosum, stratum granulosum and the intermediate layer.

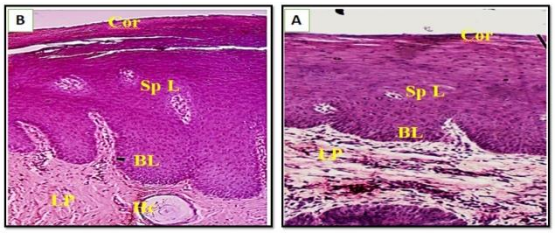


Figure 3: Histological section of the tongue showing the layers of stratified squamous, keratinized epithelium in the tongue of (A) ducks, (B) geese (LP) (lamina propria, BL) basal layer, (SPL) stratum spinosum, (Cor) stratum corneum, H&E stain, 100X.

From a microscopic examination of the ventral surface of the tongue, it became clear that the ossified epithelium (Orthokeratinized epithelium) was present at the top and the beginning of the body of the tongue which is what is called the lingual nail in ducks and geese. The lingual nail is at the front of the tongue (Figure 4).

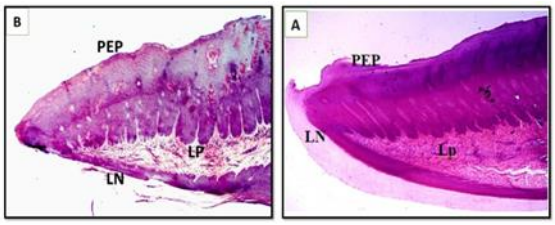


Figure 4: Histological section showing the apex and beginning of the body of the tongue in (A) ducks, B) geese (LN) lingual nail, LP) lamina propria, PEP) erosive epithelium on the dorsal surface of the tongue, H&E stain, 40X.

The ossified epithelium is an erosive epithelium, and this epithelium is characterized by incomplete keratinization of cells in the stratum corneum. The microscopic examination of the surface of the tongue in the apex and body region in each of the adult ducks and geese showed the presence of an epithelium of the type of erosive epithelium as in Figure (4). Our results showed that the thickness of the epithelium on the dorsal surface of the tongue gradually decreased from the front towards the root while the ventral epithelium increased in thickness in the same direction and the lingual nail disappears in both ducks and geese as in Figure (4). The lamina propria in the tongue of adult domestic geese ducks containing muscles collagen fibers, small and large blood vessels, scattered lymphocytes, nerves feeding the tongue and herbst corpuscles were observed very close to the dorsal epithelium of the tongue in both ducks and geese, as in Figure(5).

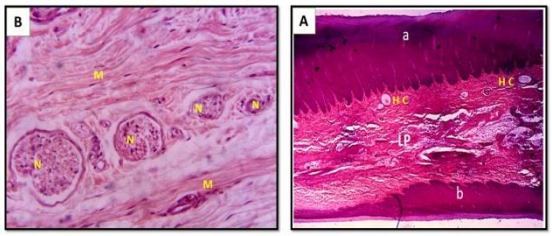


Figure 5: Histological section of goose tongue ((a) dorsal surface of the tongue (b) ventral surface of the tongue,(LP)lamina propria, (HC) Herpes corpuscles, (M) muscles, (N) bundles of nerve fibers, H&E 40X stain (A), (B) 400X.

Lingual Papillae:

The results of our study showed the presence of filiform papillae as well as small and large conical papillae on the lateral borders from the front of the body of the tongue to the root of the tongue, as well as on the lingual ridge in both birds, ducks and geese. Small filamentous papillae were observed at the front of the body of the tongue, and then their size gradually increased towards the center of the body of the tongue, as they spread among the small and large conical papillae from the front of the body of the tongue to the middle part of the tongue, and the protrusions of the filamentous papillae were enveloped by the eroded ossified epithelium, and they contained the filamentous papillae as in Figure (6) in ducks and Figure (7) in geese. While the small conical papillae occupied the front of the body of the tongue and were small in size and gradually increased in size towards the middle of the body of the tongue. These papillae were tilted backward towards the pharynx, and the conical papillae are covered with eroded ossified epithelium, and the center of the conical papillae consists of a core of connective tissue ventral and dorsal as in Figure (6) in ducks (7) in geese, whereas the large conical papillae occupied the middle of the body of the tongue to the root zone, and it consisted of a core of bone tissue which was covered from the outside with eroded ossified epithelium, as in Figure (6) in ducks (7) in geese.

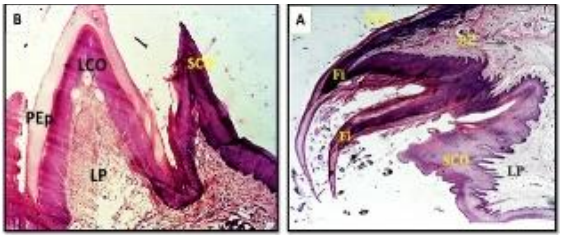


Figure 6:Histological section of lingual papillae in domestic ducks (Fi) filiform papillae, (SCO) small conical papillae, (LP) lamina propria, LCO (large conical papillae, PEP) erosive epithelium H&E stain, 40X

Figure 7: Histological section of lingual papillae in local geese (SCO), small conical papillae, LP (lamina propria, LCO), large conical papillae and (PEP) erosive epithelium H&E Tint, 40X.

Study of the Internal Structure of the Tongue Tissue:

A bony cartilaginous structure extending within the mass of the tongue is called the paraglossum, starting from the front of the body of the tongue in the form of cartilaginous tissue as in Figure (8) in ducks and Figure (9) in geese. Then it gradually turns into bony tissue in the form of bony sacs in the area of the lingual ridge in the tongue of ducks and adult local geese as in Figure (10). They became more ossified as we move towards the base and root of the tongue (11). The bone tissue wa s surrounded by adipose tissue and small bundles of muscle fibers and collagen fibers. Mason's trichrome stain was used to differentiate between muscle fibers and collagen fibers. It was also seen in the histological sections that there were small and large blood vessels feeding the tongue.

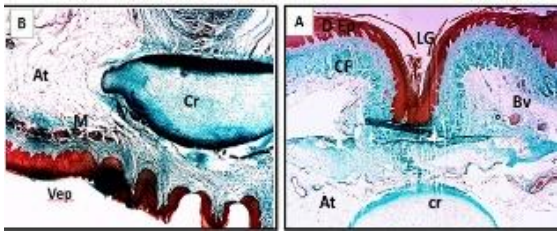


Figure 8: Histological section of the anterior body of the tongue in domestic ducks (Dep) the epithelium of the dorsal surface of the tongue, (Lg) the medial groove, (Cf) the collagen fibrils, (Bv) the blood vessels, (Cr) the cartilage in the anterior body of the tongue, (At) Adipose tissue, (M) skeletal muscle fascicles, (Vep) abdominal epithelium, Masson'S trichrome stain, 40X.

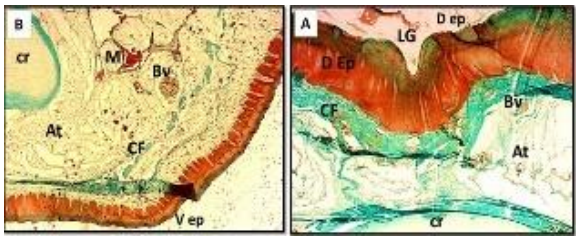
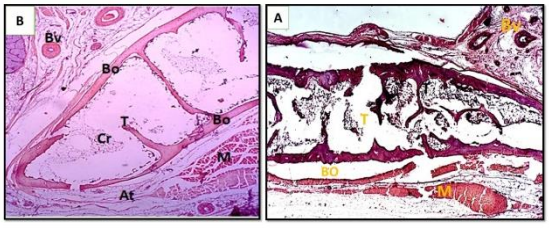


Figure 9: Histological section of the anterior body of the tongue in local geese (Dep) the epithelium of the dorsal surface of the tongue, (Lg) the medial groove, (Cf) the collagen fibers, (Bv) the blood vessels, (Cr) the cartilage in the anterior body of the tongue, (At) Adipose tissue, (M) skeletal muscle fascicles, (Vep) abdominal epithelium. Masson'S trichrome stain, 40X.



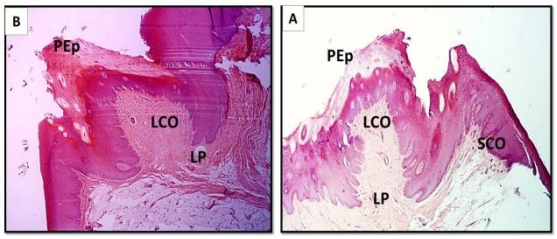
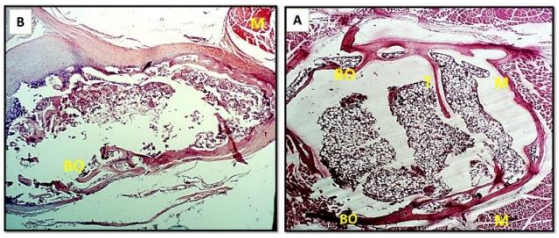


Figure 10: Histological section of the bone, H&E stain. 40X. lingual elevation (A) ducks, (B) geese showing (T) (BO) bony septa, (Bv) blood vessels, (M) skeletal muscles,



Figur 11: Histological section of the root area (A) ducks, (B) geese showing (T) bony septa, (Bv) blood vessels, (M) skeletal muscles, (BO) bone, H&E stain, 40X.

Tongue Glands:

Our results showed the presence of a number of lingual glands in the lamina propria on both sides of the tongue in both ducks and geese. The lingual glands began in ducks from the front of the body of the tongue as in Figure (12A), and they varied more in the middle of the body of the tongue as in Figure (12B), while their presence in geese was from the center of the body of the tongue as in Figure (13A) and they were distinct. The secretory units clearly appeared and the type of mucous as in Figure (13B). It was observed in both birds that the largest distribution of glands was at the lingual ridge and the root of the tongue. These glands increased in size and gradually branched towards the back from the lingual height and the root of the tongue as in Figures (14) and (16). It was seen in the duck tongue that there were several types of lingual glands according to the nature of their secretion. There were serous glands, mucous glands which were simple at the front of the body and increased in branching whenever we went to the root zone and were the convoluted and branched type as in Figures (14) and (15). The glands in geese, however, were of a simple tubular type in the front of the body of the tongue and increased by branching in the region of the lingual ridge and the root. The glands were of the mucous type as in Figures (13) and (16).

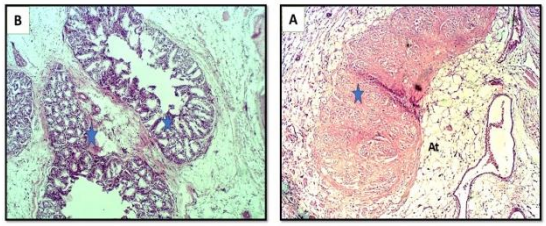


Figure:12- Histological section of duck tongue (A) in front of the body, the blue (star) indicated the beginning of gland formation, (B) middle of the body, the blue (stars) indicated the development of glands, H&E stain, 100X.

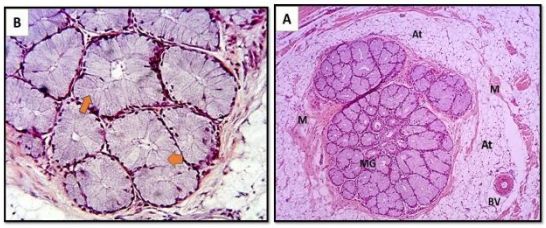


Fig.13- Histological section of the goose tongue (A) the middle of the body, (MG) representing the mucous glands, (AT) the adipose tissue, (M) the muscles, (BV) the blood vessels, (B) an enlarged image showing the mucous secretory units of the glands present in the tongue H&E stain 100X (A) H&E, 400X (B)

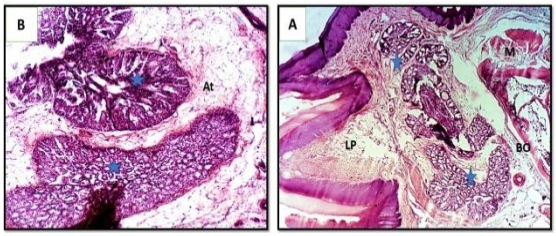


Figure:14- Histological section of duck tongue. (A) glands in the area of the lingual ridge, (B) glands in the root area of the tongue, H&E stain. 40X.

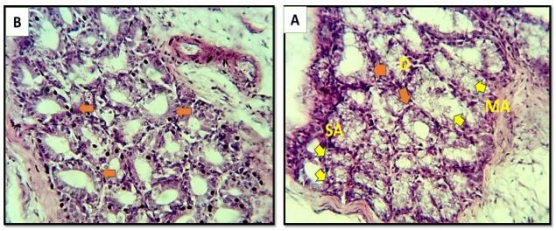


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Figure:15- Histological section of duck tongue. (D) glandular ducts, (MA) mucous glands, (SA) serous glands, (D) glandular ducts H&E stain (100X) (A, (B) 400X magnified image showing glandular ducts.

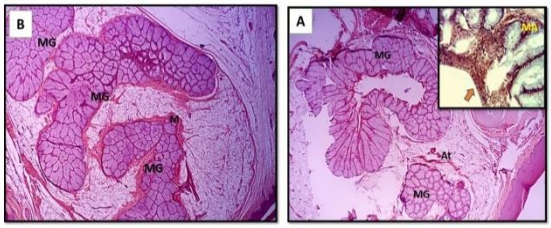

Figure:16 - Histological section of the goose tongue (A) glands in the lingual eminence, (B) glands in the root of the tongue, (MG) mucous glands, (AT) adipose tissue, (M) muscle H&E, 40X.

Mechanoreceptors:

Our results for the dorsal surface of the tongue in both birds,viz. ducks and geese, showed that the lamina propria under the epithelium contained round to oval shaped corpuscles with a center composed of an axon surrounded by several sheets of supported epithelial colloids. These sheets consist of collagen fibers called Herbst's corpuscles (Herbst) which are corpuscles containing nerve endings that feed the tongue with sensory receptors and contain nerve cells and are similar in ducks and geese as in Figure (17).

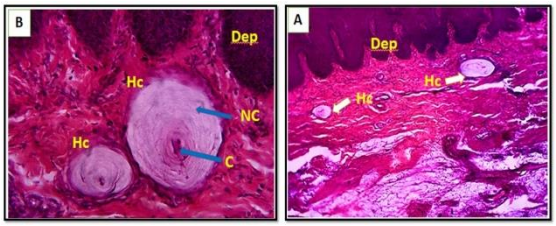

Figure:.17- Histological section of the body of the tongue (A) ducks, (B) geese, magnified section, (Hc) Herbst's corpuscles, (Dep) surface epithelium, (C), axon (Nc) sheets of colloidal fibres, H&E stain, 100X A ,B 400x.

Discussion:

Histological Study:

Our study of the histological structure of the tongue of each of the ducks and geese showed a variation in the thickness of the epithelium in the parts of one tongue. We agreed with the researchers (Akbari *et al* 2018) in their study of waterfowl which stated that the difference in the thickness of the epithelium and the degree of keratinization is due to the nature of the birds' feeding. Theese researchers are highly keratinized in herbivorous birds compared with waterfowl. We also agree with what the researchers (Reda and Mohamed, 2019) mentioned in the tongue of squashed ducks (Skieresz- Szewczyk *et al*., 2014) in their study that the mucous membrane in ducks and geese is covered with two types of keratinized epithelium; namely, the ossified epithelium and the erosive epithelium. Our results differed from those of (Skieresz-Szewczyk *et al*., 2021) in turkey. As the nail of the tongue covered the top and the front part of the body of the tongue, and this forms a well-developed external structure in the turkey tongue.

Papillae of the Tongue:

The results of our study showed the presence of filiform papillae and small conical papillae on the lateral edges at the front of the body of the tongue in ducks and geese, and small filiform papillae can be seen in the front of the body of the tongue. The lingual-filamentous papillae are short and thin and

were shorter than the conical lingual papillae. The projection of the filamentous papillae was covered by the ossified epithelium. Our findings agreed with what the researchers (Van der Leeuw *et al*., 2003) said about the tongue of domestic geese and ducks. They mentioned that the small conical papillae at the front of the body of the tongue were small in size and increased in size towards the middle of the body of the tongue. Our results also agreed with the researchers (Jackowiak and Andrz, 2006) in the cormorant bird, which is called the water crow.

Tongue Bone - Hyoid Bone Histologically:
When making histological sections in the tongue of each of the ducks and geese in our study, it was found that there was a bone mass inside the tongue tissue which was in front of the tongue in the form of cartilaginous tissue that turned into bone tissue as we moved towards the root of the tongue. This bone tissue was surrounded by fatty tissue and small bundles of muscle and fibers collagen and neuronal machinery F, as well as the presence of lymphocytes and blood vessels scattered in the tissue of the tongue. We agreed with what was mentioned by the researchers (Igwebuike and Anagor, 2013) in the tongue of muscovy ducks that the tongue was supported by hyaline cartilage or as it is called hyaline cartilage in front of the tongue. We also agreed with the researchers (Al-Jumaily *et al.*, 2013) in their study on the tongue of the Colombian pigeon. They mentioned that the tongue is supported by a hyoid bone system that extends from the front of the body of the tongue to the root.

Tongue Glands:
The results of our study showed the presence of a number of lingual glands in the lamina propria on both sides of the tongue in both ducks and geese. We agreed with what researchers (Skiereszs-Szewczyk *et al*.,2021) reported in their study of the turkey tongue. From our study, we noticed that the glands were small in size and few in number in the anterior part of the lingual rise and increased in size and branched as we moved towards the back of the lingual rise and the root of the tongue, and their shape was circular, oval or pear-shaped surrounded by a ribbon, a thin loose connective tissue externally lined with a dipose tissue.

Mechanoreceptors:
Our results showed that the lamina propria under the dorsal epithelium in the tongue of each of the local adult ducks and geese had circular to oval-shaped corpuscles that contained a center composed of an axon surrounded by several sheets of colloids called Herbst corpuscles, We partly d with the researchers (Halata *et al*., 2003) in identifying particles.

Acknowledgments.
The authors thank the University of Mosul, College of Veterinary Medicine for supporting this work.

Competing Interests
The authors declare that there is no conflict of interest.

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