

THE UNSUNG HERO OF HEALTH: THE MIRACULOUS PROPERTIES OF HUMAN SALIVA

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Abstract

Saliva is a complex fluid produced by the salivary glands. It is the secretion of the salivary glands and constitutes one of the largest secretions of the human body. It maintains the integrity of the mouth's soft and hard tissues and constitutes one of the main natural defence systems of the oral cavity. Saliva consists of varied organic and inorganic components and its secretion is influenced by sympathetic and parasympathetic stimulation. Saliva also contains hormones, antibodies, growth factors, enzymes, microbes and their products. Many of these constituents enter saliva through blood via passive diffusion, active transport or extracellular ultrafiltration. Therefore, saliva can be seen in many cases as a reflection of the physiological function of the body. It is a clinically informative, biological fluid (biofluid) useful for novel approaches to prognosis, laboratory or clinical diagnosis, and monitoring and management of patients with both oral and systemic diseases. This review article aims to elaborate on and discuss the enzymes in saliva. Newer advancements and technologies have enabled saliva to be a diagnostic biomarker. We also enumerated a list of enzymes present in saliva and their function as a short review for the first time in the literature here, thereby contributing our work to researchers to gain knowledge and encourage them to carry out further studies in the field of salivary enzymes.

Keyword: *Saliva, Salivary amylase, Oral Mucosa, Morning Saliva, Wound Healing*

1. INTRODUCTION

Oral mucosa is the moist (mucous) membrane covering the mouth (oral cavity), including the gums. It stretches from the lips, where it is continuous with the skin covering the lips, to the pharynx, a part of the throat behind the mouth. It's made up of specialized epithelial tissue that serves as a protective barrier.

Salivary glands are located within and around oral mucosa and these are specialized glands in the mouth that produce and secrete saliva. There are three main pairs of major salivary glands: the parotid glands, submandibular glands, and sublingual glands. These glands are responsible for producing the bulk of saliva in the mouth. Saliva is the secretion of the salivary gland located within and around oral mucosa and constitutes one of the largest secretions of the human body. It is an extracellular fluid produced and secreted by salivary glands in the mouth. It is composed of water, mucus, proteins, mineral salts and amylase. Many of these constituents enter saliva through blood via passive diffusion, active transport or extracellular ultrafiltration. Therefore, saliva can be seen in many cases as a reflection of the physiological function of the body.

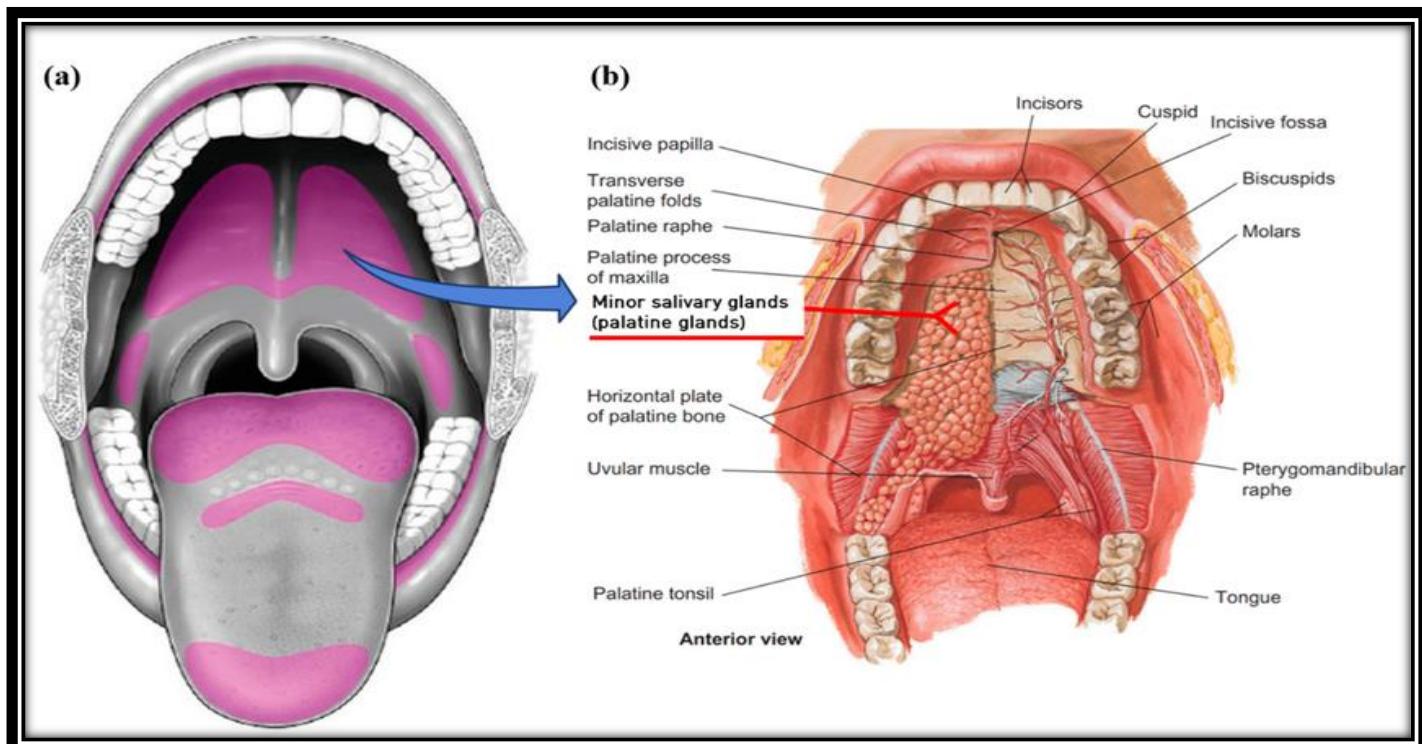


Figure 1. Oral Mucosa

Structure and Function of Oral Mucosa

The oral cavity is surrounded by the lips and is composed of two separate regions, the vestibule, the area between the cheeks, teeth, and lips, and the oral cavity proper. The oral cavity proper is mostly filled with the tongue and bounded anteriorly and on the sides by the alveolar processes containing the teeth and posteriorly by the isthmus of the fauces. Anteriorly, the roof forms by the hard palate and posteriorly by the soft palate. The uvula hangs downwards from the soft palate. The mylohyoid muscles constitute the floor of the oral cavity proper. A mucous membrane known as the oral mucosa is composed of stratified squamous epithelium and forms the inner lining of the mouth. Several submandibular and sublingual salivary glands secrete viscous and mucoid fluid to lubricate and keep the oral cavity moist. The mouth not only plays a vital role in the initial intake and digestion of food and water but also is essential for the formation of speech and normal respiration. The teeth, which are the chief structures of the oral cavity, tear and grind ingested food into pieces small enough for digestion. The tongue enables the digestion of food through compressing and pressing food against the palates; this leads to the formation of

the food bolus subsequently swallowed down the oesophagus. The tongue also functions to provide the perception of taste to humans as it contains various papillae on its dorsal surface that serve as taste buds. Moreover, the tongue is the most important articulator of speech, as it manipulates itself against the teeth and palate to form words. The palate serves as a mechanical barrier separating the oral cavity from the nasal respiratory tract, also enabling simultaneous breathing and food intake.

Composition of Saliva

Saliva is a clear liquid that is made up of water, electrolytes and organic compounds. The composition of saliva includes:

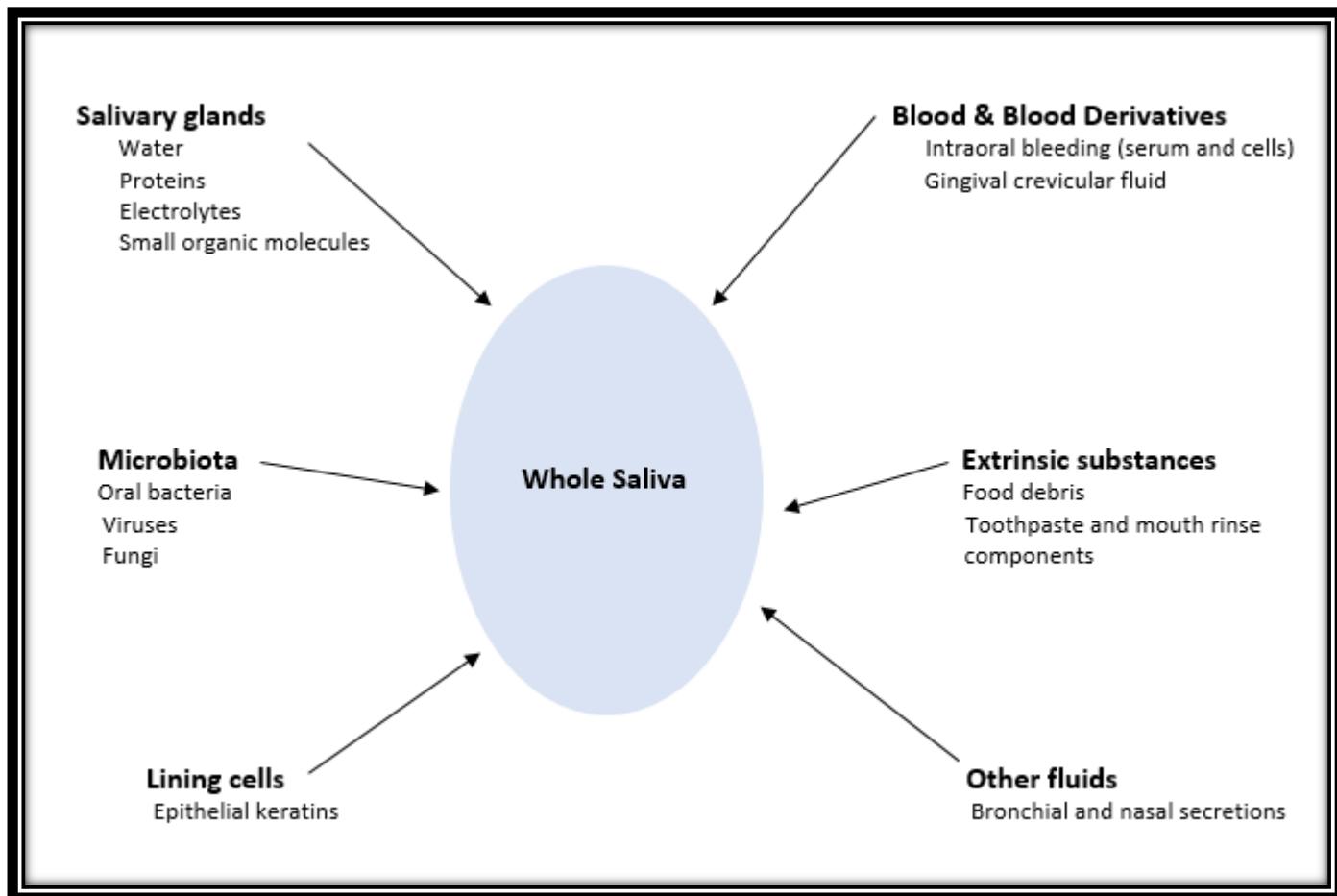
Water: The main component of saliva, making up about 99% of its volume.

Electrolytes: Includes ions like sodium, potassium, calcium, chloride and more.

Proteins: Large, complex molecules that help protect oral tissues. **Enzymes:** Salivary enzymes can be classified as amylases, lipases, and lysozymes. **Immunoglobulins:** Antibodies that help to fight bacteria.

Mucins: Organic Compounds that help to protect oral tissues.

Organic Compounds: Includes urea, ammonia, uric acid, glucose, cholesterol, fatty acids, steroid hormones, and amino acids.



2. SALIVA SECRETION

The mechanism of saliva secretion is the same in all salivary glands, although the composition and volume of saliva produced vary widely. Multiple ion and water channels, exchangers, and transporter proteins act in a coordinated manner to produce and secrete saliva. The secretion process is controlled by parasympathetic nerves which release acetylcholine that binds to muscarinic receptors on the acinar cell membrane. Stimulation of the receptors results in increased intracellular Ca^{2+} , which drives electrolytes into intercalated ducts, followed by water. Salivary glands are also innervated by sympathetic nerves, which release noradrenaline that binds to adrenergic receptors and promotes the secretion of salivary

proteins. Minor salivary glands are innervated by parasympathetic nerve fibres.

3. FUNCTION OF SALIVA

Saliva serves several important functions in the mouth and digestive system:

- Preparation of food for swallowing.
- Appreciation of taste.
- Digestive functions.
- Cleansing and protective functions.
- Excretory function.
- Regulation of body temperature.
- Regulation of water balance.

Classification of Salivary Enzyme

Saliva contains several enzymes that help with digestion and protection against infection.

- **Salivary amylase:** Breaks down starch into maltose and glucose, which helps the stomach digest food. *The parotid gland produces most of the salivary amylase.*
- **Lingual lipase:** Breaks down fats.
- **Lysozyme:** Disintegrates bacteria and prevents the overgrowth of oral bacteria.
- **Peroxidase:** Protects host cells and proteins from hydrogen peroxide, which can be damaging.
- **Mucin:** A lubricant secreted in mucous secretions.

Benefits of Saliva

Saliva offers several important benefits to the body, beyond just helping with digestion. Here are some of the key functions:

- **Aids Digestion:** Saliva contains enzymes like amylase that begin breaking down starches in food as soon as you start chewing, aiding in the digestion process.
- **Keeps the Mouth Moist:** It helps keep your mouth moist, which is essential for speaking, swallowing, and tasting.
- **Cleanses the Mouth:** Saliva helps wash away food particles and neutralize acids in the mouth, which can reduce the risk of tooth decay and gum disease.
- **Protects Teeth:** Saliva contains calcium, phosphate, and fluoride, which can help remineralize teeth and protect against cavities.
- **Antibacterial Properties:** Saliva has antimicrobial enzymes and proteins that help control harmful bacteria and prevent infections in the mouth and throat.
- **Helps with Speech:** Saliva helps keep the tissues in the mouth lubricated, making it easier to speak clearly.
- **Wound Healing:** Some studies suggest that saliva may play a role in the healing of minor cuts or injuries inside the mouth.

- **Taste Perception:** Saliva dissolves food molecules, making it easier for taste buds to detect flavours.

Pharmacological Activities of Saliva

Saliva is not only important for mechanical and chemical digestion, but it also has several pharmacological activities due to the various bioactive compounds it contains. These activities can have beneficial effects on health, including antimicrobial properties, wound healing, and even potential roles in drug delivery. Here are some of the key pharmacological activities of saliva:

1. Antimicrobial Properties

- **Enzymes like lysozyme:** These enzymes help break down bacterial cell walls, reducing the growth of harmful bacteria in the mouth.
- **Defences:** Saliva contains antimicrobial peptides that can inhibit the growth of bacteria, fungi, and viruses.
- **IgA (Immunoglobulin A):** This antibody plays a crucial role in immune defence by neutralizing pathogens before they can cause infections.

2. Wound Healing

- **Growth factors:** Saliva contains various growth factors, such as epidermal growth factor (EGF), which help promote tissue repair and wound healing in the oral cavity and even in other parts of the body when applied topically.
- **Regeneration:** Some studies suggest that saliva has regenerative effects, particularly on minor injuries in the mouth and gums, by stimulating cell growth and repair.

3. Pain Relief

- **Opioid peptides:** Small amounts of natural opioid peptides, like encephalins, are found in saliva, and these can have mild analgesic effects. They are thought to help reduce pain and inflammation in the mouth or throat.

4. Anti-inflammatory Effects

- **Cytokines and other proteins:** Saliva contains various proteins that have anti-inflammatory effects, helping to modulate the immune response and reduce inflammation in the oral mucosa.

5. Digestive Enzymes

- **Amylase and lipase:** These enzymes start the breakdown of carbohydrates and fats right in the mouth, aiding in digestion and also influencing how certain drugs or nutrients are absorbed in the gastrointestinal tract.

6. Drug Delivery

- **Saliva as a medium for drug delivery:** Due to its fluidic nature, researchers have explored saliva as a non-invasive route for drug delivery. Saliva can be used to absorb certain medications or biomarkers, making it a potential medium for diagnostics or therapeutics.
- **Nanotechnology:** Advances in drug delivery systems may also use saliva as a medium for transporting Nano-sized drugs for specific treatments, reducing side effects associated with oral medications.

7. Diagnostic Potential

- **Biomarkers in saliva:** Saliva contains various biomarkers that can reflect the state of systemic health. These markers are being explored for diagnostic purposes, such as in the early detection of diseases like diabetes, cancer, or even neurodegenerative conditions.

8. Hormonal and Neurotransmitter Regulation

- Saliva contains small amounts of hormones like cortisol, and neurotransmitters, and can reflect changes in the body's physiological state. These markers may also play a role in how the body reacts to stress and inflammation.

Effects of Morning Saliva and Evening Saliva on the Human Body

Morning Saliva

Morning saliva tends to be more acidic, with a lower pH, which can be due to dehydration or the fact that body hasn't had a chance to flush out acids overnight. The pH usually ranges from about 6 to 7, but it can be a bit more acidic in the morning. Benefits of morning saliva are:

- **Cleansing Effect:** While asleep, body works to repair itself, and the morning saliva helps in cleaning out any leftover food particles and bacteria from mouth. It's like a natural oral cleanser.

- **Digestive Aid:** Saliva contains enzymes like amylase, which helps start the breakdown of food. So, even before eaten, the saliva is already preparing digestive system to break down carbs.
- **Helps Protect Teeth:** Despite being slightly acidic in the morning, saliva plays a key role in remineralizing teeth. It helps to neutralize acids and provides essential minerals like calcium and phosphate to keep enamel strong.
- **Hydration & Protection:** Saliva keeps mouth moist, preventing it from feeling too dry. It also acts as a barrier to protect mouth and throat from harmful bacteria and pathogens.

Evening Saliva

Evening saliva tends to have a more neutral pH compared to morning saliva. It usually falls around a pH of 6.5 to 7.5, though it can fluctuate slightly depending on factors like diet or overall health. As for the benefits of evening saliva:

- **Neutralization of Acids:** After eating throughout the day, especially if consumed acidic foods or drinks (like citrus or coffee), mouth may become more acidic. Saliva helps to neutralize these acids, protecting teeth from enamel erosion and reducing the risk of cavities.
- **Oral Health:** Evening saliva can still assist in remineralizing teeth. The enzymes, minerals, and proteins in saliva continue to protect teeth and gums, even after a day of eating and drinking.
- **Hydration:** At night, more likely to experience dry mouth due to reduced saliva production while sleeping. But in the evening before sleep, saliva helps to keep mouth moist and hydrated, which can reduce the chances of discomfort or irritation as body sleep.
- **Digestive Support:** Similar to morning saliva, evening saliva also contains enzymes like amylase, which help break down food. By the evening, the digestive process has already begun, and saliva continues to aid in digesting any food remnants.

4. CONCLUSION

In conclusion, saliva plays a vital role in maintaining oral health and supporting the digestive process. It not only helps in lubricating food for easier swallowing but also contains enzymes like amylase and lipase that begin the breakdown of starches and fats in the mouth. Saliva's antimicrobial properties help protect against harmful bacteria, while its buffering capacity maintains a balanced pH in the mouth, preventing tooth decay and promoting oral hygiene. Additionally, the hydration it provides ensures that the tissues in the mouth remain healthy, making saliva essential for overall well-being. The functions and benefits of saliva and its enzymes underscore their importance in both digestion and oral health..

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