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Simultaneous determination of ascorbic acid, dopamine, paracetamol, and tryptophan with Cu_xO-ZnO nanoparticles-decorated polypyrrole and reduced graphene oxide modified glassy carbon electrode

Kh. Ghanbari [1,*] S. Bonyadi [1]
[1] Faculty of physics and chemistry, School of Science, Alzahra University

ABSTRACT

In this work, we report the synthesis of Cu_xO-ZnO nanoparticles-decorated polypyrrole and reduced graphene oxide composite (Cu_xO-ZnO/PPy/RGO). This modified electrode was characterized by means of field emission-scanning electron microscopy (FE-SEM) and X-ray diffraction (XRD) and was used for simultaneous determination of four biologic molecules namely ascorbic acid (AA), dopamine (DA), paracetamol (PAR), and tryptophan (Trp). Electrochemical studies were carried out by using cyclic voltammetry (CV) and Differential pulse voltammetry (DPV). This modified electrode (Cu_xO-ZnO/PPy/RGO/GCE) exhibited excellent electrocatalytic activity, high sensitivity, low detection limit and fast response time. The linearity range was 10-475 μM, 0.05-420 μM, 0.5-400 μM and 0.5-185 μM for AA, DA, PAR, and Trp respectively and the detection limit was 0.3 μM, 39 nM, 10 nM and 50 nM for AA, DA, PAR, and Trp respectively. The sensor was used to analysis real sample and had satisfactory results.

Keywords: *Simultaneous determination, Polypyrrole, graphene oxide, Cu_xO-ZnO nanoparticles, ascorbic acid, dopamine, paracetamol and tryptophan*

1. INTRODUCTION

Ascorbic acid (AA) is an essential vitamin in the diet of humans and is present in the mammalian brain along with various neurotransmitter amines [1]. It has been widely used in foods and drinks as an antioxidant and also for the prevention and treatment of common cold, mental illness, infertility, cancer, and AIDS [2]. Dopamine (DA) is an important neurotransmitter, which plays a significant role in the function of the central nervous, renal, hormonal and cardiovascular system [3-5]. Deficiency of DA in human body may result in some serious neurological disorders, such as Parkinson's and schizophrenia disease [6]. Paracetamol (PAR) or acetaminophen (N-acetyl-p aminophenol or 4-acetamidophenol) is a non-steroidal anti-inflammatory and prominent drug that finds widespread application for its strong analgesic and antipyretic action [7]. Considering that it is metabolized in the liver, high level of this compound can cause accumulation of toxic metabolites producing hepatotoxicity, urinary and digestive problems [8, 9]. Tryptophan (2-amino-3-(1H-indol-3-yl)-propionic acid), Trp is essential amino acid for humans and a precursor for serotonin (a neurotransmitter), melatonin (a neurohormone), and niacin and finds importance in nitrogen balance and the maintenance of muscle mass and body weight in humans [10-13]. However, Trp is scarcely present in vegetable products. So it is sometimes added to dietary and food products as a food fortifier and to pharmaceutical formulations in order to correct possible dietary deficiencies [14]. As had said AA, DA, PAR, and Trp are considered as crucial small biomolecules physiological processes in human metabolism. Therefore simultaneous determination of those, have great importance.

A range of analytical techniques such as chromatography [15], spectrophotometry [16], chemiluminescence [17] and capillary electrophoresis [18] are reported in the literature for detection of these biological molecules. All