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# Specialised integumentary glands of the Indian field mouse, *Mus booduga booduga*

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**Abstract.** Histomorphological investigations on the specialised integumentary glands of Indian field mouse, *Mus booduga booduga* have revealed the existence of hypertrophied integumentary glands in the eyelids (tarsal), oral angle and at the perineal (circumanal) regions. The histophysiological characteristics of these specialised integumentary glands and their probable behavioural significance are discussed.

**Keywords.** Indian field mouse; *Mus booduga booduga*; specialised integumentary glands; eyelid (tarsal); oral angle; perineal (circumanal); holocrine sebaceous; behavioural relevance.

## 1. Introduction

Chemical signals play a prominent role in the modulation of behavioural responses of mammals. The specialised skin glands constitute the prime sites of production of olfactory cues and have an ubiquitous occurrence in mammals (Quay 1959; Muller-Schwarze 1967; Balakrishnan and Alexander 1976, 1977a, b; Bhaskaran and Alexander 1985). Based on their mode of secretion, these glands have been categorised into 3, holocrine sebaceous glands, apocrine and eccrine sweat glands. These glands have been extensively investigated in murine and microtine rodents and different types of glands have been reported (Quay 1953, 1954a, b; Quay and Tomich 1963; Stoddart 1972). However Stoddart (1974) had reported that mice of the genus *Mus* do not possess discrete scent organs of behavioural relevance.

Our investigations on the ethology of the Indian field mouse, *Mus booduga booduga*, revealed that it is a nocturnal burrowing species with a relatively complex social structuring of the natural population exhibiting a social order warranting a complex communicating system. It has been observed that during the social interactions of the Indian field mouse, olfactory cues play a very important role with the major sites of body odour being frequently investigated by the interacting conspecifics concerned. Accordingly a study has been undertaken to elaborate the histophysiology of the specialised skin glands of these animals.

## 2. Materials and methods

Freshly trapped, healthy adult Indian field mice, *M. b. booduga* of both sexes were sacrificed by overetherisation. After shaving off the hair, skin samples were carefully excised from various regions of behavioural relevance. Skin from adjoining regions

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were also removed for comparison with typical sebaceous and sudoriferous glands. The tissue was fixed in Bouin's fluid, dehydrated in alcohol series, embedded in paraffin and sections of 6 $\mu$m were cut. The paraffin sections were stained in Ehrlich's hematoxylin and eosin.

## 3. Results

The histological investigations revealed that highly developed integumentary glands exist at the oral angle, eyelid and perineal regions.

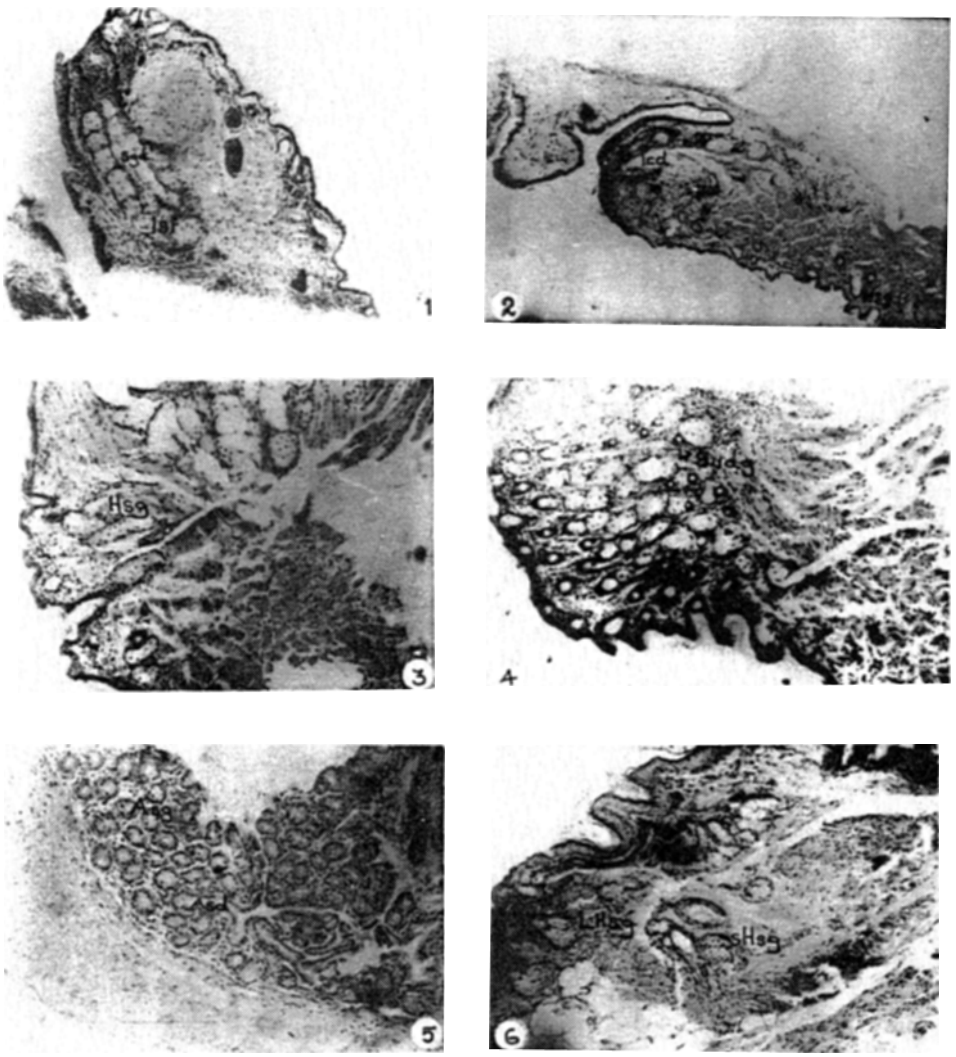
Sebaceous glands generally appear always associated with the hair follicles. Sebaceous acini have compact cells with intensely staining cytoplasm with a centrally located nucleus, which are the young holocrine cells. Further, diffusely staining mature cells could also be discerned with a frothy cytoplasm due to numerous minute oil droplets. The sudoriferous glands are comprised of large well developed coiled glandular tubules formed of a single layer of cubical epithelial cells. The larger central lumen is rather clear with secretory material found either attached to the walls of the tubules on the inner aspects as a thin layer of cytoplasm or found scattered in the lumen. The sudoriferous glands are apocrine in nature.

### 3.1 *The eyelid gland (tarsal gland)*

There is an accumulation of large sebaceous follicles at the inner corner of the eyelids and these extend into the eyelids (figure 1). The gland has a distinct duct which voids to the exterior at the inner corner of the eye (figure 2). The sebaceous acini are not associated with the eyelashes or the hair follicles on the adjacent skin. Each lobe of the glandular region extends into each eyelid filling up the space between the outer and inner epidermal layers of the eyelid. The gland extends along the entire length of the eyelid with the maximum number of lobes ranging up to 49 in males and 19 in females, being located at the inner corner of the eyelid. These lobes have a distinct large common duct into which the smaller ducts from the lobes drain their contents (figure 2).

### 3.2 *Oral angle gland*

The oral angle region has highly modified sebaceous glands as well as well developed sudoriferous glands in *M. b. booduga*. The oral angle sebaceous glands generally do not open into the hair follicle, quite contrary to the natural pattern of such glands. There are two closely situated but distinct sebaceous glandular masses, one located on the cheek wall and the other at the oral angle. The former is located at a larger area, relatively less compact and diffuse, comprised of well developed sebaceous acini embedded in the cheek musculature (figure 3). It is continous with the vibrissal hair follicles. There is no common duct but different follicular aggregations void the exudates separately to the outer skin surface. The latter is clearly delineated compact area with a few associated hair follicles. It voids into the oral angle through a distinct duct originating from a central lacuna. The glandular zone does not exhibit any externally visible morphological boundary. The cells of these two glandular zones are characteristically sebaceous glands having large




**Figures 1–6.** **1.** Vertical section through the eyelid of a male field mouse showing the hypertrophied sebaceous glands ( × 100). **2.** Vertical section through the eyelid of a female field mouse showing the smaller ducts coalescing to form the large duct which opens to the exterior at the inner corner of the eye ( × 100). **3.** Hypertrophied sebaceous glands at the oral angle ( × 100). **4.** Sudoriferous glands found at the oral angle ( × 100). **5.** Transverse section through the rectum ( × 400). **6.** Perineal region showing the large and small groups of sebaceous glands ( × 400).

(lsg, Large sebaceous follicles; sgd, sebaceous glandular duct; lcd, large common duct; nsg, normal sebaceous glands; Hsg, hypertrophied sebaceous glands; Sudg, sudoriferous gland; Asg, apocrine sudoriferous glands; Asd, apocrine sudoriferous glandular duct; LHsg, large hypertrophied sebaceous glands; sHsg, small hypertrophied sebaceous glands).

spherical cells, with a large central nucleus and sebum filled cytoplasm. Younger acini stain more intensely because of their dense cytoplasm whereas mature cells have a pale appearance due to the accumulated lipoid secretions therein.

Well developed sudoriferous glands are also seen interspersed between sebaceous

acini. The glands are coiled and tubular and void. their secretions to the exterior. The epithelial wall of each tubule is formed of a single layer of cuboidal or columnar cells (figure 4).

### 3.3 *Perineal glands*

Two types of modified sebaceous glands as well as apocrine sudoriferous tubules have been located in the mucocutaneous junction of the perineal region: (i) Large perineal sebaceous glands located at the anal papilla with younger acini being found adjacent to the inner proctodeal lining and the large sebum filled mature acini near the outer edge (figure 5). (ii) The smaller sebaceous glands are located in the deeper layers of the skin (figure 6). The individual acini tend to open into the rectum as well as into smaller ducts which coalesce to form larger ducts which open into the anal cleft.

The apocrine sudoriferous glands could be seen as tubular coiled structures. These glands drain their secretions to the exterior by separate constricted ducts.

## 4. Discussion

Olfactory cues have a signatory role in influencing the adaptive responses in nocturnal animals. Specialised integumentary glands of vertebrates are conveniently located for the selective dissemination of chemical signals into the environment. Thiessen and Rice (1976) demonstrated that skin glands in rodents such as Mongolian gerbil, Syrian hamster and deer mice are behaviourally significant. Stoddart (1974) reported that there are no specialised integumentary glands of behavioural relevance in mice belonging to the genus *Mus*.

However data obtained during the present study indicate that the highly developed integumentary glands of *M. b. booduga* are specifically localised at the eyelid (tarsal), oral angle and perineal regions. Behavioural observations on this animal suggest that their specialised glandular secretions may probably function as olfactory cues. In fact during their social interactions, the conspecifics exhibit specific behavioural responses, investigating the olfactorily relevant glandular zones quite frequently. The major zones of olfactory relevance, being located at the mouth corner, eye and anal region, elicit behavioural responses such as naso-nasal sniffing, oro-oral contact and naso-perineal investigations.

Autogrooming is a commonly observed behavioural response in *M. b. booduga*, whereby the glandular regions are frequently groomed, so that the glandular secretions are anointed all over the body. The oral angle and tarsal glands in *M. b. booduga* appear to be more involved in social interactions than the perineal glands. As Kivett (1975) and Kivett *et al* (1976) pointed out, the mouth corner glands of the ground squirrels, which are deployed in substrate marking (mouth rubbing) probably convey social cues, such as group membership, identity and social status. Studies on the Indian palm squirrel, *Funambulus palmarum* had shown that the oral angle glandular secretions are concerned with agonistic behaviour (Bhaskaran and Alexander 1985). During social interactions, the perineal glands of *M. b. booduga* are constantly subjected to olfactory investigations. Although no active scent marking such as perineal drag and anal rubbing has been observed in Indian field

mice, there is a definite possibility of these glandular secretions being mixed with urine and faeces. The frequency of anal sniffing was quite high between sexes and this suggests that the perineal glandular secretions could be concerned with evaluation of reproductive and sexual status.

The present study has explicitly demonstrated the presence of specialised integumentary glands of behavioural relevance at eyelid (tarsal), oral angle and perineal regions. Further studies on the probable behavioural relevance of the glandular secretions of these specialised integumentary glands are in progress.

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