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EVROPSKÁ UNIE



MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY



OP Vzdělávání
pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

LEAD IONS IN THE ENVIRONMENT AND WATER

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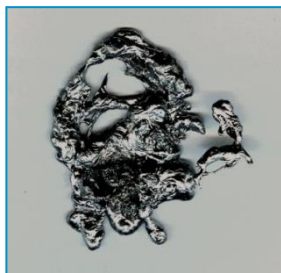
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Reg.č.projektu: CZ.1.07/2.4.00/31.0023

Název projektu: Partnerská síť centra excelentního bionanotechnologického výzkumu

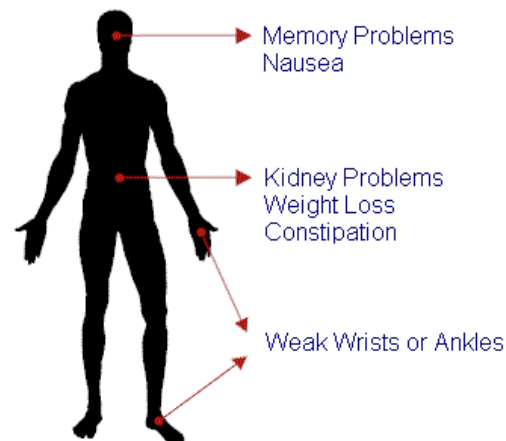


LEAD (Pb)



- ❖ lead is a heavy metal that is toxic at very low exposure levels and has acute and chronic effects on human health
- ❖ it is a multi-organ system toxicant that can cause neurological, cardiovascular, renal, gastrointestinal, hematological and reproductive effects
- ❖ **resources:** leaded petrol, leaded pigments for paints, pottery (glaze), production respectively disposal of lead batteries, some types of cosmetic products, some traditional medicines

Later Symptoms of Lead Poisoning

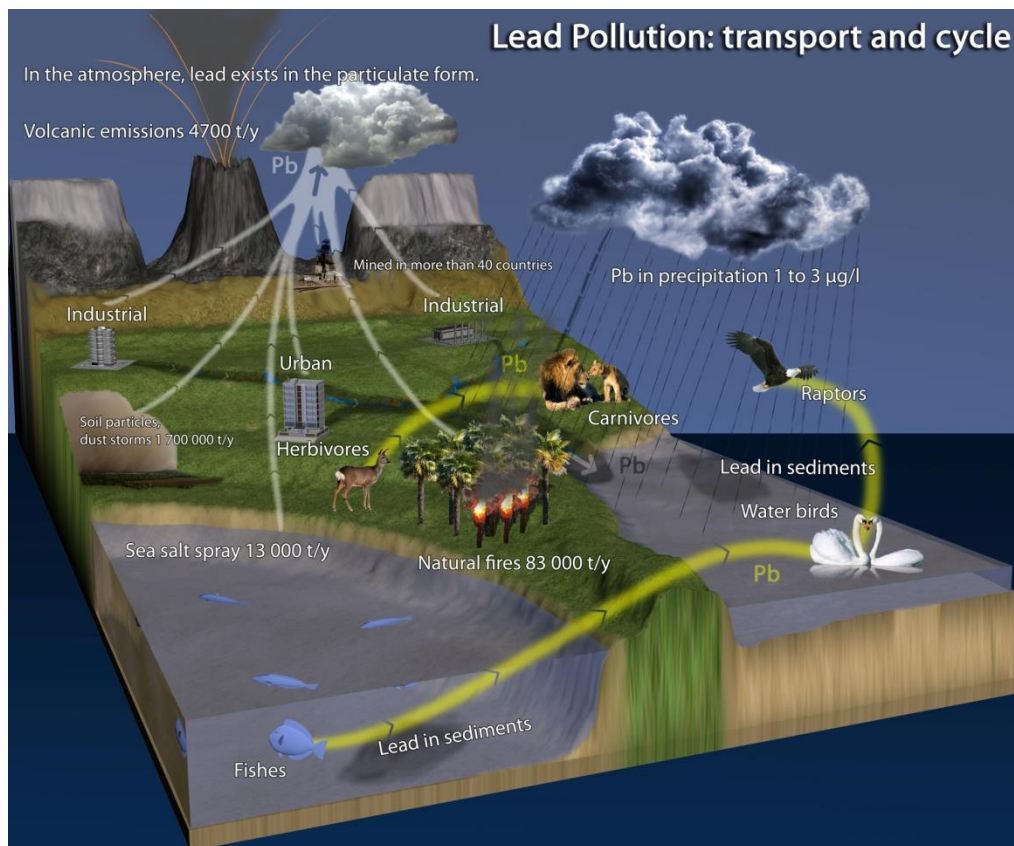


LEAD IN HUMAN



- ❖ levels of lead are not stable in the environment and vary according to industrial production, urbanization, climate changes and many other factors
- ❖ rapid, sensitive and simple analytical determination of metal ions in environment is very important
- ❖ determination of trace elements in blood and body fluids are, increasingly, being considered as useful and important tests in medicine, because the levels of some elements (lead) can be related to various pathological conditions in man
- ❖ today, the lead is considered as a substance which is toxic to babies, even at exposure levels currently common in both developed and developing countries

LEAD IN ENVIRONMENT



Lead pollution - transport and cycle

Lead exposure

About 310,000 U.S. children ages 1 to 5 have elevated blood lead levels, which can accumulate over months and years and cause serious health problems.

Effects on children

- Kids absorb up to 70 percent of lead, adults about 20 percent
- Often undetected; no obvious symptoms
- Can lead to learning disabilities, behavioral problems, malformed bones, slow growth
- Very high levels can cause seizures, coma, death

Sources

- Lead-based paint, contaminated dust in homes built before 1978
- Drinking water from lead pipes
- Contaminated food
- Soil (lead does not biodegrade, decay)
- Toys*



What parents can do

- Have child screened if there is concern of lead exposure
- Frequently wash child's hands, toys, pacifiers
- Only use cold tap water for drinking, cooking
- Test paint, dust in home if it was built before 1978

*Old toys with lead paint a known risk, but new toys from China now have come under scrutiny

Source: U.S. Centers for Disease Control and Prevention, U.S. Department of Health and Human Services

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- One possibility how to eliminate heavy metals from the body is using the chelating agents

LEAD IN ENVIRONMENT

- ❖ **EDTA** (ethylenediaminetetraacetic acid) is an organic compound used in medicine because of its ability to act as a chelating agent. Due to this feature the EDTA is used to metal poisoning treatment.
- ❖ **Albumin** is the most abundant protein in human plasma, which forms approximately 50-60 % of all plasma proteins. Each albumin molecule is composed of three units that work together to give the albumin's molecule unique ability to bind various substances. It is used as a universal carrier of substances poorly dissolved in water, such as certain hormones, enzymes, fatty acids or drugs.

AIM OF OUR STUDY

- ❖ electrochemical monitoring of lead in blood plasma and the effect and interaction of lead with EDTA, albumin, both of which are commonly used in medicine
- ❖ differential pulse voltammetry (DPV) and fully automated system

MATERIALS AND METHODS

❖ Method parameters:

E (−0.6 V – 0.1 V)

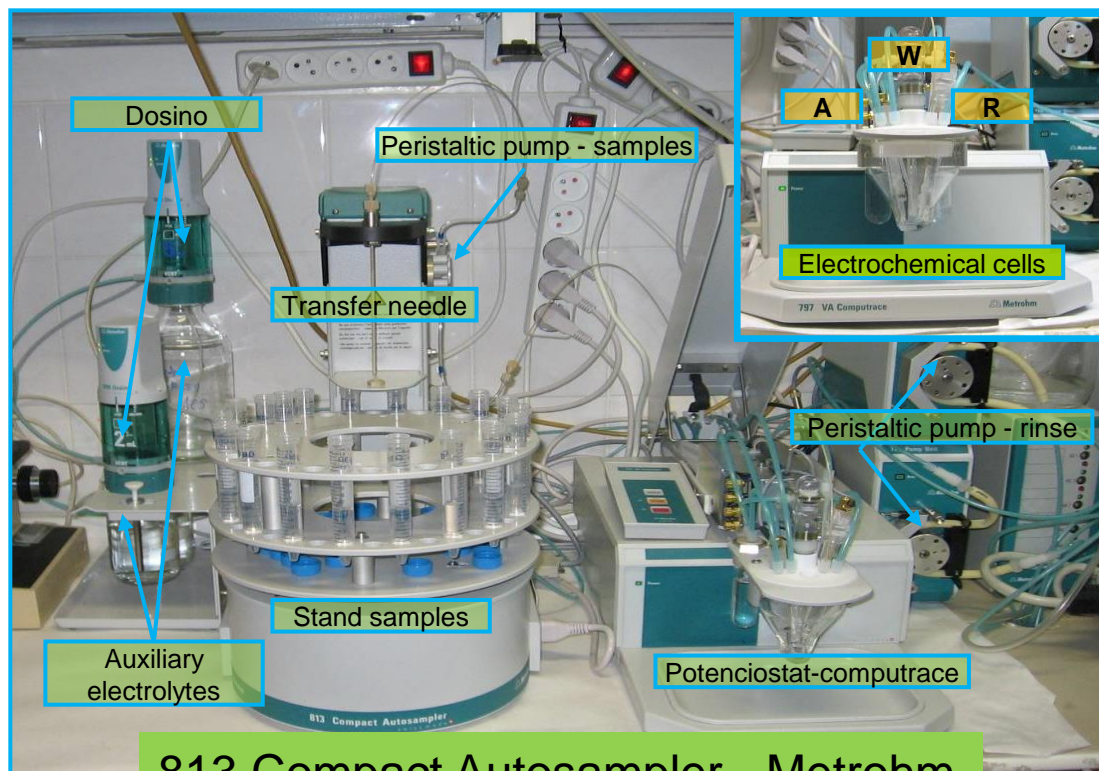
deposition potential −0.5 V

accumulation 300 s

purge time with argon 90 s

❖ Sample volume

2 ml (500 μ l sample + 1500 μ l acetate buffer pH 5.0)



813 Compact Autosampler - Metrohm



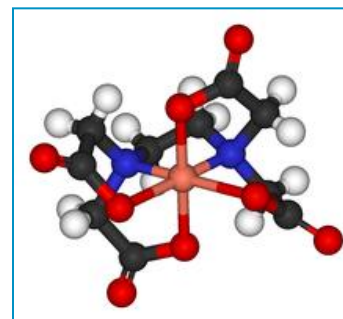
Lead (II) nitrate



Albumine (Bo)

❖ plasma protein (60 %)

❖ transport of substances

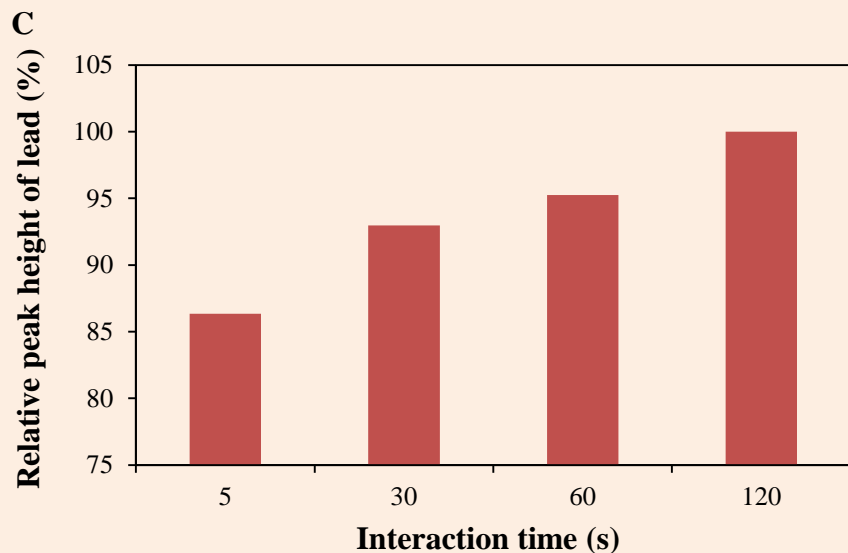
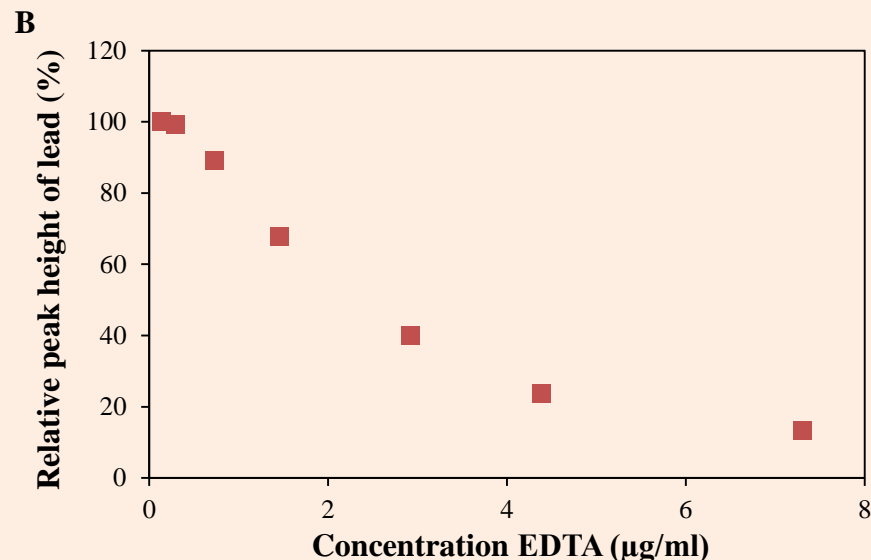
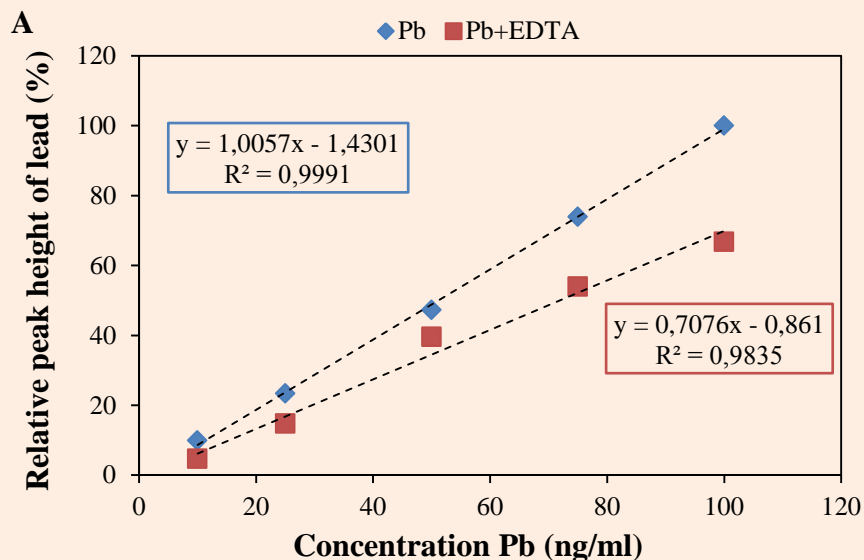


EDTA

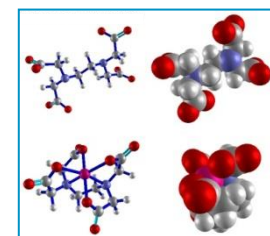
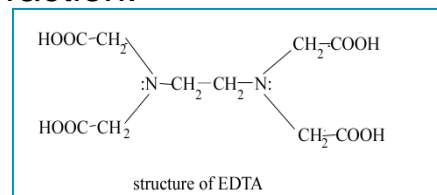
Ethylenediaminetetraacetic acid

❖ chelating agent

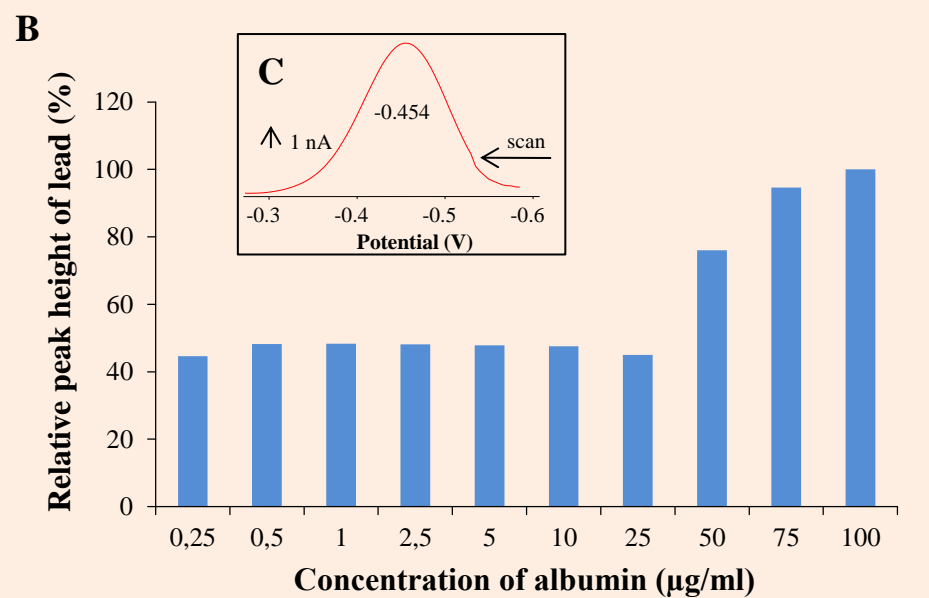
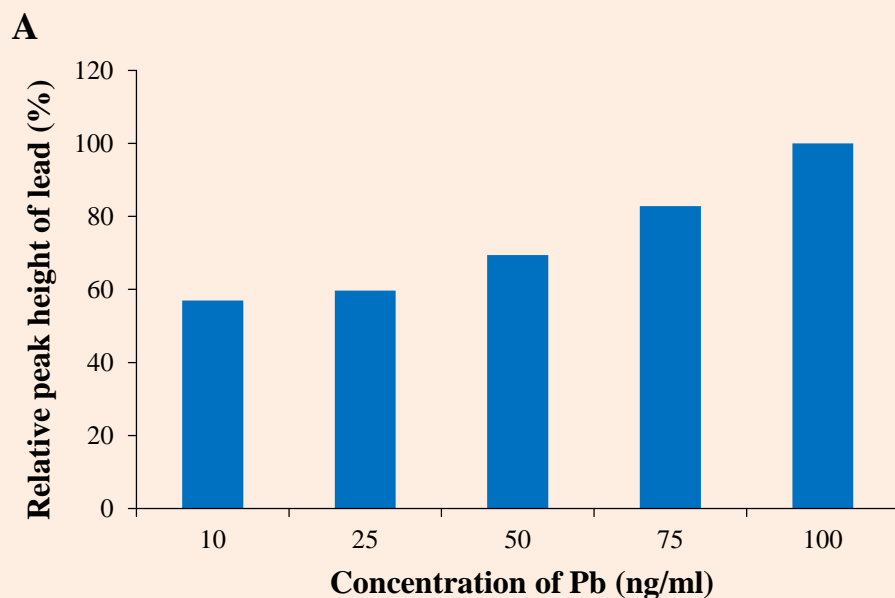
RESULTS – EDTA (Ethylenediaminetetraacetic acid)



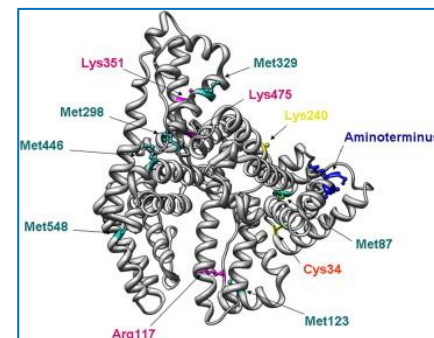
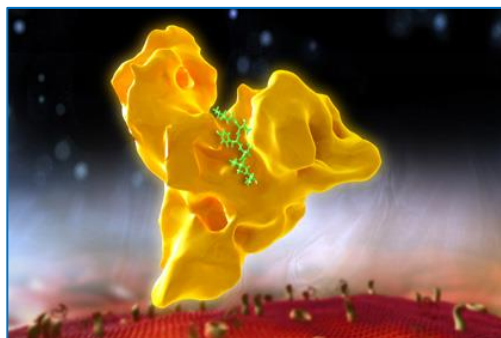
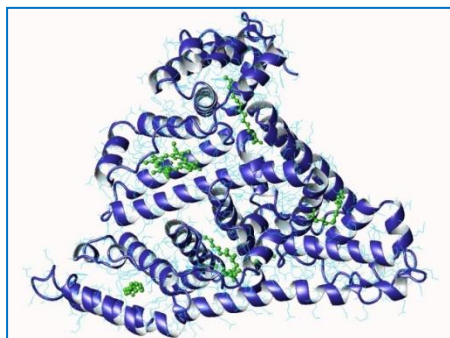
(A) Calibration curve of lead and lead calibration curve with the addition of EDTA (0.1 µg/ml). (B) The peak height of lead ions (concentration 50 ng/ml) depending on the changing EDTA concentration (0.1-7.3 µg/ml). (C) Lead concentrations 75 µg/ml with the concentration of EDTA 14.6 µg/ml, depending on the different time interaction.



RESULTS – ALBUMIN

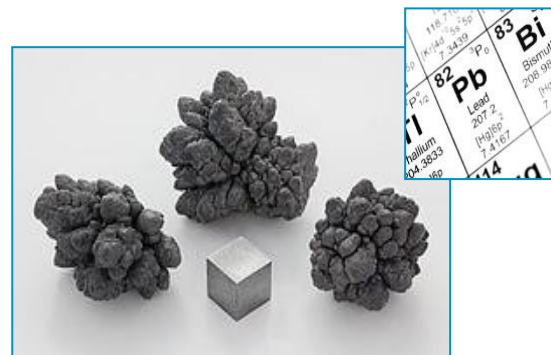


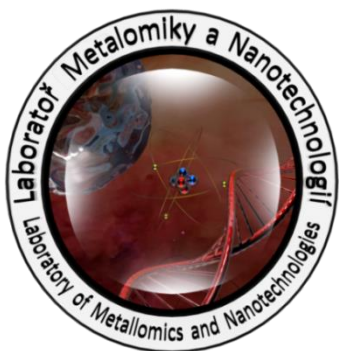
- (A) Concentration array of lead (10-100 ng/ml) with 250 μ l albumin addition (100 μ g/ml).
 (B) Concentration array of albumin (0.25-100 μ g/ml) with 250 μ l lead addition (100 ng/ml).
 (C) Standard electrochemical signal of albumin at concentration of 50 μ g/ml.



CONCLUSION

- ❖ Electrochemical detection - easy to use and relatively quick determination
- ❖ Study of the interaction can be used to develop and implement methods for the determination of lead ions in children and patient with malignant tumors





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University
in Brno



Thank you for your attention!