

THE DIFFERENTIAL PULSE VOLTAMMETRIC DETERMINATION OF ALBENDAZOLE
IN SUSPENSIONS USING ROTATING GLASSY CARBON ELECTRODE

SÜSPANSİYONLARDAKİ ALBENDAZOLÜN DÖNER CAMSİ KARBON ELEKTROT
KULLANILARAK DİFERENSİYEL PULS VOLTAMMETRİK YÖNTEMLE TAYİNİ

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The voltammetric behaviour and the determination conditions of albendazole (ALB) are described in this study using differential pulse technique based on the oxidation on the surface of rotating glassy carbon electrode. The method was applied for the determination of ALB in suspensions, containing 20 mg.ml⁻¹ ALB. The detection limit was calculated to be 3x10⁻⁵M. UV-Spectrophotometry was chosen as a comparison method. The results were also evaluated statistically for both filtered and unfiltered suspensions and insignificant variation was found between the processes.

Bu çalışmada, albendazolün (ALB) voltammetrik davranışları ve döner camsı karbon elektrot yüzeyinde yükseltgenme temeline dayanan bir diferensiyel puls tekniği ile tayin koşulları belirlenmiştir. Yöntem 20 mg.ml⁻¹ etken madde içeren süspansiyon içindeki ALB tayinine uygulanmıştır. Saptama sınırı 3x10⁻⁵M olarak hesaplanmıştır. Karşılaştırma yöntemi olarak UV-Spektrofotometrik yöntem seçilmiştir. Süzülmiş ve süzülmemiş süspansiyonlardaki sonuçlar istatistiksel olarak değerlendirilmiş, işlemler arasında anlamlı farklar bulunmamıştır.

Keywords: Voltammetry of albendazole;
Determination of albendazole;
Pharmaceutical applications.

Anahtar Kelimeler: albendazolün voltam-
metrisi; albendazol tayini,
Farmasötik uygulamalar.

Introduction

Albendazole, (ALB), 5-(propylthio)-1H-benzimidazol-2-yl-carbamic acid methyl ester, is an anthelmintic drug and it is active against most of the nematode and certain cestode worms in human and animals (1, 2). Its chemical structure is demonstrated in Fig.1.

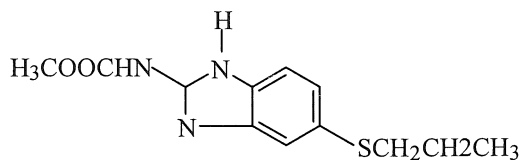


Fig.1. The chemical structure of ALB

Certain studies have been reported for the determination of ALB such as HPLC (3-9), GC-MS (10), UV-Spectrophotometry (11), Non-aqueous Capillary-Electrophoresis (12) and Adsorptive Stripping Voltammetry (13).

The aim of this study was to examine the voltammetric behaviour of ALB based on the oxidation of sulphur atom of the molecule by employing differential pulse (DP) voltammetric technique and using rotating glassy carbon electrode. The applicability and validity of the proposed method was

examined by determining ALB using a pharmaceutical dosage form.

Material and methods

Apparatus: Voltammetric system comprising of Polaropulse Model PRG-5, the electrodes dual-function EGMA type cell stand for the polarography and voltammetry with rotating glassy carbon as working, platinum wire as auxiliary and saturated Ag/AgCl as reference electrodes (all Tacussel, France) were used. Voltammograms were recorded by a Model SE 790 x-y recorder (BBC Goertz-Metrawatt, Austria). A Model M 822 pH-meter (Electromag, Turkey) was used for measuring pH of the solution. UV-Spectrophotometric studies were done using a Model UV-2401PC UV-VIS Spectrophotometer (Shimadzu, Japan).

Chemicals: Standard ALB (99.8%) and its pharmaceutical preparation, Andazol[®] Suspension (20 mg.mL⁻¹ active material) were supplied by Biofarma A.S.(Istanbul, Turkey). All the other chemicals used in the experiments were the products of Merck GmbH (Germany) and all were of analytical grade.

Supporting Electrolyte: A supporting electrolyte consisting of (MeOH : HCl water) (49:1:50) and 0.2 mole H₂SO₄ was used to conduct the experiments.

Pre-treatment of rotating glassy carbon electrode: Working electrode, rotating glassy carbon disk electrode, was polished by alumina, cleaned by methanol, rinsed with distilled water and dried with a non-abrasive tissue paper before each scan.

Voltammetric studies: 10 ml supporting electrolyte containing 5x10⁻⁴ mol-L⁻¹ ALB was put into the voltammetric cell to investigate the optimum voltammetric parameters. The investigations were carried out by scanning anodically against saturated Ag/AgCl reference electrode potential. The other parameters used during the experiments are given in the related sections. All experiments were conducted at the ambient temperature.

Spectrophotometric studies: The stock solution of 1x10⁻³ mol-L⁻¹ from standard ALB in methanol:HCl:water (49:1:50) and a series of standard solution in the concentration range of 1x10⁻⁵-5 x10⁻⁵ mol-L⁻¹ diluted from the stock solution were prepared. The spectrophotometric measurements were made at 230.8 nm using quartz cuvetts.

Analysis of pharmaceutical dosage forms: For the pharmaceutical analysis, the suspension containing 20 mg.mL⁻¹ was homogenated in ultrasonic bath for 15 minutes. Then, 0.5 mL suspension was transferred into a 100 mL flask and dissolved in supporting electrolyte. A half portion of solution was centrifuged at 3000 rpm for 10 minutes. Clear solution was filtered through a filter paper. The supernatant was diluted with supporting electrolyte for the voltammetric and spectrophotometric determination of ALB. The other half portion of solution was used without filtering for the voltammetric analysis.

Results and discussion

ALB is insoluble in water, methanol and ethanol and of this low solubility, a convenient solvent as methanol: HCl: water (49:1:50) was used throughout the whole study. Voltammograms were recorded everyday and it was observed that the currents were always stable for a week.

Voltammetric behaviour of ALB on the rotating glassy carbon electrode: Initial potential effects on voltammetric current and morphology of voltammograms were investigated. The variation of the limiting current of 5x10⁻⁴ mol-L⁻¹ ALB solution with initial potential ranging of -300 and +800 mV was examined with rotating conditions using DP technique. The effect of pulse height was not observed on the peak currents. This variation is demonstrated in Fig. 2.

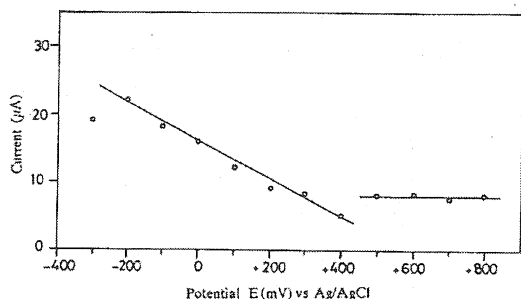


Fig.2. The variation of the limiting current of ALB in relation to initial potential

As it can be observed in the Fig. 2, the limiting current exhibits a linear decrease toward +400 mV beginning around -200 mV and then the current values were highly stable in the potential interval of +500 and +800 mV. Thus, +600 mV was chosen as initial potential for the other parameters and quantification of ALB.

To elucidate the factor which influence the voltammetric current, the rotation effect in the range of 200-1800 rpm was investigated. The plots of square-root of rotation rate, $\omega^{1/2}$, versus limiting current values of 5×10^{-4} M ALB solution are given in Fig. 3. Straight line with a small intercept was obtained in the range of 400-1500 rpm. Final conclusions indicate that the character of currents is diffusional at this rotation range. Thus, the rotation rate of 1000 rpm was chosen for the quantification of ALB.

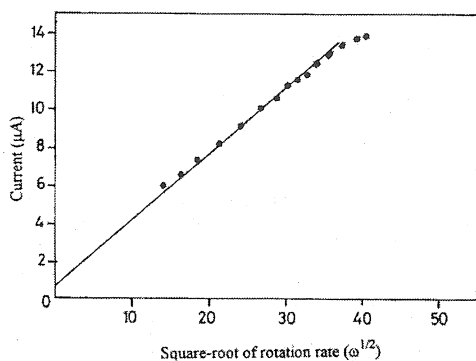


Fig.3. The variation of the limiting current of ALB in relation to square-root of rotation range

The variation of potential rate was investigated in the range of $2-100 \text{ mV.s}^{-1}$ and the appropriate one was observed to be at 4 mV.s^{-1} . The calibration studies were performed and suitable peaks which have increasing peak currents appeared in the range of $1 \times 10^{-4}-5 \times 10^{-4} \text{ mol.L}^{-1}$ as presented in Fig. 4. The detection limit was calculated to be $3 \times 10^{-5} \text{ mol.L}^{-1}$.

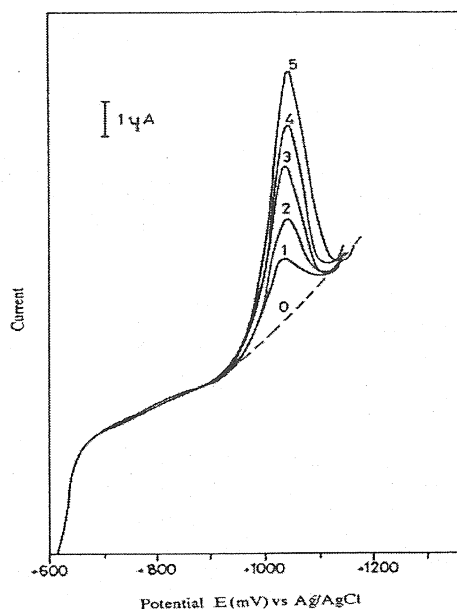


Fig.4. The DP voltammograms of ALB on the rotating glassy carbon electrode at the various concentrations. (0) supporting electrolyte; (1) $1 \times 10^{-4} \text{ mol.L}^{-1}$; (2) $2 \times 10^{-4} \text{ mol.L}^{-1}$; (3) $3 \times 10^{-4} \text{ mol.L}^{-1}$; (4) $4 \times 10^{-4} \text{ mol.L}^{-1}$; (5) $5 \times 10^{-4} \text{ mol.L}^{-1}$.

In the examination of concentration dependence, a straight line through almost origin was observed. The equation of the calibration curve was computed to be $[i(\mu\text{A})=146630 \text{ C}(\text{M})+0.212 ; r=0.9994]$. The linearity of calibration curves with its good correlation coefficient and little intercept value indicate that the process obeys Fick's Law and it corresponds that these allows to determine ALB confidently in the pharmaceutical preparations using DP voltammetric technique.

Application of voltammetric techniques to the ALB suspensions: The validity of the method proposed in this study was applied to suspensions samples, Andazol[®], containing 20 mg.ml⁻¹ ALB. Suspensions were processed as described under the experimental studies and optimum voltammetric conditions were employed for the quantification. Any interfering phenomena from the ingredients of the suspensions was not observed. UV-Spectrophotometry was used as a comparison method. Calibration studies were done by preparing standard solutions in the range of 1 x10⁻⁵-5 x10⁻⁵ mol.L⁻¹ concentration. The equation was computed by utilising the absorbance values against concentrations of ALB as [A=22763.6 C(mol.L⁻¹) -5.6x10-3; r=0.9999] at 230.8 nm.

The results of the method were compared by common statistical tests at the 95% probability level. These results are given in the Table.

According to the results of t- and F tests, insignificant difference were observed among the methods. The quantification results were in concordance with voltammetric results.

Table. Statistical results of the assay

	unfiltered	Filtered	UV-Spectr.
Mean ¹	20.14	19.94	19.84
SD ²	0.50	0.46	0.77
%RSD ³	2.48	1.60	3.88
CL ⁴	±0.42	±0.27	±0.64
t-tests	0.93	0.29	t _{0.05} =2.14
F-tests	2.36	2.81	F _{0.05} =3.18

¹ Andazol[®] Suspensions containing 20 mg.mL⁻¹ ALB (n=8)

² SD: Standard deviation

³ RSD: Relative standard deviation

⁴ CL: Confidence limit

and sensitively for the routine analysis of ALB.

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As the conclusion, the proposed method can be used sensitively practically

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