

Potentiometric Sensor for the Determination of Dibucaine in Pharmaceutical Preparations and Electrochemical Study of the Drug with BSA

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Plasticized poly(vinyl chloride), PVCs, with different membrane compositions tested for use in the construction of an ion-selective sensor for the determination dibucaine. A prepared membrane with dioctyl phthalate-PVC and ion-pair of *N*-(1-naphthyl)ethylenediamine dihydrochloride-tetraphenyl borate had a good potential to acts as a potentiometric sensor for the analysis of dibucaine. A linear relationship was obtained between potential and logC varying between 1.0×10^{-6} and 1.0×10^{-2} M dibucaine with a good repeatability and reproducibility. The sensor was applied for the determination of the drug in pharmaceuticals and biological fluids such as plasma and urine samples with satisfactory results. The drug electrode has also been used to study the interaction of bovine serum albumin (BSA) with dibucaine. The saturated quantities of dibucaine binding were 13.04, 5.30 and 9.70 mol/mol in 0.01, 0.02 and 0.1% of protein, respectively.

Key Words : Protein interaction, Dibucaine, Potentiometry, Ion selective electrode

Introduction

Dibucaine hydrochloride, 2-butoxy-*N*-(2-diethylaminoethyl) quinoline-4-carboxamide hydrochloride is a drug that was first synthesized by Miescher.¹ It is used in various formulations such as ointments, creams, suppositories and injections. In the following application it is the essential part of a haemorrhoidal ointment. Several procedures have been reported in the literature for the analysis of dibucaine. These methods are spectrophotometry,^{2,3} fluorimetry,⁴ polarography,⁵ high performance liquid chromatography,⁶ gas chromatography,⁷ thin-layer chromatography,⁸ electrophoresis,⁹ ion-selective electrodes.¹⁰

The use of ion-selective electrodes for the determination of pharmaceutical compounds have been reviewed especially with potentiometric titrations based on ion-pair formation.¹¹ These reviews showed that potentiometric detection based on ion-selective electrodes (ISEs), offers several advantages such as speed and ease of preparation and procedures, simple instrumentation, relatively fast response, wide dynamic range, reasonable selectivity, and low cost.¹² Potentiometric ion-selective electrodes have been reported for the determination of pharmaceutical compounds such as amiloride,^{13,14} pentazocine,¹⁵ betahistine,¹⁶ desipramine¹⁷ and venlafaxine.¹⁸ According to our knowledge, only one reported paper presents about potentiometric determination of dibucaine¹⁰ based on dibenzo-24-crown-8 ether-PVC electrode, with a linear calibration range of 0.001-1.0 M.

In this study, a plasticized poly(vinyl chloride) membrane with different compositions using *N*-(1-naphthyl) ethylenediamine dihydrochloride sodium tetraphenyl borate as an ionophore was used. The potential responses of different membranes sensor towards dibucaine were studied. After optimization of the membrane composition, the potentiometric sensor was successfully used for the determination of

dibucaine in body fluids with satisfactory results.

Experimental

Apparatus. Potentials were measured by direct potentiometry at 25 ± 0.1 °C with the help of ceramic junction calomel electrodes and the cell set-up was as follows:



All potentiometric measurements were made with a pH/mV meter, Corning, Model 140 (Switzerland). All emf measurements were carried out in a 50-mL double walled glass cell with a constant magnetic stirring. Response times were determined after the potential of the solution had become constant, and similar measurements were carried out in another solution of 100-fold lower concentration.

A pH-meter, Corning, Model 140 (Switzerland), with a double junction glass electrode was used to check the pH of the solutions.

Reagents and Solutions. All chemicals used were of analytical reagents grade and were used without further purification. All solutions were prepared by dissolving the chemicals and the salts of metal nitrates in distilled deionized water.

PVCs of high relative molecular weight, sodium tetraphenyl borate (NaTPB), dibutyl phthalate (DBP), dioctyl phthalate (DOP), dioctylsebacate (DOS), tetrahydrofuran (THF), Bovine serum albumin (BSA) and all other chemicals were of highest purity available from Aldrich (Milwaukee, USA), and were used without further purifications, except for THF which was distilled before use.

Aliquot solution, 0.010 M, dibucaine hydrochloride was prepared by dissolving 0.3799 g of the corresponding compound, respectively, in water and diluted to 100 mL with