THE IN VITRO EFFECT OF ACIDIC BEVERAGES ON SURFACE MICROHARDNESS AND MINERAL CONTENT OF PRIMARY VERSUS PERMANENT ENAMEL PRE-TREATED WITH RE-MINERALIZING AGENTS

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بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

﴿يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ

وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ

وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ﴾

صدق الله العظيم

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List of Abbreviations

Abb.	Full term
APF	*Acidulated Phosphate Fluoride..*
CPP-ACP	*Casein Phosphopeptide-Amorphous Calcium Phosphate*
EDAX	*Energy Dispersive Xray analysis*
EDS	*Energy dispersive X-ray spectrometer*
HAP	*Hydroxyapetite crystals*
SD	*Standard Deviation*
SEM	*Scanning Electron Microscopy*
SH	*Surface Hardness*
SMH	*Mean Surface microhardness*
VHN	*Vickers Hardness Numbers*
XRD	*X-Ray Diffraction*

INTRODUCTION

Dental enamel is considered from the most important structures of the tooth, both from a functional and esthetic consideration(1). The mineral phase consists mainly of calcium phosphate in the form of hydroxyapatite crystals, which are carbonated or fluoridated(2). Such a high mineral content proves that teeth are the hardest and probably the strongest biological tissue in the human body(3).

As the depth of dental enamel increases, the enamel hardness decreases. The changes in the local chemical composition in microstructure and in prism orientation are probably the cause of these variations in enamel hardness(4).

The human teeth are usually subjected to a series of physical and chemical attacks which lead to gradual wear of the dental hard tissues during lifetime. However, if the wear rate increases to clinically relevant levels, it causes serious destruction of the teeth and the loss of their function(5). Such a condition is called erosion, however erosive lesions have a multifactorial etiology, the increasing of acidic food and soft drinks consumption has become an important factor leading to their development(6–8).

When acids are consumed and contact the dental hard tissues, enamel dissolution starts(9), where the acid removes mineral ions from the tooth, leaving a softened surface. These acids are largely found in dietary substances. Nutritional factors play an important role in the erosive tooth wear development(10).

Demineralization is explained as the process of removing mineral ions from hydroxy-apetite crystals of enamel, while restoring these mineral ions again to the hydroxy-apetite crystals is called remineralization. Both processes of demineralization and remineralization can take place on the tooth surface, and a high sensitivity to hot, cold, pressure, and pain can be felt due to losing a large number of mineral ions from hydroxy-apetite crystals without destroying its integrity. However, lacking of hydroxy-apetite latticework integrity produces cavities. Demineralization can be a reversible process if they are exposed to oral environments that favor remineralization in the oral cavity, as the partially demineralized hydroxy-apetite crystals in teeth can grow to their original size [(11)].

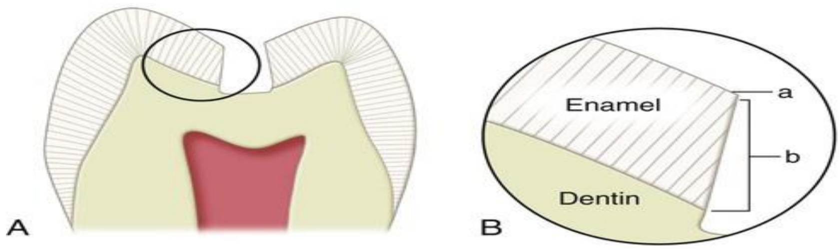
Prevention of tooth erosion can be done through diet counseling, as well as the application of products that minimize demineralization and promote remineralization of the tooth structure[(12)].

REVIEW OF LITERATURE

Enamel differs in composition in terms of type and quantity of organic and/or inorganic phases, amount of water, concentration of minor elements, and crystal size. The differences that are apparent may play a role in the development of carious lesions[13].

Differences in enamel of primary and permanent teeth:

The basic mineral component of mature enamel is the hydroxy-apatite crystal, $Ca10(PO4)6(OH)2$[13]. The HAP crystals are arranged in prisms or rods, that run approximately perpendicular from the dentine-enamel junction towards the tooth surface[14,15].



a)HAP crystals arranged in rods
b)Rods are perpendicular from DEJ towards the tooth surface

Each enamel rod consists of tightly packed carbonated hydroxyapatite crystals which are oriented along the rod axis, with a nanometre-thin layer of enamelin covering the crystals. However, deciduous teeth differ from permanent teeth, as their outer-most layer is generally devoid of the common prism structure[3].

The interfacial area between rods contains poorly crystalline hydroxyapetite that is rich in protein and probably the result of the incoherence of combining crystals of different orientation in that area[14]. In the prismless enamel layer, the hydroxyapatite crystals appear to be parallel to each other and perpendicular to the enamel surface[15]. Studies have revealed the presence of a thicker and uniform prismless enamel layer in deciduous teeth compared to permanent teeth[15].

The average growth of the deciduous crown occurs from 6 to 14 months, while the average growth of the permanent crown is from 3 to 4 years. So, deciduous teeth show lesser thickness of enamel than its permanent successor[16,17].

In general, the deciduous teeth are softer, whiter, weaker, and smaller, compared to their permanent counterparts[3].

Enamel of deciduous teeth shows smaller and more widely spread out prisms, with more complete boundaries[18], suggesting that enamel of deciduous teeth is more porous than enamel of permanent teeth. In addition, enamel of deciduous teeth varies in its organic content[19], it is less mineralized[20], and has greater carbonate content than enamel of permanent teeth[21]. The diffusion coefficient of enamel is greater in deciduous than in permanent teeth[22]. Wilson and Beynon[20](1989) suggested that overall mineral density is lower in the outermost layers, but showed no significant differences close to the enamelo-dentinal junction. In addition, according to Mortimer[17] (1970), the thinness of the enamel in deciduous teeth and its lower level of mineralization (80.6%) than that of the permanent teeth (89.7%) are the main differences between the deciduous enamel when compared to the permanent enamel. Also the chemical, morphological, and physiological aspects differ between permanent and deciduous teeth[17,21], and the behavior of primary teeth seems to be different under conditions such as caries, erosion process, and bond strength[23–25].