XXII European Conference on
ANALYTICAL CHEMISTRY

EUROANALYSIS

Barcelona 2025

31 AUGUST - 4 SEPTEMBER

ABSTRACT BOOK

EuChemS
European Chemical Society
Division of Analytical Chemistry

SCQ
Societat Catalana de Química

P3-072

DEVELOPMENT OF A MICROFLUIDIC PAPER-BASED DEVICE FOR ALUMINIUM QUANTIFICATION IN URINE: POTENTIAL IMPLICATIONS FOR ALZHEIMER'S DISEASE MONITORING

Juliana I. S Aguiar[1], Tomás Montenegro[1], Tommaso Presta[1,2], António O. S. S. Rangel[1], Raquel B. R. Mesquita[1]*

*[1]Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005, Porto, Portugal; [2]Università degli studi di Cagliari, Facoltà di Ingegneria e Architettura, Via Marengo 2, 09123, Cagliari, Italia; *Corresponding author: rmesquita@ucp.pt*

In this work, the development of a simple and low-cost microfluidic paper-based analytical device (mPAD) for the colorimetric detection and quantification of aluminium in urine samples is presented. Aluminium exposure is an increasing public health concern due to its potential neurotoxic effects and its association with disorders such as Alzheimer's disease and autism spectrum disorder. In this context, it may be highly advantageous to have a simple fast quantification method to evaluate aluminium exposure. The developed device relies on the colorimetric reaction of Al(III) ions through complexation with Chrome Azurol S (CAS) in a paper-based platform. The formed blue-coloured complex is measurable via scanner-based image analysis using a free image-processing software, such as ImageJ. The colour intensity of the product and convert it into pseudo-absorbance values and a linear relationship with the aluminium concentration is established. The microfluidc paper-based device (mPAD) assembly consists of two layers of paper, enabling vertical fluid transport with simple fabrication. The top layer, composed of Whatman Grade 3 filter paper, acts as a physical barrier to mitigate potential interferences from macromolecules in the urine matrix and as protective barrier for the reagents in the bottom layer. The bottom layer, composed of Whatman Grade 1 filter paper, contains the CAS reagent and an acetate buffer solution. Several chemical and physical optimization studies were carried out to improve the performance of the device. One of the major challenges was matrix interferences, particularly phosphate ions, which can form stable complexes with aluminium, hindering the Al-CAS reaction. To address this, $AgNO_3$ was successfully used as a masking agent, precipitating phosphate and significantly improving the method's selectivity. The mPAD enabled the quantification of aluminium within the concentration range of 0.20 to 2.0 mg/L of Al(III), which covers the levels of interest for exposure monitoring. The limit of detection and limit of quantification were 0.08 and 0.20 mg/L, respectively. The device demonstrated reliable performance for aluminium determination in real urine samples, without requiring complex sample pretreatment. Its simplicity, portability, and selectivity make it a promising tool for rapid and accessible monitoring of aluminium exposure in clinical and environmental settings.

Ackowledgements: This work was supported by National Funds from FCT - Fundação para a Ciência e a Tecnologia through project UIDB/50016/2020.