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Research Article

ULTRASTRUCTURE OF SCENT GLANDS OF SOFT-FURRED FIELD RAT *MILLARDIA MELTADA* (GRAY, 1837): AN ATTEMPT FOR EFFECTIVE RODENT PEST MANAGEMENT

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ABSTRACT

The present investigations were carried out to study the ultrastructure of four different scent glands (Preputial, Flank, Armpit and Cheek glands) in soft-furred field rat *Millardia meltada*. The size and weights of the glands were measured to reveal any variation among the glands irrespective of sex. The transmission electron microscopic (TEM) study gives a clear picture about the secretary functions of the scent glands. The morphological parameters significantly varied from gland to gland and male to female. All the scent glands are modified sebaceous glands comprising of irregular shaped lobules or follicles or acini. The proportions of sebaceous and apocrine units differ from gland to gland. The secretary droplets accumulate in the cells until they become engorged and die and the debris pass along with the secretion through the ducts. The TEM analysis showed that the attracting substances are mixed along with the lipid droplets.

Keywords: Scent glands, Ultrastructure, *Millardia meltada*, Field rat, Pest management.

INTRODUCTION

Mammal's chemical signals can send powerful messages with behaviour modulating effects that may be of considerable social importance. The major difference between pheromones (species to specific) and other chemical signals (inter specific) is in the output: when processed by the brain, chemical signals result in the sensation of smell, whereas pheromone signals trigger a unique characteristic behavioural or physiological response (Ben Ari, 1998). Mammalian pheromones are found to be involved in sexual attraction (Kannan *et al.*, 1998).

The secretions of scent glands have a distinct function in rodent behaviour. Among the scent glands present in rodents, the preputial glands of the rat play an important role in the production of olfactory substances which attract the opposite sex (Noble and Collip, 1941; Merkx *et al.*, 1988 and Kannan *et al.*, 1998).

Specialized cutaneous glands which produce odoriferous secretions are found in a number of mammals (Quay, 1965; Ewer, 1968; Mykytowycz, 1970;). Usually, the scent producing glands occur in discrete patches or association in the skin at a number of locations in the body (Kumari, 1982). The secretion of such glands has been attributed a number of functions pertaining to olfactory communication among rodents (Whitten, 1966; Mykytowycz, 1970; Thiessen and Yahr, 1977). We have been investigating the behavioural significance of scent marking in desert rodents. Out of 18 species inhabiting the Thar desert (Prakash, 1975), a mid-abdominal glandular pad has been discovered in the desert gerbil, *Meriones hurrianae* (Kumari *et al.*, 1981), the Indian gerbil, *Tatera indica* and the soft-furred field-rat, *Rattus meltada pallidior*. It is being reported for the first time in the genus *Tatera* and in any of the *Rattus* found on the Indian sub-continent. This report is concerned primarily with the

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ultrastructure of four different scent glands of the soft-furred field-rat, *Millardia meltada.*

MATERIAL AND METHODS

Adult soft-furred field-rats were collected from Kumbakonam area, Thanjavur District, Tamil Nadu, India. Freshly captured animals were weighed to 1 g, then etherized and measured for total head and body length to 1 mm accuracy. Greatest width and length of the scent marking glands were determined to the nearest 0.1 mm with the help of a vernier callipers. To examine the ultrastructure of the four different scent glands (Preputial, Flank, Armpit and Cheek glands) of male and female *M. meltada,* the hair around them were removed, glandular area and surrounding skin excised, and mildly pressed between two glass slides to prevent curling.

For transmission electron microscopic studies, the glands were collected in 2.5% buffered glutaraldehyde. The tissues were cut into 3 x 3 mm pieces and kept in glutaraldehyde at 4°C overnight. They were post fixed in 1% buffered Osmium tetraoxide for 2 hours at 4°C. The tissues were washed in the same buffer before and after fixation with osmium tetraoxide. Then the tissues were treated with graded series of alcohol viz. 30%, 50%, 70%, 80%, 90% and 100% for 10 minutes each. This was followed by treatment with propylene oxide twice for 10 minutes each. The tissues were infiltrated with Taab 812 epoxide embedding resin at 20%, 50%, 75% and 100% concentrations with propylene oxide for 2 hours each. Finally the tissues were embedded in the same resin mixture with added catalyst and cured at 60°C for 48 hours. The blocks obtained were trimmed and semi thin sections were cut with glass knives using LKB ultramicrotome. Then the sections were stained with toludine blue and screened under the light microscope to look for areas of interest. Ultrathin sections were cut using microstar diamond knife. The sections were stained with uranyl acetate and lead citrate. Stained sections were viewed in JEOL, JEM 100 SX Transmission electron microscope at an accelerating voltage of 60 or 80 KV.

RESULT AND DISCUSSION

The size and weights of the glands were significantly varied from gland to gland and male to female *M. meltada*. The transmission electron micrograph (TEM) of scent glands of male (Preputial, Flank, Armpit and Cheek glands) and female (Clitoral, Flank, Armpit and Cheek glands) of *M. meltada* were studied and their secretions details are given in the figures (1-8). The TEM study gives a clear picture about the secretary functions of the scent glands. All the scent glands are modified sebaceous glands comprising of irregular shaped lobules or follicles or acini. The proportions of sebaceous and apocrine units differ from gland to gland. The secretary droplets accumulate in the cells until they become engorged and die and the debris pass along with the secretion through the ducts.

In certain species like *Meriones hurrianae* (Kumari *et al.,* 1981) and *M. unguiculatus* (Thiessen and Yahr, 1977), the ventral scent marking gland is present in both sexes whereas in *Rattus meltada pollidior,* it is present only in male. In another category, it is present in males but also in a very low proportion of females, like *Tatera indica.* In *M. hurrianae,* the gland is present in 100 per cent males and females but in male T. *indica* and *R. m. pallidior,* it is present only in 91 and 74 per cent respectively. The absence of the ventral marking gland from one set, usually the female, and from a certain proportion even in the males is rather perplexing. It is expected that a gland which has developed during the evolutionary process should have a definitive function.

A comparison of the gland size in the three species in which it occurs among the desert rodents reveals that it is largest in male *R.* m. *pallidior*, smallest in T. *indica* and that of M. *hurrianae* assumes a middle position. It is imperative to visualise that the size of the gland should be related to the magnitude of its function. The ventral scent marking gland among rodents has been attributed a number of functions: territorial (Mykytowycz, 1962; Thiessen, 1968); familiarization, denoting the home (Daly, 1977); reproduction (Mitchell, 1967); advertising ready-to-mate stage in females (Kumari and Prakash, 1981a and b); and social hierarchy (Kumari and Prakash, 1981c) and so on. If the function of the gland was only to scent mark its home range with its sebum exudation, indicating territoriality; the area of home range of a rodent should be proportional with the area of the gland since the requirement of sebum will be more in a species which has a larger home range.

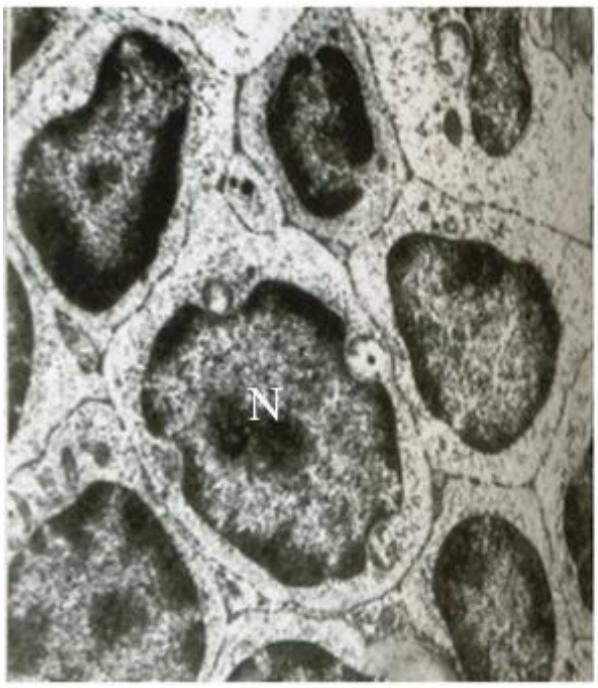

Figure 1a. Showing the preputial gland of male rat with distinguished nucleus (N). The secretory cell has large nucleus with high nuclear cytoplasmic ratio.

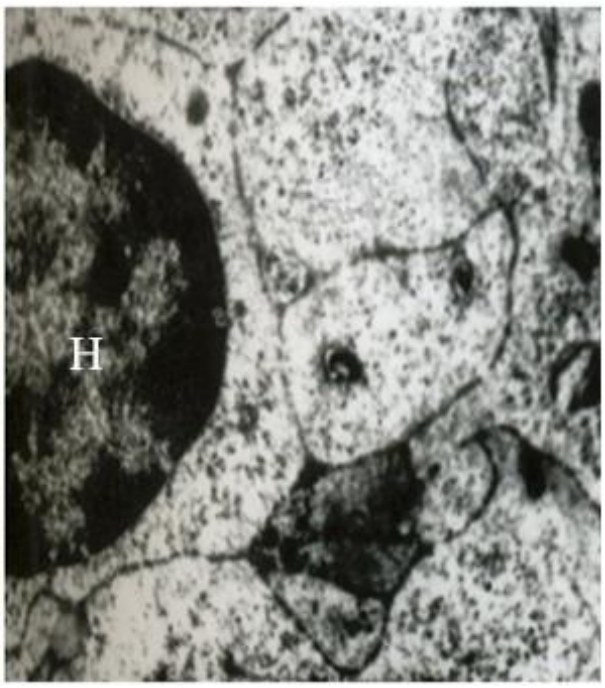

Figure 2b. The nucleus of the preputial gland produced large dense nucleus with rich amount of heterochromatin (H). The mature secretory cells released the secretory contents in to the lumen and such cells look like empty cells.

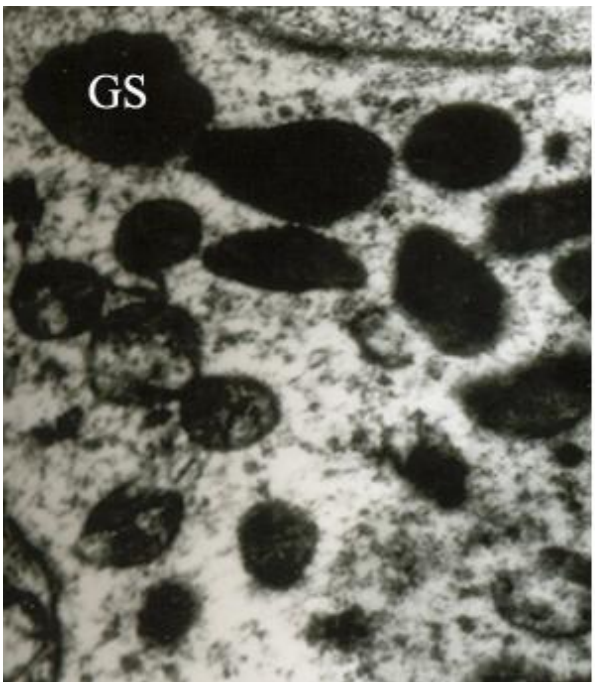

Figure 2a. The cheek gland of male rat consists of more amounts of granulated substances (GS) which are scent sources of rat.

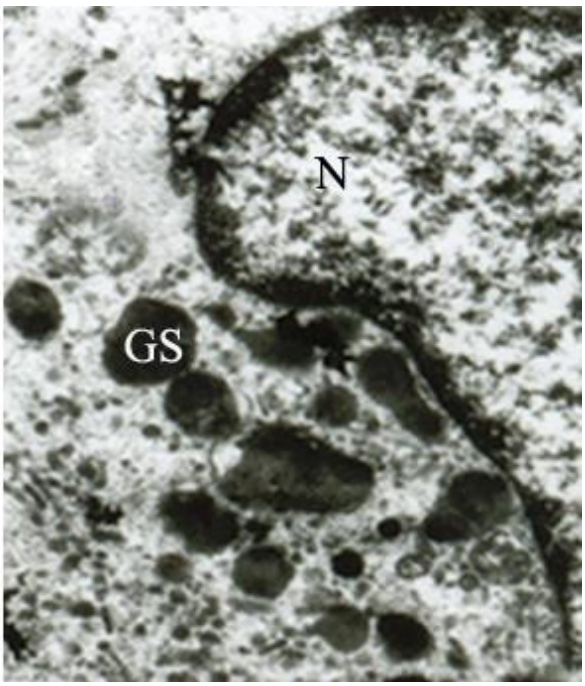

Figure 2b. The nucleus (N) of **the cheek gland** has less amount of heterochromatin. It produces less dense granular substance (GS).

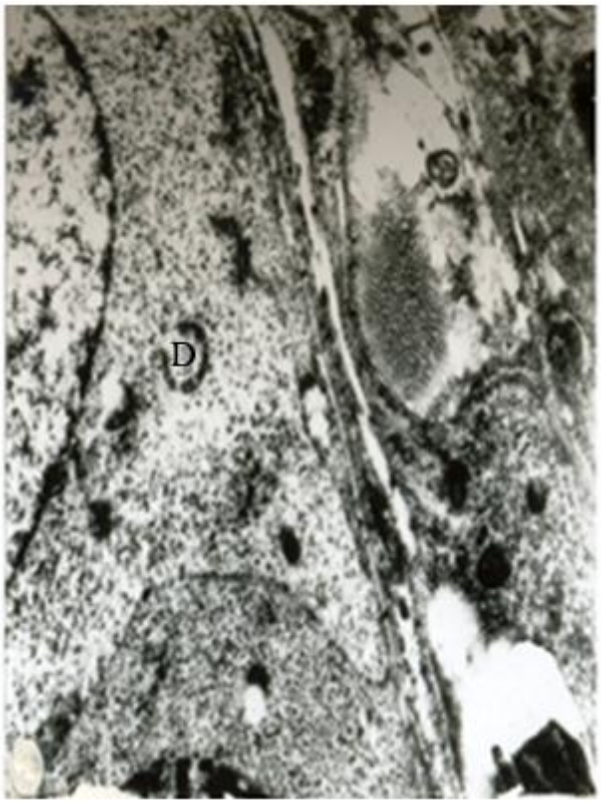

Figure 3a. The armpit gland consists of distinguished flask shaped cells with numerous connective and desmosomes (D).

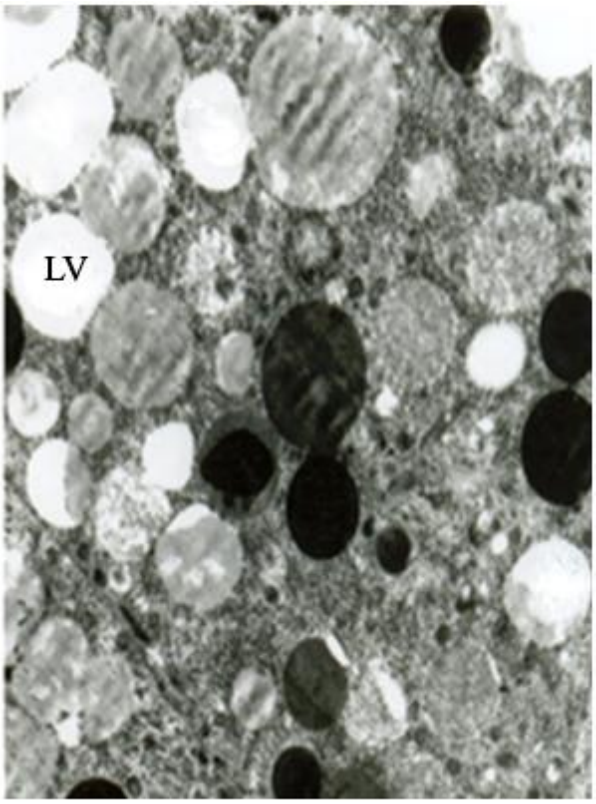

Figure 3b. The cytoplasm of the armpit gland cells consists of more amounts of lipid vacuoles (LV) and mixed minute granulated substances.

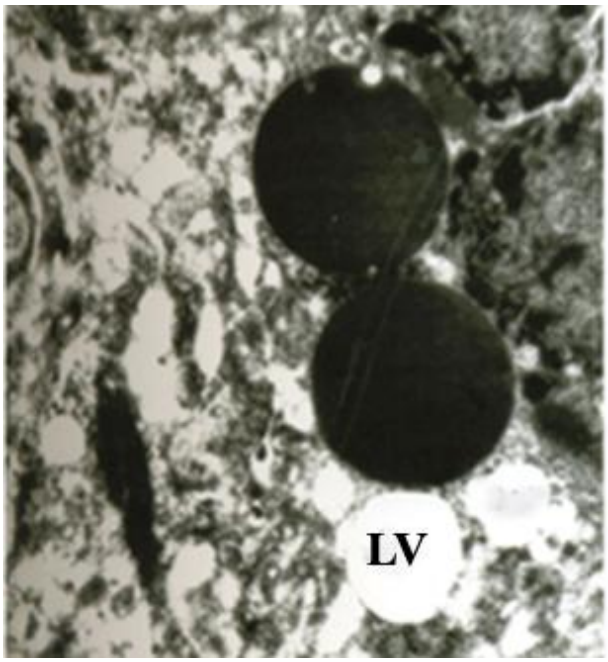

Figure 4a. The flank gland of male rat cytoplasm contained dense particles with lipid vesicle (LV).

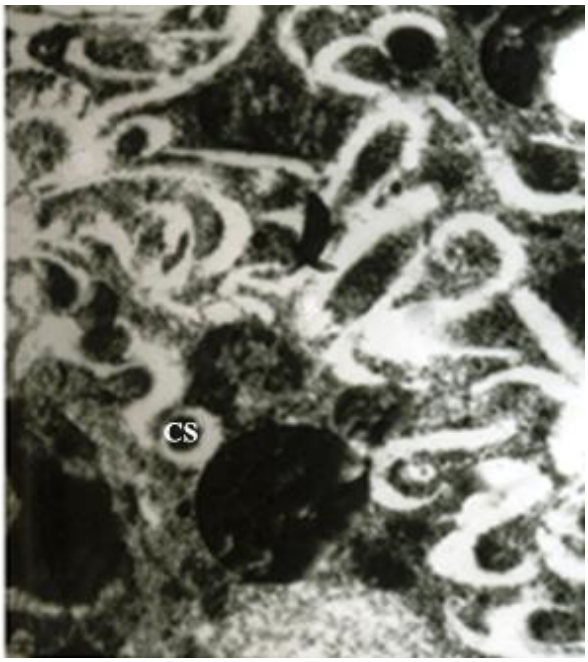

Figure 4b. The flank gland cytoplasm consist of a unique structure in the cytosolic solution (CS).

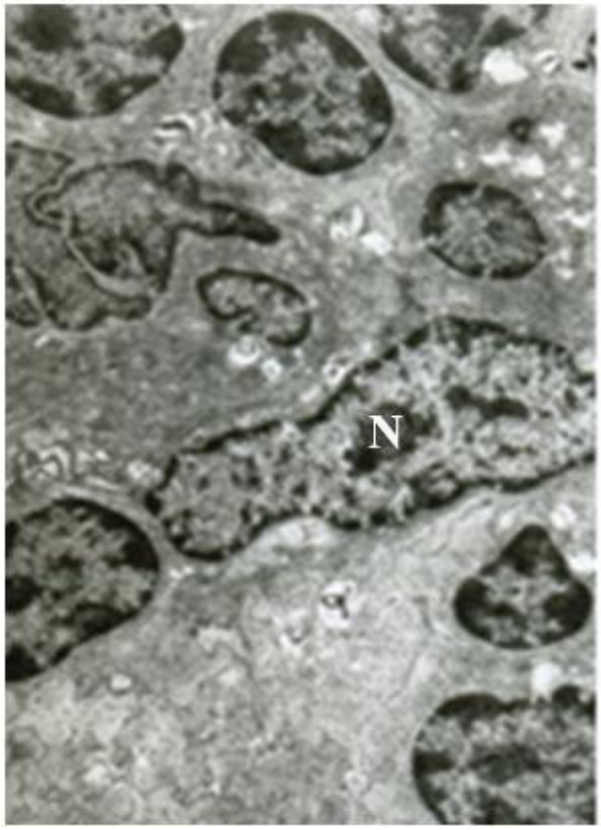

Figure 5a. Clitoral gland of female rat shows the distinguished nucleus. The significance of this cell is the presence of small nucleus with high nuclear cytoplasmic ratio.

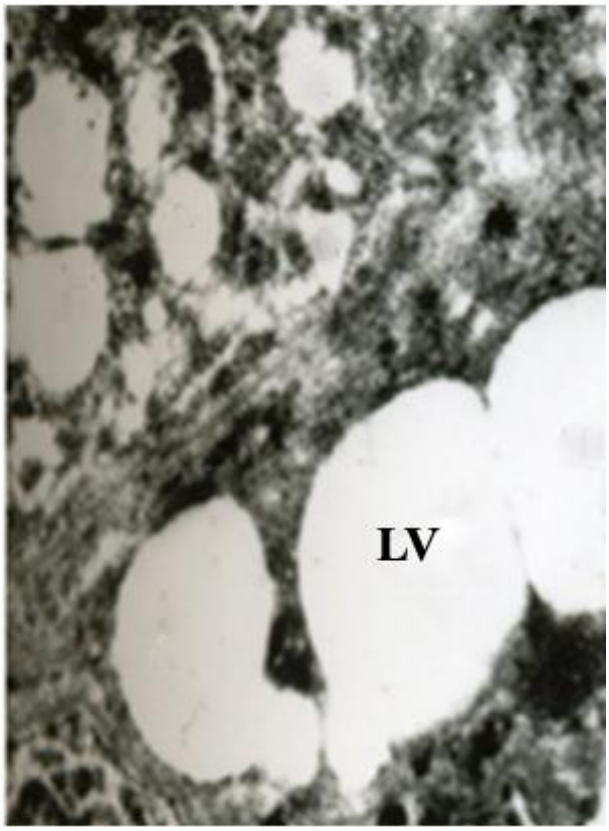

Figure 5b. The Clitoral gland shows the occurrence of large vacuole (LV) with rich amount of reticular system.

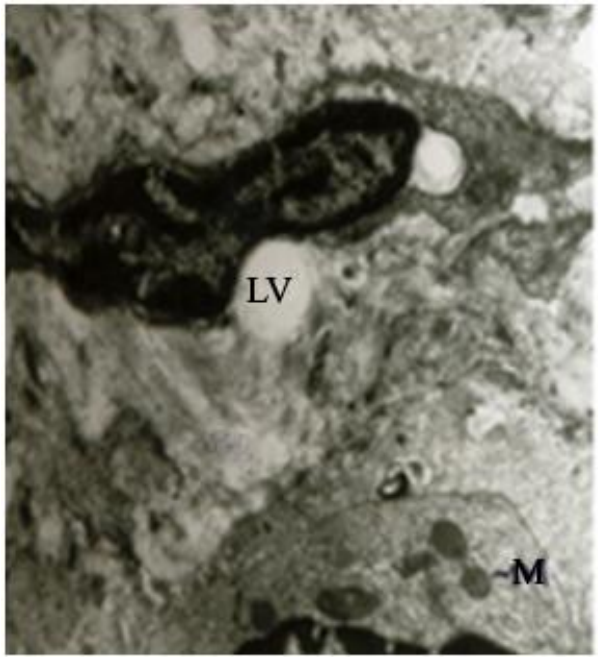

Figure 6a. Cheek gland of female rat has distinguished nucleus. The significance of the female scent gland is the presences of large vesicle (LV) and elongated nucleus with more number of mitochondria (M).

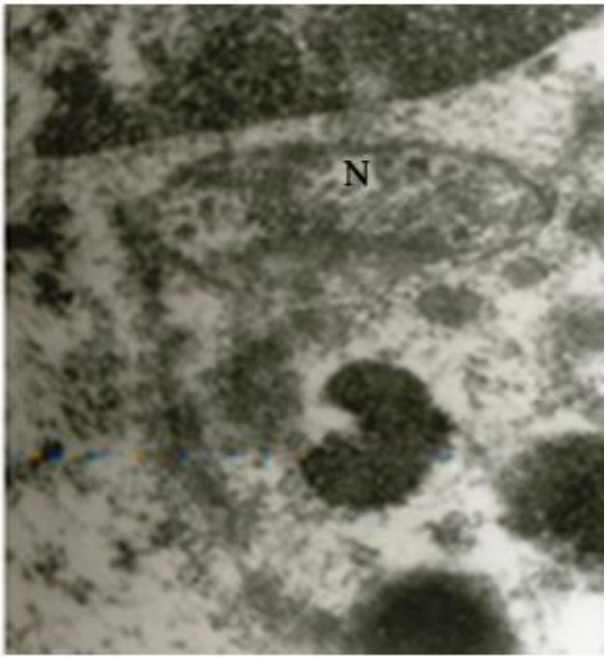

Figure 6b. The cheek gland consists of large dense nucleus (N) with rich amount of heterochromatin. The mature secretory cells released all the secretory contents in to the lumen. Such cells are looks like empty cells.

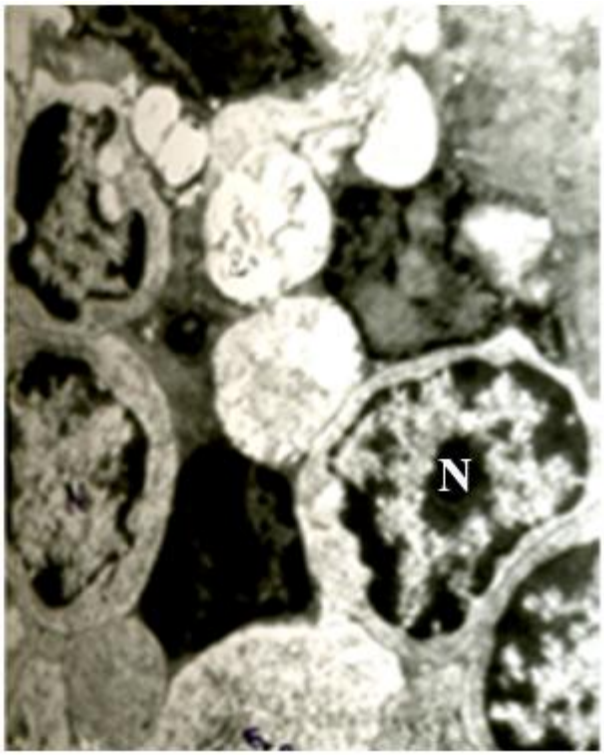

Figure 7a. Armpit gland of female rat consists of distinguished nucleus (N) with high nuclear cytoplasmic ratio and endoplamic reticulum.

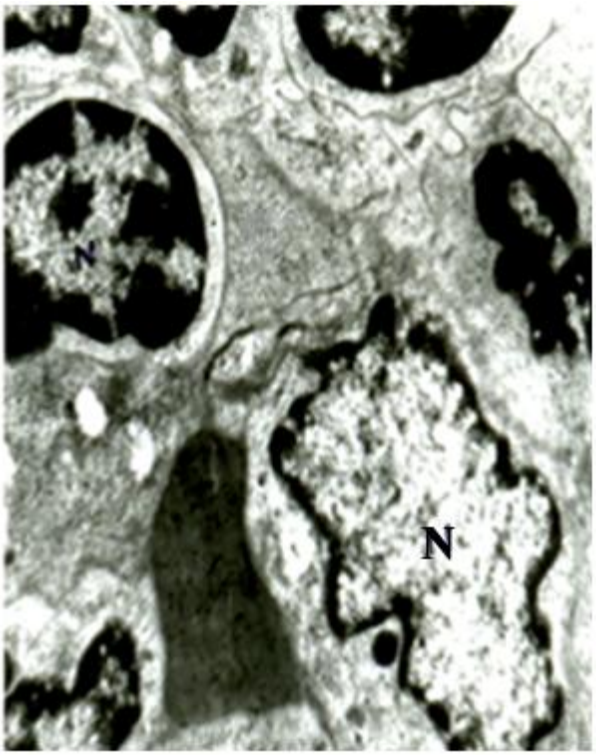

Figure 7b. The armpit gland has of large euchromatin nucleus (N) with rich amount of membrane wrinkles.

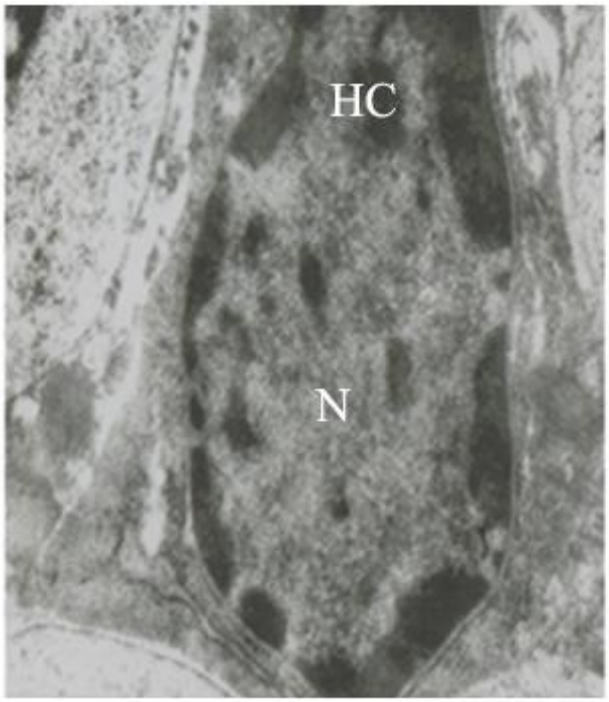

Figure 8a. Flank gland of female rat consists of distinguished flask shaped nucleus (N) and margin is endorsed by the occurrence of heterochromatin (H).

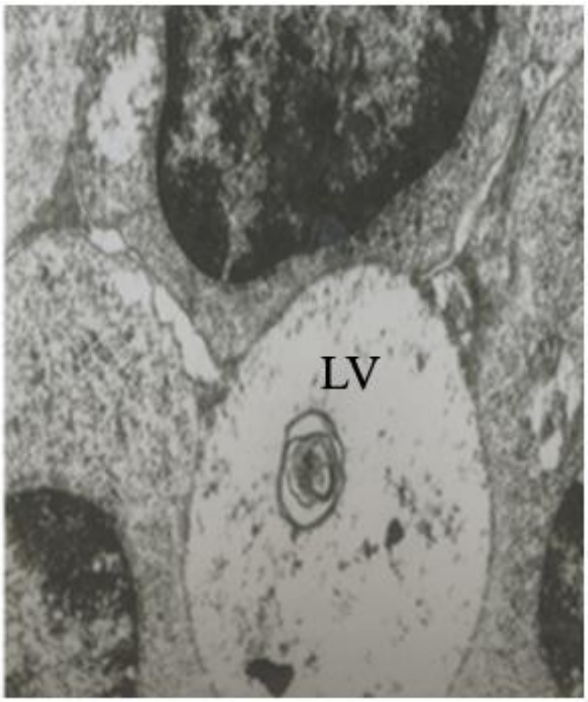

Figure 8b. The flank gland cell has large vacuoles (LV) with high nuclear cytoplasmic ratio.

The growth of the scent marking gland in *M. meltada* is a continuous process, it keeps on growing throughout the life time of the rodents but exhibit sporadically a significantly high growth rate at certain age. The correlation between the body weight (in a way indicating age) and the gland measurements also confirm the observations about the process of its continuous growth. The females *M. meltada* show interest in the scent marks of the males (Idris and Prakash, 1981; Prakash and Idris, 1982) and therefore, it is quite probable that it may have a function related to reproduction. A number of ethological investigations are in progress to understand the role of scent marking among desert rodents in chemical communication (Kumari and Prakash, 1981a, b, c; Prakash and Idris, 1982), and more exhaustive work may unveil the mystery of the role of this specialized odour producing gland present in a few rodents only.

CONCLUSION

The ultrastructural study of the scent glands of male and female *M. meltada* reveals the presence of more secretions, which are released for territorial, familiarization, scent mark its home range with sebum exudation and reproduction activities. It may be used to control the rodent in the field.

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