

Microanatomy and histological study of the Salt Glands of the territorial lovebirds (*Agapornis taranta*).

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Abstract

The present study was conducted to determine the anatomical and histological structure of the salt glands in **territorial lovebirds (*Agapornis taranta*)**.

In this study used (15) adult birds, which divided in tow groups, the first group contains (5) birds used for anatomical study includes positon, shape, segmentation, weight and width.

The second group includes (10) other birds used for histological study. Two types of stains were used. This study revealed that the lovebirds owns a pair of salt glands, It is well advanced located (left and right), anatomically the salt glands of lovebirds are situated in the supra orbital grooves of the frontal bones and covered by thine connective tissue membrane. The salt glands appear as crescent shape or narrow oval shape with anterior pointed part and posterior broad part. The mean weight (0.25 ± 0.22) gm. Its mean length gland (2.8 ± 0.47)mm and the mean width are (0.26 ± 0.88) mm.

Histological examination revealed that the functional unit of the salt gland in form of secretory lobule which is represented a tubular structure that radiate around a central canal that drain in a mine duct which is lined by stratified cuboidal epithelium and leads to collecting duct that leads to anterior of the nasal cavity.

Keywords: lovebirds, salt glands, frontal bone.

دراسة تشريحيه ونسيجه للغدة الملحية في طيور الحب المحلية (*Agapornis taranta*).

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الخلاصة

أجريت أدراسة الحالية لتحديد التركيب النسيجي والتشريحي للغدة الملحية في طيور الحب المحلية (*Agapornis taranta*). استخدم في هذه الدراسة (15) طائر ألبالغ قسمت الى مجموعتين المجموعة الأولى (5) طيور استخدمت لدراسة التشريحية لمتضمنه الموقع الشكل الشدافان أالوزن و الطول وعرض الغدة . ضمت المجموعة الثانية (10) طيور اخرى استخدمت لدراسة النسيجية واستخدمت صبغتين في هذه الدراسة أظهرت النتائج التشريحية أن طيور الحب تمتلك زوج من الغدد الملحية غير المتطورة بصورة جيدة تقع الغدة الملحية في الأخدود فوق أالحجاجي للعظام ألبهيه وتحاط بعشاء من نسيج ضام رقيق وتكون هلالية الشكل او بيضوي ضيق . كان معدل وزن الغدة الملحية (0.25 ± 0.22)غم ومعدل طولها (2.8

±0.47 ملم ومعدل عرضها (0.26±0.88) ملم . تتكون الغدة الملحية في طيور الحب من شدف أنسي وشفد وحشي. يُظهر التركيب النسيجي الوحدة الوظيفية للغدة الملحية على شكل فُصيص أفرازي متمثلاً بتراكيب نبيبية إفرازية مرتبة شعاعياً حول القناة المركزية والتي تصب في ألقناه الرئيسية والمبطنة بخلايا ظهارية مكعبة مطبقة. ألقناه الرئيسية تؤدي إلى ألقناه الجامعة التي تفتح في الجزء الأمامي للتجويف الأنفي.

Introduction

The avian salt gland has two main ducts that are a medial and a lateral. Salt gland activations occurs from increased osmolality in the blood, activate the hypothalamic information processing, sending signal through the parasympathetic vasodilatation neural activation, the release of hormones (acetylcholine and vasoactive intestinal peptide⁽¹⁾, and is considered more important than the kidney in the elimination of salt from the organism⁽²⁾.

Birds inhabit freshwater basins has a small salt glands significantly or inactive while seabirds who have limited or non-existent excess fresh water is equipped with sophisticated specialized salt glands⁽³⁾.

The avian salt gland from of longitudinal lobules, each of which has elongated secretory tubules radiating from a central canal⁽⁴⁾.

The salt gland of birds secrete a hypertonic fluid, which mainly consists of sodium chloride (NaCl). Therefore, the salt gland and the rate of secretion can be high; Of course, depending on the nature of living marine bird ratio (Nacl) is higher than in birds that drink fresh water⁽²⁾.

Some have described the morphology of birds' salt glands⁽⁵⁻⁶⁾, while anatomy and histological investigations on the salt glands of birds are very limited. However, the salt glands of the lovebirds (*Agapornis taranta*). It has not been identified. With this objective, the study was conducted to characterize the microscopic anatomy and histology of the gland salt of lovebirds.

Materials And Methods

Fifteen adults of the lovebirds (*Agapornis taranta*) of the same age were killed by decapitation.

Anatomical study:

Generally, five healthy birds were chosen for anatomical study. These anatomical indices include:

- 1) Position of salt glands.
- 2) Shape of the salt glands.
- 3) Segmentations of salt glands.
- 4) Weight, length and width.

-The Electrical balance used for measuring the weight.

-The Electronic Digital Caliper used for measuring the length and width.

Histological study:

Ten healthy adult birds were used throughout this work for histological study of salt glands. For the collection of salt glands. Each salt gland was then quickly removed from the bird. Each salt gland was immediately fixed in 10% formalin. The samples remained for (72) hours in formalin fixative⁽⁷⁾. Washing the sample with running tap water for (3)hours is necessary to remove the excess fixative and to prevent interference with subsequent process. Tissue specimens were then dehydrated in ethanol, cleared in chloroform, impregnated with molten paraffin wax and, finally embedded and blocked out. Tissue sections (4- 5 µm) were stained with hematoxylin and eosin (**H and E**) and **Van Gieson.stain**.

Result

Lovebirds (*Agapornis taranta*) have salt glands bilateral tubular lies directly under the skin in the supraorbital depression of the frontal bone (**Fig. 1**). Each gland has a pear- like a shape

with the mean weight of right and left salt gland of birds are (0.25 ± 0.22) gm. Its mean width is (0.26 ± 0.88) mm. and its mean length is (2.8 ± 0.47) mm. At the anterior end of each gland is a duct of 1-2 mm in length and opens into the external nares. Each gland consists of many concentric polygonal lobules arranged in rows and separated by richly vascularized interlobular connective tissue. Each lobe consists of a mass of branching tubes prechymal secretory radiate out from the central channel and enmeshed in a single cell layer of the capillaries (**Figure 2**).

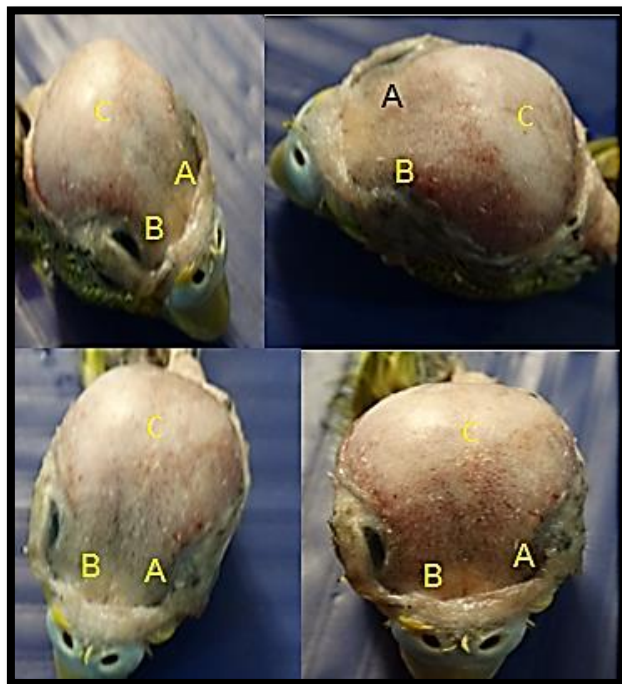
Histologically, it invested salt gland of lovebirds with a thin sheath of connective tissue or capsule (**Fig. 2**). The general histological organization of the salt gland was formed of medial and lateral a secretory lobe. This secretory lobe was divided into polygonal secretory lobules by connective tissue septa, which diverge from the peritubular connective tissue or the capsule (**Fig. 3**).

Mass of secretory tubules forms a compound tubular unit, the secretory lobule are arranged radially around and pour the medial and lateral ducts. These ducts leave the gland and become the medial and lateral collecting ducts, the medial collecting duct empties into the nasal cavity at the

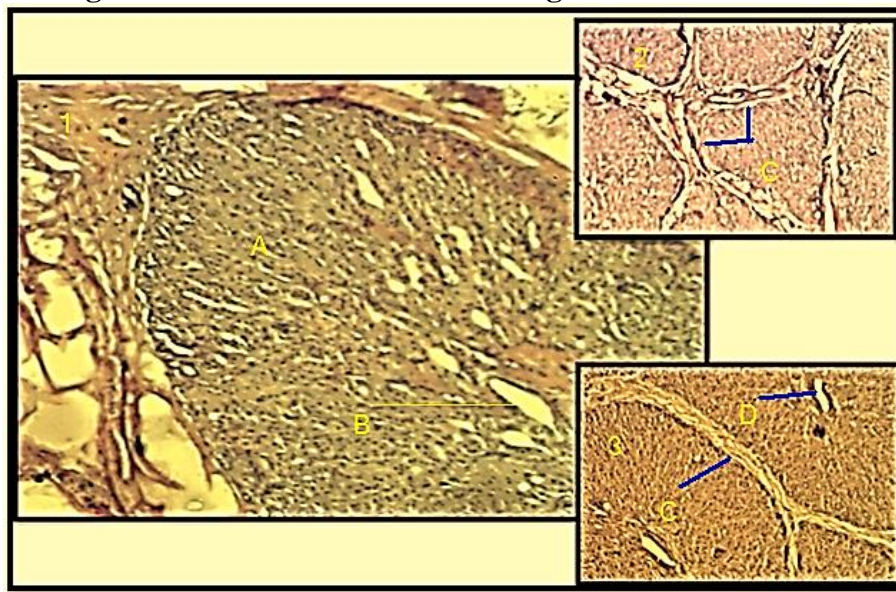
base of the vestibular concha whereas the lateral collecting duct forms a loop on the surface of the nasal septum and opens there. (**Fig. 3**).

It opens ductal system from each lobe in the central ducts that drain in the main duct, which is lined by stratified cuboidal epithelium and leads to the anterior of the nasal cavity. A single layer of principal columnar cells surrounding a narrow lumen while the peripheral tubules are lined with short columnar and round basal cells lines the secretory tubules. Columnar cells have basal nuclei while small round basal cells interspersed randomly among the columnar excretory ones. (**Fig. 3, 4**).

Secretory tubules open in intercalated ducts followed by striated ones. Single layer of low cuboidal cells lines the intercalated ducts while the striated ones are lined by simple epithelium consisting of cuboidal to columnar cells. Each gland is supplied by large branches of blood vessels where numerous arterial branches enter the intertubular spaces and distribute to lobes via highly vascularized interlobular connective tissue. Lobular arterioles penetrate to the secretory tubules area before dividing into capillaries supplying the secretory epithelium and run radially towards the lobe periphery. (**Fig. 4, 5**).



**Figure (1): Light photograph showing the salt glands (A and B) lovebirds (*Agapornis taranta*).
Showing frontal view of the bilateral salt glands, C- frontal bone.**



**Figure (2) Show The Lobule Of Salt Gland Of Lovebird
1-The Lobule Of Salt Gland. A-Lobule Of Salt Gland .B-Central Canal (H&E
X40)**

- 2- C- connective tissue septa (Van Gieson.stain X40)
- 3-D- glandular of blood vessels (Van Gieson.stain X40) .

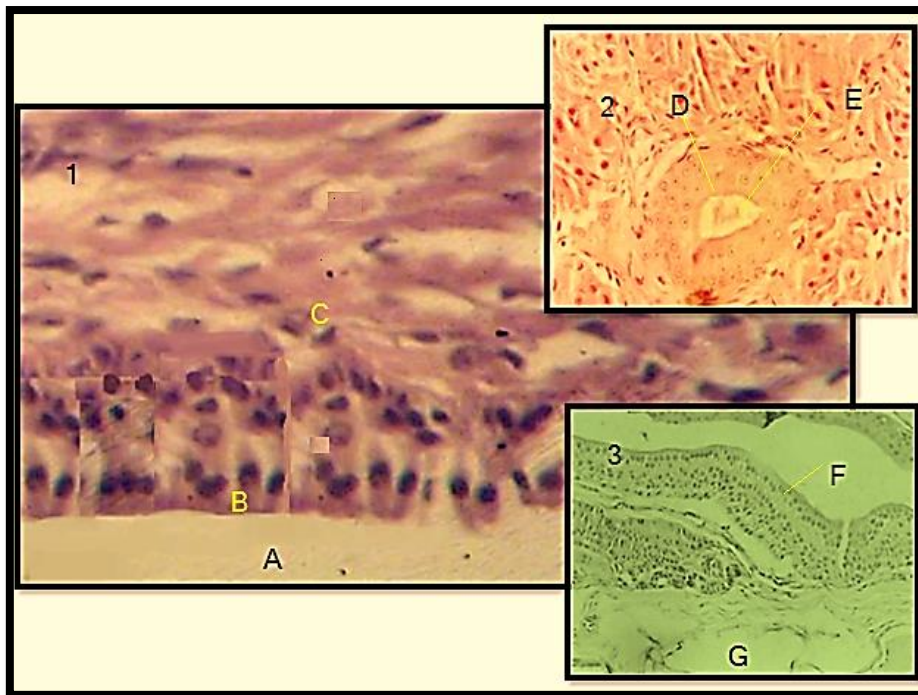


Figure (3) show the epithelial lining of the lobule of salt gland
 1-A- lumen of gland, B Stratified cuboidal epithelium. (c) Sub epithelial connective tissue (H&E X40).
 2- D- Stratified cuboidal epithelium the epithelial lining central canal E- central canal (H&E X10).
 3-F- Stratified cuboidal epithelium The epithelial lining of the main secretory duct, G- connective tissue (H&E X10)



Figure (4) show the lobule of salt gland of lovebird

- 1- Secretory lobular salt gland, B-central canal. C- Blood vessels. . (H&E X20).
- 2- D- The secretory tubules salt gland (Van-Gieson stain . X20.)
- 3- E- Medial duct of salt gland. F- Connective tissue. (Van-Gieson stain . X40.)

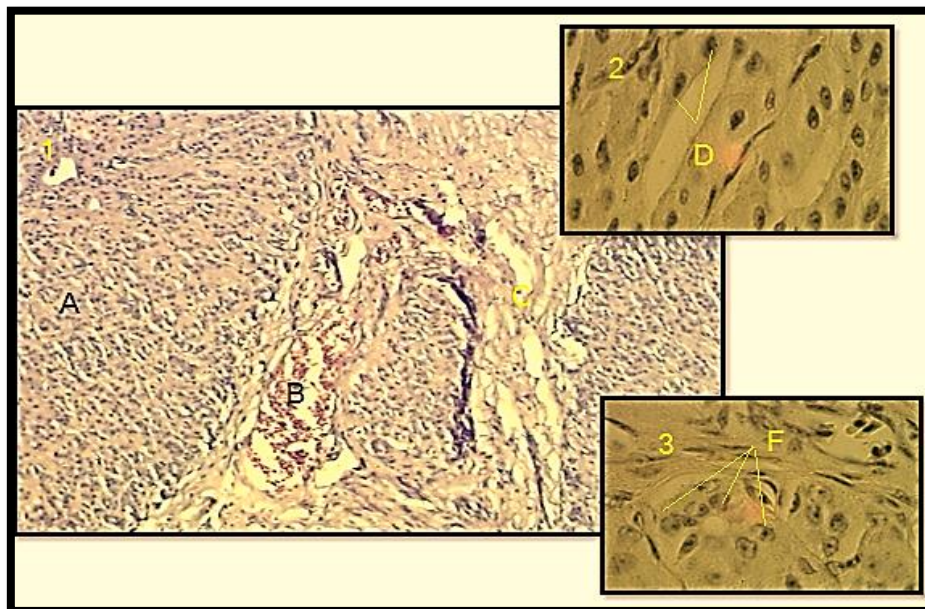


Figure (5) show the lobule of salt gland of lovebird

1-A- lobular structure of salt gland. B- Blood vessel, C-connective tissue. (H&E X40).

2- D- principal cells types of salt gland. (Van Gieson staine X40).

3-F- peripheral cell located near the end of secretory tubules (Van Gieson stain X40)

Discussion

Birds have two routes of excretion of sodium chloride, the renal and the extra renal salt excretion⁽⁸⁾. Salt tolerance are identified in these birds the efficiency of absorption of water and sodium ions through the renal tubules and sodium excretion by the salt glands^[9]. Cephalic glands of the extant marine sauropsides modified for salt excretion as nasal in birds and lizards, sublingual and premaxillary in snakes, lacrimal in turtles and lingual in crocodiles⁽¹⁰⁻¹¹⁾. It considers salt glands nasal modified controlled by the nervous system enables birds with marine habitats to excrete excess sodium chloride^(12, 13).

From the results of this study can be considered an adaptive tool of

osmoregulation to control the amount of water needed by this bird. Salt glands are best developed and highly functional in birds live in marine habitat but are poorly developed, with some exceptions in wild birds and those that inhabit the freshwater basins⁽¹⁴⁻¹⁵⁾. Some terrestrial birds such as Roadrunnes and Savana Hawks have active salt glands that can minimize water loss by hypertonic secretions in response to their protein rich diet. In addition, some desert birds that consume little water have with salt glands functional, which is stimulated in response to a rise in temperature^(16, 17). Has been reported effective salt glands in the penguins, the greater flamingo *Phoenicopterus ruber roseus*

and the duck *Anas platyrhynchos* (3, 5, 16,18).

Many studies have been associated with the efficiency of salt gland with gland size, and the number and length of the secretory lobules (9, 11). The number of the secretory lobules together with the large surface area of the array of secretory tubules together with the well-developed ductal system seen in the salt gland of *Charadrius alexandrinus* might indicate efficiency in salt concentrations. Some studies have indicated that the salt glands stimulated by water laden with salt, while its size is determined and the system of duct by drinking water that was exposed to birds salinity (5,19-20). Activity and associated salt glands with the behavior of birds and seasonal variation. Bennett concluded and Hughes (21) concluded that the salt glands of many species of ducks hypertrophy when they switch seasonally from fresh water to saline habitat. This is in agreement with the findings in the rectal salt glands of some marine mammals.

The results of the present study was that the glands salts of lovebirds have lobular arrangement is made up of many of the secretory cells enmeshed thick pipes in the small capillaries. These together form the sound barrier between the salty liquid inside the tubes and secretory bloodstream capillaries. (22)

CONCLUSIONS

The salt glands of **lovebirds** (*Agapornis taranta*) is situated in the supra orbital groove and It is sophisticated enough with two types of cells comprise the tubular epithelium peripheral cells and principal secretory cells. There is a need for more research to understand the adjustment of domestic birds to the physiological stress of salt load.

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