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Original Article

VOLTAMMETRIC DETERMINATION OF DESLORATADINE IN PHARMACEUTICAL AND HUMAN URINE SAMPLES USING GLASSY CARBON ELECTRODE

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ABSTRACT

Objective: The electrochemical behaviour of Desloratadine (DLTD) in pharmaceutical and human urine samples at glassy carbon electrode was investigated by cyclic voltammetry (CV) and square wave voltammetry (SWV).

Methods: A well defined reduction peak was observed at potential -1.55V in phosphate buffer solution (PBS) in basic medium. The reduction process was observed to be irreversible over the pH range from pH 2.0 to pH 10.0. The influence of different parameters such as the effect of pH, scan rate and concentration of the drug was studied. The probable reaction mechanism involved in the reduction of DLTD was also proposed. A SWV method with good recovery and accuracy was obtained for the determination of DLTD in pharmaceutical formulations and urine samples.

Results: The peak currents were found to be linearly dependent on the concentration range of $2.55x10^{-5}$to $1.5x10^{-3}$M of DLTD. The limit of detection (LOD) and limit of quantification (LOQ) were found to be $2.75x\ 10^{-9}$M, $3.20x\ 10^{-7}$ M respectively.

Conclusion: The proposed method was successfully applied for determination of DLTD in pharmaceutical and human urine samples.

Keywords: Desloratadine, Cyclic voltammetry, Square wave voltammetry, Glassy carbon electrode, Phosphate buffer.

INTRODUCTION

Desloratadine (DLTD) is a tricyclic antihistamine, which has a selective and peripheral H_1-antagonist action. It is an antagonist at histamine H1 receptors and an antagonist at all subtypes of the muscarinic acetylcholine receptor. Its chemical name is 8-chloro-6, 11-dihydro-11-(4-piperidinyidene)-5H benzo [5,6] cyclohepta [1,2,b] pyridine and has a structure as below (Fig.1). It has a long-lasting effect and in moderate and low doses, does not cause drowsiness, because it does not readily enter in to the central nervous system [1]. Unlike other antihistamines, DLTD is also effective in relieving nasal congestion, particularly in patients with allergic rhinitis [2]. A number of papers regarding the analytical approach for DLTD determination in plasma and pharmaceutical formulations are mentioned in literature [3-8].

n recent times a bio analytical method for determination DLTD and its metabolite 3-OH-DLTD using ultra high pressure liquid chromatography in conjunction with mix mode solid phase extraction is published which involved gas chromatography with nitrogen–phosphorus detection liquid chromatography with fluorescence detection and ultraviolet detection or mass spectrometric detection [9-15]. Mara et al. Reported electrochemical behaviour or voltammetric methods for determination of DLTD and its metabolite [16]. In the present work focused on an electrochemical determination of DLTD in pharmaceutical and human urine samples using glassy carbon electrode. It was chosen to get the reduction mechanism of >C=N< group by employing advanced electrochemical techniques such as cyclic voltammetry, square wave voltammetry. Therefore, a rapid and sensitive voltammetric method has been applied to determination of DLTD in pharmaceutical and spiked urine samples.

MATERIALS AND METHODS

Apparatus

Electrochemical studies were carried out by Autolab PG STAT101 supplied by Metrohm Autolab B. V., The Netherlands. A three electrode systems comprising of a glassy carbon electrode as a working electrode. Glassy carbon electrode (GCE-3 mm) obtained from Metrohm India Ltd Chennai. Saturated Ag/AgCl/KCl as a reference electrode and Pt wire as a counter electrode. An Elico LI-120 pH meter supplied by Elico Ltd, Hyderabad, India was used to determine the pH of the buffer solution.

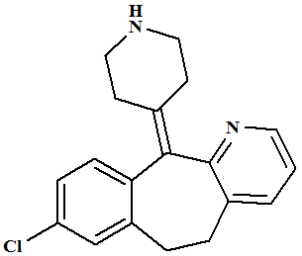


Fig. 1: Structure of desloratadine (DLTD)

Chemical and reagents

A stock solution of DLTD (1.0×10^{-3} M) was prepared by dissolving of DLTD in methanol and it was further with same solvent diluted up to 100 ml to give appropriate concentrations. The solution was stable for 2 weeks in a refrigerator at about 4°C. The working solutions of the drug were prepared daily by diluting the stock solution with a selected supporting electrolyte. The supporting electrolyte was usually phosphate buffer containing Na_2HPO_4 and NaH_2PO_4. Double distilled water was used throughout the work. All other solvents and reagents used throughout this study were of analytical grade.

Analytical procedure

After 10 ml of phosphate buffer (PBS) of pH 9.0 was placed in the electrochemical cell, to this certain volume of standard solution ($2.55x10^{-5}$M) of DLTD was added and de-aerated with pure nitrogen for 10 min. Then the voltammograms were recorded using cyclic voltammetry and square wave voltammetry over the potential range -0.90V to -1.75V vs Ag/AgCl/KCl. All measurements were carried out at room temperature.

Assay of tablets

The tablets of DLTD were obtained from local commercial sources. Ten tablets were weighed accurately and ground to a fine powder.

A portion of the powder equivalent to 1 mM DLTD was transferred to a 100 ml volumetric flask and completed to volume with distilled water and sonicated for 15 min to affect complete dissolution. The sample from the clear supernatant liquor was withdrawn and quantitatively diluted with the selected supporting electrolyte. The content of the drug in tablet was determined referring to the calibration graph using square wave voltammetry.

RESULTS AND DISCUSSIONS

Cyclic voltammetric study

The electrochemical behaviour of DLTD in pharmaceutical and human urine samples at glassy carbon electrode was investigated using cyclic voltammetry (CV) at various pH values. The cyclic voltammograms are obtained for $2.55x10^{-5}$M DLTD solution at a scan rate of 50 mV/s and exhibits a well-defined irreversible cathodic peak at about -1.55V at glassy carbon electrode in phosphate buffer solution of pH 9.0. The results are shown in Fig. 2. The drug DLTD exhibits reduction peak with lowest current and negative potentials. However, no peak was observed in the reverse scan, suggesting that the reduction process is an irreversible one. The reduction product in turn did not show any oxidized peak at the extended ranges of potential. According to the previous results presented, it is supposed that the pathway of DLTD reduction at the unsaturated C=N bond of pyridine ring is reduced on the glassy carbon electrodes preferably of the protonated form, and involves transfer of two electrons, yielding saturated bond. The proposed reduction mechanism is shown in scheme 1.

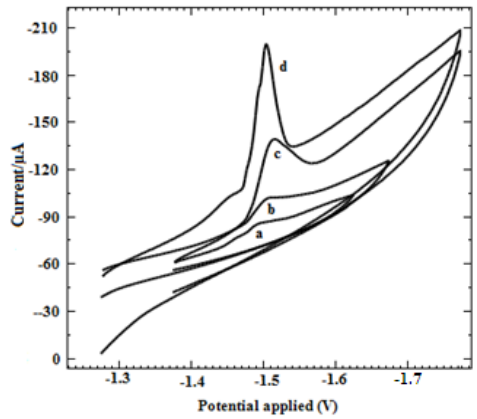
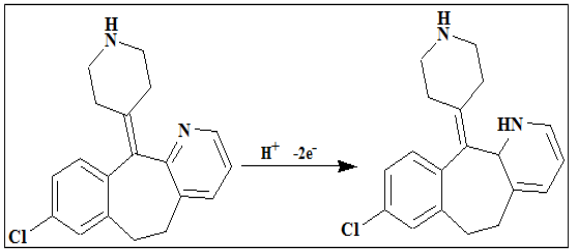


Fig. 2: Typical cyclic voltammograms of DLTD in PB solution, concentration: $2.55x10^{-5}$M at glassy carbon electrode in different pH values from pH 4.0-10.0 (a to d)



Scheme 1: Reduction mechanism of DLTD

Effect of pH

The pH of the solution is a significant aspect affecting the rate of accumulation process and the rate of electrode reaction. The influence of pH on the peak current was studied at glassy carbon electrode for DLTD of concentration $2.55x10^{-5}$M between pH 2.0 to pH 12.0. It was evident from that the maximum peak current was obtained at pH 9.0. When the pH was increased, the peak potential shifted towards more negative values indicating proton participation in the reduction process. The well defined voltammograms were obtained, which are strongly dependent on buffers and pH of the medium. Phosphate buffer was used in the study and the best results in terms of peak shape were obtained at pH 8.0 to pH 12.0, but most intense peak was observed at pH 9.0. From the plot of current vs pH (Fig. 3) and potential vs pH (Fig.4), it is clearly shows that with increase from pH 4.0 to pH 8.0 It may be due to less availability of protons at lower pH. Therefore, pH 9.0 was chosen as optimum one for the study of DLTD reduction.

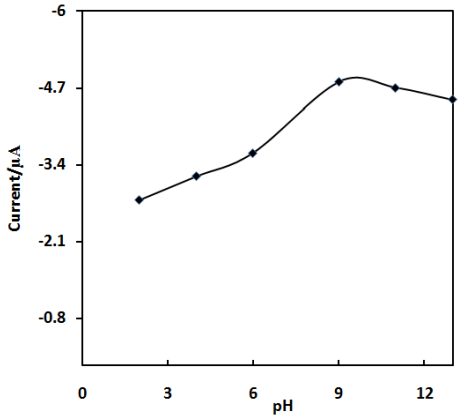


Fig. 3: The plot the of current vs pH of DLTD in PB solution, concentration: $2.55x10^{-5}$M at glassy carbon electrode in different pH values

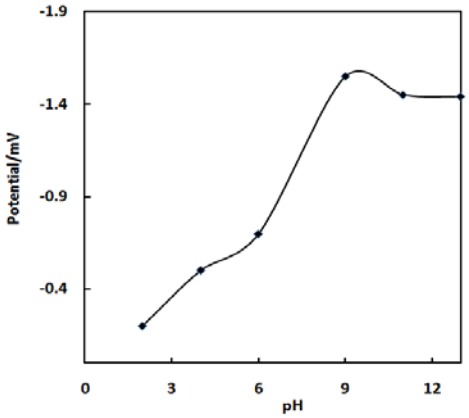


Fig. 4: The plot of the potential vs pH of DLTD in PB solution, concentration: $2.55x10^{-5}$M at glassy carbon electrode in different pH values.

Effect of scan rate

The influence of the scan rate was investigated. The results suggested that square wave voltammetric peak current reached maximum value when the scan rate was 50 mV. As for the scan rate; the current response with increasing the scan rate of 50mVs^{-1} to 100 mVs^{-1}gave the maximum response (Fig 5). Accordingly, the optimum conditions for recording a maximum developed and sharper peak for DLTD are t_{acc}: 60 sec., E_{acc}: -1.55V, scan rate: 50 mVs^{-1} and pulse amplitude: 50 mV, optimum temperature: 25°C.

Square wave voltammetric study

In order to develop a voltammetry method for determining the DLTD drug in pharmaceutical and human urine samples, we selected the square wave voltammetric mode, because the peaks are sharper

and enhanced defined at the lower concentration of DLTD than those obtained by cyclic voltammetry. According to the obtained results, it was possible to apply this technique to the quantitative analysis of DLTD. The phosphate buffer solution of pH 9.0 was selected as the supporting electrolyte for the quantification of DLTD as it gave maximum peak current at pH 9.0. Square wave voltammograms obtained with increasing amounts of DLTD showed that the peak current increased linearly with increasing concentration shown in Fig. 6.

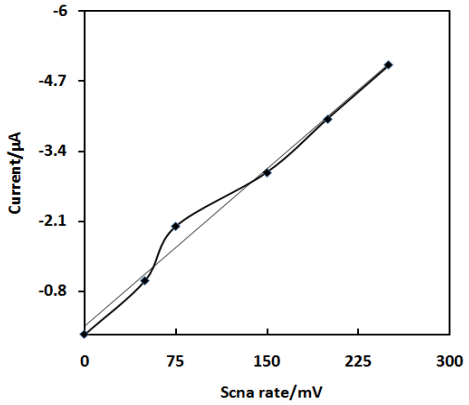


Fig. 5: Effect of scan rate on DLTD at pH 10.0 in PB solution at concentration 2.55×10^{-5}M at different scan rates: (a) 50 mV/s (b)100 mV/s (c)150 mV/s (d) 200mV/s (e) 250mV/s

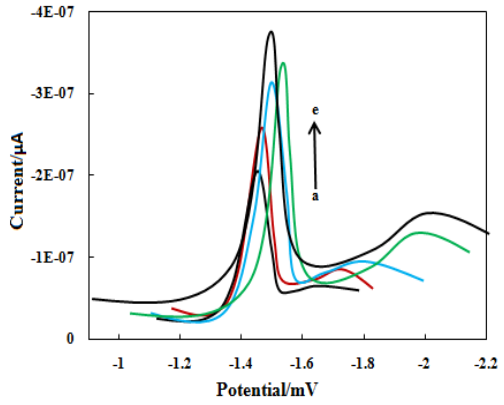


Fig. 6: Typical square wave voltammograms of DLTD in PB solution pH 9.0, concentration: 1.0x10^{-3}M to 2.55x10^{-5}M (a to e) at glassy carbon electrode

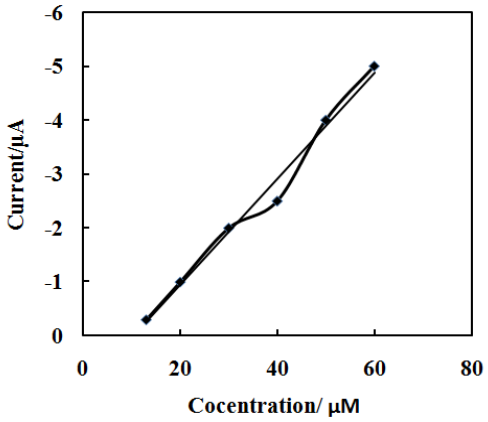


Fig. 7: Calibration plot of the DLTD in PB solution pH, at different concentrations at glassy carbon electrode

Calibration curve

In the square wave voltammetric mode a well-defined wave/peak obtained at pH 9.0 is used in the analytical estimation of DLTD in pharmaceutical and human urine samples. Both standard addition and calibration methods are used for the analysis of DLTD in pharmaceutical formulations and urine samples. The peak current is found to vary linearly with the concentration of DLTD over the range from 10µM to 70µM with the lower detection limit of 2.75x 10^{-9}M (Fig.7). The calibration curve has been found to be linear with the equation 5 = 0.6285+0.018 with a correlation coefficient of 0.9862 and relative standard deviation values are found to be 1.55%, respectively for five replicates (Table 1).

Table 1: Recovery study of DLTD

Pharmaceuticals				
Sample	**Labelled amount(mg)**	**Amount*found(mg)**	**Recovery %**	**RSD%**
1	5	4.98	99.60	1.55
2	10	9.90	99.00	1.70
3	15	14.80	98.66	2.45
Urine samples				
1	5	4.86	97.20	1.85
2	10	9.68	96.80	2.35
3	15	14.47	96.46	2.75

*Average five determinations

CONCLUSION

The electrochemical behaviour of DLTD in pharmaceutical and human urine samples at glass carbon electrode was examined in phosphate buffer over the pH range from 2.0 to 12.0 by square wave voltammetry and cyclic voltammetric methods. The drug exhibits lower current and negative potentials with lower detection limit of 2.75x 10^{-9}M. The simple, sensitive, selective, fast and low-cost voltammetric methods were developed for the determination of DLTD in pharmaceutical formulations and spiked human urine samples.

CONFLICT OF INTERESTS

Declared None

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