Saliva Composition and Function: A review.

Karthikeyan Murthykumar
2nd year BDS, Saveetha Dental College and Hospitals, Chennai, India.

Abstract
The aim of this study was to perform a literature review about the composition and functions of saliva as well as describe the factors that influence salivary flow (SF) and its biochemical composition. Saliva represents an increasingly useful auxiliary means of diagnosis. Sialometry and sialochemistry are used to diagnose systemic illnesses, monitoring general health, and as an indicator of risk for diseases creating a close relation between oral and systemic health. This review provides fundamental information about the salivary system in terms of normal values for SF and composition and a comprehensive review of the factors that affect this important system. Since many oral and systemic conditions manifest themselves as changes in the flow and composition of saliva the dental practitioner is advised to remain up-to-date with the current literature on the subject.

Keywords: Saliva, salivary glands, salivary proteins, lysozyme, lactoferrin

Introduction
Salivary fluid is an exocrine secretion consisting of approximately 99% water, containing a variety of electrolytes (sodium, potassium, calcium, chloride, magnesium, bicarbonate, phosphate) and proteins, represented by enzymes, immunoglobulins and other antimicrobial factors, mucosal glycoproteins, traces of albumin and some polypeptides and oligopeptides of importance to oral health. There are also glucose and nitrogenous products, such as urea and ammonia. The components interact and are responsible for the various functions attributed to saliva.

Saliva Functions and Composition

Taste
The SF initially formed inside the acini is isotonic with respect to plasma. However, as it runs through the network of ducts, it becomes hypotonic. The hypotonicity of saliva (low levels of glucose, sodium, chloride, and urea) and its capacity to provide the dissolution of substances allows the gustatory buds to perceive different flavors. Gustin, a salivary protein, appears to be necessary for the growth and maturation of these buds.

Buffer Capacity
Saliva behaves as a buffer system to protect the mouth as follows:
1. It prevents colonization by potentially pathogenic microorganisms by denying them optimization of environmental conditions.
2. Saliva buffers (neutralizes) and cleans the acids produced by acidogenic microorganisms, thus, preventing enamel demineralization. It is important to emphasize biofilm thickness,
and the number of bacteria present determines the efficacy of salivary buffer (4)

**Protection and Lubrication**

Saliva forms a seromucosal covering that lubricates and protects the oral tissues against irritating agents.(10,12) This occurs due to mucins (proteins with high carbohydrate content) responsible for lubrication, protection against dehydration, and maintenance of salivary viscoelasticity. They also selectively modulate the adhesion of microorganisms to the oral tissue surfaces, which contributes to the control of bacterial and fungal colonization. In addition, they protect these tissues against proteolytic attacks by microorganisms. Mastication, speech, and deglutition are aided by the lubricant effects of these proteins.(1,4,11,12,14-16)

**Dilution and Cleaning**

Sugars in their free form are present in total stimulated and unstimulated saliva at a mean concentration of 0.5 to 1 mg/100mL.(3,17) High concentrations of sugar in saliva mainly occur after the intake of food and drink.(3,17) It is known there is a correlation between the glucose concentration in the blood and salivary fluid, particularly in diabetics, but because this is not always significant, saliva is not used as a means of monitoring blood sugar.

**Integrity of Tooth Enamel**

Saliva plays a fundamental role in maintaining the physical-chemical integrity of tooth enamel by modulating remineralization and demineralization. The main factors controlling the stability of enamel hydroxyapatite are the active concentrations free of calcium, phosphate, and fluoride in solution and the salivary pH.(18,19)

**Digestion**

Saliva is responsible for the initial digestion of starch, favoring the formation of the food bolus.(9,8) This action occurs mainly by the presence of the digestive enzyme α-amylase (ptyalin) in the composition of the saliva. Its biological function is to divide the starch into maltose, maltotriose, and dextrins. This enzyme is considered to be a good indicator of properly functioning salivary glands,(20) contributing 40% to 50% of the total salivary protein produced by the glands. The greater part of this enzyme (80%) is synthesized in the parotids and the remainder in the submandibular glands. Its action is inactivated in the acid portions of the gastrointestinal tract and is consequently limited to the mouth.

**Tissue Repair**

A tissue repair function is attributed to saliva since clinically the bleeding time of oral tissues appears to be shorter than other tissues. When saliva is experimentally mixed with blood, the coagulation time can be greatly accelerated (although the resulting clot is less solid than normal). Experimental studies in mice have shown wound contraction is significantly increased in the presence of saliva due to the epidermal growth factor it contains which is produced by the submandibular glands.

**Factors Influencing Salivary Flow and Composition**

Several factors may influence SF and its composition. As a result, these vary greatly among individuals and in the same individual under different circumstances.(3,17,6,23,24)

**Individual Hydration**

The degree of individual hydration is the most important factor that interferes in salivary secretion. (23) When the body water content is reduced by 8%, SF virtually diminishes to zero, whereas hyperhydration causes an increase in SF.(6) During dehydration, the salivary glands cease secretion to conserve water.(25)
Body Posture, Lighting, and Smoking
SF varies in accordance with body posture, lighting conditions, and smoking. Patients kept standing up or lying down present higher and lower SF, respectively, than seated patients. There is a decrease of 30% to 40% in SF of people that are blindfolded or in the dark. However, the flow is not less in blind people, when compared with people with normal vision. This suggests that blind people adapt to the lack of light that enters through the eyes. Olfactive stimulation and smoking cause a temporary increase in unstimulated SF.(6) Men that smoke present significantly higher stimulated SF than non-smoking men.(26) The irritating effect of tobacco increases glandular excretion,(27) and nicotine causes severe morphologic and functional alterations in the salivary glands.

Regular Stimulation of Salivary Flow
Although there is evidence regular stimulation of SF with the use of chewing gum leads to an increase in stimulated SF, further studies are required to explain whether this stimulation increases unstimulated SF.(6)

Size of Salivary Glands and Body Weight
Stimulated SF is directly related to the size of the salivary gland, contrary to unstimulated SF which does not depend on its size.(6) Unstimulated SF appears to be independent of body weight: (23) on the other hand, obese boys present significantly lower salivary amylase concentration in comparison with controls. (28)

Salivary Flow Index
The main factor affecting salivary composition is the flow index(11,6) which varies in accordance with the type, intensity, and duration of the stimulus.(17,21,8) As the SF increases, the concentrations of total protein, sodium, calcium, chloride, and bicarbonate as well as the pH increases to various levels, whereas the concentrations of inorganic phosphate and magnesium diminish.(3,11) Mechanical or chemical stimulus is associated with increased salivary secretion. The action of chewing something tasteless itself stimulates salivation but to a lesser degree than the tasty stimulation caused by citric acid.(6) Acid substances are considered potent gustatory stimuli.(23)

Contributions of Different Salivary Glands
Other factors that influence total salivary composition are the relative contribution of the different salivary glands and the type of secretion.(17,6) The percentage of contribution by the glands during unstimulated SF is as follows:
• 20% by the parotid glands
• 65%-70% submandibular glands
• 7% to 8% sublingual glands
• <10% by the minor salivary glands
When SF is stimulated, there is an alteration in the percentage of contribution of each gland with the parotids contributing over 50% of the total salivary secretion.(3,4,18,21,29) The salivary secretions may be serous, mucous, or mixed. Serous secretions, produced mainly by the parotids, are rich in ions and enzymes. Mucous secretions are rich in mucins (glycoproteins) and present little or no enzymatic activity. They are produced mainly by the smaller glands. In the mixed glands, such as the submandibular and sublingual glands, the salivary content depends on the proportion between the serous and mucous cells.(2,11,9,8)
Medications
Many classes of drugs, particularly those that have anticholinergic action (antidepressants, anxiolytics, antipsychotics, antihistaminics, and antihypertensives), may cause reduction in SF and alter its composition.(6,10,30,31)

Thinking of Food and Visual Stimulation
Thinking of food or looking at food are weak salivation stimuli in humans. It may seem that people salivate simply because of thinking of food, but in reality they become more conscious of the saliva in the floor of the mouth between swallows. Some researchers observed a small increase in SF in the face of visual stimuli, while others observed no effect whatever.(6)

Alcohol
The intake of a single high dose of ethanol causes a significant reduction of stimulated SF. This diminishment results from the altered release of total proteins and amylase as well as in diminished release of electrolytes.(20) Rats exposed to ethanol for a prolonged period showed significant reduction in salivary secretion and diminished release of proteins.(32)

Systemic Diseases and Nutrition
In some chronic diseases such as: pancreatitis, diabetes mellitus, renal insufficiency, anorexia, bulimia, and celiac disease, the amylase level is high.(2) Alterations in the psycho-emotional state may alter the biochemical composition of saliva. Depression is accompanied by diminished salivary proteins.(33) Nutritional deficiencies may also influence salivary function and composition.(4,18)

Fasting and Nausea
Although short-term fasting reduces SF it does not lead to hyposalivation, and the flow is restored to normal values immediately after the fasting period ends.(18) Stimulated SF increases when preceded by gustatory stimulation in less than one hour before saliva collection.(34) Saliva secretion increases before and during vomiting.(6)

Gender
The differences in salivary secretion between men and women have been attributed to two theories: women present smaller salivary glands in comparison with men and the female hormonal pattern may contribute to diminished salivary secretion.(35) However, menopause and hormone replacement therapy are not associated with salivary dysfunction of the parotid.(36) There were no significant differences with regard to SF between healthy pre- and post-menopausal women and between post-menopausal women under hormonal treatment and women that did not receive treatment.(37) little information available regarding SF in healthy elderly persons.(35)

Conclusion
Since several factors can influence salivary secretion and composition a precise standard for saliva collection must be established. Such a standard would make the test results obtained through sialometry and/or sialochemistry more helpful in characterizing the true functional state of the salivary glands which in turn would serve as indicators for a diagnosis when oral and/or systemic alterations are suspected.

References