

PHD THESIS

**SIGNIFICANCE AND APPLICATION OF THE OSTEOCHEMICAL ANALYSIS IN
THE HISTORICAL AND FORENSIC ANTHROPOLOGY**

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1. INTRODUCTION

The analysis of anthropological and archaeological remains is a very complex task. It is a great challenge for researchers to reconstruct the ancient environment, society and life habits. Through the past decades research methods applied by the discipline went through major changes, so the historical, recent and forensic anthropology uses the latest biological, physical and chemical research techniques. These modern research techniques excellently complement information suggested by the morphological features, further more assists to analysis of remains in poor condition. This recent essay deals with the possibility of chemical analysis of anthropological remains, and with the opportunity to develop them. Nowadays several announcements appear in connection with this topic, although there are a few complex, systematic researches. In Hungary Imre Lengyel made international-level bone chemistry researches, which stopped because of his tragic death. This is why my aim is to make the possibility of bone chemistry researches, and the development of these methods in Hungary. I have made my assay on different recent, and ancient bone remains which were obtained from the Department of Anthropology (University of Szeged, Faculty of Sciences) and Institute of Forensic Medicine (University of Pécs, Faculty of Medicine)

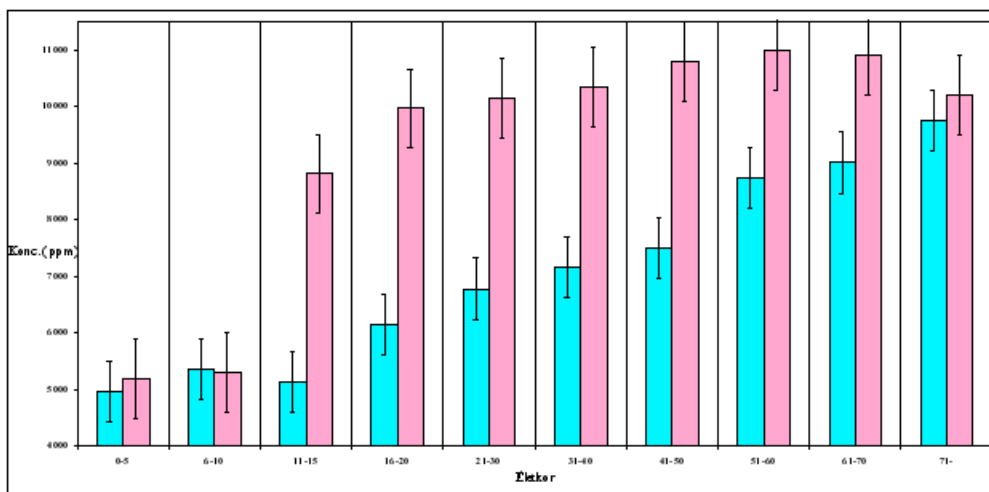
In my dissertation I delineate the general chemical structure of the bone, and the major changes during fossilization. For my assay I have applied several modern analytical methods, most importantly high performance liquid chromatography (HPLC) and matrix assisted laser desorption/ionisation time of flight mass spectrometry (MALDI TOF MS). These two methods have a general role in today's analytic and medical diagnostics, these results are successfully applied by forensic and paleoanthropology too.

2. AIMS

1. Development and routine adaptation of analytical methods which are eligible for sex determination from seriously fragmented historical and forensic material.
2. More precise revealing of connections between dietary and the chemical constitution of bone tissue. Analysis of nutritional habits among the ancient population of the Carpathian basin, especially the time of neolithisation, and the period between the IX. -X. centuries.
3. More exact revealing of burial habits with the help of scientific methods.
4. Developing analytical methods which are eligible for determination of diseases affecting ancient populations (tuberculosis).

4. RESULTS

After the tragic death of prof. Imre Lengyel I have firstly made systematic bone chemistry researches on historical and forensic remains.

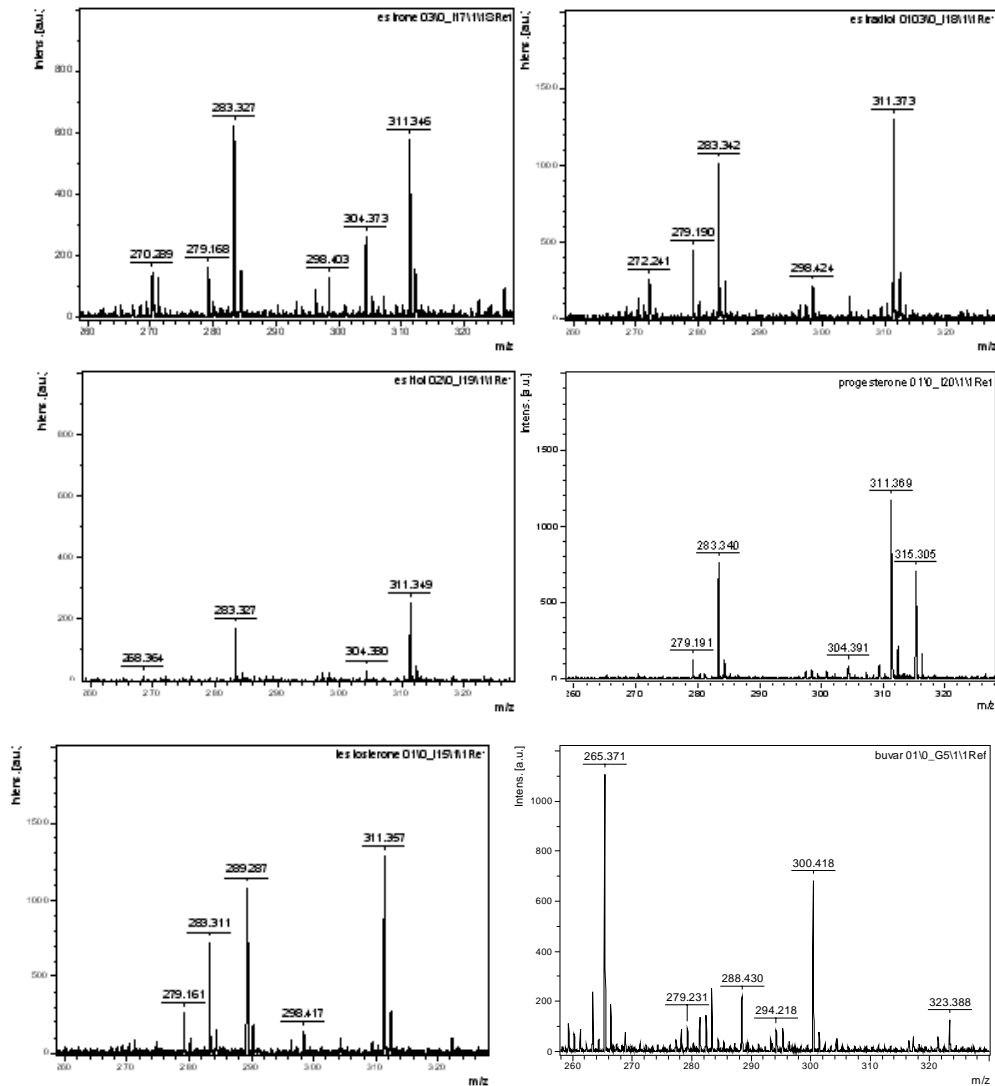


Conformation of citrate content of bones depending on lifespan

1. In the first part of my assay I present methods appropriate for sex-determination, which are completely opportune for analysis of bone remains in bad condition. One of them is the sex determination based on citrate-synthase described by Imre Lengyel,

which I changed, and applied on HPLC to be agreeable to the needs of modern analytical chemistry. The new method is appropriate to determine precisely, sensitively and reproducibly the citrate concentration of fragmented bone samples. My results correlate well with the data described by Lengyel, which tell that the citrate-synthase concentration of the female bones is higher than the similar aged male ones.

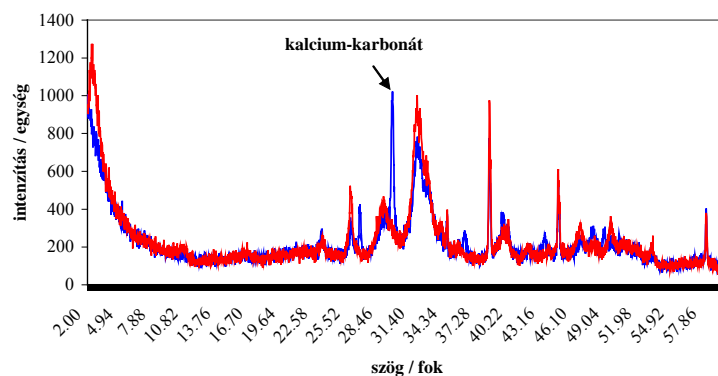
- The other method I developed is a process based on MALDI TOF mass spectrometry, which is eligible for analysis of even a few mg of fragmented bone samples, even in cases when the finding was found in aggressive, corrosive surrounding (corpses from water).



Determination of sexual hormones using MALDI TOF mass spectrometry

During the research I extracted sexual hormones (estrone, estradiol, estriol, progesterone and testosterone) from bone samples, and analyzed them using mass spectrometry. I successfully determined the sex of a recent human remain, a seriously damaged corpse turned up from the river Danube. I made control of morphological and DNA analysis techniques which confirmed my results.

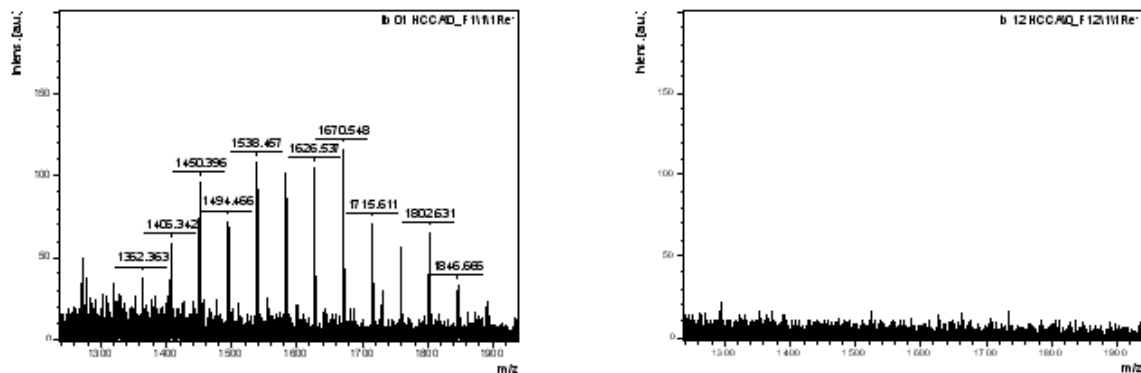
3. I performed the dietary analysis of high number systematically collected anthropological material. I used several modern instrumental analytical techniques from which I firstly applied neutron activation analysis (NAA) and the stable isotope mass spectrometry (SI MS). I detected the fundamental dietary changes in the 9.-11. centuries using chemical methods. I performed the chemical, and dietary analysis, of a complete paleolithic cemetery.
4. I proved the special burial habit among the Sarmatian residents using scientific methods.



Results of roentgen diffraction analysis of the madarasi Sarmatian remains

Based on previous anthropological findings, the remains located in the 600 graved Hun aged Madaras-Halmok quarry are in a very bad condition, and on their surface an unknown organic substance can be found. As a result of my complex chemical researches I could establish a special burial habit among late Sarmatian residents. In my opinion the dead were put in their grave, rolled in tanned leather. In the case of the group applying these special habits I was able to establish difference in life habits, which can point to yet unknown societal and ancestry differences.

5. During my researches I made the analysis of bone samples from different locations showing *Mycobacterium tuberculosis* infection, using MALDI TOF mass spectrometry. I successfully detected mycolic acids represent *Mycobacterium*. Mycolic acid accumulates in the membrane of the bacteria, and is an ideal biomarker because of its stability and hydrophobic kind. With the help of the mass spectrometric method a few milligrams of fractured bone samples can be analysed even if tests for bacterial DNA have proved to be negative.



Infected with Mycobacterium (A) and healthy (B) bone sample MALDI TOF analysis

The method shown in this study gives the base of a long-term pathological research, where I executed the analysis of low molecular mass biomarkers, proteins and peptides. As I think to determine the sequences, and chemical differentiations of proteins extracted from bone samples, can help the development of paleopathology.

6. SUMMARY

MALDI TOF mass spectrometry completely satisfies the needs of high-throughput analytical techniques. With its help a few hundreds of samples can be rapidly analyzed, giving the opportunity of complex processing of complete graves.

I hope that with the help of the developed methods discussed in my dissertation Hungary not only can join international bone chemistry researches, but also play a major role in their development.

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