# BIOCHEMISTRY - YEAR 2

## Saliva proteins

## Lecture No: 7

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# Objectives

At the end of this lecture we will understand the following points.

- Saliva proteins.
- Hyposalivation.
- Calcium binding proteins

## Saliva proteins

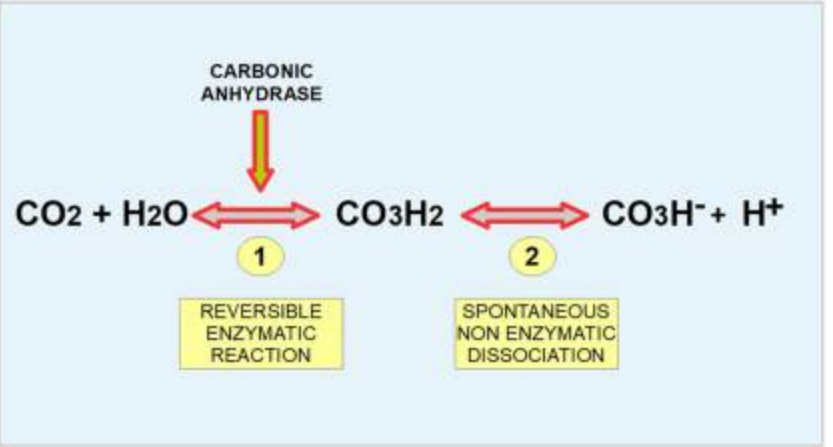
One milliliter of whole saliva contains between 1 and 2 mg of proteins and it is these proteins that give saliva its characteristic viscosity.

Almost all salivary proteins are glycoproteins, i.e. they contain variable amounts of carbohydrates linked to the protein core.

Saliva has a rich secretion of antimicrobial and immunomodulatory proteins, which contribute to mucosal lubrication and tissue coating, tooth remineralization, and buffering. They include histatins, proline-rich proteins (PRPs), statherins, carbonic anhydrases and other proteins.

## Saliva proteins

Carbonic anhydrase is a zinc-complexed enzyme found in tissues of all animal species and photosynthesizing organisms, in which it catalyzes the reversible hydration of carbon dioxide ($CO_2$). In solution, carbon dioxide exists in equilibrium with bicarbonate; however, the rate of conversion is extremely slow at physiologic pH. Carbonic anhydrase dramatically increases the speed of this reaction.



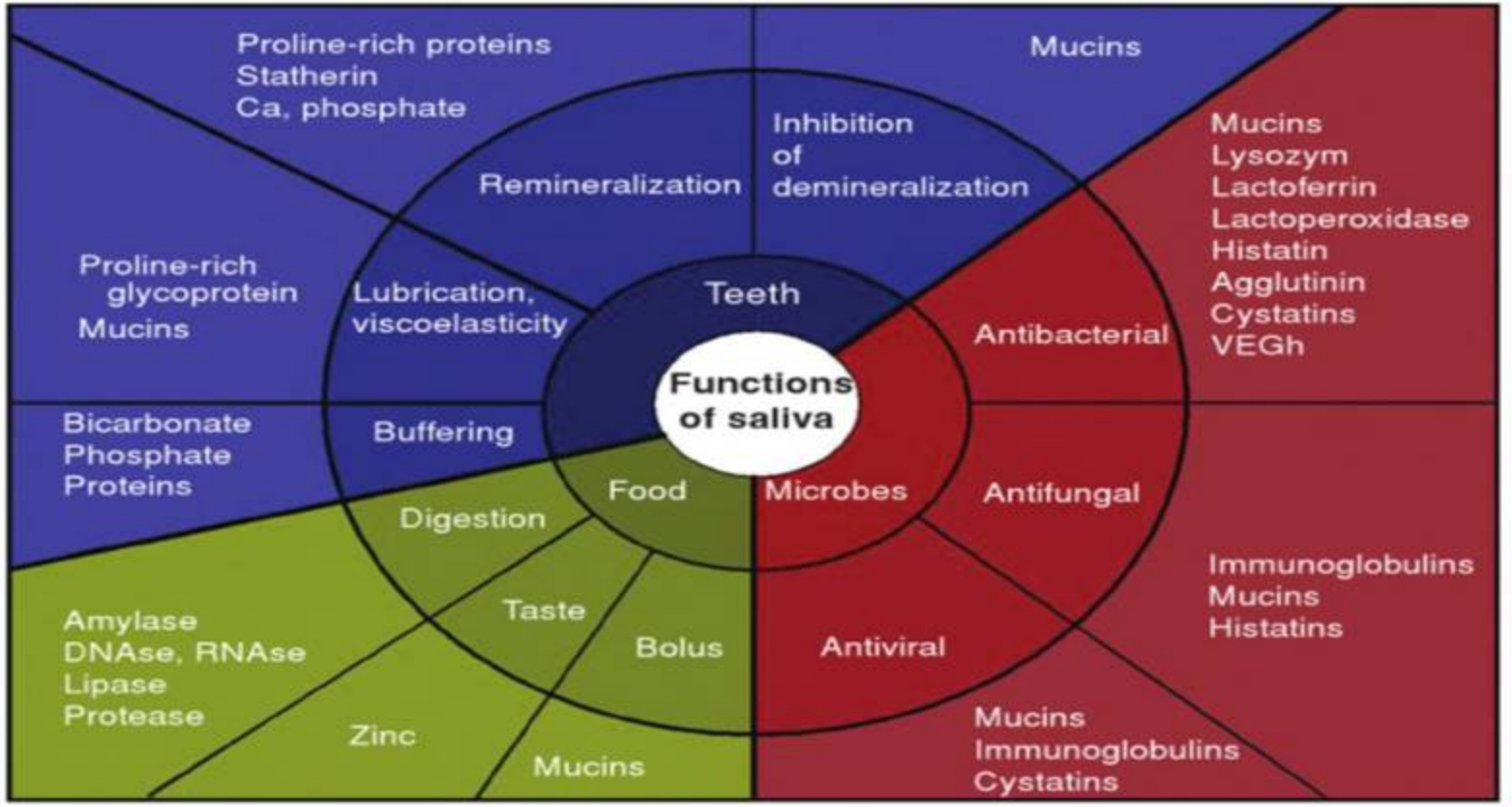
# Biochemistry - Year 2

- Saliva has several types of functions that are of profound importance for the oral health. In the absence of saliva, the teeth will rapidly decay in addition the oral mucosa will become vulnerable to bacterial, viral, and fungal infections. Thus patients with chronic dry mouth are prone to develop rampant caries. As a result of the diminished protection protein composition of saliva is more vulnerable to dental wear, due to the combined process of attrition, abrasion, and erosion as a result of the diminished protection of, in particular, the protein composition of saliva, and are more vulnerable for dental wear.

# Biochemistry - Year 2

Saliva protects the oral tissues in various ways. Upon stimulation, the cleansing action of the continuous flow of watery saliva clears the mouth of bacteria and food particles. Buffering proteins (in addition to bicarbonate and phosphate buffer systems) protect dental enamel against demineralization. Furthermore, saliva forms a lubricating protein film on the dental enamel (denoted pellicle) which prevents direct access of acids to the dental surface, and thus protects the enamel surfaces against erosion. Moreover, because of its lubricating properties, saliva reduces friction between tissue surfaces and diminishes mechanical wear.

# Biochemistry - Year 2




Ref: David T. Wong, Salivary Diagnostics, WILEY, 2008.

Figure: Overview of the relationship between the various functions of saliva and the salivary constituents involved. A number of salivary proteins participate in more than one function.

## Hyposalivation

It results in drying up of the oral epithelium tissues causing pain in the tongue epithelium with fissures. In the majority of patients, a dry mouth is caused by the use of xerogenic medication, for example, beta-blockers, sedatives, and antipsychotic medication.

Figure: Two tongues of patients with the Sjögren's syndrome showing dry epithelium with fissures caused by severe hyposalivation.

Ref: David T. Wong, Salivary Diagnostics, WILEY, 2008.

## Xerogenic medications

Include anticholinergic drugs, anorectics, antihistamines, antidepressants, antipsychotics, antihypertensives, diuretics, and antiparkinsonian drugs.

Salivary gland hypofunction is often an overlooked condition, and many patients who take xerogenic medications do not know that they are at risk for dental caries.

Acidic PRPs, which constitute as much as 25-30% of all proteins in saliva, from a complex group with a large number of genetic variants. Some of these can inhibit the spontaneous precipitation of calcium salts.

## Calcium binding proteins

Because human saliva is supersaturated with respect to most calcium phosphate salts, some proteins are needed to inhibit spontaneous precipitation of these salts in the salivary glands and their secretions. Such calcium binding proteins are statherin and proline-rich proteins (PRPs). These proteins are never absent from saliva. The resulting stable, but individually to a varying degree, supersaturated state of saliva with respect to calcium salts constitutes a protective and reparative environment, which is important for the integrity of the teeth.

**Cystatins** (cystein-containg phosphoproteins) are considered to be protective by inhibiting unwanted proteolysis. Cystatins in saliva and acquired pellicle inhibit selected bacterial proteases

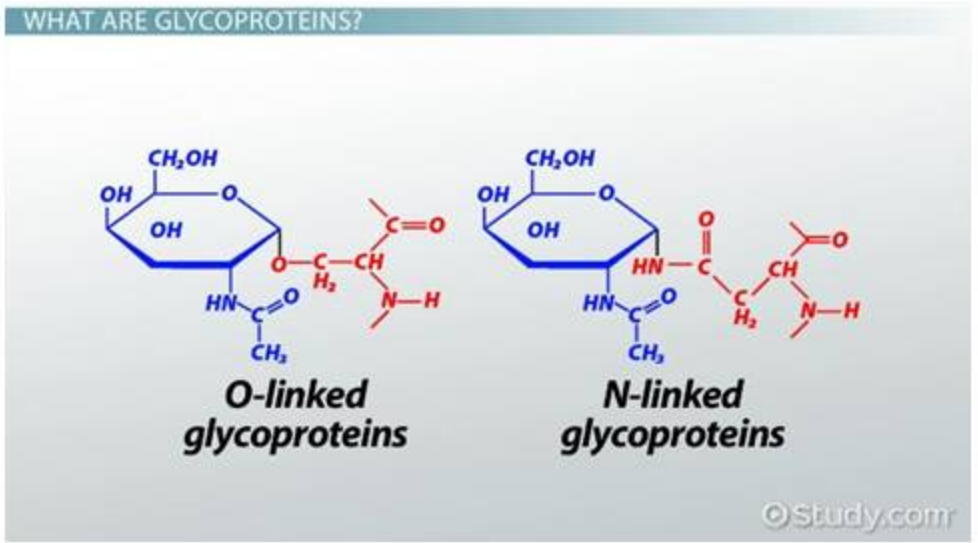
**Histatins:** Of the salivary antimicrobial peptides, histatins have a broad antimicrobial affects against bacteria as well as oral yeasts.

**Peroxidase** systems in human saliva comprise two enzymes, salivary gland derived peroxidase (SP) and myeloperoxidase (MP), together with thiocyanate ($SCN^-$) ions and hydrogen peroxide ($H_2O_2$). Thiocyanate is a filtrate from serum and most $H_2O_2$ originates from aerobic oral bacteria. Peroxidases catalyze the oxidation of $SCN^-$ by $H_2O_2$ to the antimicrobial component, hypothiocyanite ($OSCN^-$)

$$\xrightarrow{\text{SP and/or MP}}$$

$$H_2O_2 + SCN^- \rightarrow OSCN^- + H_2O$$

Serous glycoproteins: they have a much lower molecular weight than mucins and contain less than 50% carbohydrates. Man of them belong to a group called proline rich glycoproteins. These proteins are secreted from the glands. The collective name glycoprotein for all carbohydrate-linked proteins makes this group heterogeneous and large. The types of the linkage is as follow:



# The End

# Thank You All