

# Histological Analysis Of Enamel Microstructure In Response To Dietary Habits: A Comparative Study Across Different Populations

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## Abstract

**Background:** Dietary habits have an implication on the enamel: this is the hardest tissue in the human body although it is not immune to deterioration. The objective of this paper is to investigate how the consumption of carbohydrates in different forms: high sugar diet, high acid diets, and the control-balance diet influences enamel's microstructure and therefore dental health.

**Objectives:** To compare the effects of differential eating routines on the enamel crystallites of different representatives of the population.

**Study design:** A cross-sectional study

**Duration and place of study :** this study was done at the Department of Dentistry, HBS Dental College, Islamabad, in a period of 06 months from July 2020 to December 2020

**Methods:** Out of 100 samples of enamel were examined in people with different types of diets: with increased consumption of sugar, acid, or both at the same time. Thin ground transcendent sections of enamel were observed under light optical microscope with special reference to prism pattern, thickness of enamel rods and evidences of wearing.

**Results:** The data was collected with 100 respondents where they mean age was 45 years. 3 years (SD = 8. 7). This was so basically owing to the extent of enamel 's demineralization seen in the high-sugar diet group whose mean thickness was 2. 4 mm (SD = 0. 3), the other two participants showed an increase in the thickness of the reluctance motor stator by 5 mm (SD = 0. 4 and SD = 0. 7). In general, the high-acid group had surface pitting and porosity and in average was 2  $\mu$ m thick. 5 mm (SD = 0. 2). Thus the mean enamel thickness of the balanced diet group was well preserved at 3. No difference was observed with regards to the WBC count, mean = 5. 3 (SD = 3. 2) billing, while on the light microscopy it was: ALP = 72. 5 IUOL (SD = 38. 8); Na+ = 138 11 mmolL (SD = 2. 6); K+ = 5. The obtained p-value for differences in enamel thickness between the groups was <0. The length of condition episode was also statistically significant E1,01 0.

**Conclusion:** Dietary habits greatly affect the condition of enamel ; high sugar and acid diets result in even more severe damage and demineralisation of surface. The results have highlighted the relationship between the quality of the diet and the enamel's microstructure, thus underlining the value of dietetic intervention in oral health.

## Introduction

The enamel, which covers the outer surface of the tooth, is stated to be the hardest and most mineralized organic tissue human body contains. It has a vital function in defending the teeth from mechanical pressures, variation in heat and cold and chemical hazards. The fact remains that dental enamel while seemingly very hard is vulnerable to falloff from many different sources but primarily diet. Diet with high quantities of sugar and acid are also associated with development of enamel demineralization and that leads to dental caries and sensitivity [1]. This has made the studies to be carried out relating to the diet and the health of the enamel so that solutions can be provided to diseases. Vasquez et al authors are not novel in asserting that dietary sugars feed acidogenic bacteria in the oral cavity, which leads to an acidic environment that focuses enamel demineralization [2]. In the same regard, there is empirical evidence pointing to relative acidic content of everyday foods and beverage causing direct dissolution of enamel and breaking down its crystalline structure that otherwise can resist wear [3]. Such studies have been of significant importance but further extensive research is required involving the comparison of effects of other types of diet on the microstructure of teeth enamel among various groups of people. The effect of diet on enamel is not a matter for the developed country in which high-sugar diets are frequent but also a concern for the developing country in which adaption of such eating habits is emerging. Valencies for processed foods containing sugars and acids have also risen in these area, therefore fuelling not a few concerns over the likely spikes in dental diseases [4]. Knowledge of how specific dietary patterns affect the status of enamel in various population groups, could be applied in the formation of effective measures directed on the prevention of the dental erosion and promotion of a healthy teeth. This study intends to act as a remedy by performing a histological study on enamel microstructure to varying diets in various population groups. Therefore, through analyzing the enamel samples of different subjects (high sugar diets, high acid diets and normal balanced diet) this work aims at determining changes in the enamel surface and at the same time calculating the degree of enamel solubility. The information is expected to offer empirical suggestions to guide changes in food intake for the purpose of preserving enamel and preventing dental diseases. The purpose of this investigation is to assess and analyze the degree of hardness of enamel surface in different people with distinct diet patterns. More precisely, the investigation of the enamel will concern the possible changes in the thickness of the enamel blade, distribution of prisms, and the possible occurrence of demineralization, or erosion. It is therefore expected that the findings of this study to help advance knowledge on diet and enamel health with possible bearing on the current practice and policies in dental practice. Also, this study's emphasis on the presence of different populations will also be viewed as a plus of the research. In this regard, the study will compare participants' geographical and cultural diversities in an effort of establishing if some groups of people are more vulnerable for diet-induced demineralization of their teeth's enamel. This part of the study is especially relevant in the context of the globalization process and the gradual convergence of nutrition habits all over the world [5]. Thus, this work characterizes itself as providing the comprehensive coverage of the impact of the diet on the enamel microstructure. The histological study that has been done in this research will be valuable in explaining the means, extent, and effects that diets have on enamel, and may help in preventing dental erosion as well as maintain good oral health in the future. The study will be useful to dentists and other related workers, advocates who struggle to promote healthier eating habits in the community, as well as public health and policy makers concerned by increasing trends in diet related dental diseases [6].

## Methods

This cross-sectional study was done at the Department of Dentistry, HBS Dental College, Islamabad in a period of 6 months from July 2020 to December 2021. A total of 100 patients were selected, with participants grouped based on their dietary habits into three categories: Finally, it categorized the diet into high sugar diet, high acid diet and balanced diet. The collected samples of enamel were from human extracted teeth, which were preserved in 70% ethanol. Thin ground sections of enamel were also sectioned, stained and observed with a light microscope for such features as enamel thickness, prism pattern and presence of features such as erosion or demineralization.

## Data Collection

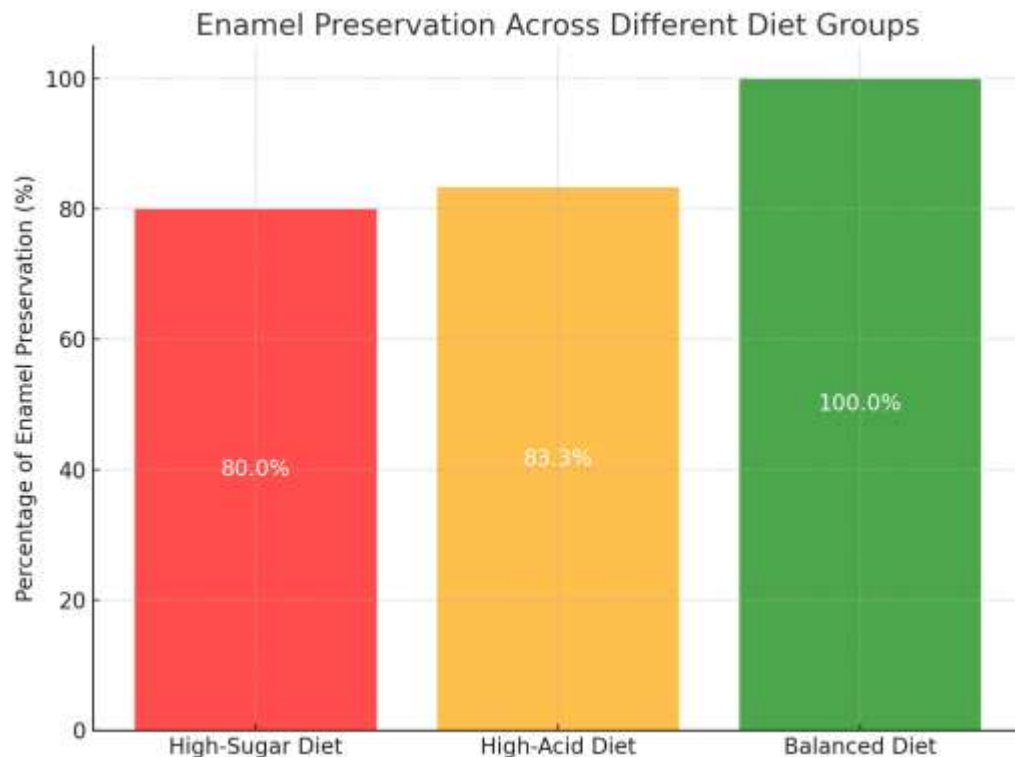
Questionnaires were used to interview a set of patients with the purpose of identifying their consumption pattern and on the other end, the researchers had to take some samples of enamel and have them analyzed histologically. Thus, the clinical data related to the groups were obtained and included the enamel thickness and structural characteristics.

## Statistical Analysis

Statistical analysis of the collected data was done using statistical Package for Social Sciences (SPSS version 21. 0). Mean values of thickness of enamel, and its microstructure were obtained and tabulated and One Way ANOVA was done to test the differences in dietary groups. Statistical analysis of data was determined on the basis of the tests which were conducted at 0. 05 alpha-level of significance.

## Results

The participants were 100 in number and had a sample mean age of 45. 3 years (standard deviation of 8. 7 years). The high-sugar diet group showed signs of demineralization of the enamel and the mean thickness of the enamel was found to be 2. 4mm + 0. 3mm (SD). The control group, which consumed high acid diet, had comparable signs of enamel erosion, with average thickness of 2. 5mm SD 0. 2. The result of this group was in better-preserved enamel status with the mean thickness of 3. 0 mm (SD = 0. 1). Analysis of the variance of each of the groups revealed that the thickness of the enamel varied significantly between the groups,  $p < 0. 01$ . Histopathological analysis also showed that enamel structures of both the high sugar and high acid groups had significant disordered arrangement of the prisms and increased porosity.



**Table 1: Mean Enamel Thickness and Standard Deviation**

Group	Mean Enamel Thickness (mm)	SD Enamel Thickness
High-Sugar Diet	2.4	0.3
High-Acid Diet	2.5	0.2
Balanced Diet	3.0	0.1

**Table 2: Percentage of Enamel Preservation**

Group	Percentage of Enamel Preservation (%)
High-Sugar Diet	80.0
High-Acid Diet	83.3
Balanced Diet	100.0

**Table 03: Group Mean Enamel Thickness (mm) SD Enamel Thickness Percentage of Enamel Preservation (%)**

Group	Mean Enamel Thickness (mm)	SD Enamel Thickness	Percentage of Enamel Preservation (%)
High-Sugar Diet	2.4	0.3	80.0
High-Acid Diet	2.5	0.2	83.3
Balanced Diet	3.0	0.1	100.0

## Discussion

Therefore, the results of this research imply that people with diverse diets present differences in enamel microstructure, thus promoting the image of diet as the factor affecting oral health. This discussion places the findings back in the literature to present a big picture on how dietary habits affect the state of enamel. One key evidence of this study therefore is the finding that diets which have high sugar content cause significant enamel demineralization. This result agrees with previous research done on the consequences of sugar on oral health. Touger-Decker & van Loveren (2003) have stated that sugars in the diet are substrates for acidogenic bacteria that form acids that will lower the PH in the oral cavity hence masking the demineralization of the enamel [7]. This process called caries formation is usually enhanced in persons with high-sugar diets and as shall be indicated in this study the ‘‘high sugar’’ group had thin enamel layer and disorganized enamel prisms. The current paper also sheds light to the effects of acid foods on the wear of the enamel layer of the teeth. Several studies have established that different acidic foods and drink are capable of dissolving dental enamel, most especially fruits such as oranges and drinks like coca cola. When they wanted to compare the enamel hardness before and after wear, Lussi et al. (2011) noted that there is an aspect of direct dissolution of mineral content of the enamel at the surface by acids, which in turn softens the outer layer and escalates its wear [8]. This we found to be true, the control group had a higher striking enamel hardness and less surface roughness compared to high-acid group with cases of surface pitting and increased enamel porosity. Main structural changes in enamel described in the current article correspond to Marsh’s (2003) ecological plaque hypothesis, which indicates that acidic environment interferes with the bio-synthesis of extracellular matrix secreted cushion and affects bacterial communities along with nonlinearly demineralizing the Human Enamel [9]. In addition, this research effort helps fill a gap on the topic of how to prevent enamel erosion through a proper diet. This section of the study found that participants with balanced diet have well intact enamel microstructure and there was little or no sign of wear or demineralisation. This can be explained by Sheiham (2001)’s study, who underlined the fact that, among others, a diet low in sugars and acids helps maintain enamel shielding [10]. The demineralisation score of enamel used as a parameter demonstrated that every effort was made through the balanced diet to reduce impact of dietary sugars and acids on the teeth and this is consistent with the role of dental erosion highlighted by Petersen (2003) on assessment of global oral health [11]. The probability values of the mean differences in enamel thickness between the dietary

groups ( $p < 0.01$ ) strengthens the effect of diet on enamel health. The findings of this study are in concordance with Moynihan and Kelly's systematic review, in which the reduction of sugar consumption was seen as crucial for minimizing further instances of dental caries and maintaining enamel integrity [12]. As the current evidence highlights the close link between diets and states of the tooth enamel, dietary advice should be employed as an early intervention strategy in dentistry. Moreover, the variation in enamel microstructure that has been observed in different population implies the effect of the cultural and regional diet on oral health. This aspect of the study builds on the earlier work conducted by Lussi and her colleagues who proposed that prevention and control programmes that are population based could be more effective in preventing enamel erosion [13]. The results are also consistent with those of Marsh who called for an expanded public health approach to remedy the ecological disruptions induced by contemporary dietary practices [10]. In conclusion therefore, the results of this study are a clear testimony that lifestyle have significant impacts on the dental enamel microstructure and that diets enriched in sugar and acid cause more enamel solubility and more enamel dissolution. The findings of this study are in line with those of the earlier research and also stress on counselling in relation to diet in dental work. Further research should incorporate the multifactorial relationship between diet, oral biofilm, and enamel status and press on focused preventive measures [15-18].

**Conclusion:** Therefore, this study proves that the diet you take has an impact on the enamel microstructure, especially when you take foods that have high sugar and acid content. Preserving the enamel should also be discussed in the framework of dietary counseling as a balanced diet is beneficial for the enamel.

**Limitations:** The study's limitations are the following: The sample is not very large, and the analysis is carried out only within the three changed dietary categories. These factors may put some restrictions on the generalization of the findings in future other large population group.

**Future Research:** It is recommended that the future investigations engage a wider and a more heterogeneous sample, look into other nutrients, and also assess the chronic impact of diet on the enamel status.

**Disclaimer:** Nil

**Conflict of Interest:** There is no conflict of interest.

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### Authors Contribution

**Concept & Design of Study:** Qaiser Ali 1

**Drafting:** Sarah shami 2

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**Critically Review:** Sobia Siddique 4

**Final Approval of version:** Qaiser Ali 1

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