DETERMINATION OF HEAVY METALS IN PATIENTS WITH MALIGNANT TUMORS

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Introduction

Determination of trace elements in blood and body fluids in medicine is still considered useful. However, analysts have encountered with many challenges in the determination of trace elements in real samples. Metals are toxic especially for children. Some compounds used in alternative medicine may contain undesirable additives of heavy metals, in particular lead. Due to the alternative treatment with these compounds could pose a potential risk of increased levels of metals in the body. The aim of this work was electrochemical monitoring of heavy metals levels (Zn, Cd, Pb and Cu) in the blood plasma of child patients treated for various oncological diseases.

Materials and methods

- Determination of metals by differential pulse voltammetry were performed with 797 VA Computrace instrument connected to 813 Compact Autosampler (Metrohm, Switzerland), using a standard cell with three electrodes (Fig. 1).
- Parameters of the measurement: purging time 90 s, deposition potential -1.15 V, accumulation time 240 s, initial potential -1.3 V, end potential 0.2 V. Measurements were carried out in a glass cell with a volume of 2 ml (15 µl sample + 1985 µl of acetate buffer pH 5.0).
- Sample preparation: 10 µl blood plasma + 500 µl digestion mixture (350 µl HNO_3 + 150 µl H_2O_2). Samples were digested in MW Anton Paar, rotor MG-65 (Fig. 2).
- We analysed ten child patients from Prague's hospital Motol, treated for various oncological diseases.

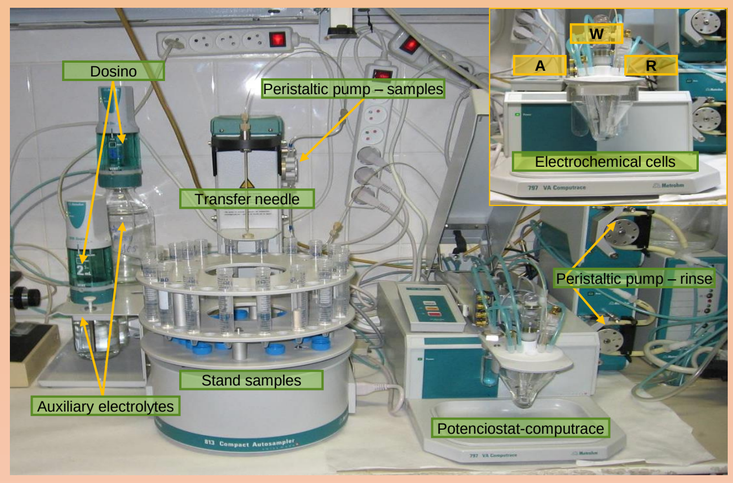

Fig. 1: Metrohm 797 VA Computrace in connection with 813 Compact Autosampler (Metrohm, Switzerland); using a standard cell with three electrodes

Fig 2: Microwave digestion system

Fig 3: Blood plasma

Results and discussion

Calibration curves of measured metals are shown in Fig. 4. Individual patient diagnosis and according measured values of monitored metals shows Fig 5. Blood serum samples were adjusted and ions Zn(II), Cd(II), Pb(II) and Cu(II) were determined electrochemically. Determined zinc levels ranged from 1.9 – 22.6 µg/ml, levels of cadmium ranged from 0.1 – 0.6 µg/ml, lead levels ranged from 0.2 – 0.9 µg/ml and copper levels ranged from 0.8 – 7.5 µg/ml in blood plasma. Ions of zinc and copper are usually present in the blood plasma **Physiological values** of **zinc** serum are **0.6 – 0.9 µg/ml** and in the case of **copper** 0.9 – 1.9 µg/ml (**children 6 – 12 years**). Other determined metals, cadmium and lead, are in very low concentration levels in the human body. Physiological values of **cadmium** in the range of **0.0003 – 0.0012 µg/ml** and **lead** < 0.25 µg/ml (**for children 0.1 – 0.15 µg/ml**) were detected in blood. In comparison with physiological values, the determined concentrations of all metal ions were higher in the plasma of child patients. These results suggest that tumor diseases cause important changes in the level of ions. Highest levels of Zn(II) were detected in neuroblastoma (22.6 µg/ml) and nephroblastoma (15.5 µg/ml), Cd(II) in the VKS lymphadenopathy (0.6 µg/ml), Pb(II) for nephroblastoma (0.9 µg/ml) and tumor testes (0.8 µg/ml) and Cu(II) in tumor testes (7.5 µg/ml) and nephroblastoma (2.9 µg/ml). Changes in levels of metal ions play an important role in the pathogenesis of cancer. In our pilot experiment, we found an important increase of metal ions level at patients with malignant tumors.

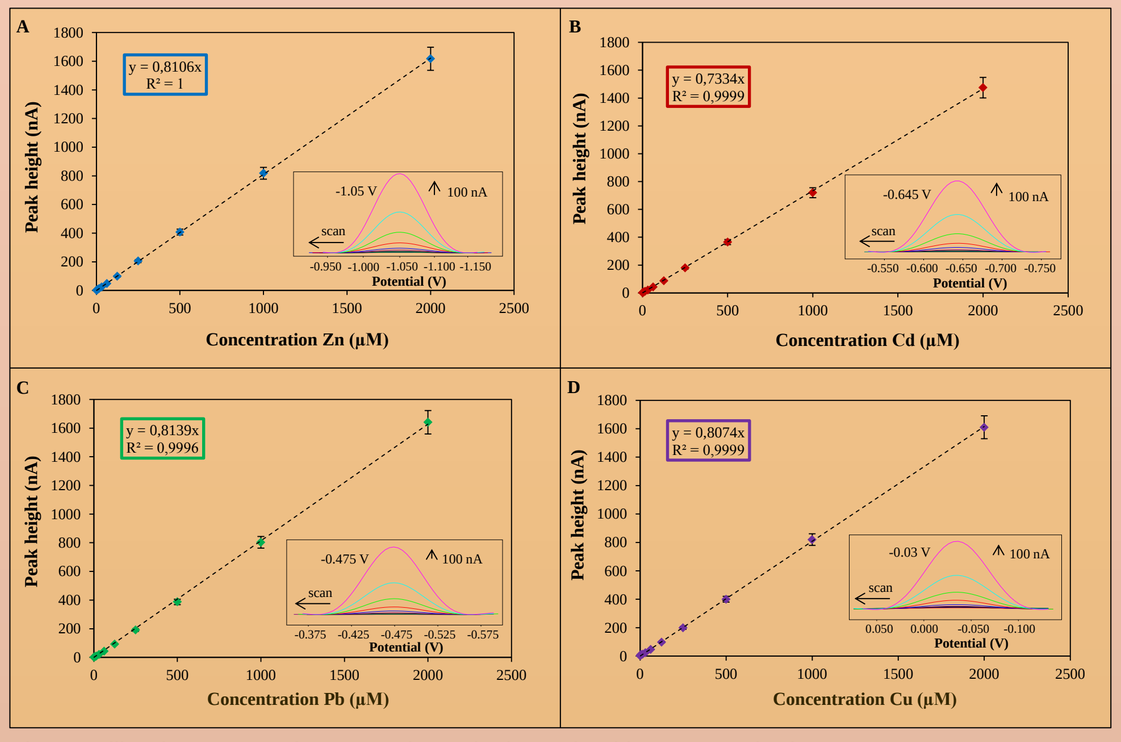

Fig 4: Calibration curves of measured metals determined by DPV method

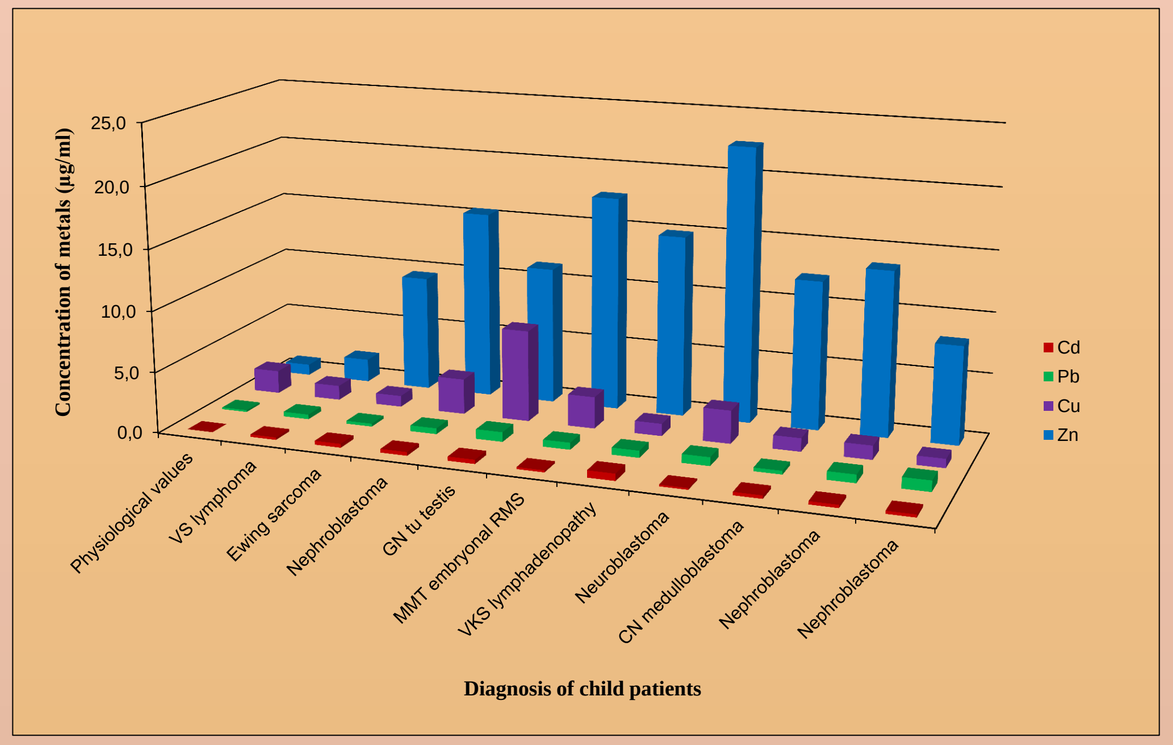

Fig 5: Diagnosis of child patients and according measured values of monitored metals. The analysis of one sample was carried out in triplicate (RSD to 10 %)

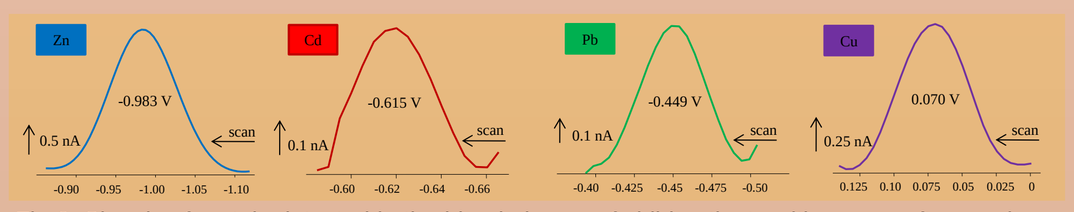

Fig 6: Signals of metals detected in the blood plasma of child patients with cancer after previous digestion

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