Research Article

Salivary pH as a Diagnostic Marker of Oral Health Status

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ABSTRACT

Saliva contains a lot of host defense factors. Wide arrays of studies have been done to find exact correlation of salivary markers with oral health status. With a multitude of biomarkers, the salivary pH may be tried to be used as a quick chairside test for determining the oral health status. The aim of this study was to analyze the pH of saliva and determine its relevance to the oral health status. The study population consisted of 60 patients. They were divided into two groups of 30 patients each: Group A had clinically healthy gingiva, Group B who had grade –III calculus and generalized chronic periodontitis. The randomized unstimulated saliva from each patient was collected and pH was tested. Data was analyzed statistically using analysis of variance technique. The salivary pH was more acidic for patients with grade –III calculus and generalized chronic periodontitis as compared with the control group (P = 0.001). These results indicate a significant change in the pH depending on the oral hygiene status and severity of the periodontal condition. The salivary pH shows significant changes and thus relevance to the oral hygiene status and severity of periodontal disease. Salivary pH may thus be used as a quick chairside diagnostic biomarker of oral health status.

Keywords: Saliva/physiology, hydrogen-ion concentration, periodontitis, oral health status.

INTRODUCTION

Oral diseases such as dental caries, gingivits, periodontitis and oral malodor are always initiated at the interface between microbial ecosystem and host tissue. Changes in microbial and environmental dynamics in microbial ecosystems may increase the potential for pathogenicity within a microbial ecosystem and subsequently initiate and promote oral diseases. These successional changes have recently and tentatively been referred to by Marshas the ecological plaque hypothesis. [1] Hence, the properties of the environment determine, which microorganisms can occupy which site while the metabolic activities of those microbial communities subsequently modify the properties of the environment.[1] It is known that oral diseases are predominantly associated with Gram-negative anaerobic organisms and that, before destructive periodontal diseases are initiated, these microorganisms must colonize tooth surfaces at and just below thegingival margin. [2, 3] Strong evidence exists to consider for the association of the following micro organisms with periodontal disease: Campylobacter rectus, Eubacterium nodatum, Fusobacterium nucleatum, Prevotella intermedia/nigrescens, Peptostreptococcus micros, Streptococcus intermedius-complex, Treponema denticola and spirochetes. Eikenella corrodens, Staphylococcus and yeasts associated with human immunodeficiency virus periodontitis and peri-implantitis have shown weak association.[4] A study by Takahashi et al.[5, 6] on the effect of pH on the growth of microorganisms showed that P. gingivalis grows at a pH of 6.5-7.0, P. intermedia grows at a pH of 5.0-7.0 and F. nucleatum grows at a pH of 5.5-7.0. The diagnosis of active phases of periodontitis and the identification of patients at risk for active disease represents a challenge for clinicians. Clinical parameters including probing depth, attachment level, bleeding on probing plaque index (PI) and radiographic loss of alveolar bone are used to assess disease severity.[7] Occasionally, monitoring of the microbial infection [8] and analysis of the host response in gingival crevicular fluid (GCF) are utilized in an attempt to identify individuals at risk for future breakdown.[9, 10] Use of saliva as a diagnostic fluid meets the demands for being inexpensive, non-invasive and easy-to-use diagnostic methods.[11] As a clinical tool, saliva has many advantages over serum, including ease of collection, storing and it can be obtained at low cost in sufficient quantities for analysis.[12] Physical parameters like salivary pH, buffering capacity, flow rate, viscosity and chemical assays like salivary hormones, antibodies and tumor markers are gaining importance in the diagnosis of many systemic disorders. Saliva can be collected in different forms - a) resting or unstimulated whole saliva, b) stimulated whole saliva, c) glandular saliva (mainly parotid) - with or without stimulation, sub-mandibular/sub-lingual saliva, d) palatine saliva. Whole saliva is composed of secretions from salivary gland as well as from GCF, desquamated epithelial cells, microorganisms and leukocytes. Normal whole saliva secretion varies between 800- 1500 ml / day or 1.0 to 3.0 ml / minute with a pH in the range of 6-7 for unstimulated whole saliva.[12] This study is aimed at evaluating the pH of saliva, determine its relevance to the oral health status and thus evaluate its suitability as a diagnostic marker of disease.

MATERIALS AND METHODS

Study population

The study was conducted in the out-patient department of Department of Periodontology Vivekananda dental college for women, Elayampalayam, Tiruchengode. The study population consisted of 60 patients within the age group of 20-45 years. Group A had 30 subjects of who had clinically healthy gingiva, Group B had 30 patients who had generalized chronic periodontitis. All patients were verbally explained the nature of the study and an informed written consent was obtained (as per Helsinki declaration).

Patients with history of systemic diseases or conditions that may adversely affect the oral health or the composition of saliva were excluded from the study. The exclusion criteria for the study were:

- Patients who were completely edentulous were not selected for the study
- Smoking, malocclusion, mouth breathing and local pathologic factors conducive to induction of periodontal disease
- Patients with history of diabetes, kidney disease, cancer, fungal or respiratory infections
- Patients giving history of hospitalization or intake of medications in a period of 6 months
- Patients with current or past habit of tobacco smoking or chewing.

Gingival and periodontal findings were recorded for each patient. Control group included patients with clinically healthy gingiva with a probing depth of up to 3 mm. The test groups included patients with generalized chronic gingivitis as evidenced with inflammation of the gingival without loss of attachment. They were selected based on the National Institute of Dental Research criteria – gingival inflammation index (bleeding index).[14]

0 = No bleeding.

1 = Bleeding after the probe is placed in the gingival sulcus up to 2 mm and drawn along the inner surface of the gingival sulcus.

The criteria for periodontitis were based on loss of attachment with pocket depth of ≥ 5 mm in at least 30% sites.

Saliva sampling

Saliva was collected as per the protocol is derived from the World Health Organization/International Agency for Research on Cancer guideline "Common Minimal Technical Standards and Protocols." [15] Saliva samples were obtained in the morning after an overnight fast, during which subjects were requested not to drink any beverages except water. The subjects were given drinking water (bottled) and asked to rinse their mouth out well (without drinking water). 5 min after this oral rinse, the subject was asked to spit whole saliva. The subjects were asked to refrain from talking and drop down the head and let the saliva run naturally to the front of the mouth. The subjects were also asked not to cough up mucus as saliva is collected. The subjects spit into the collection tube about once a minute for up to 10 min. 5 ml of saliva was collected in sterile 10 ml beakers. The salivary sample was collected between 9:00 am and 11:00 am. The pH of the saliva was immediately measured in order to prevent any deterioration of the sample.

Salivary analysis

Salivary pH was measured with the help of colour coded pH strips (as shown in Figure 1). Salivary pH was analyzed with the pH guide. (Figure 2)

Figure 1: Colour coded pH strips

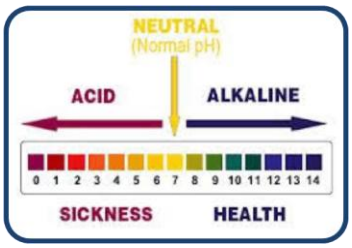


Figure 2: Colour indicators

Statistical analysis

The mean and standard pH for all the two groups was calculated. The P value was calculated by one-way analysis of variance using SPSS software and was considered statistically significant if P value was < 0.05.

RESULTS

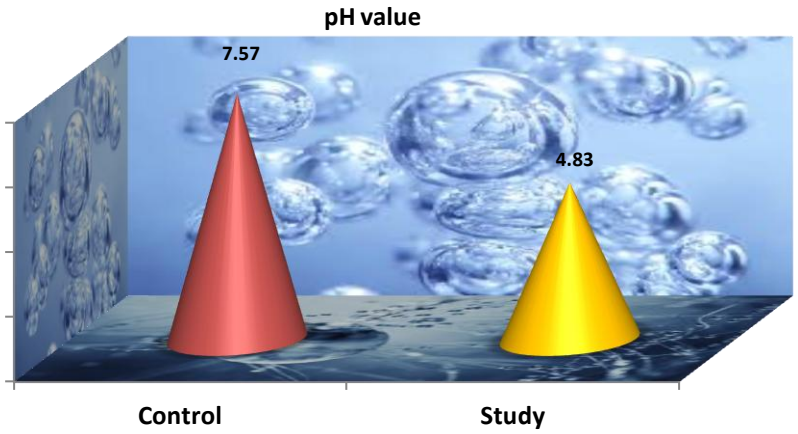
We compared the mean salivary pH of the generalized chronic periodontitis patients and healthy controls. As shown in Table 1, the average pH for the population with clinically healthy gingiva was 7.57 ± 0.50. The average pH of the group having chronic generalized periodontitis was 4.83 ± 1.02. It was found that the pH of saliva from population having chronic generalized periodontitis comparatively had a more acidic pH of saliva than the clinically healthy group (P < 0.001**) [Table 1, Graph 1].

DISCUSSION

Saliva is a complex fluid, over 99% being made up of water. Apart from secretions of all the glands it also contains desquamated oral epithelial cells, microorganisms and their products, leucocytes, serum constituents, fluid from gingival crevice and food remnants.

Table 1: Distribution of salivary pH among the control and the study group

		N	Min	Max	Mean	SD	t	p
pH VALUE	Control	30	7	8	7.57	0.50	13.16	< 0.001**
	Study	30	3	6	4.83	1.02		
Group Total		60	3	8	6.20	1.59		



Graph 1: Graphical representation of pH Value among the Control and Study group

The concentrations of dissolved solids (organic and inorganic) are characterized by wide variation, both between individuals and within a single individual. Of the approximately 750 ml of saliva secreted daily, submandibular glands[1] account for 60%, parotid for about 30% and sublingual glands for 5% or less. About 7% of saliva is derived from minor salivary glands.[16] The saliva that basically forms the environment of the oral cavity is the resting or pooled saliva. Saliva has a pH normal range of 6.2-7.6 with 6.7 being the average pH. Resting pH of mouth does not fall below 6.3. In the oral cavity, the pH is maintained near neutrality (6.7-7.3) by saliva. The saliva contributes to maintenance of the pH by two mechanisms. First, the flow of saliva eliminates carbohydrates that could be metabolized by bacteria and removes acids produced by bacteria. Second, acidity from drinks and foods, as well as from bacterial activity, is neutralized by the buffering activity of saliva. Inflammation of the gingival tissue results in gingivitis, which if not resolved leads to inflammation of the periodontium called as periodontitis.[18]

The induction and progression of periodontal tissue destruction is a complex process involving plaque accumulation, release of bacterial substances and host inflammatory response. It is characterized by pocket formation and bone loss. Pockets are caused by microorganisms and their products, which produce pathologic tissue changes that lead to deepening of the gingival sulcus. The saliva that basically forms the environment of the oral cavity is the resting or pooled saliva. Henskens et al.[19] evaluated the effect of periodontal treatment on the protein composition of whole and parotid saliva. Significant changes in salivary protein composition including that of albumin occurred only in whole saliva, after treatment. The gingival sulcus contains a fluid that seeps into it from the gingival connective tissue through the thin sulcular epithelium and is called as GCF. Thus, it is contributory to the pH of saliva. For this reason, unstimulated whole saliva was collected from the subjects. A saliva pH of 7.0 usually indicates a healthy dental and periodontal situation. At this pH, there is a low incidence of dental decay combined and little or no calculus. Therefore, stable conditions should basically be found in this environment. A saliva pH below 7.0 usually indicates acidemia (abnormal acidity of the blood). If a chronic condition exists, the mouth is more susceptible to dental decay, halitosis and periodontitis. Chronic acidemia can be a causative factor for a multitude of diseases affecting the whole body. A saliva pH above 7.0 usually indicates alkalinity. Excessive alkalinity can bring about the same anaerobic conditions as acidemia, but it is much rarer condition. Plaque bacteria take calcium compounds in the environment and use the minerals to protect them from the high pH. The two key factors to plaque formation are first there must be oral bacteria to attack food particles and elevate the pH. Second the pH must elevate above 7.6 to grow dental plaque crystals that cause periodontal disease.

CONCLUSION

Saliva is a fluid that can be easily collected, contains locally-derived and systemically derived markers of periodontal disease and hence may offer the basis for a

patient specific diagnostic test for periodontitis. Salivary pH in patients with chronic generalized periodontitis was more acidic than the control group. Changes in the environmental dynamics may increase the potential for pathogenicity within a microbial ecosystem and subsequently initiate and promote oral diseases. Salivary pH may be used as a quick chair side diagnostic biomarker.

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