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Comparative Evaluation of Human Salivary Electrolytes in Children of Mixed and Permanent Dentition.

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ABSTRACT

Saliva is composed of organic, inorganic contents andmacromolecules. Salivary composition changes during childhood due to maturation of salivary glands.The recent development of saliva as a diagnostic medium has placed dentistry at the forefront of monitoring systemic health and disease and has served saliva as a ' Tearless' diagnostic tool. 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: Mixed dentition (6 - 11) 5 males and 5 females and Permanent dentition (12-15 years) 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; sodium, calcium and chloride showed linear increase with age from mixed to permanent dentition while potassium concentration decreased in the permanent dentition group. 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 arrival of the twenty-first century has suddenly forced on dentistry a new paradigm regarding the standards used in patient health care management. Traditional methods and procedures used in early times are being questioned in the light of new emerging methods in emerging information/technologies [1].

The recent development of saliva as a diagnostic medium has placed dentistry at the forefront of monitoring systemic health and disease and has served saliva as a ' Tearless' diagnostic tool. The most commonly used laboratory diagnostic procedures involve the analyses of the cellular and chemical constituents of blood. Many diagnostic analytics and biomarkers present in the blood in the form of hormones, electrolytes, antibodies are also present in saliva. Saliva offers some distinctive advantages. Whole saliva can be collected non-invasively, and by individuals with limited training. No special equipment is needed for collection of the fluid. Diagnosis of disease via the analysis of saliva is potentially valuable for children and adults, since collection of the fluid is associated with fewer compliance problems as compared with the collection of blood. Further, analysis of saliva may provide a cost-effective approach for the screening of large populations [2].

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 and proteins established for particular age groups[3].

Only few studies on salivary composition of healthy children are available [4].

Thus this study aims at analyzing physiologic variability of naturally occurring electrolytes 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 6-15 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 [5]. After assessing and confirming their caries status these children were stratified equally into two dentition groups: Mixed (10 children; 5 male and 5 female ranging from 6-11years) and Permanent (10 children; 5 male and 5 female ranging from 12-15 years). Exclusion criteria included patients who were physically or mentally compromised, having developmental delay, auditory or visual dysfunction, known neurological diseases, history of drug intake and patients with arrested carious lesions [6]. 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 [4]. 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 [6].

Methods of laboratory analysis

For detection of electrolytesin saliva, the saliva sample obtained from each subject was 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[7]. The machine used was Varian Vista Pro with detection limits of 1 ppm for each element

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RESULTS

Results were tabulated and statistically analyzed with descriptive &unpaired't' test. 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 mixed and permanent dentition, the groups sodium, chloride and calcium levels showed a linear increase in concentration from mixed to permanent dentition age groups. Salivary potassium concentration was highest among all the elements in both age groups which is in correlation with our previous study. Also it showed a linear decrease from mixed to permanent dentition groups. There was no statistically significant difference in the electrolytes detected in unstimulated whole saliva of children in both the dentition groups.

	Mixed	Permanent
Sodium	8.02	8.45
Potassium	18.15	17.32
Chloride	5.71	6.31
Calcium	4.07	5.34

Table 1: Levels of electrolytes detected in mixed and permanent dentition

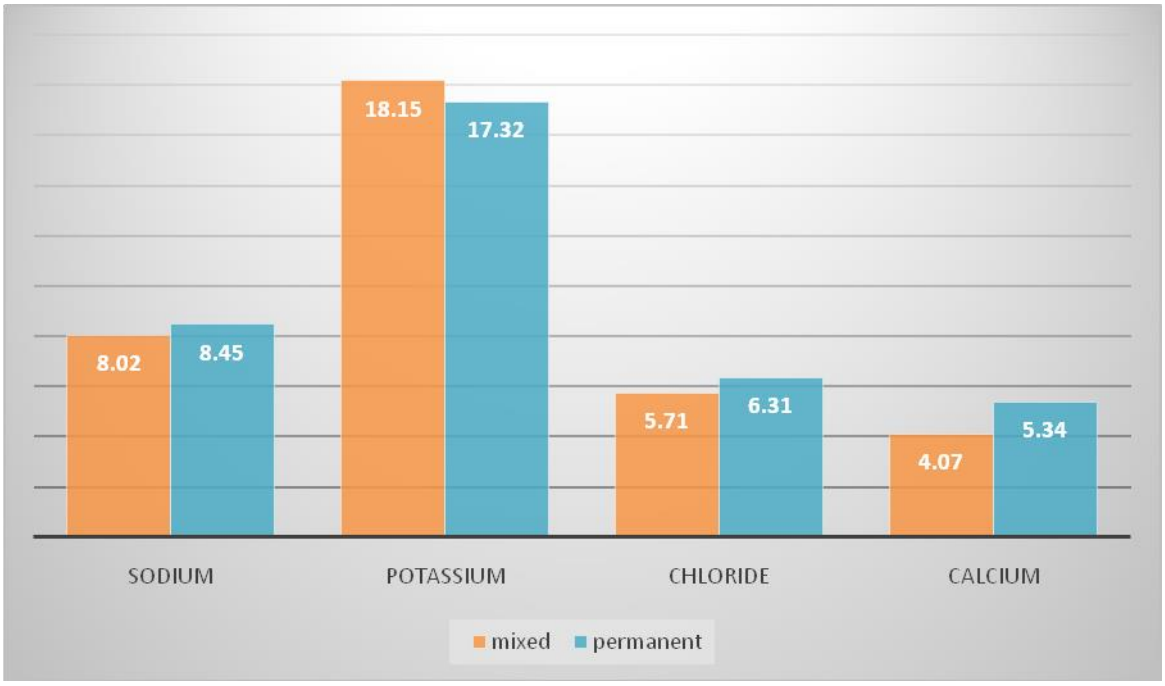

Figure 1: Levels of electrolytes detected in mixed and permanent dentition.

DISCUSSION

The inorganic contents of whole saliva were analyzed 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 [4]. 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 decrease from one dentition to the next. The reason for this still needs to be postulated. However it has been reported by HalaFathallah

Benghasheer et al[8] 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[9] in 2009. While studies by Hell[10] , Dodds et al[11],and Kargul et al[3], reported a positive correlation between K and dental caries while Zahir& Sarkar[12] found no significant variation in K levels between caries and caries free groups. However, Shashikiran et al[13] study, who investigated K concentrations in sound and carious enamel of extracted primary and permanent teeth 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.Losee& Ludwig [14] 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 [15].

An overview of values showed a linear increase in calcium concentration from mixed to permanent 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[16]. 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 [17] 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 is lower in mixed dentition than permanent dentition which points toward the fact of increased caries risk, thus correlating higher caries incidence in children than adults [18].

The sodium and chloride concentrations also showed decrease in mixed dentition as compared to permanent 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. The major limitation of this study is its small sample size. The data obtained in this study is preliminary and expansion of the subjects is needed to obtain improved valid results.

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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REFERENCES

[1] Anthony M. Iacopino J Dental Edu 2007; 71(4):450-462.
[2] Eliaz Kaufman, Ira B. LamsterCrit Rev Oral Bio Med 2002; 13(2):197-212.
[3] H Ben-Aryeh, M Fisher, R Szargel and D Laufer. Arch Oral Biol 1990; 35(11):929-931.
[4] BetulKargul, AysenYarat, Ilknur Tanboga. The Saudi Dental J 1998; 10(3):100-106.
[5] AR Vieira, M.L. Marazita, T. Goldstein McHenry. J Dental Res 2008; 87(5): 435-439.
[6] Katie P. Wu, Chang Gung Med J 2008;31:281-6.
[7] Thomas J Manning. The Chem Educator 1997; 2(1):1-19.
[8] Hala Fathallah Benghasheer, Alaa Sabah Hussein, Mohamed Ibrahim Abu Hassan. Salivary sodium and potassium in relation to dental caries in a group of multiracial school children. E J Dentistr 2013.
[9] Abou El-Yazeed M, Taha S, Elshehaby F, Salem G. Aust J Basic Appl Sci 2009; 3(2):720-730.
[10] Hell A. Proc Fin Dent Soc 1977; 73(2), 1-34.
[11] Dodds MW, Johnson DA, Mobley CC, Hattaway KM. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1997;83(2): 244-251.
[12] Zahir S, Sarkar S. J Indian Soc Pedo Prev Dent 2006; 24(1):27-9.
[13] Shashikiran ND, Subba VV, Remath MC. Estimation of trace elements in sound and carious enamel of primary and permanent teeth by atomic absorption spectrophotometry: An in vitro study. Indian J Dent Res 2007; 18(4):157-62.
[14] Losee FL, Ludwigs TG. Trace elements and caries. J Dent Res.1970; 49(6):1229-1235.
[15] T.J. Lasisi et al. Ann Ibadan Postgr Med 2012; 10(1): 25–30.
[16] Buche J. The Calcium Connection. Herbs, Minerals and Goods web site. Montreal, Canada; 2004. p. 1-5.
[17] Kavanagh DA, Svehla G. Arch Oral Biol 1998; 43(12):1023-7.
[18] Anderson P, Hector MP, Ramprasad MA. Int J Paediatr Dentistr 2001; 11(4):266-73.
[19] Aline Cristina Gonçalves et al. Diagnostic Pathol 2013.
[20] Walter Luiz Siqueira et al, Quintessence Int 2007;38:301–306.
[21] Preethi BP, Anand Pyati, Reshma Dodawad. Biomed Res 2010;21 (3):289-294.