

Saliva - Miracle Fluid

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Abstract

Saliva is dynamic secretion that maintains the oral health by its several chemical and physical properties. At all the times, throughout day and night saliva is fit into its function either during resting or active state. Its importance on oral and systemic health is recognized only during xerostomia conditions. Either defects in the chemical composition or the salivary flow rate, the deficiency in the salivary characters is reflected on the oral and systemic health of the individual. Saliva was given a little importance in the research field till the recent past wherein lot much has been learnt through various research studies on saliva in several local and systemic conditions. Even though saliva could be considered as a supplementary fluid in the diagnosis of several diseases, but the importance of the same can not be neglected.

Introduction

Saliva has been an interesting fluid in the field of medicine since the ancient times dating back to several centuries. In olden days there was a belief that the salivary smell and thickness is a representative of wellness of the body [1].

Since the 18th century when saliva was used to assess the organic contents, the digestive influences in the 19th century to the modern diagnostic application with highly sensitive techniques in the recent dates have made saliva a more reliable fluid in diagnosis [2].

Saliva, its physiology [3,4,5,6,7,8]

- Saliva is an enzymatic fluid secreted by the salivary gland cells known as acinar cells. Two kinds of

specialized acinar cells exist, the serous and mucous cells secrete the serous and mucous secretions. The serous secretion is proteinaceous in nature and has enzymatic, antimicrobial, calcium-binding property [9,10,11].

- Mucous cells are predominant secretory cell type of the sublingual gland & most of minor salivary glands and also occur in submandibular glands.
- Their secretion consists of large amount of *mucins* which helps in lubrication, effective barrier against the aggregation of microorganisms [3,4,12].
- Continuous slow secreting minor glands, have an important role in protecting and moistening oral mucosa, especially when major salivary glands are mostly inactive. Their secretions are rich in mucin, antibacterial proteins and secretory immunoglobulin [10,11].

The secretory units open into a small duct called the intercalated duct. These ducts join to form larger striated ducts and finally empty into a larger excretory duct [5,6].

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Ductal modification of saliva-

- Net reabsorption of Na⁺ and Cl⁻ by luminal & basolateral membranes-hypotonic final saliva.
- Secretion of K⁺ and HCO₃⁻.
- Flow rate is directly related to Na⁺, Cl⁻ and HCO₃⁻ in saliva. And inversely related to K⁺ [4,5,6,7]

Composition of saliva- [4,5,6,7]

- Water: 94 to 99.5%
- Solids: 0.5 to 0.6%

Organic contents-

- Glycoproteins
- Enzymes: α- amylase
 - Lysozyme
 - Lactoperoxidase
 - Kallikrein
 - Esterase
 - Acid phosphatase
- Mucins
- Lactoferrin
- Blood clotting factors
- Hormones - Parotien
- Secretory Immunoglobulin-IgA, IgG and IgM.

Inorganic Substances

- Sodium
- Calcium
- Chloride
- Bicarbonate
- Phosphate
- Potassium

Trace elements

- Fluoride
- Magnesium
- Iodides
- Thyocyanate

Functions of saliva [4,5,6,7,8,9,10,11]

1. Protection

Mechanical washing action

- Flushes away non-adherent bacterial and cellular debris from the mouth.
- Clearance of sugars from the mouth, limits their availability to acidogenic plaque microorganisms.

Lubricant: (mucin)

- Protects the lining mucosa by forming a barrier against noxious stimuli, microbial toxins and minor trauma.
- Allows the oral surface to move one another with minimal friction during function.

2. Buffer

- Is mediated by bicarbonates, phosphates, and some salivary proteins. Metabolism of salivary proteins and peptides produce ammonia and urea which help in increase of pH.
- Buffers the acid produced by plaque microorganism.

3. Pellicle formation

- Salivary proteins bind to surface of the teeth and oral mucosa, thus forming *salivary pellicle*. This forms the binding site for bacteria along with the carbohydrate starch resulting in *plaque* formation.

4. Maintenance of tooth integrity: [7, 9,11]

- Saliva is saturated with Ca⁺ & PO₄⁺: acidic protein rich proteins & statherin
- High concentration of these ions ensures that ionic exchange with the tooth surface results in post eruptive enamel maturation, increase in surface hardness, and decrease in permeability and increase in resistance to demineralization.
- Helps in remineralization of initial caries.

5. Antimicrobial action: [7,8,9,11]

- Lysozyme is an enzyme that can hydrolyse the cell wall of some bacteria.
- Lactoferrin binds free iron & so deprives bacteria of this essential element.
- Secretory antibodies present in saliva (IgA) has the capacity to agglutinate microorganisms that are swallowed and prevent their agglutination to oral tissue.

- Mucin and specific agglutinins help to aggregate microorganisms.

6. Tissue repair: [5,6,8,9]

- Experiments have shown that wound healing is faster & wound contraction is also increased in the presence of saliva. Supplemented with the antimicrobial property, saliva helps the oral wounds to heal considerably well.

7. Digestion

- The liquid nature of saliva helps forming the food bolus and prepares the food for deglutition.
- Breaks down starch through enzyme salivary Amylase
- Lipases, partially breakdown the fat content in food
- Dilutes gastric chime when saliva is ingested along with the bolus. [5,6,7]

8. Taste

- Saliva is required to dissolve substance to be tasted and carry them to the taste buds.
- It also contains a protein called *gustin* that is thought to be necessary for growth & maturation of the taste buds which is thought to be secreted by circumvallate papillae. [5,6,7]

9. Salivary anticaries activity

- Clearance of carbohydrate and microbial from the oral cavity.
- Buffering action neutralizes the acids.
- Remineralization of incipient carious lesion through $-Ca^+$, PO_4^{4-} , Fl^-
- Increase enamel resistance to acid decalcification through Fl^-
- Salivary urea and bicarbonate can increase rate of glycolysis, thus leading to faster carbohydrate metabolism, which in turn leads to reduced duration of the enamel exposure to critical pH levels. [8,9,11]

Saliva as a diagnostic fluid

Blood and serum occupy the centre stage in the diagnosis of various diseases, but the effectiveness of saliva in the same regards has been neglected.

Saliva being considered as the ultrafiltrate of plasma, does contain many of the vital elements in minor quantities as to that of blood. The assessment of these microelements could be of definite diagnostic significance in many of the systemic and local diseases. The variations in the salivary flow rate and the viscosity factor of saliva have already gained a lot importance in the diagnosis of certain diseases pertaining to the functional deficiency of the salivary glands, example; Sjogren's syndrome. [10,12]

Similarly in the recent decade, many researches have been carried out on considering saliva as a supplement to blood and serum in diagnosing various other diseases. Many suggest that saliva could be of much importance in assessing the enzymes and certain hormone levels.[10, 12, 13]

Advantages of using saliva as a diagnostic fluid - [1, 2, 13,]

1. Saliva collection is totally a non-invasive technique.
2. Simple chair side collection is satisfactory
3. Minimal instruments are required
4. No special trained technician is required
5. No pain or discomfort experienced by the patient
6. Any number of collection could be done if required
7. Less expensive, economically feasible and affordable
8. Low risk of contamination and disease transfer to either patient or the operator

Saliva collection can be done depending upon the requirement in either of the two types; resting saliva or stimulated saliva collection. A special fluid, gingival crevicular fluid could be collected using a capillary tube by suction method in assessing the gingival and periodontal diseases. [1,2,12,13]

Proteins of diagnostic importance in saliva

Salivary proteins can be of much help even though they are present in minor amounts. The two-dimensional gel electrophoresis coupled with mass spectrometry tests has been able to reveal several proteins in saliva, about 120 proteins 35 specific salivary and 67 common serum proteins.[1,2]

Hormones and their applications in saliva

Many of the hormones and enzymes have been identified which are of clinical and diagnostic importance in the recent past. Hormone levels to the

likes of estrogen and luteinizing hormone and also the sialic acid and glycoaminoglycans are found to be elevated during menstrual periods compared to that of pre-ovulatory and post-ovulatory periods. [14,15]

Dental caries and saliva [9, 10, 11, 16,17,18]

The viscosity property of saliva has been known to influence the incidence of dental caries since long time. Higher the viscosity higher will be the rate of occurrence of dental caries. As well a similar caries increase is noticeable in cases with xerostomia. [9,10]

It has been reported from several studies that the salivary pH and buffering capacities in children with early childhood caries are found in decreased levels compared to children without. [16,17,18]

Studies regarding the salivary IgA levels are conflicting. Few studies are of the opinion that the salivary IgA levels are increased in the early stages of the children affected with caries and others report that sIgA has no correlation between the children with and without caries and further other stating to show decreased salivary IgA levels. [16, 18,19]

Saliva in gastro intestinal diseases

Identification of IgG antibodies in saliva is a moderately accurate, sensitive method for the detection of *Helicobacter pylori* infection in gastritis and could be considered as a test prior to endoscopy. This could be used as a screening test for seroepidemiological studies. Possibly this test could also be applied in peptic ulcer and gastric carcinoma for detection of *H.Pilori* in saliva. [20,21]

Chemicals assessment in saliva

Certain chemicals once into the systemic circulation can be found excreted in saliva in minor quantities. Chemicals, as in systemic poisoning, alcohol consumption and certain systemic drugs are excreted in good quantities and hence their levels could be of importance. [2,13]

The studies in patients with oral lichen planus have found the nitric oxide levels increased in saliva. It has been established through several researches that the nitric oxide is produced by the induction effect of nitric oxide synthetase enzyme originally described in macrophages. Hence the nitric oxide production could be expressed in higher levels in inflammatory conditions including oral lichen planus and recurrent aphthous ulcer. Also as oral lichen

planus is associated with stress in several of the cases it is of the fact that involvement of the neuronal and immunological interaction in the etiopathogenesis of lichen planus would indicate the release of nitric oxide in elevated levels. And hence the expression of nitric oxide in saliva in these patients may have pathophysiological implications for erosive and ulcerative lesions in oral lichen planus. [22,23]

Saliva in forensic sciences

Saliva has found its place in the forensic applications as it has been used in ascertaining several crime cases or physical or sexual abuse cases, where in the criminal or the culprit would leave stains or fresh salivary secretions in and around the crime scene. Utilizing the available amount of saliva in such cases has been used to identify the individual either a culprit or a victim through the DNA tests. Fresh saliva in these conditions are much favorable than the dried stains.[24,25]

Lipid profile assessment in saliva

Studies on the lipid profiles in saliva have shown a moderate levels of correlation between serum and salivary total cholesterol, High density lipoprotein-cholesterol, Low density lipoprotein-cholesterol and triglycerides. [26,27]

Saliva as a bio-marker

The recent advanced sensitive amplification tests like PCR, RT-PCR, Q-PCR, high density oligonucleotide micro-assay has made the usage of saliva as a diagnostic probe for rapid detection of oral biomarkers. The development of micro and nano technology has made the diagnostic application of saliva much feasible.[1]

For example; assessment of m-RNA in saliva of the oral squamous cell carcinoma patients, and detection of viral antigens as in HIV patients are gaining high attention in the recent past.[1]

The salivary levels of the total protein, total sugar, protein-bound sialic acid, and free sialic acid were significantly higher in oral cancer patients with squamous cell carcinoma compared to that of normal individuals. [28,29]

Saliva could also harbor various other bio-markers of a distant disease; like that of a breast cancer. Measuring the values of the bio-markers can also be of significance in the post therapeutic

stages as an indicator in the prognosis of the disease.^{1,2}

Conclusion

Saliva, probably the neglected fluid secretion of human system in the past has now been found to harbor more valuable information both in physiological and pathological conditions. Even though the components are less in quantity compared to that of serum, their assessments are of definite significance in the diagnostic applications. Beginning with the simple tests such as physical and chemical compositions to the recent advanced diagnostic methods like micro-array, RT-PCR, mass spectrometry and nano-scale analysis, more light is thrown into the details of use of saliva to a larger extent than ever believed. Owing to its vital components, saliva can be used a reliable diagnostic tool in future.

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