Age Related Changes of Human Salivary Electrolytes in Children between Deciduous and Mixed Dentition.

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ABSTRACT

Human saliva plays a vital role in maintaining the integrity of oral tissues and its composition changes during childhood due to maturation of the salivary glands thus indicating the need of age-matched controls for the clinical use of saliva as a diagnostic tool for diseases. Thus this study aims at analyzing physiologic variability of naturally occurring electrolytes in unstimulated whole saliva of children as a function of age. For this study unstimulated whole saliva specimens were collected from 20 healthy children equally divided into: Deciduous dentition (3 - 5 years) 5 males and 5 females and Mixed dentition (6 - 11) 5 males and 5 females. The samples were studied for estimation of electrolytes by inductively coupled plasma emission spectrometer. The electrolytes detected in this study were sodium, potassium, calcium and chlorine showing linear increase with age from deciduous to mixed dentition with potassium concentration highest in the mixed dentition group. Thus this study establishes a correlation between age and salivary composition. Hence constructing a comprehensive catalogue which is physiologic for salivary electrolytes with newer biochemical aids is necessary for saliva to serve as a diagnostic aid.
Keywords: *age, saliva, electrolytes, healthy individuals*.

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INTRODUCTION

The role of saliva is much broader and it can also serve as a diagnostic tool for monitoring health and disease status of an individual [1]. Sialochemistry will play an increasingly important role in the early detection, the monitoring and progression of the systemic and oral diseases and serve as a tearless diagnostic tool. For saliva to play a role as a diagnostic aid it is necessary to examine the consequences of pre-analytical physiologic variations with respect to age. But for this approach to succeed we must understand the basic concept of salivary composition and the role of its constituents.

Saliva is composed of organic, inorganic contents and macromolecules. Salivary composition changes during childhood due to maturation of salivary glands. Thus for saliva to serve as a diagnostic aid there is a need for age-matched controls with physiologic levels of salivary electrolytes established for particular age groups [2].

There are only few studies on salivary composition of healthy children are available [3]. Thus this study aims at analyzing physiologic variability of naturally occurring trace elements in unstimulated whole saliva of children as a function of age.

MATERIAL AND METHODS

Criteria for patient selection

In the present study, 20 normal healthy children ranging from 3 to 11 years were selected from housing societies in and around Pimpri - Chinchwad area of Pune district who were free from any systemic or local diseases which affect salivary secretions and totally caries free with dmft/DMFT score of 0 [4]. After assessing and confirming their caries status these children were stratified equally into three dentition groups: Primary (10 children; 5 male and 5 female ranging from 3-5 years) and Mixed (10 children; 5 male and 5 female ranging from 6-11years). Exclusion criteria included patients who were physical or mentally compromised, having developmental delay, auditory or visual dysfunction, known neurological diseases, history of drug intake and patients with arrested carious lesions [5]. Informed consent forms were obtained from the custodial parent or guardian of the subject after explaining the procedure to the parent or guardian.

Method of saliva collection

To minimize the effect of circadian rhythms, all whole saliva samples were collected one hour after lunch for the unstimulated condition [3]. The child was seated in a well-ventilated and well-lit room. The head was kept at 45 degrees flexion with one hand holding onto a 4ml cryoprecipitation vial with a funnel inserted into it, in a calm atmosphere to simulate unstimulated conditions. The saliva was allowed to drip into the funnel held to the lower lip. For each trial, the collection continued for 2 minutes but if the saliva sample was insufficient within 2 minutes, the collection was continued until 2 ml of saliva per subject was obtained [5].

Methods of laboratory analysis

For detection of electrolytes in saliva, the saliva samples obtained from each subject were diluted with distilled water in a proportion of 1:4. This diluted saliva sample was then subjected to inductively coupled plasma emission spectroscopy. The basic aim of analytical atomic spectroscopy is to identify elements and quantify their concentrations in various media [6]. The instrument used was Varian Vista Pro with detection limits of 1 ppm for each element. Mass spectrometry (MS) is an analytical technique used for determining masses of particles of ions which gives the elemental composition of that ion for elucidating the molecular masses of molecules, as atomic mass units and hence their molecular structures.

RESULTS

On subjecting the salivary samples to laboratory diagnosis the following results were obtained sodium, potassium, chloride and calcium were detected in salivary samples of both age groups as their concentration levels were more than 1ppm.

Comparing between the primary, mixed dentition groups, sodium, chloride and calcium levels showed a linear decrease in concentration from primary to mixed dentition age groups. Salivary potassium concentration was highest among all the elements in both age groups which is in correlation with our previous study. There was no statistically significant difference in the electrolytes detected in unstimulated whole saliva of children in both the dentition groups.

Table 1: Levels of electrolytes detected in deciduous and mixed dentition.

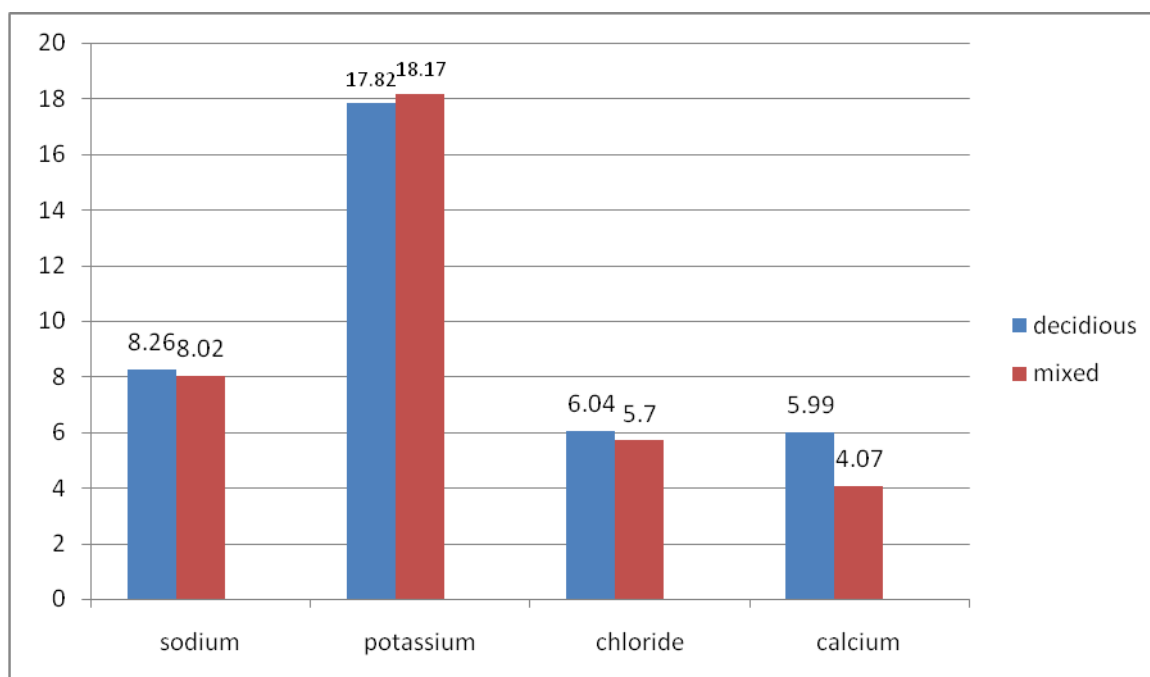|	Deciduous	mixed
Sodium	8.26	8.02
Potassium	17.82	18.17
Chloride	6.04	5.70
Calcium	5.99	4.07

Figure 1: Levels of electrolytes detected in deciduous and mixed dentition.

DISCUSSION

The inorganic contents of whole saliva were analysed in this study. A number of physiological factors influence the composition of whole saliva. These are, the source of saliva, the method of collection and the degree of stimulation. Because it is difficult to use a collecting device with children un-stimulated whole saliva was collected in this research. The time of saliva collection is also important. In this study saliva was collected during acrophase as salivary flow rate peaks during afternoon time [3]. The elements detected in this study were, sodium, potassium, calcium and chloride as their concentration in whole saliva of children of both age groups was more than 1 ppm.

The potassium concentrations in this study show a linear increase from one dentition to the next. The reason for this still needs to be postulated. However it has been reported by Hala Fathallah Benghasheer et al [7] that there is an inverse relationship between caries experience and salivary potassium concentrations, which also coincides with the study carried out by Abou El-Yazeed et al [8] in 2009. While studies by Hell[9] , Dodds et al[10],and Kargul et al[3], who reported a positive correlation between K and dental caries and While Zahir & Sarkar [11] found no significant variation in K levels between caries and caries free groups. However, Shashikiran et al [12] study, who investigated K concentrations in sound and carious enamel of extracted primary and permanent teeth. The results of their study showed that the concentrations of K were significantly higher in sound enamel of primary and permanent teeth than in carious enamel of primary and permanent teeth, suggesting that the higher concentrations of K along with other investigated

elements could be one of the reasons for non cariousness in primary and permanent teeth. It would likely seem that K had a modifying effect on tooth resistance to dental caries by altering the solubility of enamel. Since Losee& Ludwig [13] suggested that the receptivity of the enamel apatite lattice to variety of salivary elements facilitates their incorporation into the enamel. Furthermore, they suggested that such reactions occur mainly in the outer layers of the enamel where the substitution of new elements can influence the enamel solubility by increasing the crystallinity and thereby reducing the overall surface area available for the action of acids. However a definite correlation cannot be deduced.

Also salivary potassium levels can be used to detect function of aldosterone hormone in the body along with kidney disorders [14].

An overview of values showed a linear decrease in calcium concentration from primary to mixed dentition age groups .Calcium is one of the efficient buffers for regulating the body fluids unlike phosphates which are more resistant to depression of plaque pH towards the critical pH[15]. Thus calcium was chosen for analysis. Moreover, It has been proved that an inverse relationship exists between salivary calcium concentration and dental caries however ,the results of this study are indicative of increased caries susceptibility in mixed dentition.

Kavanagh and Svelha [16] postulated that a key salivary parameter to consider in terms of remineralization is the extent of variations in calcium concentration .While phosphate levels in resting saliva do not vary markedly, large fluctuations in calcium concentrations occur in one individual. A lower calcium concentration results in a lower thermodynamic driving force for hydroxyapatite precipitation at normal oral pH, a higher driving force for hydroxyapatite dissolution at low pH, and a higher critical pH than normal value of 5-5.3. In this study the salivary calcium concentration in lower in mixed dentition than primary dentition which points toward the fact of increased caries risk , however in our previous study [17] it has been proven that calcium content increases in permanent dentition, thus correlating higher caries incidence in children than adults [18].

The sodium and chloride concentrations also showed linear decrease in mixed dentition as compared to primary dentition. More studies are indicated to formulate a reason; however both salivary sodium and chloride concentration are effective markers for childhood diseases like cystic fibrosis[19] that alters ion concentration in both sweat and saliva. Although sweat is the gold standard but a various problems have been attributed in collection and analysis of sweat.

Salivary sodium concentration has also been found to significantly decrease in cerebral palsy patients [20]. This indicates its use as a diagnostic tool and attributes the need for further studies.

CONCLUSION

From this study we can conclude that saliva has a great potential for clinical disease diagnostics. It has long been recognized that saliva serves as a mirror of body's health as it contains proteins, hormones, antibodies, electrolytes and other molecules that are frequently measured in standard blood tests to monitor health and disease [21]. Thus there is a necessity for constructing a comprehensive catalogue which is physiologic for salivary electrolytes and salivary total proteins along with qualitative analysis of individual amino acids, their linkages and formations with newer biochemical approaches. Thus this study lays a foothold and may serve as a reference value for growing interest in saliva as a diagnostic tool.

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