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Research Article

PHARMACOLOGICAL EFFECTS ELECTROCHEMICAL STUDIES OF TERBUTALINE SULPHATE AT POLY (TINIDAZOLE) MODIFIED GLASSY CARBON ELECTRODE

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ABSTRACT

An electrochemical response of Terbutaline sulphate (1-(3,5-Dihydroxyphenyl)-2-tert-butylaminoethanol sulphate) was investigated using cyclic Voltammetric technique with the aid of poly Tinidazole modified glassy carbon electrode. The Voltammetric response was evaluated in 0.2ML^{-1} phosphate buffer solution (PBS). The poly Tinidazole modified glassy carbon electrode showed a significantly enhanced current peak indicating its catalytic activity towards Terbutaline sulphate. The parameters such as effect of pH, scan rate, concentration were studied. The correlation co-efficient R=0.99914 has been calculated using linear regression equation. Also limit of detection (LOD) and limit of quantification (LOQ) were calculated.

Keywords: Terbutaline Sulphate, Tinidazole, Glassy Carbon Electrode and Cyclic Voltammetry.

1.1 INTRODUCTION

Many analytical methods have been developed for determination of terbutaline Sulphate in variety of substrates, these includes spectrophotometry, capillary electrophoresis, HPLC, electrochemical methods[1]. Terbutaline sulphate, an anti-asthmatic drug used to target lung locally. Terbutaline causes bronco dilation by direct stimulation of beta -2 adrenergic receptors present in bronchial smooth muscles.[2].Terbutaline is 5-[2-(tert-butylamino)-1-hydroxythyl] benzene-1,3-diol selective beta$_2$-adrenergic bronchodilator[3]. Which is widely used in the treatment of bronchial asthma and lung disease. It also has been used as feed additives to stimulate protein accretion and inhibit the adipose accumulation in farm animal[4-5]. In recent days many people have been focused on placing a drug or a formulation in a particular region of the body for a specific period of time[6]. TBS has been used as growth promoters. Researchers showed that it could increase muscle mass, and improve growth rate and feed conversion when fed to animals. However, the drug residues in animal tissues may pose a potential risk, such as muscular tremors, vomiting, nervousness and cardiac palpitations. Therefore, the determination of such drug is important for quality assurance in pharmaceutical preparations and level assay in biological fluids[7,8].

Tinidazole is an anti –parasitic drug used as a treatment for a variety of amoebic and parasitic infections. It is chemically similar to metronidazole a drug with some unpleasant side effects[9-11].

The purpose of present work describes the development of a simple, precise, accurate method for the estimation of TBS. By using the glassy carbon electrode coated with Tinidazole by polymerization method. Which is used to study the electrochemical oxidation response of Terbutaline Sulphate.

1.2 MATERIALS AND METHODS

1.2.1. Chemicals and apparatus

Terbutaline sulphate and Tinidazole were purchased from Sigma-Aldrich, other chemicals used for preparing supporting electrolyte are of analytical grade and double distilled water was used throughout. Stock solution of Terbutaline sulphate (0.068mg/25mL) was prepared by dissolving 0.068mg in 25mL double distilled water.

All the Voltammetric measurements were taken from electro analyser Model EA-201 with computer interface supplied by Chemilink Systems, Mumbai. A three electrode system was employed, consisting of Ag/AgCl as reference, platinum electrode as counter electrode and modified glassy carbon electrode (2mm diameter) as working electrode. pH of supporting electrolyte was adjusted by pH meter supplied by systronics (India).

1.2.2 Pretreatment and Modification of glassy carbon electrode

The glassy carbon electrode was polished by using alumina powder to get clean and glassy finishing. The polished glassy carbon electrode was activated by electrochemical pre-treatment method[12]. The polymer film modified electrode was prepared by electrochemical polymerization of Tinidzole (TNZ) in 0.2M Phosphate buffer solution (pH 8.0) containing 1mM Tinidazole with cyclic Voltammetric sweeps in the potential range 850 to -1500mV of scan rate 100mVs^{-1}. After 20 cycles, the surface of the electrode was washed with double distilled water to remove the physically adsorbed material, then air dried and used for the electrochemical studies.

1.2.3 Electro polymerisation of Tinidazole on a Glassy carbon electrode

Electro polymerization was performed on a GCE. Fig.A.1. display the continuous cyclic Voltammetric sweeps of 1mM TNZ in phosphate buffer solution at pH 8.0 by scanning over the range of 850 to -1500 mVs^{-1}for 20cycles. During the electro polymerisation process, indiscernible peaks started to appear after 5th cycle. An anodic peak at 861 mV was observed due to the formation of poly-TNZ. The peak descended gradually with the increase in cyclic time; such decrease indicates the poly (TNZ) membrane forming and depositing on the surface of the GCE by electro polymerisation. Tinidazole was oxidized to free radical at the surface of GCE rapidly resulting in the possible structure of electro polymerised poly (TNZ). After polymerization the poly (TNZ) modified GCE was carefully rinsed with distilled water to remove the physically adsorbed material. Then the film electrode was transferred to an electrochemical cell and cyclic Voltammetric sweeps were carried out to obtain electrochemical steady state.

1.3. THEORY RESULTS AND DISCUSSION

1.3.1. Electrochemical response of modified glassy carbon electrode (Tinidazole)

Fig.A.2. shows that The electrochemical response of potassium ferricyanide of 1mM ferricyanide at bare and poly Tinidazole modified glassy carbon electrode in KCl as supporting electrolyte between potential scan -200 to 600 mVs^{-1} has been studied. The Voltammograms showed a great enhancement of current upon the modification of GCE with poly Tinidazole which indicating there is increase in surface area of electrode after modification. Surface area of modified electrode is calibrated with the help of potassium ferricyanide.

1.3.2 Electrochemical behaviour of Terbutaline Sulphate

Terbutaline sulphate showed good signal with poly Tinidazole modified GCE when compared to that of bare GCE where there was no any indication of peak .100µL of Terbutaline sulphate stock solution and 10mL of phosphate buffer (pH 3.0) were added to the electrochemical cell. Then Poly TNZ-MGCE (working electrode) with reference and auxiliary electrodes were dipped in the test solution and potential is applied in the range of -100mV to 1400mV.Cyclic voltammograms of Terbutaline sulphate in phosphate buffer is shown in Fig.A.3., curve 'b' for bare glassy carbon electrode which was not showing any oxidation peak indicating the low sensitivity of the bare glassy carbon electrode. Curve 'a' shows the oxidation peak of Terbutaline sulphate at potential Ep_a -1012mV/s with corresponding peak current Ip_a -10.12mA indicate the sensitivity of Poly TNZ-MGCE. Surface area of modified electrode is calibrated with the help of potassium ferricyanide.

1.3.3. Effect of pH on the Terbutaline sulphate voltammograms

The electro oxidation of Terbutaline sulphate of 0.068 mg/25mL solution in phosphate buffer over a pH range from 2 to 9 of scan rate 100mV/s was studied at poly Tinidazole MGCE using cyclic Voltammetric technique. The oxidation (anodic) peak current increases with increase in pH and reaches maximum at pH 3 with potential Ep_a 1012 mV/s and peak current Ip_a 10.12 mA. Further peak current decreases with increase in pH has been observed. The corresponding linear regression equation is **Ip_a=0.147x10^{-5}+0.87026 and correlation coefficient R=0.9971**.

The plot of pH versus current indicate that the electron and proton involves in oxidation process.

1.3.4. Effect of Scan Rate

The effect of Scan Rate on the electrochemical response of 0.068mg/25mL of Terbutaline Sulphate at poly Tinidazole MGCE was studied in the potential range 10 to 100 mV/s. On plotting current versus square root of scan rate it was found that the oxidation peak current linearly increases with increase in the scan rate which indicates that the process is diffusion controlled. Using linear regression equation the correlation co-efficient was found to be R=0.99914, and slope of A=2.65133 B=0.0198.The linear regression equation is given below.

$Ip_a = 0.0198x10^{-6}+2.6513$ μA –and correlation coefficient R=0.99914

1.3.5. Effect of Terbutaline Sulphate Concentration

The variation of concentration of Terbutaline Sulphate was studied in the range $2x10^{-5}$μl to $1.4x10^{-4}$ μl at poly Tinidazole modified glassy carbon electrode using PBS of pH 3.0 of scan rate 100mV/s. The plot of Ip_a versus concentration of Terbutaline Sulphate showed the linear relationship between the anodic peak current Ip_a and the concentration with a correlation co-efficient of R=0.9993 A=1.27, B=0.0607, Limit of detection (LOD) and limit of quantification (LOQ) were found to be 5.3164 μM and 17.721 μM respectively.

$Ip_c = 0.0607x10^{-5}+1.27$ ---------- R=0.9993

1.4. CONCLUSION

The electrochemical behaviour of Terbutaline Sulphate was studied at Tinidazole modified GCE by cyclic Voltammetric technique. The different parameters such as effect of scan rate, pH, and concentration of Terbutaline sulphate has been studied. The Current method is advantageous than some of the spectroscopic techniques which are tedious. This technique is very simple, less time consuming, high sensitivity and low cost procedure for the preparation of modified electrode.

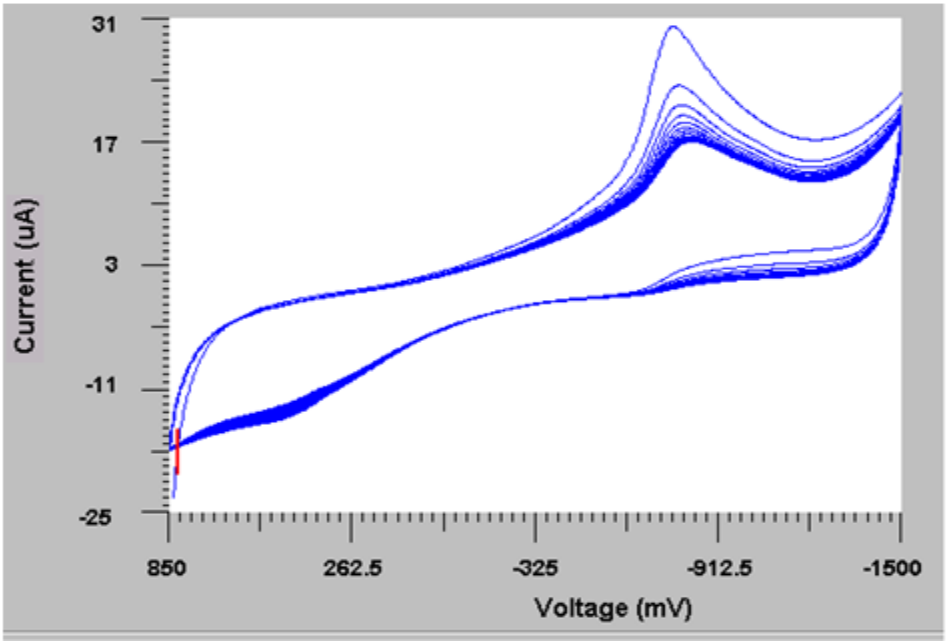

Fig. A1: Cyclic Voltammograms for the electro polymerization of 1 mM of Tinidazole (TNZ) in 0.2 M Phosphate buffer solution on a GCE

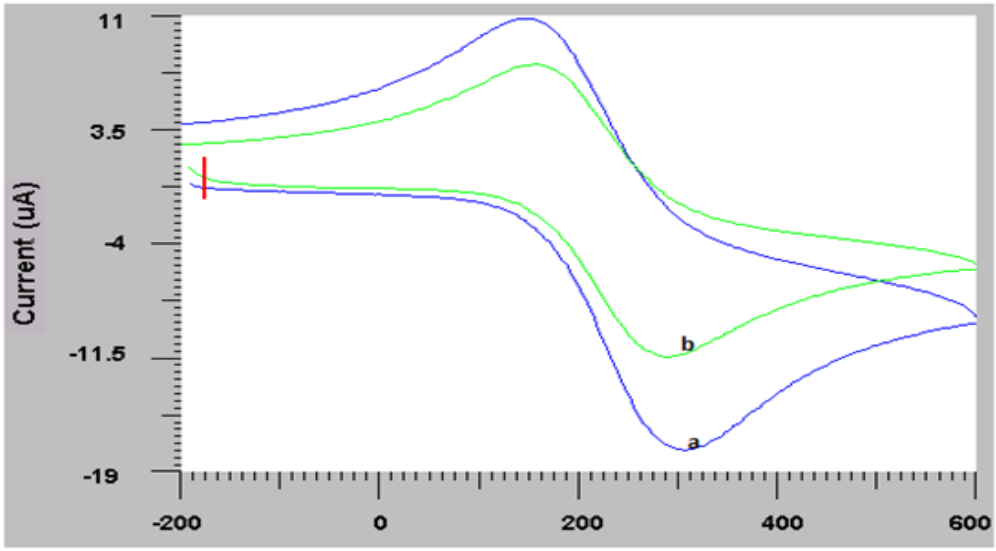

Fig. A2: Comparison of 1mM K_4 [Fe (CN) $_6$] in 1 M KCl solution at Poly TNZ MGCE curve (a) and bare GCE curve (b)

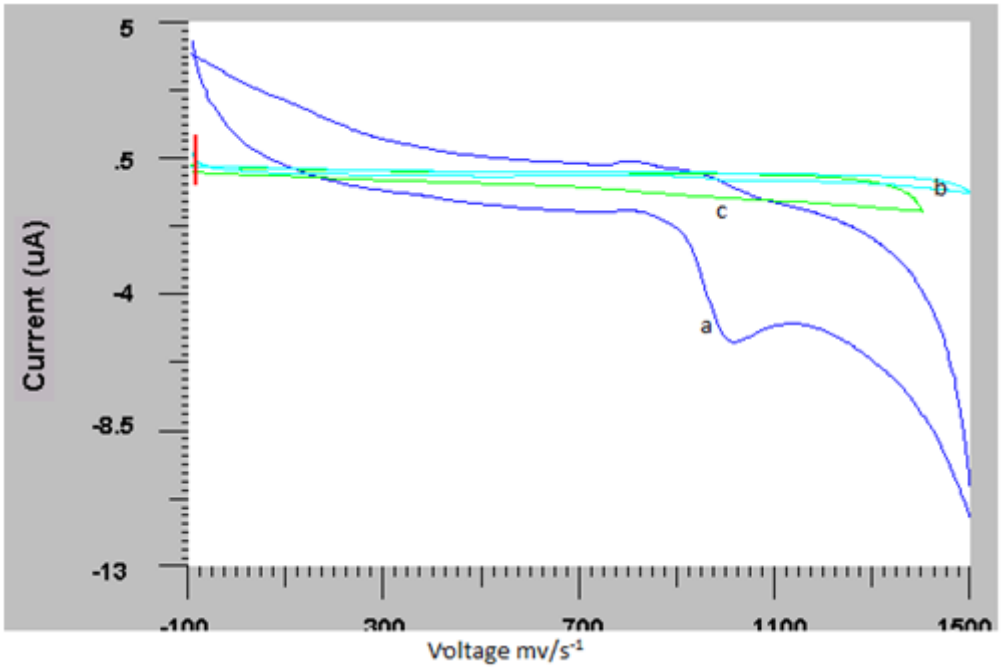

Fig. A3: Cyclic voltammograms of Terbutaline sulphate at poly (tinidazole) modified glassy carbon electrode curve (a), bare glassy carbon electrode curve (b) and blank solution of MGCE (c); scan rate 100 mvs

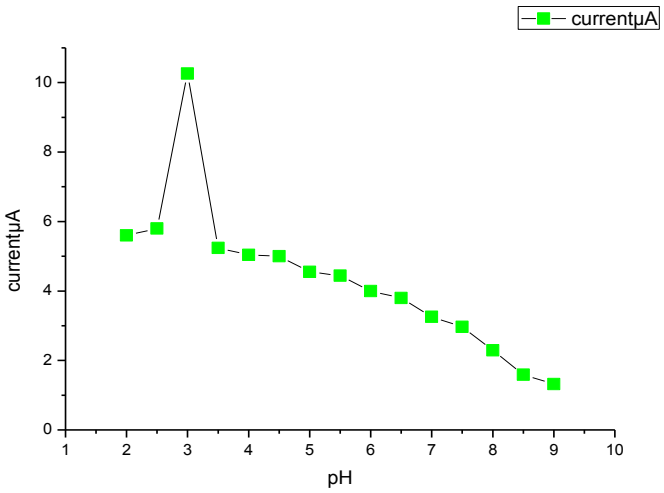

Fig. A4: Dependence of oxidation peak current on the phosphate buffer solution pH

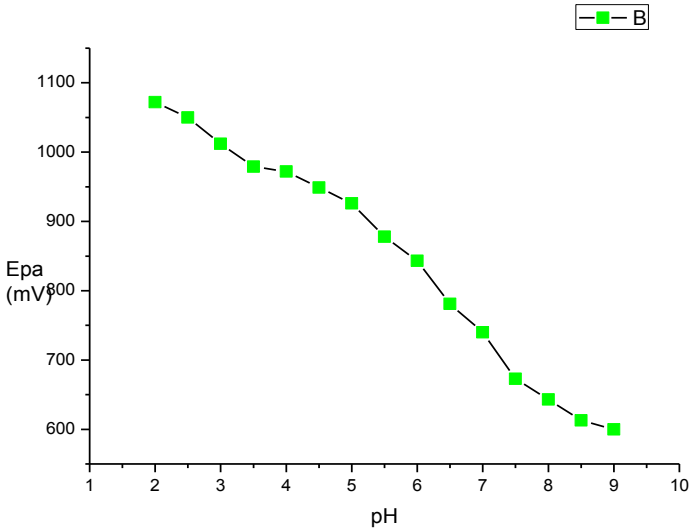

Fig. A5: Dependence of oxidation peak potential on the phosphate buffer solution pH

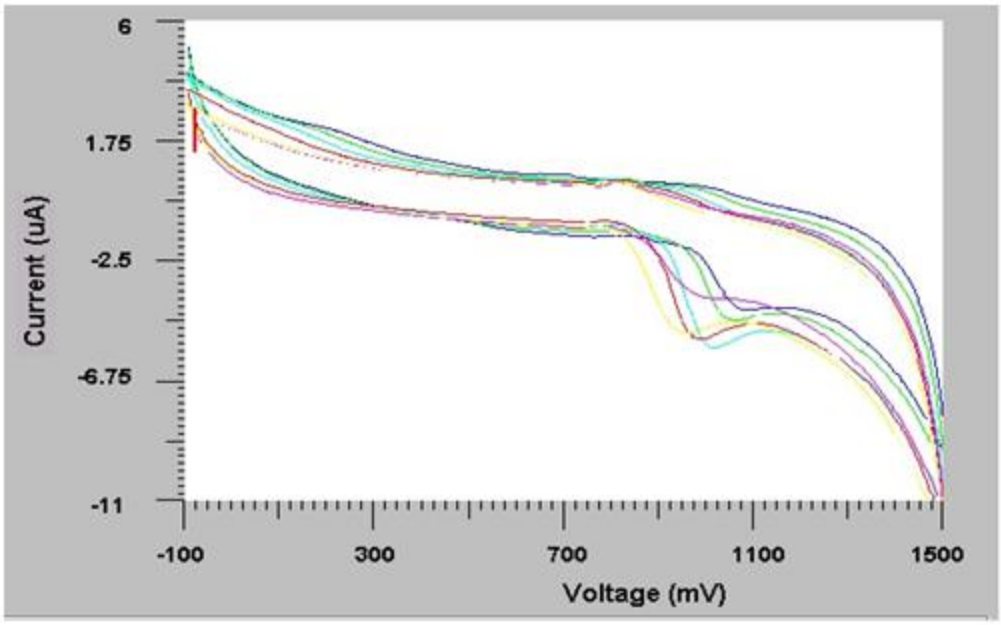

Fig. A6: plot of different scan rate of TNZ- MGCE AT 100 Scan rate

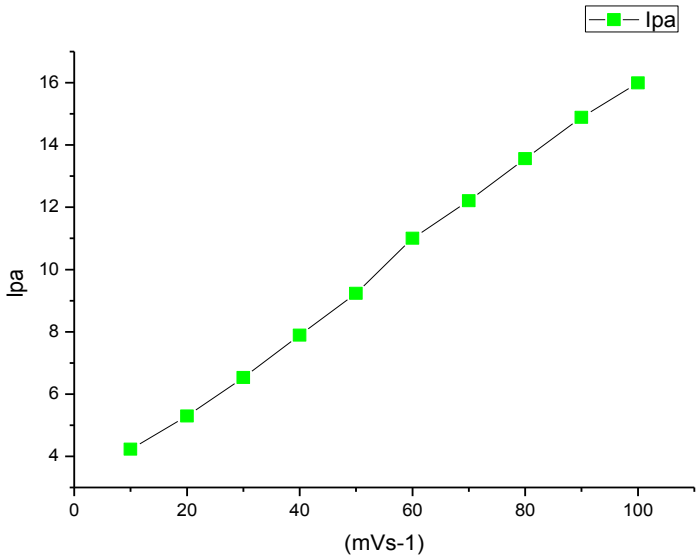

Fig. A7: Plot of oxidation peak current versus scan rate

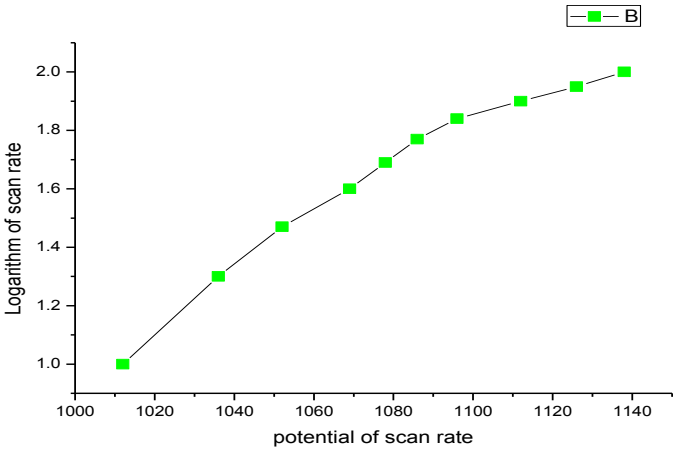

Fig. A8: Plot of potential scan rate versus logarithm of scan rate

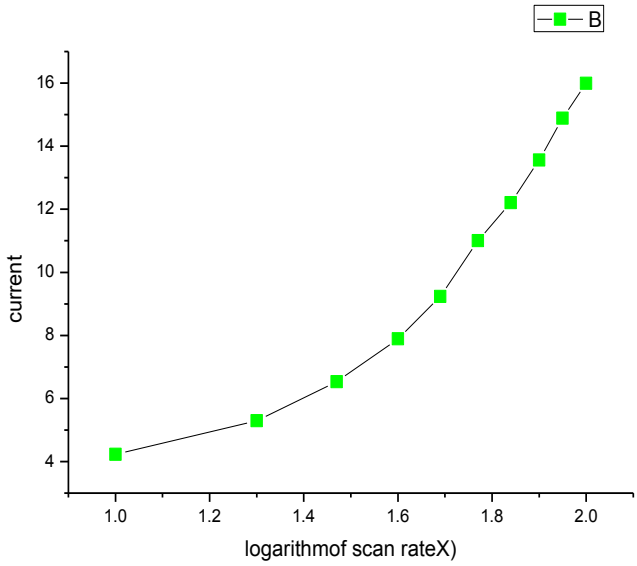

Fig. A9: Plot of logarithm of scan rate versus current

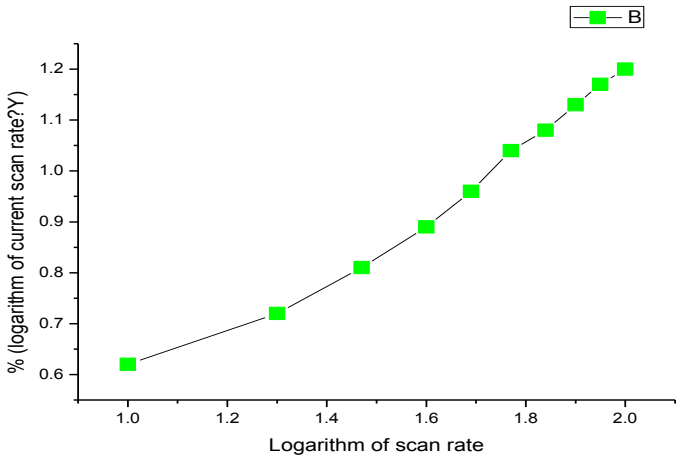

Fig. A10: Plot of logarithm of current scan rate versus logarithm of scan rate

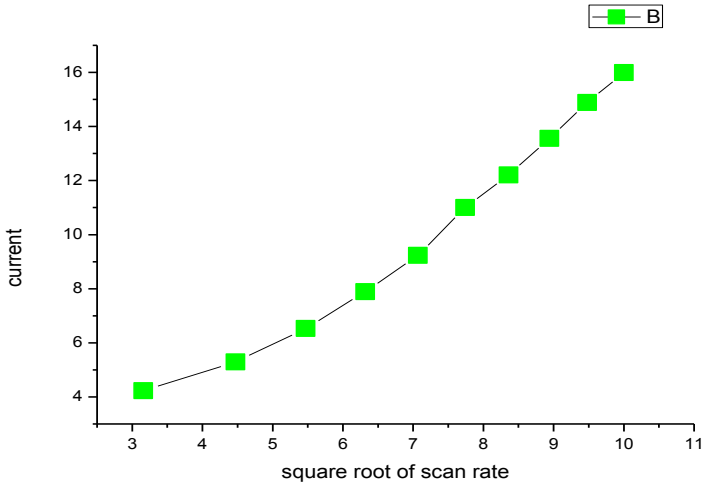

Fig. A11: Plot of current versus square root of scan rate

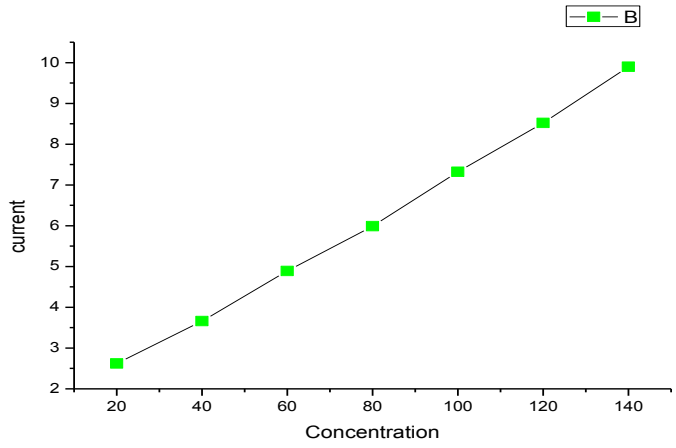

Fig. A12: cyclic voltammograms of variation of concentration of Terbutaline sulphate $2x10^{-5}$µl/ to $1.4x10^{-4}$ µl/ at scan rate 100mV/s

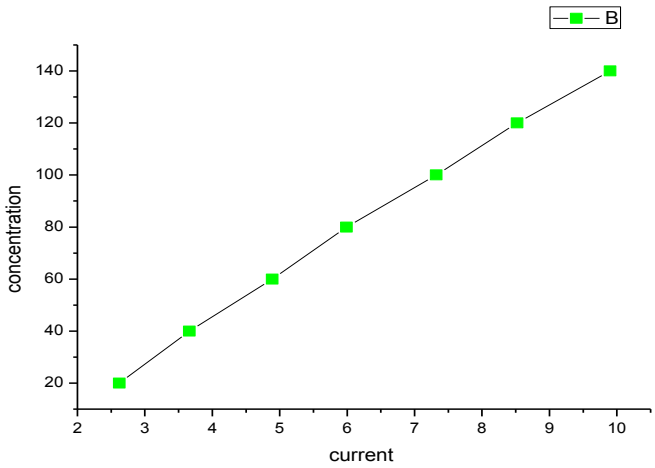

Fig. A13: The plot of oxidation current versus concentration of Terbutaline sulphate

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