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Selective Electrochemical Determination of Desipramine Using a Lipid Modified Carbon Paste Electrode

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Abstract: ***Carbon paste electrodes have been modified with some lipidsfor the sensitive and selective detection of the antidepressant (Desipramine). Voltammetric experimental conditions were optimized taking into account the importance of quantifying desipramine in the complex media and in the pharmaceutical formulations. The sensor(Lauric acid modified carbon paste electrode) responds to desipramine giving a cathodic current (at +0.88 V vs. Ag/AgCl electrode and pH 9). The response was characterized with respect to preconcentration potential, accumulation time, paste composition, possible interferences and other variables. A linear relationship between peak response and desipramineconcentration over the range from 1 x10^{-7} to 1 x10^{-6} M. with standarad deviation of 5.5 %.A detection limit of 3.3 x10^{-10}M was obtained under the optimum conditions The method has been applied to the determination of desipramine in serum and urine samples.***

Keywords: Desipramine, Linear sweep voltammetry, carbon paste electrode, Fatty acids, modifiers.

1. Introduction

The tricyclic antidepressants are the most widely used drug for treatment of depression. And hence their measurements in body fluids are of great interest in bioanalysis. Wang et al determined the sensitivity and selectivity of tricyclic antidepressants at carbon paste and lipid –coated glassy carbon paste electrodes.[1,2], modified carbon paste electrodes were used for the determination of promethazine and other organic compounds based on the enhancement of the peak response [3-6], the use of carbon paste matrix is dictated by its interesting mechanical and electrochemical properties as well as by its ability to preconcentrate organic molecules [7-10]. To increase the sensitivity and selectivity of preconcentration step, variety of modifiers were incorporated into the carbon paste matrix also carbon printed electrodes were used for the determination of some anions [11,12]

Lipid –modified carbon paste electrodes were electrochemically characterized and their potentials for drug analysis with conventional carbon paste electrodes. The presence of lipids (Fatty Acids, Phospholipids) in the paste matrix enhanced the current Reponses with improved reproducibility. On using 300 s accumulation time , the tricyclic imipramine exhibit a 40-fold enhancement of the response compared to that obtained without accumulation [13], for desipramin some authors reported some sensors for determination of desipramine[14-15]

2. Experiment

2.1Electrodes

Carbon paste was prepared by thoroughly hand mixing 2g. of graphite powder and 0.8 ml of paraffin oil in a mortar and pestle in a minimum amount of chloroform ; the solvent was allowed to evaporate overnight at room temperature . Modified electrodes were prepared in a similar fashion except that the graphite powder was first mixed with a definite weight of the fatty acids. The working electrode s were prepared by pressing the paste into a tip of micropipette then polishing using clean paper (Fig. 1.). A fresh surface was utilized for each experiment.

2.2 Instrumentation

A computer-aided electrochemistry system was used in the voltammetric and amperometric studies. The system consists of a potentiostat Model 263A (EG&G PARC, Princeton Applied Research Corporation, USA) and Electroanalytical software Model 270/250 version 4.0 (PARC).

An Orion research model 601 digital ionalyzer pH-meter

2.3 Procedures

25 ml of the selected supporting electrolyte was used and an experiment was carried out to record the base line. Then the analyt is added after suitable dilution. Using a scan rate of 50 mV/s and the other selected conditions

3. Results and Discussions

The electrochemical oxidation of desipramine results in one irreversible anodic peak at Lauric acid modified carbon paste electrode (LuMCPE) at potential of + 880 mV. Different analytical parameters such as pH, supporting electrolyte, paste composition , accumulation time and many other factors were investigated. As following

3.1 The effect of supporting electrolytes and the solution pH

Phosphate, sodium acetate and sodium borate were tested,. A concentration of 0.1 M phosphate was selected which it gives, the most favorable results in terms of signal versus backgrounds current From other hand, the results collected using solutions of different pH values ranged from 3.0 to

11.0, showed a little current enhancement in acidic media. A marked increase in response was observed at pH above 7.0 with a maximum value at pH equals 9.0. Then a distorted peak with decreasing current was noticed at pH values higher than 9.0. as shown in Fig. 2.

3.2 Effect of accumulation Time

From the resulting linear sweep voltammograme one can observes a rapid increase in the peak current intensity of desiramine as a function of deposition time with a maximum at 300 s. as shown in Fig. 3. This indicates an electrode process governed first by surface adsorption and subsequently by diffusion into the pasting liquid [16].as a function of

3.3 The effect of the paste composition

Different ratios of The modifier (Lauric acid) were immobilized with the carbon paste ranged from 1 % to 10 %. The best response was obtained with 5 % Lauric acid as indicated in Fig 4., Higher percentage than this ratio resulted a distortion of the peak shape.

4. Calibration Curve

Quantitative work based on the dependence of peak current on the desipramine concentration. A linear behavior was observed over the range from 1 x 10-7 to 1 x10-6 M with correlation coefficient of 0.994 and sensitivity of 1.69 mA/ mM. the collected data were drawn and presented in Fig. 5.

5. Reproducibility

The reproducibility of the adsorption process has been estimated from five trials for two different concentration of desipramine (5×10^{-7} and 5×10^{-6} M) . A standard deviation of 5.5 % was obtained

Effect of possible interfering compounds

The potent interfering compound which can be present in biological samples is ascorbic acid . the effect of concentration up 10-7 M decreased the peak current of the presence of amino acid glycine, alanine and glutamic acid was investigated and a concentration of 1:1, interfering : desipramine showed no effect of Desipramine peak response.

6. The Detection Limit

The limit of detection was calculated based on S/N = 3, a value of 3.3×10^{-10} M which is more better than the reported one [15]

7. Analytical Application

The suggested method was applied to determine desipramine in biological media (urine and serum). The samples of urine were diluted in which 1.0 ml of urine completed to 10 ml using phosphate buffer pH .9.0, then different concentrations of desipramine were added and the voltammograms recorded, a recovery of 97.2 % was obtained

The same procedures were followed for the determination of desipramine in serum samples and a recovery of 95.2 % was obtained

8. Conclusion

A new carbon paste electrode modified with Lauric acid or Stearic acid was used for the voltammetric determination of the tricyclic antidepressant drug Desipramine, the method was applied for the determination of the drug in biological samples (urine and serum). On plotting [Desipramine] versus the peak response a, a linear behavior was observed over the range from 1×10^{-7} to 1×10^{-6} M desipramine under the optimum conditions with a correlation coefficient of 0.9980. . The collected results showed a good repeatability with standard deviation of 5.5 % and a detection limit of 3.3 x10-10 M was calculated

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Figure 1: Carbon paste Electrode modified with Lauric Acid

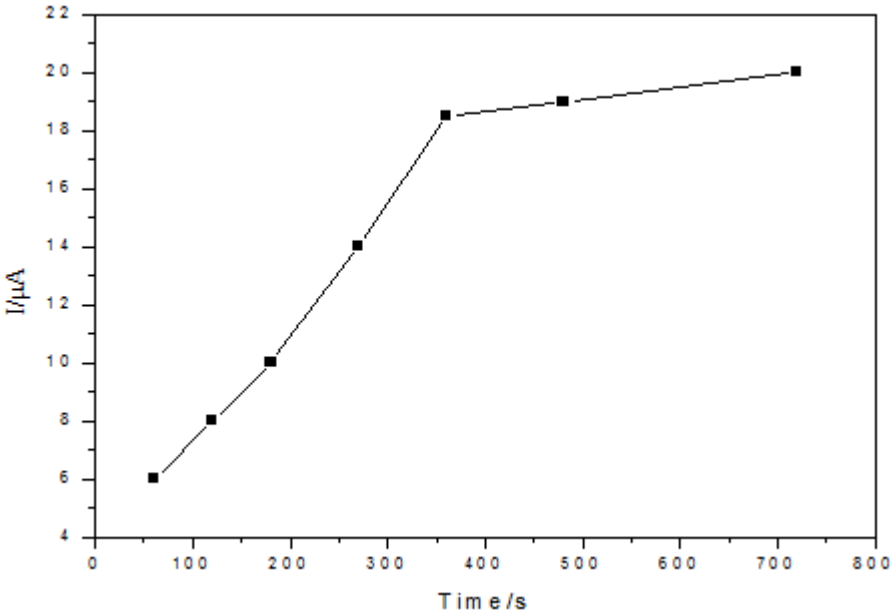

Figure 2: The peak current response of 1 x 10-5 mol dm-3 at different accumulation times , scan rate of 50 mV , Phosphate buffer, pH = 9.0

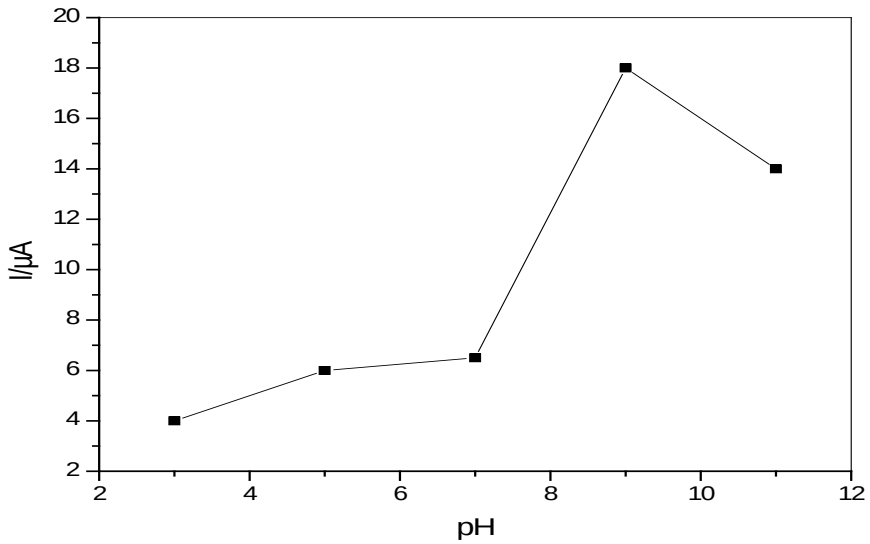

Figure 3: Linear scan peak currents as a function of pH ,[Dsipramine] = 1 x10-5 moldm, accumulation time 300s.

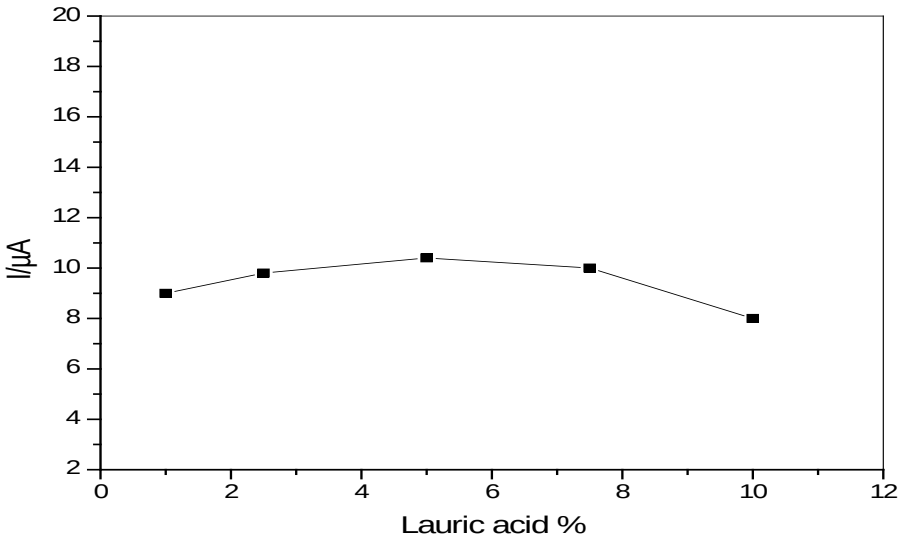

Figure 4: Linear scan peak currents as a function of lauric acid ratio in the paste composition, ,[Dsipramine] = 1 x10-5 moldm, accumulation time 300s

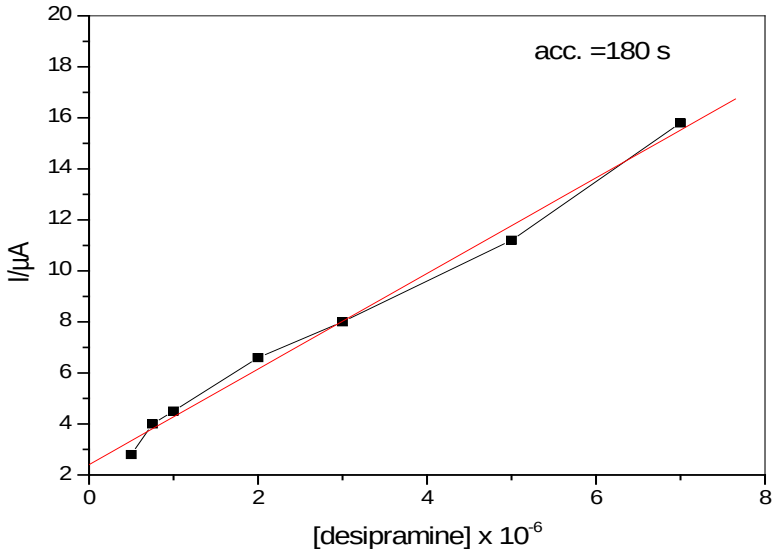

Figure 5: The peak response as afunction of {desipramine] using phosphate buffer pH 9.0 and scan rate of 50 mV, Accumulation time =180 s.