


Saliva composition and function





Learning objectives

- ▶ What is saliva?
 - ▶ Secretion of saliva
 - ▶ Properties of saliva
 - ▶ Composition of saliva
 - ▶ Function of saliva
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What is Saliva?

- ▶ The term saliva refers to the mixed fluid in the mouth in contact with the teeth and oral mucosa, which is often called 'whole saliva' produced in humans and other animals.
- ▶ Saliva is an extracellular watery fluid and usually frothy substance.
- ▶ It is produced by the salivary glands that aids in the digestion of food.
- ▶ It serves as an aid to swallowing and digestion by moistening and softening food.

- Normally the daily production of whole saliva ranges from 0.75 to 1.5 liters.





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- It is secreted by salivary glands in the mouth.
- In humans, saliva is 99.5 % water plus electrolytes, mucus, white blood cells, epithelial cells (from which DNA can be extracted), enzymes (such as amylase and lipase), antimicrobial agents such as secretory IgA, and lysozymes.



Saliva secretion


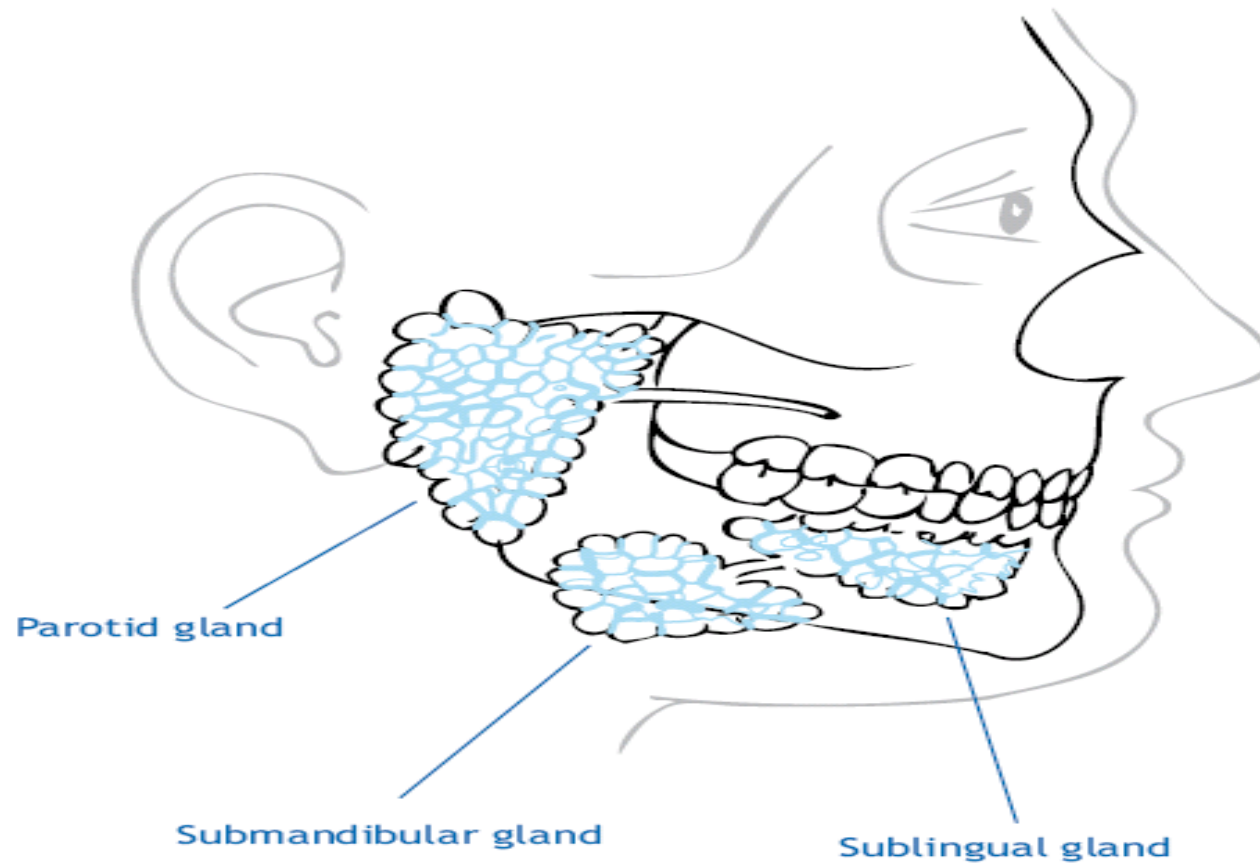
- It is basically the secretion of three pairs of glands.
 - ❖ Parotid – 20%
 - ❖ Submandibular– 70%
 - ❖ Sublingual – 5%
 - Remaining comes from small glands of mouth and pharynx – 5%
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Figure 1




Localisation of the three paired major salivary glands.



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- The basic secretory units of salivary glands are cluster of cells called an Acini . These cells secrete a fluid that contains water, electrolytes, mucus and enzymes, all of which flow out of the acinus into collecting ducts.

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- There are two types of secretions - serous and mucous.
 - The acini can either be serous, mucous, or a mixture of serous and mucous.

SEROUS

VERSUS

MUCOUS

Serous gland is a constituent of salivary glands, producing a solution with proteins in an isotonic watery fluid

Produces a thin, watery secretion, comprising zymogens, antibodies, and inorganic ions

Cells contain round, central nuclei

Cells contain dispersed chromatin

Stained in dark due to the presence of zymogens

Contain large, striated ducts

Involved in solubilizing dry food, maintaining oral hygiene, and initiating starch digestion

Mucous gland is a constituent of salivary glands, producing a slippery, aqueous secretion

Produces a thick, viscous secretion, comprising of mucin

Cells contain flattened nuclei against the basement membrane



Cells contain condensed chromatin

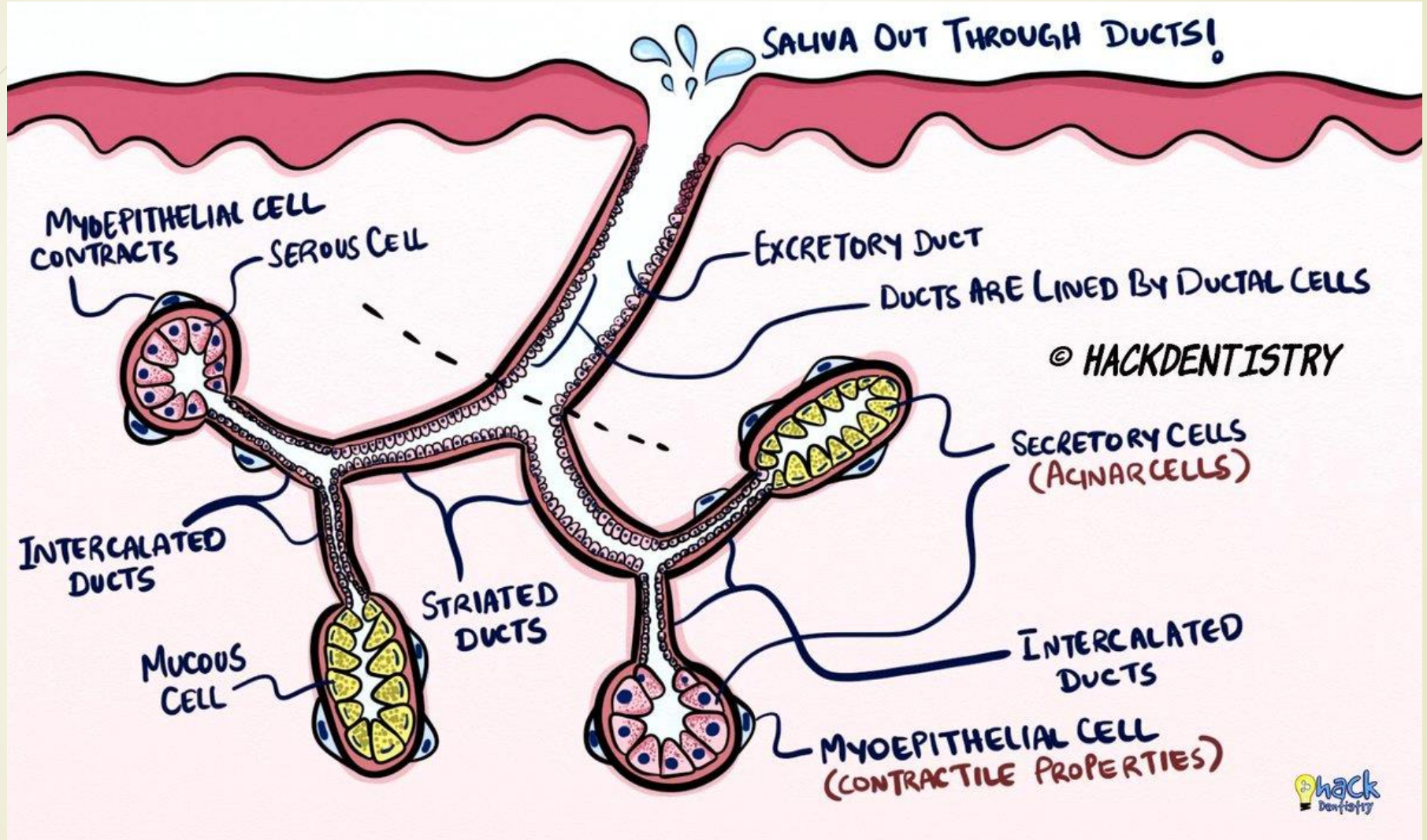
Stained in light due to the presence of mucin

Contain small, striated ducts

Involved in lubricating the oral cavity and making food into the slippery bolus

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- ▶ ACINUS is also known as ALVEOLUS/TERMINAL SECRETORY UNIT.
 - ▶ The arrangement of these cells are in small groups around a central globular cavity which is continuous with the lumen of the duct.
 - ▶ The fine duct draining each acini is called INTERCALATED DUCT.
 - ▶ Many intercalated ducts join to form STRIATED DUCTS / INTRALOBULAR DUCT.
 - ▶ Two or more intralobular ducts join to form INTERLOBULAR DUCTS/ Secretory duct, which unite to form main duct of the gland.



Properties



- ▶ Volume : there is production between 0.75 – 1.5 liter of saliva per day.
- ▶ Appearance: a clear colorless fluid.
- ▶ pH = 6.2 – 7.6.
- ▶ Specific gravity 1.002 -1.012 .
- In healthy, non-medicated persons, the unstimulated whole saliva flow rates 0.3 – 0.5 ml/min. and the stimulated whole saliva flow rates 1.0 – 1.5 ml/min.



► **The formation of saliva takes place in two stages:**

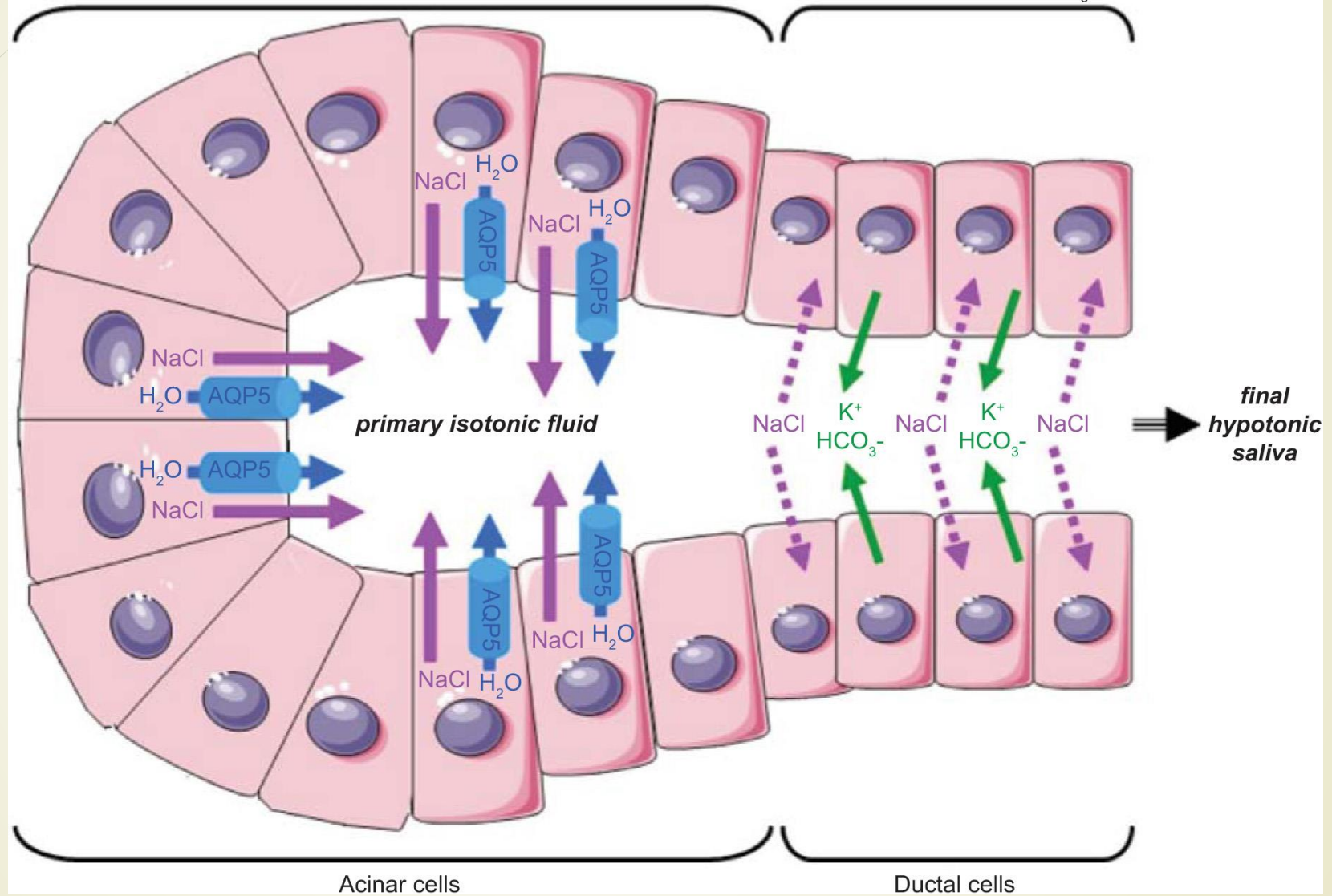
► *First stage*, the secretory acini produces an isotonic primary saliva with ionic composition is similar to that of plasma.

► *Second stage*, the primary saliva is modified as it passes through the duct system by selective reabsorption of Na^+ and Cl^- (but not water) and some secretion of K^+ and HCO_3^- .

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- The final saliva is secreted into the mouth. Thus, it becomes **hypotonic** with salt concentration below that of primary saliva.
 - Small ducts within salivary glands lead into larger ducts, eventually forming a single large duct that empties into the oral cavity.

First secretory step:
secretion of a primary isotonic fluid rich in NaCl

Second secretory step:
reabsorption of NaCl and
secretion of K^+ and HCO_3^-



Salivary Composition

- ▶ Normally saliva is composed of more than **99.5%** water and less than **0.5%** of solutes (such as electrolytes, enzymes, mucus, antibacterial compounds).



Organic Components of Saliva

such as:

Amylase

Lysozymes

Histatins

Secretory IgA

peroxidases

Lipase

Kallikrein

proline-rich protein

mucins

Statherin

Urea

Glucose

Vitamins

Free amino acids

Composition

saliva

Solids-0.5%

Water- 99.5%

Organic substances

Enzymes

Amylase(ptyalin)
Maltase
Lingual lipase
Lysozyme
Phosphatase
Carbonic anhydrase
kallikrein

Other organic substances

Mucin
Proline rich proteins
Lactoferrin
IgA
Blood group antigens
Free amino acids
Nonprotein nitrogenous
substances-
Urea,uric acid
creatinine,xanthine

Inorganic substances

sodium
Calcium
potassium
Bicarbonates
Bromide
Chloride
Fluoride
Phosphate

gases

Oxygen
Carbon dioxide
nitrogen



There are three major enzymes found in saliva.

- ❖ α-amylase :starts the digestion of starch before the food is even swallowed. It has a pH optima of 7.4.
- ❖ lingual lipase. Lingual lipase has a pH optimum ~4.0 so it is not activated until entering the acidic environment of the stomach.
- ❖ Antimicrobial enzymes that kill bacteria.
 - ❖ Lysozyme
 - ❖ Salivary lactoperoxidase
 - ❖ Lactoferrin
 - ❖ Immunoglobulin A
- ❖ Proline-rich proteins (function in enamel formation, Ca²⁺-binding, microbe killing and lubrication)



Mucins:

Mucins (**glycoproteins**) are essential components in human saliva. They lubricate the oral mucosa and give saliva its viscosity characteristic.

Lactoferrin:

It is an iron binding protein (it can deprive microorganisms from iron acting as playing an antimicrobial role).



Statherins:

It prevents the precipitation of calcium phosphate in saliva, maintaining a high calcium level in saliva available for remineralisation of tooth enamel and high phosphate levels for buffering.

Histatins:


A group of small histidine-rich proteins that have an **antimicrobial and antifungal** effect.

FUNCTIONS OF SALIVA





Lubrication and moistening

- ▶ This important function is due to the presence of mucin. During eating the salivary secretion is increased which moisten as well as dissolves the food. The moisten and masticated food is converted into semi solid form called bolus. The lubrication of the bolus by saliva greatly helps in swallowing of the bolus. The lubrication of the oral cavity also helps in talking.
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Digestion of polysaccharides

- ▶ Digestion of carbohydrate starts at the mouth. In mouth, food undergoes mastication. During mastication, food comes in contact with saliva (secreted by salivary gland). Saliva contains salivary amylase (ptyalin).
- ▶ The enzyme hydrolyzes α -(1-4) glycosidic bonds at random deep inside polysaccharide (starch, glycogen). Producing dextrins, maltose, maltotriose, glucose.
- ▶ It requires Cl^- ion for activation and pH 6.7.




Diluent and cooling effect

- ▶ Saliva dilutes the effect of acidic solutions or spicy foods.
 - ▶ Hot foods and drinks may be cooled in the mouth before they are swallowed.
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MOISTENING AND CLEANSING

- a) Saliva keeps the oral and pharyngeal mucosa moist. This helps in speech & swallowing.
 - b) Saliva helps to maintain oral hygiene. When salivation is suppressed (as during fever, post- operatively or as seen in mouth breathers), oral mucosa dry up. Dried mucosa sheds epithelium which harbors bacteria.
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SALIVA AS A SOLVENT:

- By bringing about dissolution of the food components the saliva stimulates the taste buds, this action stimulates appetite and greatly increased the further flow of saliva and also the gastric juice.
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EXCRETORY FUNCTION:

- ▶ Several substances like lead, mercury iodides, alkaloids like morphine, urea, uric acid, ammonia are excreted in the saliva. The excretion of these substances by salivary gland has promoted its test to be used for medicolegal purposes.




Role in regulating water content in body:

- Since saliva contains 99.5% water and daily secretion of saliva is 1 liter or more, decrease in body water content decreases salivary secretion and results in thirst sensation.



Buffering function:

- Saliva contains bicarbonate, phosphate, proteins, etc. They act as buffers to keep the salivary pH within the normal limits. Decreased pH predisposes to caries whereas increase in pH will be responsible for tartar material and destroys the gingival margin.
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- ▶ **IMPORTANCE:** The buffering action of saliva helps to keep the pH of the oral fluids within a range , optimum for activity of salivary amylase.
- ▶ pH of oral fluids is also critical for survival of the bacterial flora of the mouth and influences the development of dental caries.




Deiodination

- ▶ Salivary glands deiodinate thyroid hormone and thus take part in the regulation of the blood level of this hormone.
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Esophageal clearing

- The saliva play an important role in clearing and neutralizing the esophagus of any refluxed acidic gastric secretions.
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Vitamin absorption

- Saliva contain a glycoprotein **haptocorrin** that aids in vitamin B12 absorption.




ANTIOXIDANT :

- Antioxidant defense mechanism is exerted by uric acid and ascorbic acid .
 - Profound amount is secreted by the parotid during meal times.
 - This helps in reducing oxidant stress and maintain oral integrity.
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Maintenance of tooth integrity

- Demineralization occurs when enamel disintegrates due to the presence of acid. When this occurs, the buffering capacity effect of saliva (increases saliva flow rate) inhibits demineralisation.
 - Saliva can then begin to promote the remineralisation of the tooth by strengthening the enamel with calcium and phosphate minerals.
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ANTIBACTERIAL :

- ▶ The acinar cells secrete peroxidase and ductal cells secrete thiocyanate which establishes bactericidal system of saliva.
- ▶ Peroxidase in presence of hydrogenperoxidase and thiocyanate catalyses the formation of hypothiocyanate which is inhibitory to bacteria.
- ▶ Lysozyme hydrolyzes the bacterial cell wall resulting in cell lysis.



Antibacterial effect

Saliva contains various types of antibacterial agents which suppress bacterial growth.

Immune response

Immunoglobulins in saliva, notably IgA and IgG, initiate the host defense mechanism when challenged by oral bacteria such as mutans streptococci.



Learning Resources

1. Lecture note
2. Mushtaq biochemistry-vol 1

