EVALUATION OF FRICTION AND WEAR OF ENAMEL DURING THE LOSS AND RECOVERY OF MINERALS EXPOSED TO DEMINERALIZING LIQUIDS

S.I. Topete-Velasco *, M.E. Sedano-Hernández, F.J. Aranda-García, C. Sedano-de la Rosa
*sara.topete@academicos.udg.mx
Departamento de Ingenierías, Centro Universitario de la Costa Sur, Universidad de Guadalajara, Av. Independencia Nacional 151, Autlán de Navarro, Jalisco, CP 48900, Mexico.

ABSTRACT

Depletion of minerals in dental pieces is a process caused by the ingestion of acidic foods and drinks present in the oral cavity, progressively dissolving the enamel. The tests were carried out at 10, 20, and 30 N, with a stroke of 2 mm and a frequency of 1 Hz using artificial saliva as lubricant and a 52100-chrome steel sphere as the counter face. Bovine milk presents a better lubrication action than toothpaste coefficient of friction of dental enamel against chromium steel sphere. The objective of this work is to evaluate the friction and abrasive wear of dental enamel subjected to different cycles of demineralization and remineralization using different agents for each process.

Friction; Experiments in Tribology; Wear, Enamel

INTRODUCTION

Teeth contain two layers of dentin and enamel, both composed of Hydroxyapatite (HA). An inorganic mineral consisting mainly of calcium and phosphorus [1]. Dental demineralization is a process caused by the ingestion of acidic foods and drinks dissolving the enamel. Remineralization is the process that replaces minerals lost from the teeth' surface. The structure of calcium phosphate generates chemical bonds that promote the formation of HA crystals. It is important to take care of the mineral levels in teeth because they are the main components of enamel. Tooth wear refers to the progressive loss of enamel due to chemical and mechanical processes such as demineralization and abrasion. The objective of this work is to evaluate the friction and abrasive wear of dental enamel during the loss and recovery of minerals exposed to demineralizing.

EXPERIMENTAL

The teeth were obtained by extracting third molars from adults ranging in age from 20 to 30 years old. The demineralization cycles consisted of immersion of the samples in 5 ml of rested tequila and sparkling red wine at 3, 6, 12, and 24 h using a magnetic stirrer at 100 rpm. The remineralizing cycles consisted of immersion of the samples in bovine milk, toothpaste, and mouthwash. Alternative abrasive wear tests were carried out by adopting some parameters of the ASTM-G133 standard. The tests were carried out at 10, 20, and 30 N, with a stroke of 2 mm and a frequency of 1 Hz using artificial saliva as a wet condition and a 52100-chrome steel sphere as the counter face.

RESULTS

The maximum COF was obtained with rested tequila reaching an average value of 0.7. On the contrary, the lowest value was obtained with sparkling red wine with an average value of 0.05, showing a better lubrication action, while artificial saliva showed an average value of 0.23, corresponding to the control specimen without the demineralization process. The largest lost volume was obtained at 30 N and a demineralization exposure time of 24 h in rested tequila. The smallest lost volume was observed at 10 N and an exposure time to demineralization of 3 h into sparkling red wine.

On the other hand, the maximum COF observed in the experiments was toothpaste, with an average value of 0.057. The minimum COF obtained from bovine milk has an average value of 0.022. Thus, bovine milk presents a better lubrication action than toothpaste at 10 N and different remineralizing agents. To characterize the wear scars and identify the wear mechanisms present in the experiments SEM, Raman Microscopy, and XRD techniques were used.

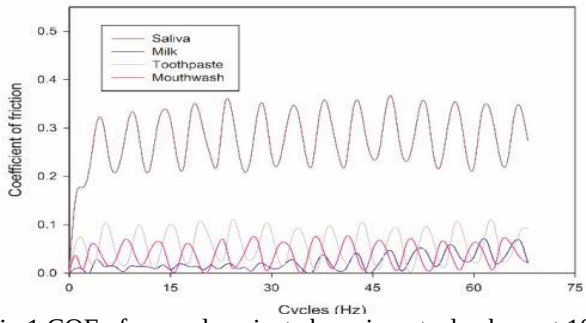

Fig.1 COF of enamel against chromiumsteel sphere at 10 N, and different remineralizing agents.

REFERENCES

[1] M. K. Arifa, R. Ephraim, and T. Rajamani, "Recent Advances in Dental Hard Tissue Remineralization: A Review of Literature," Int J Clin Pediatr Dent, vol. 12, no. 2, pp. 139– 144, 2019, doi: 10.5005/jp-journals-10005-1603.