Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-3 Issue-1 || February 2024 || PP. 133-138

https://doi.org/10.55544/jrasb.3.1.22

Optical Anatomy and Microscopical for the Comparison of the Olfactory Mucosa of Puppies with Lambs

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www.jrasb.com || Vol. 3 No. 1 (2024): February Issue

Received: 03-02-2024	**Revised:** 05-02-2024	**Accepted:** 07-02-2024

ABSTRACT

Dogs are animal that have been used by humans for a long time in many fields because of its characteristics, which have been used in fishing, guarding, insurance, drug detection and in the field of prevention and detection of crime, The present study was done to demonstrate the histological structure and the olfactory mucosa in both lambs and puppies, so two lambs and two puppies were included in this study. The puppies were killed by using xylazine 4ml and ketamine 8ml, the lambs were already slaughtered, the nasal cavity was arrived by using the wire sow and the olfactory mucosa was immediately obtained and immersed in 10% formalin for 24 hour, then the histological technique was applied to obtain slide of 5 µm thickness and stained by haematoxylin and Eosin, and examined under light microscopic. The present result, revealed that the olfactory epithelium of the puppies was taller than in lambs and the sensory hairs was crowded in both species, also the lamina properia of the lambs showed more mucus glands continues with surface.

Keywords- Olfactory mucosa, Optical anatomy, Histological comparison.

I. INTRODUCTION

In the top part of the nasal canal is the olfactory mucosa, which is composed of olfactory neurons' bundles of tiny axons, blood vessels, Bowman's glands, fibroblasts, and the underlying lamina propria[1].

Nasal cavities are accessed by means of two external nostrils, sometimes known as "nares." The canine's nasal passages are symmetrical and open on both sides. The turbinates and para nasal sinuses are located inside the nasal cavity. The olfactory epithelium is housed in the turbinate bones, which are a network of twisted folds of bone that are enveloped in a mucous membrane. Microsmatic animals, which include humans and other low-acuity microsmatics, have turbinates that greatly expand the olfactory epithelium's surface area. The maxiloturbinates are the first sites of air inhalation; there, specialized ciliated epithelium and supporting cells warm, moisten, and cleanse the air.

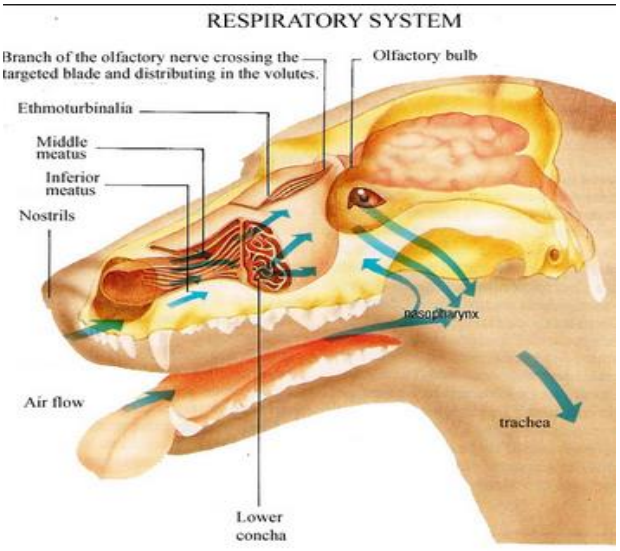

Figure 1: - Anatomy of olfactory system of dogs (puppies)

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The air that is inspired then proceeds to enter the sinuses of the frontal, maxillary, and sphenoid regions as well as the posterior ethmoturbinates. Although the maxilloturbinates' mucosa has a few olfactory sensory neurons, the bulk of odor processing is carried out by the primary olfactory epithelium that lines the frontal sinuses and ethmoturbinates. On top of that, the vomeronasal organ has an extra layer of olfactory epithelium in dogs.

You may find this tissue on both sides of your nose, right below the canine teeth, above the roof of your mouth and at the base of your nasal cavity [2]. There are three main cell types that make up the olfactory epithelium in vertebrates: bipolar olfactory receptor neurons, sustentacular cells, and basal cells, which are stem cells that constantly produce new olfactory receptor neurons and sustentacular cells [3].

Aim of Study:

❖ To show Histological & Anatomical Comparative Study Of Olfactory Mucosa Between Dog And Sheep

II. LITERATURE REVIEW

Dogs rely on their olfactory sense more than any other sense. Legend has it that a dog's nose is a thousand times more acute than a human's. One interesting statistic is that dogs have almost 220 million olfactory receptors in their noses, while humans only have 5 million.[4]

The chemosensory system is comprised of the gustatory system, which includes the sense of smell, and the olfactory system, which together provide the brain with information about the chemical composition of things via transduction [5].As shown in Anatomy, dogs' acute sense of smell allows them to find everything from accident victims to forensic corpse material. Nostrils and a nasal cavity make up a dog's nose, which is used for breathing air and scents.[6]

A sheep's sense of smell is second to none. Their acute sense of smell allows them to identify potential threats. Rams use scent to find pregnant ewes and ewes use it to find their lambs. Additionally, sheep rely on their acute sense of smell to find water and distinguish between feeds and pasture, whether those changes are little or large.[7]

One example of an animal that has a close and unique attachment with its offspring is domesticated sheep. While other senses, including sight and, to a lesser degree, hearing, are involved in the formation of the exclusive bond in sheep, olfaction—the sense of smell—plays a crucial role. Although there has been less research on domesticated sheep breeds, the bonding process seems to work in the same way in feral and wild sheep populations [8].Nostrils, ethmoid bone, nasal cavity, and olfactory epithelium (mucus-covered layers of thin tissue lining the nasal cavity) make up the majority of the peripheral olfactory system. Layers of epithelial tissue primarily consist of mucous membranes, olfactory glands, olfactory neurons, and olfactory nerve fibers [9].When odor molecules enter the nasal cavity, they can dissolve in the mucus lining its walls. This process can occur either when odorants enter the nasal cavity through the nostrils during inhalation (olfaction) or when odorants enter the nasal cavity through the throat during chewing or swallowing (retro-nasal olfaction). Olfactory glands emit metabolic enzymes present in mucus and mucous membranes that create and store mucus are both covered with mucus.[10]

Smelling is a function of the olfactory system, which is a branch of the nervous system. The majority of animals, including reptiles and mammals, possess both a primary and secondary olfactory system. Both the primary and secondary olfactory systems are responsible for detecting odors in the air and in fluid phases, respectively [11]. The mother-infant relationship is a defining characteristic of several mammalian species. To illustrate the exclusive nature of this bonding style, consider how selective moms with whom they have not yet established a connection would withhold maternal care from their young [12]. Every single cell in the thick layer of olfactory epithelium that lines the inside of a dog's nose, which is located on the ethmo-turbinate bones, is a potential olfactory receptor cell.[13]

There is a dense network of olfactory nerves in the nasal mucus membrane, which leads to the olfactory receptors in the nasal cavity, which are physically separate from the vomeronasal organ. The olfactory epithelium in the nasal cavity is composed of receptor neurons, which are nerve cells. The dendrites of these neurons terminate in a knob that is coated in mucus and contains several thin cilia. In the vomeronasal organ, receptor neurons usually do not have cilia but do have microvilli on their surface. a canine brain region that is very well-developed for smell [14]. The lamina propria, located deep inside the glandular layer, has a rather strong blood supply but is characterized by the presence of enormous bundles of unmyelinated nerve fibers that originate from the proximal portions of the olfactory cells .[15]

Since most other species, such seals, primates, and ungulates, are known to form selective mother-young social bonds, researching attachment in lambs is excellent due to the lack of ethical and logistical concerns. Domestic sheep also provide a good foundation for more complex research since they are ubiquitous, manageable, and well-studied in terms of behavior and natural history. One aspect of responsiveness is olfactory perception; whereas most animals that aren't mothers find the aroma of amniotic fluid and newborns to be disagreeable, some animals who are mothers and have certain hormone profiles discover that these same odors enhance their responsiveness.[16]

Puppies are becoming more used in biomedical research due to their similarity to human patients in terms of genetics and clinical presentation, setting them apart from purpose-bred laboratory animals [17].

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III. EXPERIMENTAL PART

3.1 Experimental Animals-1 3

Young dogs (puppies) average age were (3 - 4) months. (local breed) were obtained from bulk dogs in tikrit city. They were reserved for two weeks in cage and feed ,bread and water. Young sheep(lambs) average age were (3 - 4) months. Were obtained from local market of Tikrit city. They were reserved for two week in cage and feed hay, food green and water ,and monitor the health status for both animal (puppies & lambs)

3.2 Preparation for Anatomical study 3-2

In this experiment ,five puppies and five lambs were studied by comparative anatomically. The animals were killed with a high dose of 8ml Ketamine & 4ml xylazine, after the death of the puppies, was made surgical cutting using surgical instrument, saw, knife, starting with the dissection opening the skull of puppies by using the saw and the dissected the skull into equal halves and taking the dorsal conchae with its olfactory epithelial lining and put it in formalin 10% and was transferred to a tissue shedding laboratory .

The head of each lamb was taken to the anatomical wall, the lambs head with scalpel was dissected, the saw was taken and the dorsal conecha were placed in formalin 10%.

3.3 Preparation for histological study

- ✓ Fixation
- ✓ Dehydration
- ✓ Clearing
- ✓ Infiltration and embedding
- ✓ Tissue sectioning:
- ✓ Tissues attachment7-De-wax and hydration
- ✓ Staining
- ✓ Mounting

The histological Technique was prepared according to Bancroft (18), immersion the olfactory mucosa of puppies and lambs in deferent jars containing 10% formalin , after 24 hours were transferred into graded dehydrants (100 %, 90%, 80%, and 70%) Alcohol for hour for each step, after that clearing by xylene was done for 2 houres.

Infiltration and embedded in paraffin wax 60℃ were put for 12 hours. Tissue blocking was done and sectioning by manual microtome was performed 6 µm thickness was obtained and processed for final stage of staining by Haematoxylin and Eosin, Haematoxylin 5minute , Eosin 1 minute , then examined after drying with dry labal by light microscope at X 40 and 10 power.

IV. RESULTS

4.1 Olfactory mucosa anatomy

4.1.1 Olfactory mucosa anatomy in puppies

In this study opening the skull showed the number of conchae is higher olfactory acuity compared to low acuity in lambs ,and thickness of the turbinate bones thinner in puppies than the lambs ,and very soft in puppies also the number of conchae in puppies larger than the lambs form the conchae appeared convoluted folds in form (Fig. 2).

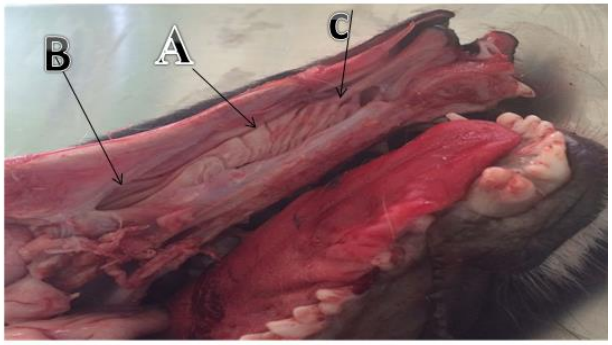

Fig. 2:- Olfactory mucosa in puppies showed the, dorsal conchae of dog(A),Branch of the olfactory nerve crossing(B), ventral conchae (C)

4.1.2 Olfactory mucosa anatomy in lambs

The present study of lambs appeared, the turbinate bones showed folded, layer form, from up to done the dorsal middle and ventral conchae , which are different from the puppies for , the shape and size , also the space of nasal cavity in lambs larger than the space of puppies (Fig. 3)

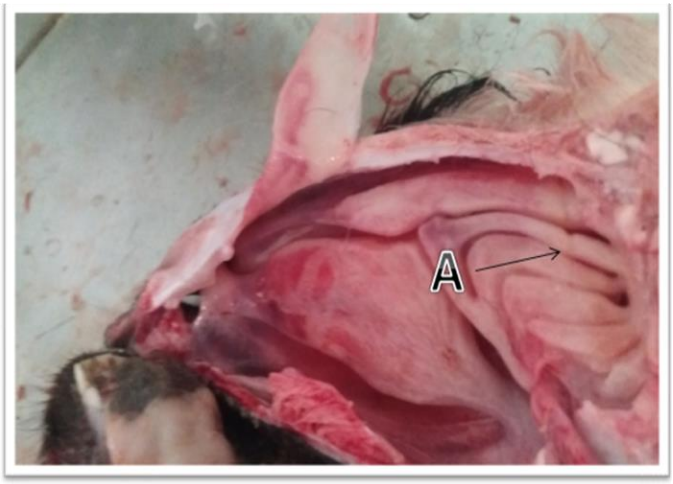

Fig.(3):- Olfactory mucosa in Lambs showed the, dorsal conchae of sheep (A).

4.2.1 Olfactory epithelium of puppies

The olfactory mucosa of the nasal cavity in the puppies demonstrating a tall olfactory cells, with presence of olfactory neuronal cells (which appeared spindle shape) with oval nuclei and its luminal surface had micro-hairs for detection of olfactory molecules. The supporting cells were also tall cells in between these neuron cells with flattened nuclei (fig. 4).

The olfactory epithelium is formed by tall cells resting on the basement membrane, the epithelium is

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ISSN: 2583-4053

Volume-3 Issue-1 || February 2024 || PP. 133-138

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mostly seen of sensory nerve cells , spindle in shape with spherical-oval nuclei the surface or apical surface of these cells had a tuft of hair, also there was goblet cells near by sensory cells and basal cells (germinal cells) these cells were present adjacent to the Basement membrane (fig. 5). The olfactory mucosa was containing, the epithelial neuronal cells which are present resting on the basement membrane (B.M) with presence of the sensory hairs on its surface .The basement membrane had pyramidal small cells for replacement the degenerated cells of olfactory epithelium . The lamina propria was engorged with mucus glands in the form of acini. The sub mucosa was containing blood vessels (B.V) and dense connective tissue (C.T) (fig. 6) .

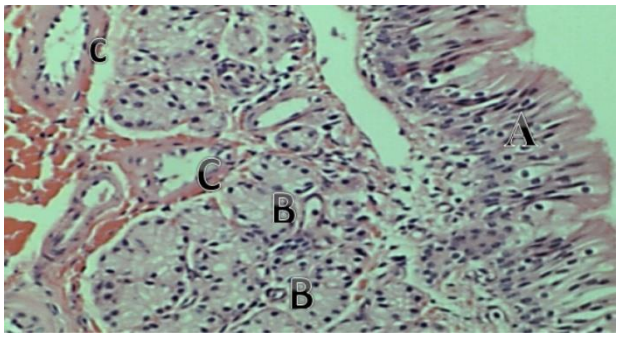

Figure 4:- Olfactory epithelium of dog (puppies) showed the olfactory epithelium (A); mucus gland (B); in the lamina propria Blood vessels (C) (H&E X 10)

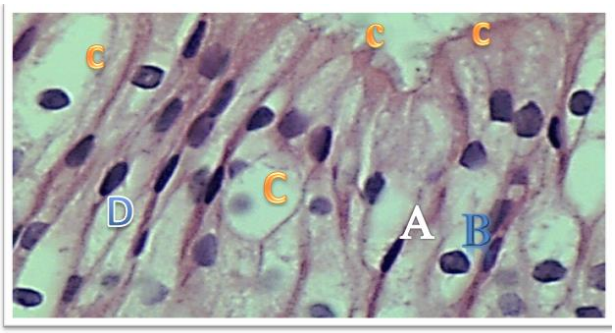

Fig (5):- Olfactory epithelium of Dog (puppies) showed the sensory epithelial cell (A), supporting cell (B), goblet cell (C), sensory hair (D) (H & E, X40)

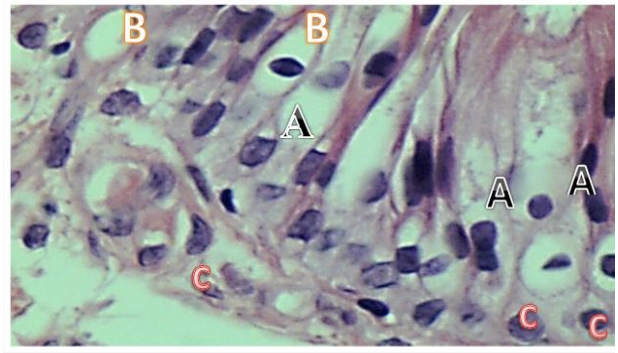

Fig. (6):- Olfactory epithelium of Dog (puppies) showed the Sensory olfactory cell (A), Goblet cell (B), Basal germinal cells (C) (H & E X40)

4.2.2 The olfactory mucosa of the Lambs

The olfactory epithelium of the sheep was present densely and the olfactory cells (neurons) : which were bipolar are lesser then of that in dog and appeared smaller in size , however the sensory hairs on the surface of the epithelial cells were present clearly and can be recognized well. The B.M was containing basal germinal cells on its surface with sustenticular cells and other neuron (fig. 7).

The highet of the olfactory epithelium was lesser then of the dog and these was crowding in the presence of the sensory cells on its luminal surface. The mucus cells of the lamina propria(L.P) were continuous with the surface of epithelium through a ducts and the lamina propria was engorged with lymphocytes and solitary of mucus acini, also the B.V were demonstrated in L.P (fig. 8).

The basal germinal cell was present in an abundant and from a syncytial line of nuclei in its cells near by the basement membrane. The lamina propria was formed by delicate or loose C.T infiltrated with much lymphocytic infiltration. The blood vessels were distributed in between WBCs, empty from blood and there was a number of mucus glands are continued to the surface of olfactory epithelium, its number were lesser to that of dog (fig. 9).

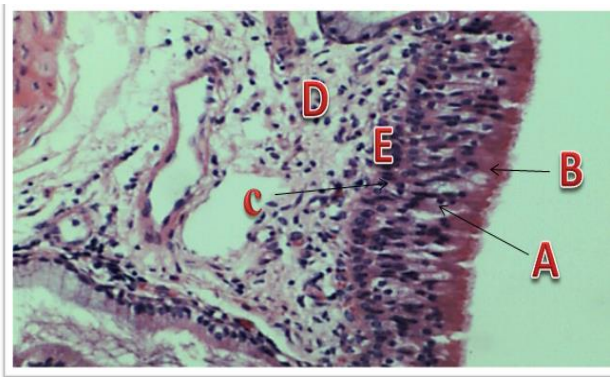

Figure 7:- olfactory epithelium of sheep (lambs) showed the olfactory mucosa (A); hair sensory cell (B); basal germinal cells (C); lamina propriea (D); lymphatic (E) (H&E X10)

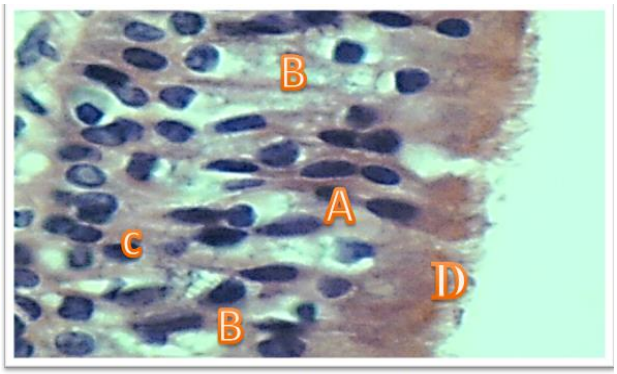

Fig. (8): Olfactory epithelium of sheep (lambs) showed the olfactory epithelium nerve cell (A). Supporting cell (B), Basal cell (C) sensory hair (D) (H & E X40)

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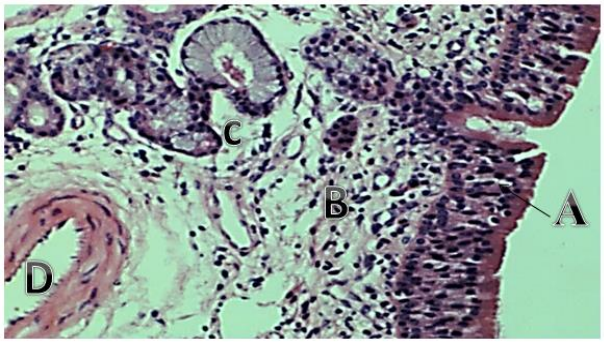

Figure 9:- Olfactory epithelium of sheep (lambs) showed the olfactory epithelium (A); lymphatic aggregation (B); in lamina propria mucus acini (gland) (C); blood vessels (D)(H&E X10)

V. DISCUSSION

It is well known that the smell of the certain animals like wild animals and dogs have highly sensitive to detect the olfaction from different from away it. The present work was focused for the demonstrating the anatomical and histological studies of the olfactory mucosa of the puppies and to compare these studies with other domesticated animals which was the lambs.

The result of this study was indicated that the olfactory epithelium of the puppies was tall sensory bipolar neurons with present of sensory hairs on its surface that facing the nasal cavity, otherwise in the lambs, the sensory neuronal bipolar cells is shorten and high in number, but the sensory hairs also high percentage like in puppies.

These results were in agreement with Karlsson and Lindblad, (17) who showed that the dog is proving to be mine of information , and is leading to a much more bounced view of the mammalian olfactory system than was promoted by exclusive attention to the mouse model. The presence of the mucus acini of glands were present more in lambs than in puppies, these are consider as adhesive matrix for the particles on the surface of olfactory epithelium and the could be more in lamps to replace the bipolar neurons which was shorten and lesser than in puppies and the phenomena could be interpret that even the lambs have highly sensitive detection for olfaction and this explain the off lamps to recognize its lambs among many other lambs,

These results were agreement with [Jean E. Kratzing, 15] who showed that deep to the Glandular layer, the lamina propria has a moderately rich blood supply but its distinctive feature is the presence of large bundles of unmyelinated nerve fibers originating from the proximal portions of the olfactory cells.

VI. CONCLUSION

It was concluded that dogs(puppies) have a higher sense of smell than sheep(Lamps) in terms of anatomical and histological study where the olfactory system of speech is :-

- ❖ more sophisticated.
- ❖ the olfactory epithelium of speech is longer than in lambs.
- ❖ sensory hairs were more crowded on the surface of both species.
- ❖ more mucous gland
- ❖ continuous surface.

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