2 Regulatory Mechanisms and Salivary Gland Functions

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Introduction

The salivary response to various stimuli is modified in a purposeful way in terms of volume and composition. The diversity is achieved by activating different types of gland, different types of secretory cell within a gland, different types of reflex arcs, and different patterns of nerve impulse firing—regulating the ratio of the different transmitters being released. Although it is generally thought that salivary secretion is solely under neural control, recent studies have shown that some gastrointestinal hormones also contribute to the control of secretion and thus influence the responsiveness of glands.

In addition to their secretory function, the salivary glands also have excretory and possibly endocrine functions. Examples of excretory functions are the passive movement into the saliva of the nonprotein-bound fraction of circulating hormones (such as cortisol and melatonin) and the active uptake and release of iodide, which may be deleterious for the gland when it is radiolabeled and used in the treatment of thyroid tumors.[1,2] Secretory products, including amylase and growth-promoting factors, are also released into the blood, suggesting endocrine actions.[3]

> ! Salivary glands have exocrine, endocrine, and excretory functions.

Functions of Saliva

Saliva has protective and digestive functions in the mouth (**Fig. 2.1**). It lubricates the oral structures with a mucin-rich film; maintains neutral pH through its buffering

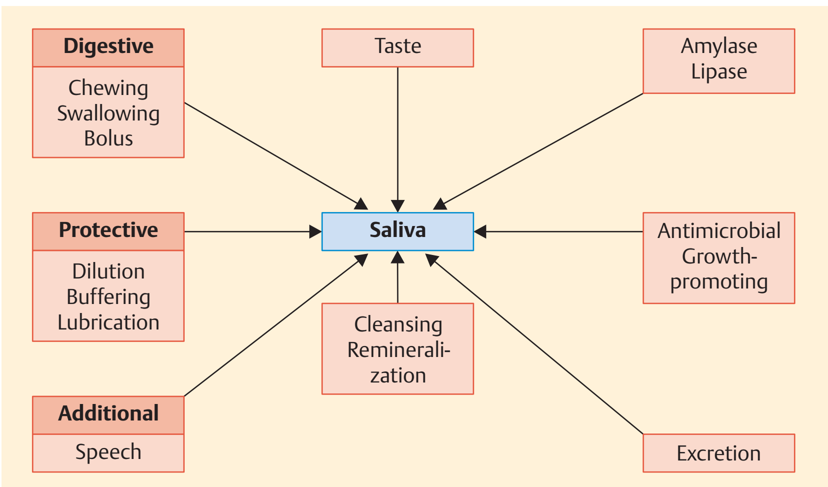

Fig. 2.1 Functions of saliva

(ISBN 9783131464910),

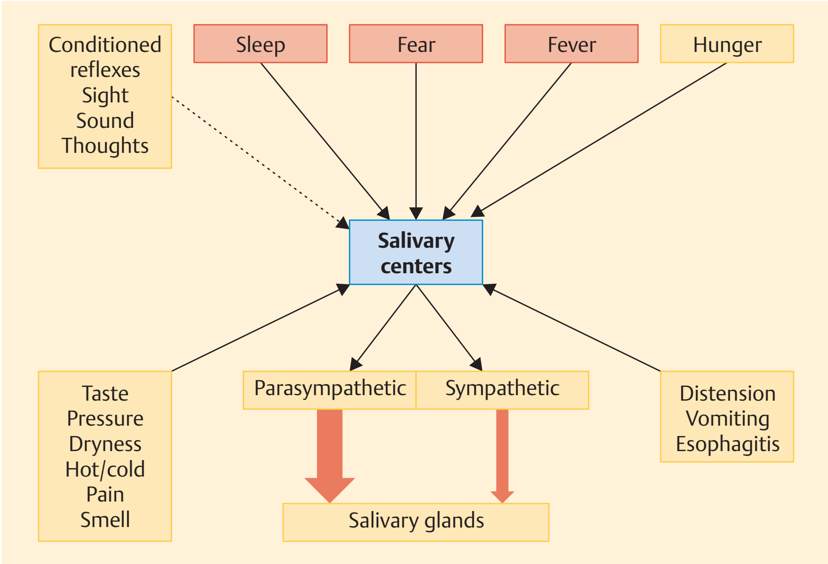

Fig. 2.2 Input to salivary centers. (Text in red boxes indicates inhibitory influences.)

capacity; remineralizes the enamel of the teeth; cleanses the oral cavity; carries out antimicrobial actions; stimulates wound healing; dissolves tastants; aids in the maintenance of the taste buds; makes chewing, bolus formation, and swallowing possible; and breaks down food chemically through the activity of enzymes, notably amylase and lipase.

The action of the saliva is not restricted to the oral cavity. It also protects the upper respiratory tract from infections and the esophagus from regurgitated gastric acid; in addition, mechanical and chemical damage to the esophageal and gastric mucosa can be repaired by the action of salivary growth-promoting factors. Amylase and lipase continue to act in the stomach—in the case of amylase, until acid has penetrated the food bolus. In addition to its protective and digestive functions, saliva is also necessary for articulate speech.

Needless to say, saliva is also part of the pleasures of life, and is required for kissing. In some species, saliva is involved in thermoregulation.[4–6]

> **!** The protective and digestive functions of saliva are not restricted just to the mouth.

Spontaneous and Reflex Secretion

Secretion is an active, energy-dependent process. Mucin-rich saliva is secreted spontaneously at a low rate from the minor glands. During the night, they secrete without exogenous influences, while when they are at rest during daytime, a neural reflex drive in these glands, and in the submandibular glands in particular, to mucosal dryness and low-grade mechanical stimulation causes resting secretion ("unstimulated secretion"). Intermittently, as a consequence of eating, the submandibular gland and the parotid gland in particular secrete large volumes of watery saliva ("stimulated secretion"). Although the relative contribution made by the minor glands to total saliva production (1–2 L per 24 hours) is small (5%–10%), it prevents the sensation of oral dryness.[7,8]

> **!** The minor glands secrete mucin-rich saliva day and night and prevent the feeling of having a dry mouth.

Stimulus for Reflex Secretion

Taste—pleasant and unpleasant—evokes a rich flow of saliva, exemplified by the effect of citric acid (**Fig. 2.2**). If pleasant, taste initiates the cephalic phase of acid secretion in the stomach. Chewing evokes secretion by stimulating mechanoreceptors that are sensitive to the stretching of the periodontal ligaments and to pressure applied to the gingival mucosa. Pain maintains secretion—e.g., due to aphthous ulceration. Thermal stimuli are also important, with both hot food and ice causing salivation. The flow rate is higher in response to liquids served cold than to those at room temperature. Mucosal dryness is yet another stimulus. Pleasant odors associated with food activate olfactory receptors via nasal flow during inspiration or via retronasal air flow from the oropharynx and the oral cavity, causing the submandibular glands to secrete. Strongly irritating odors also trigger a parotid