

Comparative stereological study of granular and striated ducts in mandibular glands in Wistar and Brown Norway rats

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Abstract

Mandibular glands in adult rats contain granular ducts, derived from the striated ones, which enrich the saliva with different components. The aim of our study was to conduct a comparative stereological study of the striated and granular ducts in two rat strains (albino Wistar and Brown Norway). With this purpose in view, we harvested salivary glands from 5 animals from each strain in part and histologically processed them. We analyzed fields with the total surface of 1699510 μm^2 with the aid of AmScope software and the statistical analysis was performed with GraphPad Prism 6.01 program. The results showed that in both species, the number of sections through the granular ducts is higher than the one of striated ducts and the total surface occupied by the granular ducts is higher than the one occupied by the striated ones. The statistical analysis revealed the fact that there are no significant differences between the number of striated or granular ducts from one species to another, nor between the surface occupied by each type of duct (striated or granular) on the sections taken into study in the two rat strains. Thus, the mandibular gland in Wistar and Brown Norway rat resemble one another regarding the surface occupied by the striated and granular ducts and also the number of the two types of ducts on the section taken into study.

Keywords: Brown Norway, granular, mandibular, striated, Wistar.

Introduction

The parenchyma of the mandibular gland in rodents contains two secretory compartments. They are represented by acini and ducts (Coire et al., 2003). The ducts present in the mandibular gland of rodents divide in: intralobular (intercalated, granular and striated), excretory and main excretory ducts (Amano et al., 2012). Among the ducts, the granular and striated ones can be secretory, but not in all rodent species (Tandler et al., 2001). Moreover, the granular ducts are not encountered in the mandibular gland of all rodent species (e.g. they are not found in chipmunks (*Tamias striatus*), antelope squirrels (*Citellus tereticaudus*) and guinea pig (*Cavia porcellus*) (Flon et al., 1970; Tandler et al., 2001), but in adult rats they are found in great numbers (Tandler et al., 2001).

At birth, the mandibular gland of rats is not completely developed. It grows in volume along with the development of the acinar cells, as well as the ones lining the granular ducts. The increase in volume takes place due to the cell hypertrophy and their hyperplasia (Enesco and Leblond, 1962; Pardini and Taga, 1992).

The granular ducts are present in the mandibular glands in rodents and are majoritary (Tandler et al., 2001), being sometimes mistaken for mucous acini (Amano et al., 2012). Thus, the structures present at birth in the mandibular gland of rat are transient (Hand et al., 1996; Denny et al., 1997; Hecht et al. 2000., Coire et al. 2003) and reach maturity after passing through two phases, namely: acinar and ductal (Coire et al., 2003). It seems that the granular ducts arise from the striated ones, starting with the third week of life (Cutler and Chaundry, 1975; Gresik, 1980) and reach maturity after 3 months (Srinivasan and Chang, 1975; Coire et al., 2003). Some authors write that the ducts can form starting from the cells lining the intercalated ducts (Denny et al., 1993;

Srinivasan and Chang, 1975; Zajicek et al., 1985). In mouse, the granular ducts form earlier than in rat (Pardini and Taga, 1997).

The salivary glands broadly differ from one species to another, depending on the environment they live in and the food type. We set out to assess if there are intraspecific differences regarding the number and surface occupied by the striated and granular ducts in albino Wistar and Brown Norway rats, by conducting a morphometrical study.

Material and methods

The present study unreel in the University of Agricultural Sciences and Veterinary Medicine in Cluj-Napoca and was approved by the Bioethics Committee. The biological material was represented by 5 albino Wistar rats and 5 Brown Norway rats, all males. The rats were sacrificed by prolonged anesthesia with isoflurane and the mandibular glands were harvested as soon as possible. The samples were fixed in 10% buffered formalin for 7 days long and renewed the fixation solution 3 times. The next steps consisted in dehydration with ethanol in increasing concentration, clarification with n-butanol and paraffin embedding. Alternate 5 μm thick sections were cut with a Leica rotary microtome and subsequently stained with Goldner's trichrome method.

Determination of the surface of striated and granular ducts

The histological slides were examined with the aid of Olympus BX41 light microscope using the 10x objective and the images captured with the photo camera attached to the microscope (Olympus E-330). The measurements were made with AmScope software and we measured one field from each rat in part, with an area of 1699510 μm^2 . We determined the number of striated and granular ducts and the section surface of each duct in part, and then determined the percentage of each type of ducts on the surface taken into study.

Statistical analysis

The total surfaces obtained for striated and granular ducts were compared between the two rat strains with the aid of GraphPad Prism 6.01 program for Windows, using Unpaired t test and the level of significance was set at 5%.

Results and discussion

Both the mandibular gland in albino Wistar rat (Fig. 1.) and the one in Brown Norway rat (Fig. 2.) contain numerous granular ducts (whose cells are filled with future secretion products) and striated ducts in obviously smaller numbers.

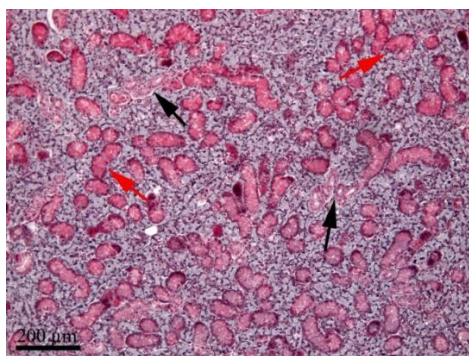


Fig. 1. Mandibular gland in albino Wistar rat – striated ducts (black arrows); granular ducts (red arrows)

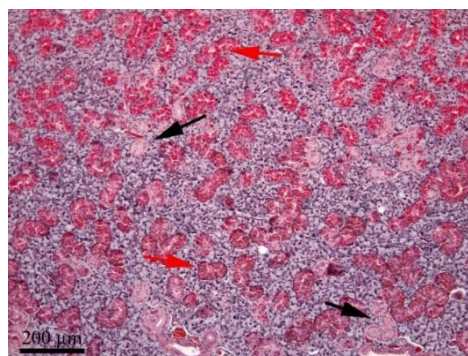


Fig. 2. Mandibular gland in Brown Norway rat – striated ducts (black arrows); granular ducts (red arrows)

The data regarding the number of striated and granular ducts on the section surface taken into account, as well as the total surface of striated and granular ducts in each rat in part (albino Wistar and Brown Norway) are presented in Table 1.

The average number of sections (transversal or oblique) through the ducts present on the surface taken into study, was represented by 46 striated ducts and 169.8 granular ducts in albino Wistar rat and 41 striated ducts and 157.8 granular ducts in Brown Norway rat.

In the case of the mandibular gland in albino Wistar rat, the average total surface of the sections through striated ducts was 87985.35 μm^2 and 552455.65 μm^2 for granular ducts, which represents 5.18% from the total surface taken into study (1699510 μm^2) for the striated ducts and 32.51% for the granular ones, respectively (Chart 1).

Table. 1. Number of ducts/picture and total surface of ducts

Rat strain	No. of striated ducts/picture	Total surface of striated ducts (μm^2)	No. of granular ducts/picture	Total surface of granular ducts (μm^2)
W1	46	132499.19	145	569354.83
W2	38	64264.98	167	570983.41
W3	33	59238.48	175	557325.57
W4	57	90138.36	187	510577.53
W5	56	93785.71	175	554036.86
BN1	40	95588.94	158	583563.94
BN2	38	124312.90	157	575768.66
BN3	38	180799.08	137	454496.19
BN4	34	91001.38	166	552408.29
BN5	55	137414.40	171	582920.96

W – Wistar albino rat; BN – Brown Norway rat.

The results were comparable in the case of the mandibular gland of Brown Norway rat, in which the total average surface of the sections through the striated ducts was 125823.34 μm^2 , as for the granular ones 549831.61 μm^2 , the striated ducts representing 7.40% from the total surface taken into study (1699510 μm^2) and the striated ones 32.35% from the total surface of the section (Chart 1). Thus, we can state that in section, the granular ducts occupy approximately the same percentage out of the mandibular gland surface in the two rat strains taken into study, while the striated ones present an insignificant difference of 2.23% in the favor of the granular ducts in albino Wistar rat.

The differences recorded in both the surfaces of granular ducts (p value = 0.5317) and striated ones (p value = 0.0952) in the two rat strains were not statistically significant. Upon statistical analysis of the difference between the number of sections of the striated ducts on the section surface of the mandibular gland in albino Wistar rat and Brown Norway rat, respectively, it turned out to be insignificant (p value = 0.5476). Similarly, $p > 0.05$ in the case of the number of sections through the granular ducts in the two rat strains (p value = 0.1349), which signifies that in this case, the differences were also statistically insignificant in the two rat strains taken into study.

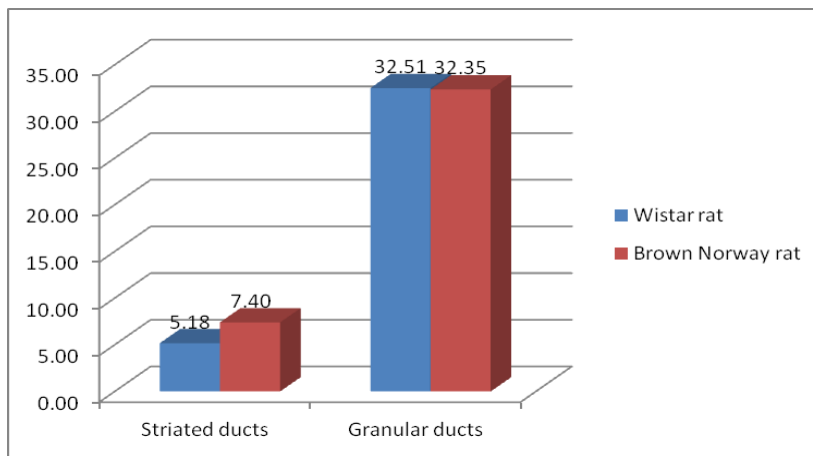


Chart 1. Percentage of intralobular ducts in Wistar and Brown Norway rat

In the scientific literature, authors mention the fact that the granular ducts occupy a moderately large volume in adult rats, increasing by 132% between the first and third month of life (Coire et al., 2003). The rats taken into the present study were mature males, thus the mandibular glands from both rat strains contained a large number of granular ducts, which occupy 32.51% from the section surface in albino Wistar rat and 32.35% in the case of Brown Norway rat.

Amano et al. (2012) write that the striated ducts are well represented in rodents, aspect confirmed in our study as well, occupying 5.18% from the section surface in albino Wistar rat and 7.40% from the section surface in Brown Norway rat, with an average number of 46 sections of striated ducts/surface taken into study in albino Wistar rat and 41 for Brown Norway rat, respectively. The granular ducts are sinuous (Taga and Pardini, 2002; Greaves, 2012), thus the number of sections through these ducts is larger than the one through the striated ducts. The explanation of the better representation of this type of ducts could be the importance of the products synthesized and eliminated by the cells lining it. Among these substances, there are different bioactive polypeptides, hormones and growth factors (Amano et al., 2012).

Conclusion

Both studied rat strains contained better represented granular ducts than the striated ones in their mandibular glands, occupying a more significant surface and the intraspecific differences of number and surface occupied by the ducts (striated and granular) were not significant among albino Wistar and Brown Norway rat.

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