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Electrooxidation of morin on glassy carbon electrode modified by carboxylated single-walled carbon nanotubes and surfactants

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ABSTRACT

Voltammetric characteristics of morin on glassy carbon electrode (GCE) modified by carboxylated sing walled carbon nanotubes (SWNT-COOH) and surfactants in phosphate buffer have been found. Catio cetylpyridium bromide (CPB), nonionic Triton X100 and anionic sodium dodecylsulfate surfacta under different concentrations have been tested as modifier of SWNT-COOH/GCE. The form of CVs a oxidation potentials are not changed significantly in the presence of all type surfactants on the el trode surface that confirms negligible influence of surfactant on electron transfer rate. Morin oxidat currents are increased on surfactant-modified electrodes. The best characteristics are observed on C (1 μM)/SWNT-COOH/GCE when 1.8-fold increase of oxidation currents has been observed in compa son with SWNT-COOH/GCE. Mechanism of morin oxidation on CPB/SWNT-COOH/GCE is suggested the basis of relationship between oxidation potential and pH of supporting electrolyte. Electrooxi tion is adsorption-controlled irreversible two-step process with participation of one electron and o proton on each step. The linear dynamic ranges of morin determination under conditions of differen pulse voltammetry are 0.1-100 and 100-750 μM with the limits of detection and quantification 28.9 a 96.0 nM of morin, respectively. The developed approach applied for morin quantification in mulbe leaves using preliminary extraction with ethanol.

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1. Introduction

Morin (3,2′,4′,5,7-pentahydroxyflavone) is one of the natural flavonoids that is presented in plants, fruits, flowers and plant derived materials [1,2]. It belongs to flavonol subclass and consists of two aromatic rings (A and B in Scheme 1) which are linked by an oxygen-containing heterocycle (ring C).

Morin possesses various biological and biochemical effects including anti-inflammatory, antineoplastic, cardioprotective activities [3–5] and chemopreventive effect against oral carcinogenesis *in vitro* and *in vivo* [6]. Moreover, it shows antioxidant properties that realized via different mechanisms: scavenging of reactive oxygen species, inhibition of the enzymes participating in reactive oxygen species production, chelation of low valent metal ions such as Fe^{2+} or Cu^{2+} and regeneration of membrane bound antioxidants such as α-tocopherol [7–10].

Antioxidant properties of morin are caused by ability to el tron transfer that allows to use electrochemical methods for th investigation. Electrochemical measurements leading to the det mination of physicochemical parameters for antioxidants (e redox potential, number of electrons transferred, electrode rea tion rate constant, etc), are relevant also for understanding t reaction mechanisms. On the other hand, the electroanalyti techniques have advantages over other analytical methods, such rapid response, higher sensitivity and low detection limits, as w the possibility to improve the selectivity by using suitable electro conditions.

Therefore, a number of electrochemical methods usi bare glassy carbon (GCE) [11,12], platinum [13,14] and har ing mercury dropping [15] electrodes as well as vario modified electrodes based on graphene oxide/silver nanopar cles [16], poly(tetrafluroethylene)-deoxyribonucleate acid fil modified GCE [17], polyvinylpyrrolidone-doped carbon pa electrode [18], multi-walled carbon nanotubes-paraffin oil pa electrode [19] and nujol-graphite or diphenylether-graphite pa electrodes [20] have been developed for morin determi tion. Application of chemically modified electrodes increases t sensitivity and selectivity of quantification. Different types

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