# Beta-Adrenergic Control of von Ebner's Glands in the Rat[a]

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Von Ebner's lingual salivary glands secrete through multiple ducts into the clefts of the circumvallate and foliate papillae. At the microscopic level, gland acini are filled with secretory granules.[1] Since 80% of the lingual taste buds are contained in the foliate and circumvallate papillae in the rat,[2] and since taste receptor sites on the microvilli are bathed in saliva,[3] these glands provide a microenvironment important in taste transduction in posterior tongue taste buds.

Little is known concerning the neural control of von Ebner's glands. Recently we have shown that the source of their parasympathetic control is via cells in the inferior salivatory nucleus in the medulla.[4] We now have applied the morphometric methodology used by Getchell and Getchell[5] in a study of Bowman's glands to characterize the extent of $\beta$-adrenergic control of the von Ebner's gland acini.

## METHODS

Rats were starved overnight to cause accumulation of secretory granules in gland acini. At 8:30 A.M. five groups of 10 rats each were injected intraperitoneally with the $\beta$-adrenergic agonist isoproterenol (IPR) dissolved in saline at doses of 7.5, 15, 20, 30, and 60 mg/kg. Control rats were injected with saline. An additional group was injected with 30 mg/kg IPR and 42 mg/kg DL-propranolol hydrochloride (PROP), a $\beta$-adrenergic antagonist. Two hours later the rats were sacrificed, the tongue removed, and a standard portion of the von Ebner's glands dissected. The gland tissue was fixed by overnight immersion in cold, buffered, 4% glutaraldehyde and 1% paraformaldehyde, post-fixed with 1% osmium tetroxide, embedded in Epon, sectioned at 1 $\mu$m and stained with 1% toluidine blue. Five representative acini were randomly selected from each rat for photomicroscopy. Measurements of acinar and secretory granule area were made from 4" × 5" black and white prints using computerized planimetry and the percentage of the total acinar area occupied by the granules was calculated.

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## RESULTS

Secretory granules in control acini occupy the whole of the cell cytoplasm. Isoproterenol causes the percentage of the cell area occupied by the granules to be reduced. All doses of IPR produced a reduction in secretory granules that was significantly different from control values ($F(5,59) = 7.44$, $p < 0.001$). Even with the highest dose, however, reduction was never complete (TABLE 1). When both the agonist IPR and antagonist PROP were given together, there was no significant reduction.

TABLE 1. Effect of Increasing Concentration of Isoproterenol on Secretory Granule Depletion

| Isoproterenol Dose mg/kg | % Acinar Area Occupied by Secretory Granules X ± SD |
|---|---|
| 0 | 55 ± 8 |
| 7.5 | 45 ± 3 |
| 15 | 41 ± 3 |
| 20 | 43 ± 2 |
| 30 | 33 ± 3 |
| 60 | 24 ± 1 |

## DISCUSSION

It is apparent from these results that von Ebner's glands are under the control of the $\beta$-adrenergic nervous system. Injection of the $\beta$-adrenergic agonist reduces the secretory granules in the acinar cells. The reduction is related to the concentration of the injected agonist, but never exceeds 50% of control values. The reduction produced by IPR is completely blocked by the $\beta$-adrenergic antagonist PROP.

These results are similar to the 41% reduction in secretory granules obtained by Getchell and Getchell[5] using $\beta$-adrenergic stimulation of Bowman's glands, and quite different from the total degranulation of the rat parotid gland.[6] One explanation to account for these differences is that for Bowman's and von Ebner's glands one group of secretory granules is under control of the $\beta$-adrenergic system, while a second group is under some other neural control. If this proves to be true and if the granules are of a different composition, it would mean that the characteristics of the saliva bathing the taste buds in the circumvallate and foliate papillae could be modulated under neural control. Since flow of saliva is initiated by gustatory stimulation, afferent neural activity from taste buds could alter salivary composition and thereby control their microenvironment.

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