

A STUDY ON LOCAL ANAESTHETICS. PART 202. DETERMINATION OF THE CRITICAL MICELLAR CONCENTRATION OF CARBISOCAINIUM CHLORIDE IN WATER USING SPECTRAL METHODS AND THE PROBE PYRENE

ŠTÚDIUM LOKÁLNYCH ANESTETÍK. ČASŤ 202. STANOVENIE KRITICKEJ MICELOVEJ KONCENTRÁCIE KARBIZOAKÍNIUMCHLORIDU VO VODE VYUŽITÍM SPEKTRÁLNYCH METÓD A SONDY PYRÉNU

Original research article

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Abstract The micellization process of the local anaesthetic carbisocainium chloride in water was investigated by two spectral methods using the probe pyrene. First, the absorption spectroscopy in ultraviolet/Visible (UV/VIS) region was based on studying changes in characteristic absorption spectrum of pyrene in the presence of a surfactant. The resultant plot of the sum of absorbances for all the major pyrene peaks as a function of the total surfactant concentration shows, around the critical micellar concentration, a typical sigmoidal increase. Second, the fluorescence emission spectroscopy in UV/VIS region of spectrum by the probe pyrene was applied for the determination of the *critical micellar concentration* from the measurements of the pyrene I_1/I_3 ratio as a function of the surfactant concentration. The pyrene ratio data were fitted by the Boltzmann-type sigmoid of decreasing character.

Slovak abstract Micelizačný proces lokálneho anestetika karbizokaíniumchloridu vo vode sa študoval dvomi spektrálnymi metódami v UV/VIS oblasti spektra využitím sondy pyrénu. Prvá, absorpčná spektroskopia, je založená na skúmaní zmien v charakteristickom absorpčnom spektre pyrénu v prítomnosti surfaktantu. Výsledná závislosť súčtu absorbancií všetkých hlavných pyrénových píkovo od koncentrácie surfaktantu vykazuje, okolo kritickej micelovej koncentrácie, typický sigmoidálny vzrast. Fluorescenčná emisná spektroskopia pomocou pyrénu ako sondy, druhá metóda, sa použila na determináciu *cmc* zo závislosti pyrénového pomeru ako funkcie koncentrácie surfaktantu. Táto závislosť bola fitovaná sigmoidálnou funkciou Boltzmannovho typu, ktorá má klesajúci charakter.

Keywords local anaesthetic – carbisocainium chloride – critical micellar concentration – pyrene – Sigmoidal-Boltzmann equation

Kľúčové slová: lokálne anestetikum – karbizokaíniumchlorid – kritická micelová koncentrácia – pyrén – Sigmoidálna-Boltzmannova rovnica

1. Introduction

One of the basic phenomena occurring in surfactant solutions is the aggregation of amphiphilic molecules. The formation of these aggregates, the so-called micelles, is determined by the chemical nature of amphiphilic molecules and the physicochemical conditions of the solvent (Fainerman et al., 2001). When dissolved in water, they lower the surface tension of the water and increase the solubility of organic compounds (Basu Ray et al., 2006). The narrow concentration range where aggregates start to form and the physicochemical properties of the solution change abruptly has been called the critical micellar concentration (*cmc*) (Fainerman et al., 2001).

The process of self-association of surfactants into micelles, vesicles and membranes plays a very important role in many

areas, ranging from biological systems to technical applications (Tanford, 1980).

There are several techniques such as tensiometry, conductometry, fluorimetry, calorimetry and nuclear magnetic resonance (NMR) spectroscopy for the determination of *cmc*. Spectral methods such as absorption spectroscopy in ultraviolet/visible (UV/VIS) region of spectrum and fluorescence spectroscopy using other compounds as probes are also used for the evaluation of *cmc* (Aguiar et al., 2003; Basu Ray et al., 2006).

Pyrene as a fluorescent probe has become one of the most studied of all organic molecules in terms of its photophysical properties (Vullev et al., 2005). As a consequence of the strong influence of the surrounding medium on fluorescence