Fine Structure of the Mandibular Gland of Chinese Hamster (*Cricetulus griseus*)

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The mandibular glands of the Chinese hamster were examined by light and electron microscopy. The mandibular acinar cells were noted to be categorized in a seromucous type, because the acinar cells stained slightly basophile and moderately positive for periodic acid-Schiff (PAS) and alcian blue (AB) reactions and the intercellular canaliculi were detected in the cells. The acini were composed exclusively of light cells containing various secretory granules. The acinar cells exhibited a sexual dimorphism; in the female AB staining was more intense, and also the granules having the matrix of a fine hair-like material were more numerous than in the male. Intercalated duct cells were composed exclusively of light cells and contained round and polygonal granules. The striated ducts consisted of two distinct portions, the secretory and typical striated portions without secretory granules. The epithelial cells of secretory portion were columnar in shape and contained acidophile granules which gave a strongly positive PAS reaction, and comprised light and dark cells containing secretory granules varying in size and density. The epithelium of typical striated portion was composed of both light and dark cells containing fine vacuoles and vesicles, but no secretory granules. No sexual dimorphism was detected in the striated duct.

Introduction

The mandibular glands of many rodent species are well known to be different from those of other species of mammals in the following characteristics: The acini do not show the presence of mucous cells and the striated ducts in the proximal part are modified into granular tubules influenced by sex hormones. A number of fine structural studies on the mandibular gland of rodents including mouse and rat have been described [1, 2, 4, 5, 7, 8, 10, 14, 17, 18, 19, 31-33]. As for the Golden hamster, several reports have been published on the fine structures of the mandibular glands [3, 6, 9, 11, 13, 28]. In the Chinese hamster, Spicer and Duvenci [27] chiefly investigated the acinar cells of the mandibular gland by light microscopy; however, the ultrastructures of these glands in Chinese hamster have not been reported previously. This paper deals with some of the fine structures of the mandibular gland in Chinese hamster and draws comparison with the findings of the mandibular glands from other rodents reported previously.

Materials and Methods

Seven male and seven female 90-day-old Chinese hamsters used in this investigation were provided from Nippon Institute for Biological Science. The tissues of the central part of the mandibular gland were removed immediately and fixed in a cold mixture of 1.25% glutaraldehyde and 1%
osmium tetroxide. The details of the preparation of tissues and the observational methods have been described elsewhere[30].

Results

Acinus: Acinar cells had the cytological characteristics of seromucous cells and were slightly basophile and moderately positive to periodic acid–Schiff (PAS) and alcian blue (AB). A sexual dimorphism was evident after staining with AB; the AB reaction in the females was more intense than that in the males. The round or ovoid nuclei were situated in the basal region. In epoxy resin sections examined by light microscopy, acinar cells in both sexes contained a lot of round granules weakly stained with methylene blue. At the ultrastructural level, acinar cells were entirely composed of light cells and had many variable secretory granules in the supranuclear and apical regions of the cytoplasm; round granules containing a fine granular material of low density (Fig. 1), a fine hair-like material of low, moderate and high densities (Figs. 2,3,4) and round homogenous granules of high density (Fig. 3). In the female, the granules having the matrix of fine hair-like material were more numerous than those in the males (Figs. 1,3). The Golgi apparatus was well developed in the supranuclear region and consisted of lamellae, vacuoles and vesicles (Fig. 1). The granules were occasionally located closely to the Golgi membranes. Short segments of rough endoplasmic reticulum (RER), free ribosomes and mitochondria were distributed widely throughout the cytoplasm. Each acinus had a narrow lumen, and the intercellular canaliculi, one of the cytological characteristics in the seromucous cells, were detected (Fig. 3). A few short microvilli extended into the lumen, closely to which many granules were accumulated, and were extruded from the cell by an eruptocrine type secretion (Fig. 2). The acinar cells had relatively flat lateral and basal borders, but occasional interdigitations between neighboring cells were observed. Myoepithelial cells were detected around the acini.

Intercalated duct: The segments exhibited no histological differences between the sexes and were noticeably few in sections. The epithelium of the duct was PAS-positive and AB-negative, consisting of cuboidal light cells alone. The round or polygonal granules of low and high densities were seen in the apical portion of many light cells (Fig. 5), and also polymorphic granules in a few cells (Fig. 6). The Golgi apparatus was not well developed generally, whereas in occasional light cells the Golgi complex was developed in the supranuclear region and consisted of lamellae and vesicles. Short segments of RER were dispersed throughout the cytoplasm, but free ribosomes and mitochondria were relatively numerous. The lateral and basal borders of the cells were relatively flat, and the short microvilli were studded sparsely on the luminal surfaces.

Striated duct: The striated ducts did not show morphological differences between the sexes and consisted of two portions, the secretory portion and the typical striated portion without secretory granules. The epithelial cell of the secretory portion was columnar in shape and contained acidophile granules which proved positive extensively for PAS reaction, but did not stain with AB. It was composed of light and dark cells containing secretory granules with various sizes and densities. The light cells, predominant in number, had round granules of high density, round or polygonal granules of low to moderate densities in the supranuclear and apical regions of the cytoplasm (Fig. 7). The granules of high density were smaller than those of low to moderate densities, and were chiefly observed in the apical portion. In contrast, the granules of low density were more frequent in the supranuclear portion. These granules seen in the supranuclear portion had greater
diameters than those of the apical portion (Fig. 8). Moreover, polygonal small granules of high density were observed in the occasional light cells (Fig. 9). The Golgi apparatus was relatively well-developed in the supranuclear region and was composed of vesicles and vacuoles. Short segments of RER were distributed sparsely, whereas free ribosomes and mitochondria were relatively numerous. Typical basal striations or the so-called basal infoldings, were prominent. The lateral borders of the duct cells were relatively flat. The apical surfaces of epithelial cells of the duct showed various forms, e.g., relatively flat, leaf-like, or apocrine process-like. In the lumen, there were a few dense granules (Fig. 10). The dark cells with electron dense cytoplasm were few. As for features of the granules and cytoplasmic organelles, mitochondria, RER and free ribosomes presented an almost complete similarity to those of light cells whereas the Golgi apparatus was poorly developed (Fig. 11).

The epithelium of typical striated portion was composed of light and dark cells (Fig. 12). These cells had fine vacuoles and moderately dense vesicles in the supranuclear and apical regions, but no secretory granules. The cytoplasmic organelles were poorly developed as compared to the secretory portion. The typical basal infoldings were prominent.

The results are summarized in Table 1.

### Discussion

There is only a report of Spicer and Duvenci [27] that demonstrates the mandibular acini of the Chinese hamster to be PAS- and AB-positive, thus containing acid mucopolysaccharides. On the other hand, as to the mandibular gland of the Golden hamster[3, 6, 9, 22], there are several reports describing that the acinar cells reveal similar structures to those of mice and rats and are categorized in a seromucous type, proving to be moderately AB- and PAS-positive. According to these reports and our observations, the mandibular acinar cells of the Chinese hamster are considered to be seromucous and not mucous in type.

No attempt has ever been made, to our knowledge, of transmission electron microscopic observation on the mandibular gland of the Chinese hamster. As for the Golden

| Table 1. Morphological features of the mandibular gland in Chinese hamster. |
|---------------------------------|-----------------|-----------------|
| Acinus                          | Intercalated duct | Secretory duct  |
| Seromucous cell                 |                 |                 |
| PAS                             |                 |                 |
| AB                              |                 |                 |
| Cell types                      |                 |                 |
| Granules                        |                 |                 |
| Density of granules             |                 |                 |
| Microvilli                      |                 |                 |
| Myoepith.                       |                 |                 |
| Nerve terminal                  |                 |                 |

S.P.: Secretory portion, T. P.: Typical striated portion
L: Light cell, D: Dark cell
(*) : Granules containing hair-like material
The number of + signs in each column indicates the quantitative degree ranging from absence or negative (−) to numerous or strong (++).
hamster, there are quite a few reports describing the ultrastructures of the mandibular gland [4,5,9,23]. In the present study, the acinar cells of the Chinese hamster were found composed entirely of light cells containing at least 4 kinds of granules. These granules are heterogenous, respectively, and are thought to be mature as estimated according to their location as described previously [30]. The granules containing a fine hair-like material observed in the present study are considered to be characteristic ones in the mandibular gland of the Chinese hamster.

In the present study on the Chinese hamster, the acinar cells exhibited a sexual dimorphism; in the female the AB staining was more intense, and also the granules possessing the matrix of fine hair-like material were more frequent than those in the male. The sexual dimorphism between the salivary glands have been well documented for the mandibular granular tubules of mice [2,15,26]. As regards the sexual dimorphism of the mandibular acinar cell, on the other hand, there are several reports on the Golden hamster [4,11,13,20,21,27] and the Chilian rodent [25], but no report mentions on the mandibular acinar cell of the Chinese hamster. Shackleford and Klapper [20,21] described that in the acinar cells of the female Golden hamster, the AB staining was more intense and photometric measurement of sialic acid was almost twice as high as that in the male, and since ovariectomy reduced the sialic acid content of the female mandibular gland, the female sex hormones might influence the content of sialic acid in hamster mandibular mucin. Kromman [11] described that the histochemical reaction of tryptphan and tyrosine in the mandibular gland of the male Golden hamster was more pronounced than that in the female. Dorey and Bhoola [4] described that the ultrastructural appearance of the granules in the acinar cells of the female Golden hamster showed little resemblance to the granules in the male. Moreover, Smith and Frommer[24] reported that in the male Chilian rodent, the granules gave a more intense PAS reaction than that of the female.

The intercalated ducts of the mandibular gland in the Golden hamster were described to be lined by cuboidal cells without well-developed cytoplasmic organelles and to be positive with PAS and toluidine blue, but not with AB [3,5,9,23]. In this study, the intercalated ducts of the mandibular gland in Chinese hamsters were similar to those of Golden hamsters [5,9,23], mice [10,22] and rats [5,19,22].

The striated ducts of the mandibular gland of most rodent species have been well documented to be modified into granular tubules in the proximal part, and the granular tubules of mice [2,15,26], rats [12,24] and Mongolian gerbils [16] are well known to exhibit a sexual dimorphism. In the mandibular gland of the Golden hamster [4-6,9,22,23], it has been described that the epithelium of secretory portion contains granules reacting with PAS, but not with AB. However, there are no detailed descriptions on the sexual differences of this portion. In the mandibular gland of the Chinese hamster, the fine structures of the striated duct were noted to be similar to those of Golden hamster and revealed no histological differences between the sexes.

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References
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Explanation of figures

Fig. 1 Acinar cell of the male mandibular gland. The secretory granules of low density are observed. Golgi apparatus is well developed.

Fig. 2 The granules of the female acinar cell. The granules containing hair-like material of low density are extruded into the lumen by an eruptocrine type secretion.

Fig. 3 Acinar cells of the female mandibular gland. Round secretory granules containing hair-like material of moderate and high densities, and round homogenous granules of high density are observed (compare with Fig. 1). An intercellular canaliculus is detected.

Fig. 4 High magnification micrograph of the granules shown in Fig. 3. The granules having hair-like material of high density are observed.

Fig. 5 Intercalated duct of the male mandibular gland. The round or polygonal granules of various densities are seen in the cytoplasm. On the luminal surfaces short microvilli are studded sparsely. The cytoplasmic organelles are poorly developed.

Fig. 6 Intercalated duct cells of the female mandibular gland. Polymorphic granules are observed.

Fig. 7 Secretory portion of striated duct of the female mandibular gland. The epithelial cells have round secretory granules of various sizes and densities.

Fig. 8 Striated duct cell of secretory portion in male mandibular gland. The granules of high density are largely observed in the apical portion and are smaller than those of low density.

Fig. 9 Striated duct cell of secretory portion in male mandibular gland. Polygonal granules of high density are seen in the apical portion.

Fig. 10 Secretory striated duct of female mandibular gland. The apical surfaces of epithelial cells of the duct show various forms and a dense granule is found in the lumen.

Fig. 11 Striated duct cells of secretory portion in male mandibular gland. Dark and light cells containing various granules are observed.

Fig. 12 Typical striated portion of striated duct in female mandibular gland. Light and dark cells are observed. Both cells contain no secretory granules.