

# DETERMINATION OF TRACE ELEMENTS BY ICP-MS FROM DENTINE TEETH CARIES

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**Abstract:** Teeth are good indicators for exposure to heavy metals and for evaluation of nutritional status. To determine the trace elements in carious dentin of permanent teeth we have used inductively coupled plasma with mass spectrometry (ICP-MS). For this purpose, there were collected permanent teeth decayed (premolars and molars) from adults (men), aged 40 to 60 years old (N = 30), in 3 different areas: 10 samples from the Câmpia Turzii area (CT area exposed to Pb), 10 samples from the area of Satu-Mare (SM area exposed to Pb) and 10 samples collected from Cluj-Napoca (control group CJ). We have analyzed the concentrations of 8 elements (macroelements, trace elements and heavy metals: Ca, Mg, Cu, Fe, Zn, Mn, Cd, and Pb) in the dentin of permanent carious teeth. The concentrations of Fe, Zn, Mn, Mg, Cd and Pb were higher in carious permanent teeth from exposed subjects comparing with the control group CJ. Cu and Zn levels are higher in CT group. According to these results, we can conclude that trace elements and heavy metals are positively associated with caries. The concentrations of trace elements found in teeth often provide information about disability or illness, poisoning or contamination.

## INTRODUCTION

Decay, an important public health problem is also a chronic pathological process, its hard tissues of the tooth, characterized demineralization, infection and their progressive necrosis, from the periphery to the pulp chamber.

Biomonitoring of trace elements in human teeth is important to assess the status of an individual nutritional point of view. The relationship between micronutrients and health is not a purely biological problem, but it should be seen in the context of social conditions.(1)

Intensification of industrialization, urbanization and the increasing number of vehicles have been accompanied by increasing the action of toxic trace elements in the environment. The concentration of Pb in teeth can be considered an indicator of environmental pollution. Pb concentrations above 4 mg / kg in teeth has been suggested as an indicator of lead poisoning.(2,3)

## PURPOSE

The aim of this study was to determine the concentration of trace elements incorporated in carious dentin of permanent teeth in male adults from different areas of residence.

## MATERIALS AND METHODS

The study included 30 adults (men) aged 40 to 60 years old, who lived permanently, since birth, in three different areas: two areas exposed to Pb pollution (Câmpia Turzii, CT group and Satu-Mare, SM group) and a control group (Cluj-Napoca, CJ group). Adult teeth, decayed permanent (premolars and molars) were examined for cavities by the dentist.

The method, inductively coupled plasma with mass spectrometry (ICP-MS), was used to determine the trace elements in carious dentin of permanent teeth.(4,5,6)

## RESULTS

Table no. 1 shows concentrations of essential micronutrients (Cu, Mg, Zn and Mn), those that are potentially toxic (Cd, Pb) and concentration of macronutrients (Ca and Mg) of carious dentin in permanent teeth.

**Table no. 1. Concentrations of trace elements (ppm) in dentin of carious permanent teeth**

Element (ppm)	Control group CJ Mean $\pm$ standard deviation	CT group Mean $\pm$ standard deviation	SM group Mean $\pm$ standard deviation
Ca	243910.99 $\pm$ 53566.28	290272.32 $\pm$ 60377.98	329861.40 $\pm$ 32281.16
Mg	4046.29 $\pm$ 1271.89	4501.16 $\pm$ 966.96	4472.98 $\pm$ 814.31
Mn	2.20 $\pm$ 1.17	4.96 $\pm$ 2.93*	4.51 $\pm$ 2.97*
Fe	210.72 $\pm$ 67.24	429.42 $\pm$ 151.59*	435.52 $\pm$ 161.25*
Cu	11.66 $\pm$ 9.47	16.73 $\pm$ 14.59	12.10 $\pm$ 8.24
Zn	188.59 $\pm$ 40.12	308.83 $\pm$ 70.97*	143.42 $\pm$ 28.16
Cd	0.12 $\pm$ 0.07	0.19 $\pm$ 0.12	0.45 $\pm$ 0.36
Pb	2.52 $\pm$ 1.64	3.77 $\pm$ 1.01*	4.76 $\pm$ 1.13*

\* p<0.05

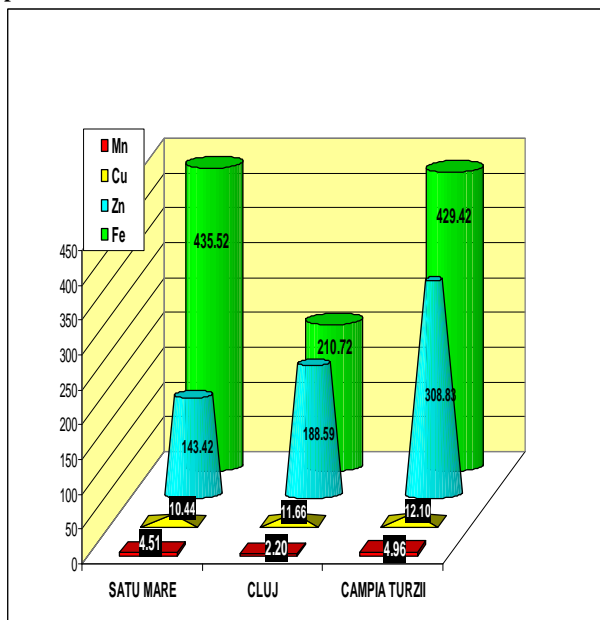
We found a statistically significant difference in the concentrations of Fe, Mn and Zn in dentin of permanent decayed teeth from SM and CT groups compared to the control group CJ. In the CT group, there were recorded samples with very high values of Zn (e.g. 16778.11ppm). Very high values of Fe, Zn and Mn were found in each group (cavities in those teeth were probably metal amalgam filling).

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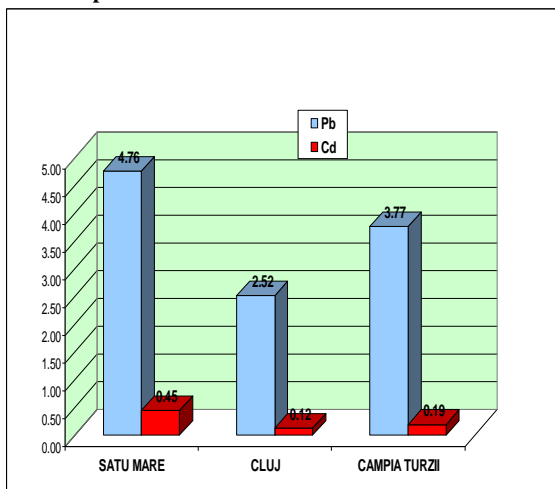
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## CLINICAL ASPECTS

**Figure no. 1. Mean concentration of trace elements (ppm) of patients from studied areas**



**Figure no. 2. Mean concentration of Pb and Cd (ppm) in dentine of patients from studied areas**



### DISCUSSIONS

No significant difference was found in concentrations of Mg and Ca between the 3 groups analyzed.

The concentrations of Fe, Mn, Cd and Pb were higher in decayed permanent teeth exposed face of lots of group M.

Concentrations of Cu and Zn are higher in teeth from CT group compared to that of dentine teeth in CJ group and SM group.

Ratio Mg/Ca in SM group was lower than in the other two groups. The ratio between Cd/Pb was higher in areas exposed to pollutants.

Pb concentrations above 4ppm in dentin were found in the CT and SM areas (4 samples in each exposed group).

### CONCLUSIONS

1. We have analyzed the concentrations of 8 elements (macroelements, trace elements and heavy metals: Ca, Mg, Cu, Fe, Zn, Mn, Cd, and Pb) from dentin of decayed permanent teeth.
2. The concentrations of Fe, Zn, Mn, Mg, Cd and Pb were higher in decayed permanent teeth from exposed subjects comparing with the control group CJ.
3. The concentrations of Cu and Zn are higher in teeth from CT group compared to the teeth of the groups CJ and SM.
4. In the CT and SM areas, there were found Pb concentrations above 4 mg/kg in dentin, suggesting intoxication with Pb (possible occupational exposure). The concentration of Pb in teeth can be used as an indicator of environmental pollution.
5. Human exposure to an environment polluted by Pb and Cd, was associated with an increased risk in the occurrence of tooth decay.
6. According to these observations, we conclude that trace elements are positively associated with decay. The oral cavity is a "mirror" of the health of the human body.

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