CONTRIBUTIONS TO THE KNOWLEDGE OF THE SPECIALIZED TEGUMENTAL GLANDS FROM CROCIDURA ZAODON
OSGOOD, 1910 (INSECTIVORA, SORICIDAE)

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Les zones du rhynarium, circimonial, du conduct auditif externe, plantare, prepucial, perivulvare, circumanal, anal, et proctoaeale, mammaire et les laterales du corps du musaraigne Crocidura zaodon, presentent des glandes specialises avec un role de protection, de marque du territoire de reconnaissance intraspecifique.

Dans quelques-unes de ces zones les glandes respectives presentent un tres fort dimorphisme sexuel sous l'aspect de leur forme et de leur grosseur.

The tegumental glands drew the scientists' attention to the secretion they produce, either at human beings (Pissot, 1899, Schiefferdecker, 1917) or at mammals (Pallas, 1781; Hilaire, 1815). The first descriptions refer both to the usual cutaneate and to the specialized glands of human and of animals (axiles, cerumenes, anals, mamaly etc.).

In spite of all these facts the wild mammals remained less studied from this point of view. Schaffer (1940) published a monography regarding the mammal tegumental glands. Nobody else wrote such a synthesis until 1973 when (Sokolov) the paper mentions the author's results and cite ones already existant in the whole world.

Sokolov and col.'s (1988 a, b) later researches extend the study of glandular structures with the help of electronic microscope and also the interpretations concerning the glands physiology, the composition of their secretions and their importance in the communication between animals and the body protection. Quay (1954, 1959) presented a lot of results on the tegumental glands study at several mammal species. Taking into account the fact that, among the mammals, the representatives of Insectivora order were less suited to such studies owing to the difficulties of catching, breading and keeping them in captivity, we try to add, with the help of this paper, a new species of African shrew, to the list of the species studied in point of tegumental glands — Crocidura zaodon.

METHOD AND MATERIAL

The studied specimens of Crocidura zaodon (♂ and ♀) come from the scientifical mammals collection kept in alcohol at the National Museum of the Natural History (Smithsonian Institut, Washington, D.C.). The collec-
tings were made in August (♀) and October (♂) of 1909, in the mountainous zones of Kenya — Africa. The inventory numbers of the two specimens are 165 590 (♂) and 165 560 (♀).

The teguments proofs were taken from the following parts of the body: rhinarial, circumoral, the external auditory duct, the pads and soles of anterior and posterior legs, perianale, anal and proctodeale, prepuciale and perivulvare, mammals, and body sides. The examining of the seriated slides was made only at the optical microscope after they have been introduced into paraffine, after the division into sections of 5 μ thick, the coloration with hemalanm and tricrom Azan and the assembling in canadian balsam.

Since the material was captured tens of years ago and the whole body was fixed in formalin of 10% not all the sections were revealing for the glandular structures histology of the above mentioned zones. The fixing itself couldn’t be perfect. That is why the results refer especially to the presence and the absence of specialized (skin) cutanate glands in the respective zones, and also to a series of measurements made with the help of the ocular microscope after its correlation with the objective micrometer for various optical combinations which have the possibility of being used.

RESULTS

The rhinarium zone presents 2 types of sebaceous glands: some small only of 30—40 μ long and 40—50 μ wide (Fig. 1). This part of the epidermic thick of 50—80 μ is crossed by very thin hair follicles that usually receive in their sheaths the openings of the sebaceous glands of the excretory ducts. Here we did not see any apocrine or eccrine sweat glands. The bigger sebaceous glands exist both at ♂ and ♀ of Crocidura zaodon, any sexual dimorphism regarding these structures could not be pointed out. Without being unusually hipertrophied as in other zones are, these sebaccic glands can be atributed to the specialized glands category. The vibrisses of the rhinarium zone deserve a special remark as they have deeper follicles in the intradermic space (approx. 400 μ) by comparison with the usual hair follicles placed at 100—150 μ deep. In addition, the vibrisses follicles do not receive the opening of any type of cutanate gland in their sheaths.

In the circumorale zone the epidermis is thinner than of rhinarium one, seldom surpassing 50 μ thick. The sebaceous glands identified in this zone belong to the tegument covered with hair. At this species of shrews the lips tegument that continuous with the oral mucous has practically no type of cutanate glands.

The depth of the lips epiderme is of 20—30 μ. At the 2 sexes the above mentioned sebaceous glands present a semnificative sexual dimorphism because of proportions of 1:3 of these structures (Figs. 2, 3). Thus, in the circumorale zone at ♂ the length of these glands is of 40—50 μ and of 20—30 μ wide, while at ♀ it is of 150 μ and respective 40—60 μ.

The tegument of the external auditory meatus has both sebaccic and eccrine sweat glands.

The first one have an ovale form with a diameter of max. 40 μ. The sweat glands have rather simple secretory duets, with few spires and the
transversal section of only 20—30 μ diameter. The epiderme is also thinner in this zone (10—20 μ). Both the sebaceous and the sweat glands are very rare in the external auditory duct at both sexes of Crocidura zaodon. It couldn't be revealed the existence of a sexual dimorphism as concern the size of the two types of glands. Even though these tegumental glands are here in order to produce cerrumen, their rarity permits to consider less important the part played by the respective secretions in protecting the external auditory conduct, and in preventing the infiltration of the dust, sand and ectoparasites. It is possible that here the poor activity of the cutaneous glands is compensated by the tegumental folds that close and protect the ear entrance zone.

The soles and plantar pads zone is naked. Therefore here there are only eccrine sweat glands. Their secretory tube diameter is only of 20—25 μ. If, on the plantar surface between pads there are whole areas where the sweat glands are inexistant, in the pads they appear at each level section at least 2—3 agglomerations of slices, due to the secretorial “balls”.

The low number of sections (6—7) in the respective “balls” certify the fact that the secretory tubes of the eccrine sweat glands are relatively simple without complicated sinuosities in the plantar zone. Out of every aglomeration of sections there can be seen some more elongated ones that lead to the epiderme. One of them, deep of 150—160 μ, is crossed by excretory ducts of the eccrine sweat glands.

Besides the usual dermo-epidermic papillae some of the structures penetrate deeply into the derme. They ensure the connection of the secretory “balls” with the exterior and lead the sudoripary secretion to the plantar pads surface. The secretory “balls” are placed at a depth of 250—400 μ in derme and the excretory duct length is of approx. 200 μ. It has to remarked the fact that the depth of these glands is compared with the ventrale plantar surface and not with the lateral epiderme of the soles, by comparison with which the respective “balls” are placed at a depth of only 100—130 μ. This is a result of the fact that the excretory canals orientation and their openings are only on the ventrale face of the plantar soles and pads.

The epiderme itself is thinner on the sides (70 μ) and without important dermoepidermic papillae, while towards the ventral surface the dermoepidermic limit is much more sinuous, between papillae being placed the sweat excretory ducts.

If the epiderme measures up to 160 μ depth towards the ventral face of pads (for exemple), here its keratinous stratum is of 60 μ depth that means double than the depth of the same stratum on the soles and pads sides (30 μ).

The sebaceous glands of some fo the plantare zones belong to the lateral and dorsale plantare parts, where it also exists the pilous stratum, these being in most cases attached to the hair follicles.

The cutaneous glands around the anale orifice are remarkable by their hypetrophy (Figs. 4, 5). The apocrine sudoripary ones being extremely rare at shrew of Crocidura zaodon, the main part of this tissue zone is full of sebaceous glands. They are made of lots of acins. The biggest one not surpass 250 μ but such a complexe sebaceic gland measures approx. 700 μ long and
40 μ wide. It is obvious the dimension difference between the sebaceous glands of the same zone that are simple and measure only 70×40 μ.

The secretions of these specialized tegumentary glands are important especially for ensuring the unpleasant smell persistence that keeps the predatory animals away and providing protection for these shrews.

In the intermediary zone of the anal region there are the so called anal glands also represented by the sebaceic and the apocrine sweat types.

Also here, the sebaceous glands are compound, but with dimensions of 400—500 μ × 300 μ. On the other hand this place begins to be taken by the glands belonging to the following columnare zone.

They are the proctodeale glands, getting this name because of their pouring of secretions products into proctodeum.

The proctodeale glands lobules are elongated (700—800 μ) and delimited between them by fibres of conjunctive tissue. All the lobules converge towards the excretory duct of the whole gland and the openings of these ducts are in the anal tube.

If the importance of the glands of the first two zones (circumanal, and anal) is especially for protection, the proctodeale gland importance is physiological, of emoliation of feces one. All types of glands of these 3 zones are identically developed at both sexes of Crocidura zaodon.

In the preputial skin there are no skin glands that belong to the internal surface. Only the sebaceic glands situated under the epiderme of the prepuce external surface are very rare but relatively well developed (on an average of 40×90 μ). Examining attentively the direction of the excretory ducts it can be noticed that the secretion products do not deverse directly at the skin surface but in the sheaths of hair follicles which are very thin in this zone.

In the perivulvare zone there are also sebaceic glands attached to the hair follicles. Their dimensions (on the average, 170×100 μ) are a little bigger than the sebaceic glands of the prepuce. We suppose that in both zones there are also eccrine sweat glands but we didn’t have the possibility to identify them as specialized glands; the rare sections through the secretory tubes of some of these glands are rather attributed to the common cutanate glands of the neighbouring tegument.

Mammary glands of Crocidura zaodon are of a compound type each of them having only two excretory canals. These glands join to the tip of the nipple, between them remaining only the keratinic stratum which borders the contour of each canal. Within the depth of the nipple the two canals are also made evident by their exterior walls due to the interposing of the conjunctive tissue. The passing toward the galactophore canals is marked by the gradual replacement of the keratinic stratum with the glandular epithelium.

The proper glandular side which is the profound part of the mammal of Crocidura zaodon is made by mammal alveoles, conjunctive septes which border the glandular lobules which are grouped in their turn in glandular lobes. We have to remark the folding of the nipple (Fig. 6) excepting the lactation period when it is hard to be identified by naked eye especially
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because of the foulding and retreating of the mammilla in the skin invagination that appears together with the ceasing of the mammary gland secretion.

As it is already known from other species of Crocidura, during gestation and milkage the glandular tissues hypertrophy and the conjunctive tissue as well as the tegumental one undergoes changes that favors the cubs milkage. If in the tegument around the nipple there are sebaceic glands attached by hair follicles and eccrine sweat glands (rarely apocrine) the tegument of the actual nipple is completely hairless and has no gland which was mentioned above.

The lateral glands are easy to be identified with naked eyes. They appear as little protuberances of the tegument in the side zones of the body. On microscopical section a slight invagination of the tegument that delimits these glandular formations, can be identified.

Both at ♂ and ♀ the dominant structures belong to the sebaceic glands. They are unusually elongated at ♂, measuring 750—800 μ on their longitudinal axle and only 50—100 μ on the transversal one (Fig. 7).

At ♀ the sebaceic glands the structure of the lateral glandular organs are composed of more acins of various forms, the whole intraepidermic stratum being of max 650 μ by comparison with ♂ where it is at least of 900 μ (Fig. 8).

At first sight the shape of these glands reminds that of the apocrine sweat tubic glands. They are really very much elongated but have a sebaceic gland structure with several strata of cells, the degenerated ones being gradually replaced towards the secretorial lumen by others, resulted from the divisions of their basilar stratum (of these glands). Most of the sebaceic acins measure 150×70 μ and the biggest ones are of 300 μ long and 200 μ wides.

As regards the form and the size of the sebaceic glands of the lateral organs, it may be said that there is an obvious sexual dimorphism at Crocidura zaodon.

This conclusion is also valid in point of the possible seasonal variations, the specimens to be analysed being collected in different months of the same year. Thus between specimen ♀ collected in august 1909 (full reproduction period) and the one ♂ of october 1909 when usually the insectivores cease their reproductive cycle, it should have been obvious that the specialized sebaceic glands were less pregnant in ♂ than in ♀. But even in these conditions the lateral glands of ♂ are better developed than those of ♀. This conclusion allows us to admit the assertion of a series of authors (ex. K o t e n k o v a, 1988; M y k y t o w y c z, 1974; R o j n o v, 1988, etc.) assuming that these glands secretions also represent important chemical stimulae in the mammals biology.

CONCLUSIONS

1. Besides the common skin glands at Crocidura zaodon there are also some specialized ones, identified in the following zones: rhinarium, circumorale, external auditive duct, plantare soles and pads, prepucial and peri-
vulvar, circumanal, anal and proctodeal, mammary and on the sides of
the body.

2. The differences between the common skin glands and the specialized
ones consists of their density and size, the specialized ones being unusually
hiperthrophiated. A difference regarding the structure can be seen at the
proctodeal and mammary glands.

3. At Crocidura zaodon, among the specialized skin glands studied
and mentioned above, the most important are those of the following zones:
circumanal, anal, proctodcal, side glands and mammary glands.

4. Skin glands which are slightly different in size by comparison with
the common ones (e.g.: in the external auditive duct and plantare zone) are
specialized, producing a series of secretions for the zone protection (e.g.: ceru-
men) or of intraspecific recognition (e.g.: eccrine sweat glands secretion of
the plantare zone and of the sides of the body).

5. The variability of the size and sometimes of the form of the skin
glands belonging to the same type points out a clear sexual dimorphism at
least in some zones (e.g.: in the circumoral zone the sebaceic glands are bigger
at $\varphi$, while in the laterale zone of the body they have a simple and elongated
form (approx. 800 $\mu$) at $\varphi$ and composed at $\varphi$.

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SPECIALIZATE DE LA CROCIDURA ZAODON OSGOOD, 1910 (INSEC-
TIVORĂ, SORICIDAE)

REZUMAT

La ambele sexe de Crocidura zaodon există o serie de glande tegumentare
specializate. Acestea sînt fie de tip sebaceu, fie de tip sudoripar (eccrine și
mai rar apocrine). Ele se deosebesc de cele comune prin formă, dar mai ales
prin mărimă neobișnuită (800—900 $\mu$ lungime, față de numai 30—40 $\mu$ cit
măsoară cele comune). Dimorfismul sexual apare evident numai în cazul a
două zone din cele cercetate: circumorală și pe laturile corpului. Zonele
rhinariumului, conductului auditiv extern, plantare, prepuțială și perivulvară,
circumanală, anală și proctodeală au glande tegumentare specializate, dar
fără un evident dimorfism sexual. Cunoașcînd că este reală variația sezonieră
a gradului de hipertrofiere a glandelor sebacee din organul glandular de pe
laturile corpului, acele glande sînt întotdeauna de talie mai mare la $\varphi$ decît
la $\varphi$. În tegumentul conductului auditiv extern asemenea glande sînt și
rare, și mici. De aceea am interpretat că rolul protector al cerumenului pentru
Fig. 1 — Transversal section through the skin of the rhinarium zone at the Crocidura saodon ♂; seb. gl. — smaller sebaceous glands (the same size like the common ones) in the right side and specialized ones in left side; f.p. — follicles of the vibrisses, without tegumental glands attached to their sheaths.

Fig. 2 — Transversal section by the tegument of the circumorale zone at ♂ of C. saodon.
Transversal section through the circumoral zone tegument at ♀ of *C. zaodon*. Bigge sebaceic glands at ♀ than at the ♂ for the same zone, are to be noticed.

Section through the circumanale zone tegument at ♂ of *C. zaodon* the specialized sebaceic glands are very hypertrophied by comparison with the common ones and they are made of many acins.
Fig. 5 — Section by the circumanale zone tegument at $\frac{1}{2}$ of C. zaodon there is no obvious sexual dimorphism regarding the shape and the size of sebaceous specialized glands.

Fig. 6 — Longitudinal section through the mammilla of C. zaodon, the mammary tegument, strongly folded all the time except during the suckling period, do not present any cutaneous glands; the tegument around the mammilla is rich in sebaceous glands the sweat ones being in a very low number.
**Fig. 7** — Section through the lateral glandular organ at $\delta$ of *C. zonodon*. The specialized sebaceous glands are elongated.

**Fig. 8** — Section through the lateral glandular organ at $\varphi$ of *C. zonodon* the specialized sebaceous glands are composed of more flaps.
chitcanul C. zaodon este redus. Probabil pliurile pieleaste de la intrarea în ureche compensează lipsa secrețiilor respective. Glandele mamare sint de tip compus, cu numai două canale în mamelon.

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