VETERINARSKI ARHIV 71 (1), 11-18, 2001

The vomeronasal organ in Angora goats *(Capra hircus)*

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BESOLUK, K., E. EKEN, M. BOYDAK: The vomeronasal organ in Angora goats *(Capra hircus)*. Vet arhiv 71, 11-18, 2001.

ABSTRACT

The aim of this study is to determine the morphology of the vomeronasal organ in Angora goats *(Capra hircus)*. The heads of eight adult Angora goats *(Capra hircus)* obtained from the slaughterhouse were used as materials. Six heads with vomeronasal organ were examined by macro and micro dissections, the others were removed from the longitudinal ridge of mucosa in the ventral portion of the nasal septum for routine histological examinations. Vomeronasal organ was extended on either side of the nasal septum from the level of incisive papilla to the third upper premolar tooth. It consisted of bilateral vomeronasal duct and vomeronasal cartilage on the floor of the nasal cavity. The mean vomeronasal cartilage length and diameter at the centre were 6.5 cm and 3.5 mm, respectively. The respiratoric epithelium was observed along all the epithelium of vomeronasal duct except a small area ventromedially where the olfactoric epithelium was present. The lateral wall of vomeronasal duct was covered with pseudostratified columnar epithelium, and its medial wall was lined with olfactory epithelium comprising the supporting, olfactory and basal cells. It was concluded that the morphology of vomeronasal organ was variable among in both race and/or species, and that the results from this study are to throw light on future studies on vomeronasal organ.

Key words: vomeronasal organ, morphology, Angora goat, *Capra hircus*

Introduction

In mammals, olfactory sensory perception is mediated by two anatomically and functionally distinct organs: the main olfactory epithelium and vomeronasal organ (DULAC and AXEL, 1998). Vomeronasal organ

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ISSN 0372-5480
Printed in Croatia

separates from main olfactory epithelium because being enclosed by a cartilaginous capsule (KEVERNE, 1999). It consists of two narrow and parallel ducts embedded in the hard palate along the junction of the hard palate and nasal septum (NAGPAL et al., 1988). The ducts are 7 cm long and 3 – 4 mm wide, and are surrounded by a thin cartilaginous layer in sheep and goats (GETTY, 1975). They are lined in part with olfactory mucosa and become blunt their caudal extremities. They also open rostrally into the incisive ducts connecting the nasal cavities with the oral ones through the rostral end of the hard palate (SAKSENA and CHANDRA, 1980; KUMAR et al., 1981), therefore, they are in communication with these two cavities (DYCE et al., 1996).

Many animals use their vomeronasal organ to gain direct and specific contact with chemical cues released by congeners and biological fluids. These cues provide considerable information about the physiological status of the emitter, and facilitate or regulate social interactions such as sexual relationships (DOVING and TROITER, 1998). The vomeronasal organ, a chemosensory organ, is commonly thought to function as an organ to determine the flavour of food in mouth by olfaction (GETTY, 1975; DURSUN, 1994). In mammals, sexual behaviours of males and females are induced and their hormonal status may be also changed via the stimulation of vomeronasal organ (JACOBS et al., 1981; TROITER et al., 1996; SALAZAR et al., 1998). The functions of vomeronasal organ and olfactory systems are evaluated within the broad context of chemical communication in mammals. Vomeronasal organ is primarily responsible for mediating responses to some, but by no means all, pheromone-like signals. It also mediates some responses to odour quality signals (JOHNSTON, 1998; BELLUSCIO et al., 1999). Other researchers (NICKEL et al., 1979; KUMAR et al., 1981) suggested that vomeronasal organ may be related to "Flehmen reaction", which is characterised with a peculiar sustained retraction of upper lip. In the literature, no study was found on the morphology of vomeronasal organ in Angora goat *(Capra hircus)*, native breed in Turkey. Considering this we have aimed to describe the morphology of vomeronasal organ in this species and to compare with other race and/or species.

Materials and methods

A total of eight heads of adult Angora goats *(Capra hircus)*, 4 males and 4 females, native breed in Turkey, obtained from the slaughterhouse of Konya province, were utilised in this study. The heads were removed from the body immediately after slaughtering. The vessels were rinsed with 0.9% physiologic saline through the common carotid arteries. The heads were fixed with 10% formaldehyde by having been injected into the same arteries. Six heads were investigated by macro and micro dissections. Vomeronasal organ of the remaining two heads of both sexes were removed from the longitudinal ridge of mucosa in the ventral portion of the nasal septum for routine histological examinations. These two were dehydrated, cleared and immersed in paraffin blocks, and then cut in 7 μm thick transverse sections stained with Crossman's trichrome stain and PAS. The sections of vomeronasal organ were observed under Nikon SMZ - 2T dissecting microscope and Leitz Laborlux – 12 light microscope. The observations were revealed and photographed.

Results

Dissection findings. Vomeronasal organ of Angora goats *(Capra hircus)* was a bilateral formation located in the ventral part of the nasal cavity, and was in direct relationship with the vomer bone, the palatine process of the maxillary bone and the incisive bone. It was laterally encircled by the nasal mucosa, and extended on either side of the nasal septum from the level of incisive papilla to the third upper premolar tooth. It consisted of bilateral vomeronasal duct and vomeronasal cartilage on the floor of the nasal cavity separated by the nasal septum.

Vomeronasal cartilage (Fig. 1) seemed to be slightly flattened mediolaterally, and was nearly closed except its dorsal part which had only a narrow gap for the passing of the blood vessels and the nerves. Its concavity embraced vomeronasal duct, and extremity in dorsal part seemed to be narrowed laterally and to be widened medially. The mean vomeronasal cartilage length and transversal diameter at the centre were 6.5 cm and 1.66 mm, respectively.

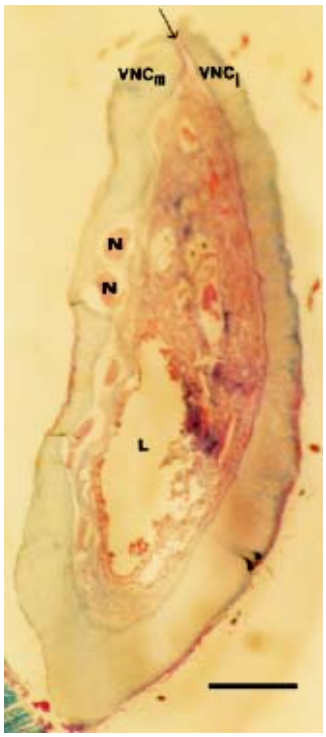

Fig. 1. Transverse section of right vomeronasal organ, caudal view. Lumen of vomeronasal duct (L), nerve fibers (N), medial and lateral parts of vomeronasal cartilage (VNC_m and VNC_l), arrow shows the gap between VNC_m and VNC_l. ×24; scale bar = 0.5 μm

The rostral narrow extremity of vomeronasal duct opened into the lateral surface of the incisive duct, while its caudal extremity was blind. Vomeronasal duct had a crescent shaped lumen in cross section. The vomeronasal nerve originated dorsomedial to the caudal extremity of vomeronasal duct.

Histological findings. The respiratoric epithelium was seen nearly along all the epithelium of vomeronasal duct except a small area ventromedially where the olfactoric epithelium was present.

The medial wall of vomeronasal duct (Fig. 2) was lined with olfactory epithelium comprising the supporting, olfactory and basal cells. The supporting ones were oval and/or elliptical in shape. They were stained lightly with PAS and seemed to be located superficially in the epithelium. The olfactory ones had round and dark stained nuclei. The basal ones were prismatic in appearance and placed close to the basement membrane. The lamina propria was relatively less vascular and consisted of few mucous glands in the passing space between the lateral and medial walls. A great number of nerve plexuses spread throughout the lamina propria of medial wall.

The lateral wall of vomeronasal duct (Fig. 3) was lined with pseudostratified columnar epithelium appeared as undulated with large number of lightly PAS-positive goblet cells. The basement membrane having a row of dark basal cells was very thin, had rather irregularly shaped

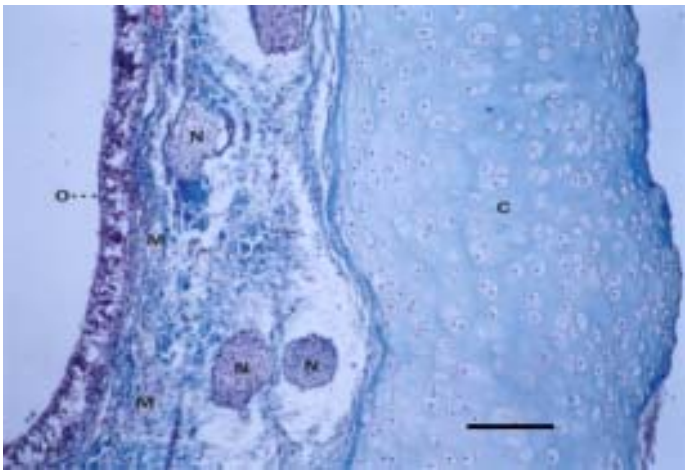

Fig. 2. Transverse section of medial wall of vomeronasal duct. Cartilage (C), mucous glands (M), nerve fibers (N), olfactory epithelium (O). Crossman's trichrome stain; ×115; scale bar = 2 μm

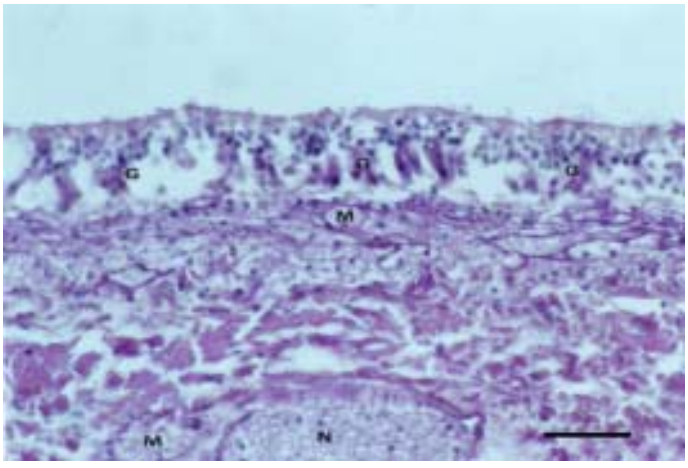

Fig. 3. Transverse section of lateral wall of vomeronasal duct. Goblet cells (G), mucous glands (M), nerve fiber (N). PAS; ×320; scale bar = 0.7 μm.

nuclei. There were numerous mucous glands and blood capillaries in its lamina propria. Few nerve fibers were seen deep into the propria.

Discussion

Although the caudal extremities of vomeronasal organ in buffalo (KUMAR et al., 1981) and sheep (KRATZING, 1971) were reported to be ended at the level of the first or second premolar, respectively, we found that its caudal extremity was terminated at the level of the third premolar tooth in Angora goats *(Capra hircus)*.

JACOBS et al. (1981) recorded that the ventral part of vomeronasal duct in cattle was not covered with vomeronasal cartilage. However, we observed that vomeronasal duct was thoroughly encircled with vomeronasal cartilage ventrally. Although the dorsolateral part of vomeronasal duct in dog was reported to be lack of vomeronasal cartilage (ADAMS and WIEKAMP, 1984), we found that its only dorsal part was lack of vomeronasal cartilage in Angora goats *(Capra hircus)*.

Although KRATZING (1971) reported that the lumen of vomeronasal duct in sheep was located at the medial side of vomeronasal cartilage, in our study, the lumen was seen to be placed at the ventromedial side of vomeronasal cartilage. MAY (1964) stated that vertical vomeronasal organ diameter at the centre in sheep was 1 cm, but in our study it was almost 5 mm in Angora goats *(Capra hircus)*.

In conclusion, we hope that this study revealing macroscopically and microscopically the structure and location of vomeronasal organ in Angora goats *(Capra hircus)* will shed light on future studies on vomeronasal organ.

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Received: 10 September 2000
Accepted: 20 February 2001

BESOLUK, K., E. EKEN, M. BOYDAK: Vomeronasalni organ u angora koza *(Capra hircus)*. Vet. arhiv 71, 11-18, 2001.

SAŽETAK

Cilj istraživanja bio je opisati morfologiju vomeronazalnog organa u koze pasmine angora *(Capra hircus)*. Istraživanje je provedeno na ukupno šest glava koza, i to makroskopskom i mikroskopskom pretragom koja je uključivala i histološku analizu. Utvrđeno je da se vomeronazalni organ proteže duž nazalnog septuma, i to od razine incizivne papile pa sve do gornjeg premolara. Organ se sastoji od bilateralnog vomeronazalnog kanala i vomeronazalne hrskavice na dnu nosne šupljine. Srednja dužina iznosila je 6,5 cm, a promjer u srednjem dijelu 3,5 mm. Respiratorni epitel utvrđen je duž cijeloga vomeronazalnoga organa, osim na ventromedijalnom dijelu gdje je bio prisutan olfaktorni epitel. Postrana stijenka vomeronazalnog organa prekrivena je cilindričnim epitelom, a srednja je stijenka prekrivena olfaktornim epitelom koji je u sebi sadržavao olfaktorne i bazalne stanice. Na temelju svojih nalaza autori zaključuju da morfologija vomeronazalnog organa ovisi o pasmini i/ili vrsti te da je u tom pogledu potrebno obaviti daljnja istraživanja.

Ključne riječi: vomeronasalni organ, morfologija, angora koza, *Capra hircus*