Electrochemical behavior and determination of ketoprofen at glassy--carbon electrode

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Introduction

Ketoprofen (2-(3-benzoylphenyl)-propionic acid) is a nonsteroidal anti-inflammatory drug (NSAID) with analgesic and antipyretic actions, that make it valuable in the treatment of rheumatoid arthritis and to relieve mild to moderate pain (Medina-López, Vara-Gama, Soria-Arteche, Moreno-Rocha, & López-Muñoz, 2018). The widespread and growing medical application needs to be followed by the development of analytical techniques for detection of ketoprofen traces in various body fluids or wastewaters. Several methods have already been reported for quantitative determination of ketoprofen, including chromatography (Emhofer, Himmelsbach, Buchberger, & Klampfl, 2017; Jin, Zhang, Jin, & Lee, 2018), UV-spectrophotometric (M. Blanco, Coello, Iturriaga, MasPOCH, & Alaoui-Ismaïli, 1997), capillary electrophoresis (Marcelo Blanco, González, Torras, & Valverde, 2003) and fluorescence (Maciążek-Jurczyk, 2014; Molina-García, Santos, Ruiz-Medina, & Llorent-Martínez, 2013). Application of all these methods is time-consuming and require numerous sample pretreatment steps. Electrochemical methods have a number of advantages like high selectivity and sensitivity or simple design of the analytical equipment. Electrochemical studies of ketoprofen have already been performed using mercury drop (Ghoneim & Tawfik, 2003), boron-doped diamond (Domínguez, González, Palo, & Sánchez-Martín, 2010) or platinum electrode (Muthu, Latha, G.Bhaskar, & Yoshihara, 2010) and recently indium tin oxide (ITO)-coated optical fiber sensor (Bogdanowicz et al., 2018). The aim of the present work was determine the electrochemical behavior of ketoprofen analyzed at glassy-carbon electrode. The limit of detection of ketoprofen was calculated.

Materials and Methods

Ketoprofen was purchased from of purity greater than 98% was obtained from Cayman Company (Ann Arbor, MI, USA) and all other chemicals were of analytical grade and used without further purification. Ultrapure water was used to prepare aqueous solutions. The pH of the buffer

solutions was measured using the pH-meter electrode. The voltammetric determination of ketoprofen was carried out in 0.01 M PBS (physiologically pH = 7.0) using cyclic voltammetry and differential pulse voltammetry. Electrochemical measurements were performed using the potentiostat AutoLab PGStat 128N (Metrohm) at room temperature in a standard three-electrode assembly, which consisted of Ag/AgCl/0.1 M NaCl as the reference electrode, a platinum wire as the counter electrode, and GC electrode (disk diameter, 3.0 mm) as the working electrode. The experimental conditions: cyclic voltammetry (CV), the potential ranging from -1 to -1.8 V, scan rate 100 mV/s. Differential pulse voltammetry (DPV), the potential ranging from -1 to -1.8 V, the amplitude modulation of 50 mV, the pulse width of 70 ms, and the scan rate of 5 mV/s.

Results

Cyclic voltammetry was performed to investigate the electrochemical behavior of ketoprofen on GC electrode at a scan rate of 100 mV/s. Performed measurements show, that the reduction peak of ketoprofen occurs at -1.3 V and is irreversible. The Figure 1 show the differential pulse voltammograms of ketoprofen under various concentrations. The cathodic peak current of ketoprofen is linear to its concentration and systematically increases with increasing concentration in the range 9 µM to 5 mM and limit of detection (LOD) was found to be 11.4 µM, respectively (S/N = 3).

Fig. 1. Differential pulse voltammograms of various concentrations of ketoprofen (0.01 M PBS, pH = 7.0) at glassy-carbon electrode, scan rate: 100 mV/s. Insert: the plot of the peak current vs. concentration of paracetamol.

Discussion

The glassy carbon electrode was used for determination of ketoprofen in pH 7.0. Obtained results show that this electrode can be used as a working electrode without any modification to obtain measurable signals (LOD=11.4 μM).

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