Development and application of automatic and miniaturized methods for iodine and iron quantification for thyroid-related disorders

Joana L. A. Miranda, Raquel B. R. Mesquita, António O. S. S. Rangel

Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal;
Email: arangel@porto.ucp.pt

Introduction/Objective

Contribute to the development of cost-effective, robust, reliable, automatic and miniaturized methods

There is evidence of a strong interaction between iron, iodine and thyroid metabolism

Developing flow techniques for the determination of iodine and iron

Iodine

The proposed method consists in a fluorometric detection of the catalytic effect of iodide on the redox reaction between Ce(IV) and As(III), using the Sandell-Kolthoff reaction, in a miniaturized chip-based flow manifold

Iron

The proposed method aimed for the measurement of non transferrin binding iron (NTBI) and it consisted in the functionalization of a resin, for NTBI retention and spectrophotometric detection in a microsequential injection Lab-on-valve (LOV) manifold

Method - Iron

Bidentate 3,4-hydroxyquinidine (3,4-HPO) ligand: previously used as a colour reagent for iron(III)

Somewhat liganded

Syringe pumps

Syringe pumps

UV

Flow injection analysis for total iodine determination

Method - Iodine

Iodine status is based on the concentration of iodine excreted in urine.

Iodine is a component of the thyroid hormones essential for human growth and development.

To accomplish the determination of total iodine in urine, an on-line oxidation process aided by UV radiation was implemented in the developed system.

Diagram of the chip-multisyringe flow injection analysis for total iodine determination.

Some functionalized beads in consecutive cycles

Optical fibers are connected to the multi-channel spectrometer for fluorescence measurement; W: waste.

Conclusions

The development of the proposed methods for the determination of total iodine and NTBI determination is still on going:

- The iodine determination requires the minimization of thiocyanate interference and the on-line digestion of the organo-iodine compounds, accomplished by UV radiation. The developed method is intended to be simpler, faster and more sensitive than the classic approach of the Sandell-Kolthoff reaction.
- The determination of NTBI, several functionalized beads were tested with different ligands attached, proved that the bidentate was the most effective; blood serum will be tested to access potential interferences. The determination using the Lal-on-valve method appears to be an effective alternative automatic solution to the usual batch method.

Acknowledgements

J. L. A. Miranda thanks for the grant NORTE-08-5369-FSE-000007_BD_1. Scientific collaboration from FCT - Fundação para a Ciência e a Tecnologia through project UID/Multi/50016/2019 and with the Group of Analytical Chemistry, Automation and Environment, Department of Chemistry, University of the Balearic Islands, Palma de Mallorca, Spain and the REQUIMTE – LAQV Group from Universidade do Porto is acknowledged.