DIRECT ELECTROTHERMAL ATOMIC-SPECTROPHOTOMETRIC METHOD FOR DETERMINATION OF TIN IN HUMAN PLASMA

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Summary. Tin is spread all over the world. Many studies have been related to the toxicity of the element and its compounds. In the last few decades, the essential character of tin has been established. The aim of the present study is to develop a direct method for tin analyses in human plasma using graphite furnace with Zeeman correction and matrix modification. The optimized furnace conditions and evaluation of the analytical reliability indicate that the atomic absorption assay is suitable for the purposes of toxicological analyses.

Key words: *tin, atomic absorption, graphite furnace, analytical reliability*

INTRODUCTION

Tin is widely spread all over the world. It has been economically important for man since the Bronze Age. However, the essential character of tin has not been known for a long period of time. In the few last decades, it has been established that the element has essential significance in the living body. Tin is very important for nutrition. It takes part in the structure of polypeptide gastrin, secreted in gastrointestinal tract [5]. Especially important is the role of tin in the antioxidant defense and thus in the prevention of cancer [1]. Many studies have been related to the toxicity of tin and its compounds mainly because of extended exposure of man from canned foods and various organo-tin compounds used as plasticizers and fungicides. The toxic effects of tin include inhibitory activity on phospholipid transport and DNA synthesis, mobilization of calcium ions; stano- and stani-compounds stimulate activity of the enzyme hemooxygenase and initiate hem-degradation in the tissues [3].

The analytical techniques for the determination of tin include spectrofluorometry, ICP–spectrometry, chemiluminiscence, neutron-activated analysis. Preferable method is electrothermal atomic-absorption spectrometry (ETAAS).

The aim of the present study is to develop a direct method for tin analyses in human plasma using graphite furnace with Zeeman correction and matrix modification.

MATERIALS AND METHODS

All analyses have been performed using Perkin-Elmer 5000 atomic absorption spectrophotometer with a graphite furnace HGA-500, Zeeman-effect background corrector, autosampler Perkin Elmer AS-40 and data station Perkin Elmer ASDS 10. The samples have been injected onto L'vov platforms in pyrolytical coated graphite tubes. The operating parameters of the spectrophotometer are shown in Table 1.

Table 1. Working parameters of atomic absorption spectrophotometer "Perkin-Elmer Zeeman 5000"

Wavelength – nm	268. 3
Slit of the monochromator – nm	0. 7
Light source (EDL) – W	8
Type of absorbance measurement	Peak Area
Integration time – s	6
Zeeman corrector	+
Sample volume - µl	10

Table 2. Analytical reliability of the direct method for tin determination in plasma using ETAAS with pyrocoated graphite tube and L'vov platform

Parameter	Plasma
Imprecision within a batch (CV %, n = 20)	3. 02
Imprecision between batches (CV%, n = 10)	3. 69
Accuracy (Recovery %)	102
Detection limit (µg/l)	3. 22
Characteristic mass (pg)	31

Blood has been obtained using Becton Dickinson Vacutainer Systems tubes. Plasma has been diluted in polypropylene vessels by proper volume of modifier with the following content: 0.1% $NH_4H_2PO_4$, 0.05% $Mg(NO_3)_2x6H_2O$), 0.14% $Pd(NO_3)_2$, 2% HNO_3, 0.2% TritonX 100.

The calibration curve has been used by the following standards: 0. 168; 0.336; 0.504; 0.627; 0.840 µmol/l.

RESULTS AND DISCUSSION

Furnace parameters for tin analysis have been optimized by altering the pyrolysis and atomization temperatures. Pyrocoated graphite tubes with L'vov platform have been used. Zeeman background corrector removed the spectral interferences during the analysis. The matrix modifier promoted complete pyrolysis of diluted plasma.

To avoid the losses of the element and to improve the form of atomization peak, an additional step at 300°C and two-step pyrolysis at 1300°C have been introduced. Using of Maximum Power Heating System and gas-stop during the atomization allowed to achieve high temperature of atomization at 2400°C and thus volatizing of the element within a few seconds. These atomization conditions reduce the aging of the graphite material. The optimal temperatures of pyrolysis and atomization obtained by us are similar to those reported by other authors [4, 5]. The special covering of the graphite tubes by tantalum or molybdenum minimize the interferences of some ions [6]. The tubes used in this study had no such metal covering. This caused constant non-selective absorption at about 0.050 A.S. and required correction of standard and plasma absorption by graphite cuvette blank.

The experimental results from the optimization of pyrolysis and atomization temperatures are shown in Fig. 1 and Fig. 2.

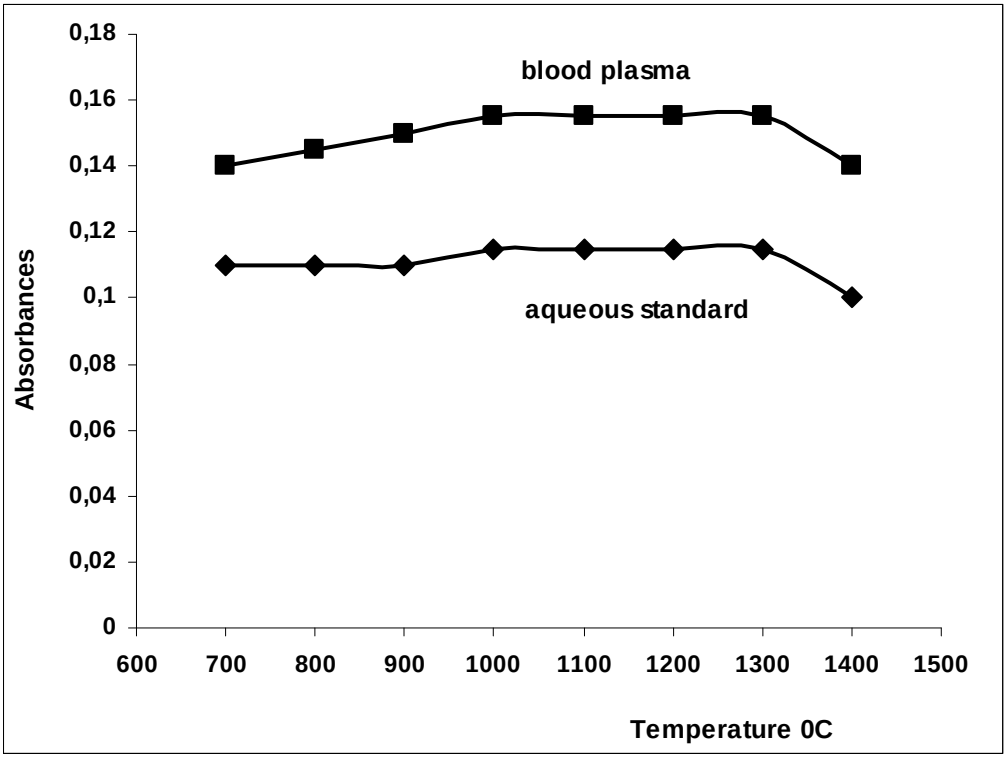

Fig. 1. Optimization of pyrolysis temperature for determination of Sn in blood plasma using ETAAS with pyrocoated graphite tube and L'vov platform

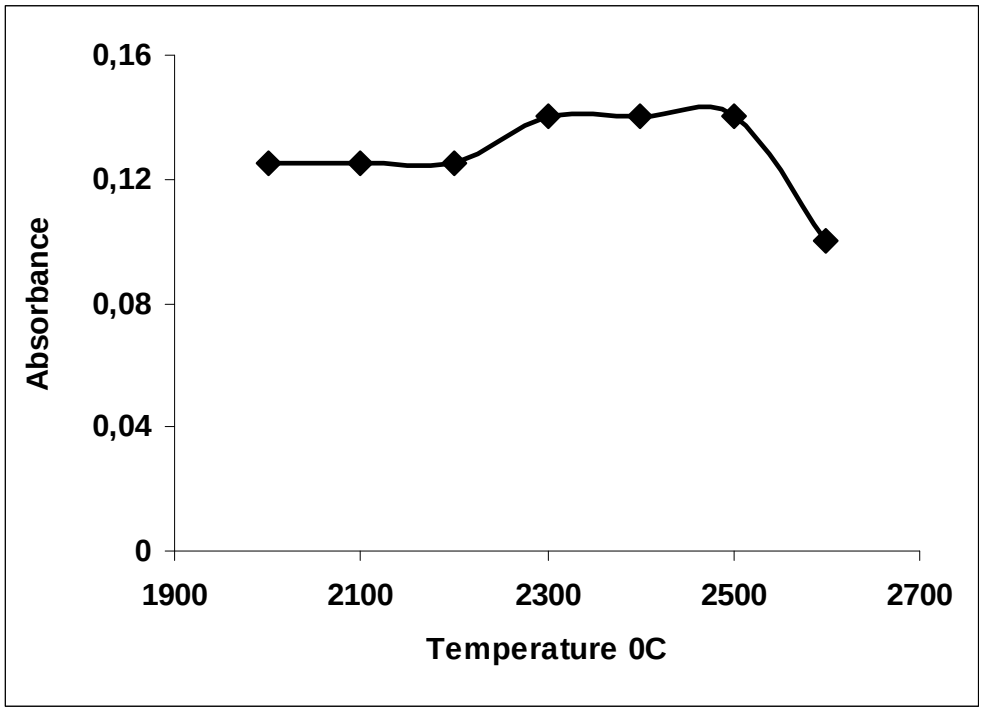

Fig. 2. Optimization of the atomization temperature for the determination of Sn in blood plasma using ETAAS with pyrocoated tube and L'vov platform

The evaluation of the analytical reliability is presented in Table 2. The imprecision within batch is calculated by 20-fold determination of one and the same diluted plasma. Imprecision between batches is expressed for 10 days. The accuracy is expressed as R% (recovery). The sensitivity, expressed as characteristic mass, is 31 pg/ 0.0044 A.S. The detection limit is 3. 22 µg/l.

The developed direct method for Sn determination in plasma is based on modern technology of graphite-furnace atomic absorption analyses: rapid electronics, efficient correction of non-selective absorption, measurement of integrated peak-area and pyrocoated graphite tubes with L'vov platforms. The analytical reliability is characterized according to all requirements of IFCC (International Federation of Clinical Chemistry). The normal concentration of tin in human plasma is about 1 µg/l. The optimized furnace conditions in this study allow reliable quantitative determination of the element over 7. 4 µg/l and make the method suitable for routine monitoring of plasma tin levels for toxicological purposes.

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