

**Molybdenum Level in Permanent Teeth, Enamel  
and Saliva of a Group of Adolescents, in Relation to  
Dental Caries and Gingivitis, and its Effect on  
Solubility,  
Microhardness and Fluoride Uptake of Dental  
Enamel**  
*An in vivo and in vitro study*

**A Thesis**  
**Submitted to the College of Dentistry,  
University of Baghdad in Partial Fulfillment of the  
Requirements for the Degree of Doctor of Philosophy in  
Dental Science/ Preventive Dentistry/ Cariology**

**By**  
**Raad Saleh Shahatha Al-Ani**  
**BDS, HDD, MSc**

**Supervised by**  
**Prof.Dr. Sulafa K. El-Samarrai**  
**BDS, MSc, PhD**

**Pedodontics & Preventive Department  
College of Dentistry  
University Baghdad**

## *Abstract*

The element molybdenum is found in all living organisms and is considered to be an essential and beneficial micronutrient for most life forms. The current study included two parts, the first one deals with assessment of molybdenum levels in the premolar tooth, enamel and stimulated saliva in relation to severity of dental caries and gingivitis. The sample consisted of a group of 50 adolescents (22 males and 28 females) 11-16 years old, referred by Orthodontics for the extraction of upper first premolars. Clinical examination was carried out under standardized conditions according to criteria of WHO (1997) at the dental clinic of College of Dentistry, Al-Anbar University. Decayed, missed and filled index (D<sub>1-4</sub>MFS index) was applied for recording caries experience, where the decayed fraction of the index was recorded according to lesion severity. In addition, (PII) and (CL-I) were applied for oral hygiene and (GI) for gingival health status. Salivary and teeth samples were analyzed using atomic absorption spectrophotometer for the measurement of molybdenum ions. All adolescents were found to be affected by dental caries and females demonstrated higher values of DMFS (7.57±1.53) compared to that of males (6.81±0.68). Means of molybdenum concentration in teeth, enamel and saliva were 0.219±0.038, 0.127±0.026, and 0.0111±0.005 respectively. There were significant differences between means of molybdenum concentrations in tooth, enamel and saliva according to age groups and gender. This study shows that there was a negative significant correlation between molybdenum concentration in tooth and enamel with D<sub>1-4</sub> and DMFS. Females have higher concentrations of molybdenum in their saliva than males, and the difference was statistically significant. Results showed that age group (15-16) years have the higher concentration of molybdenum in saliva, and the tooth contained the maximum molybdenum concentration. Molybdenum concentration in saliva was found to be significantly correlated with PII and CL-I, but statistically not significantly correlated with GI. The second part deals with determination of the effect of molybdenum on enamel solubility, enamel microhardness and fluoride uptake by dental enamel. Different concentrations of molybdenum as sodium molybdate were used (0.01, 0.05, 0.1, 0.2, 0.5, 1.0 and 2.0 %).

Regarding enamel solubility, 0.01 - 1.0 % of molybdenum cause significant decrease in the calcium contents in the demineralization solution ( $P < 0.01$ ). Group treated with 0.2 % of sodium molybdate showed the maximum reduction in the amount of calcium dissolved from enamel samples (68.9 %). Significant differences were found between means of phosphate when 0.1, 0.2 and 0.5 % of molybdenum was used ( $P < 0.05$ ). However, the maximum percentage of phosphate reduction has been found at molybdenum concentration of 0.05 % (75.601%). Group treated with 0.05% of sodium molybdate showed the maximum reduction in the amount of phosphate removed from enamel samples (75.60%). The ratio of calcium to phosphate was increased when treated with 0.01, 0.05 and 0.2 % of molybdenum. The reduction in the dissolution of phosphate was significantly more than calcium during demineralization. Results revealed that means of microhardness was significantly higher after application of molybdenum ( $P < 0.001$ ) and a significant difference between means of microhardness numbers before and after application of molybdenum in comparison with sodium fluoride concentrations ( $P < 0.05$ ). Results of X-ray diffraction showed that 0.2% sodium molybdate was applied a distinct increase in degree of mineralization and complete separation of the mineral phases compared with sodium fluoride. Regarding fluoride uptake, the mean of fluoride concentration was significantly increased due to the effect of molybdenum ( $P < 0.05$ ).