Summary of the Thesis

This thesis is focused on the use of chemically modified different electrodes for the investigation of organic compounds to get excellent reproducible results by voltammetric techniques. The organic compounds were chosen for electrochemical investigation were dopamine, ascorbic acid, uric acid, serotonin and omeprazole. In the real sample these compounds were interfere each other during the investigation by overlapping their voltammetric responses. Because of the advantages like, high conductivity, wide potential window for analysis, chemically inert, relatively inexpensive, easy modification, easy preparation of paste with organic binder and easily renewal of electrode surface, the carbon paste electrode was chosen for the investigation. In addition graphite pencil electrode and glassy carbon electrode were chosen in the investigation of organic compounds by using voltammetric technique. This thesis also discusses on the different types of modifications used for the electroactive species. In this research work the bioactive organic compounds like dopamine, ascorbic acid, uric acid, serotonin and omeprazole were investigated at modified carbon paste electrode, graphite pencil electrode and glassy carbon electrode surface by using voltammetric techniques.

The work carried out in this thesis is divided and described into seven chapters.

Chapter-1

Introduction, Review of Voltammetry and Theoretical Considerations

This chapter covers the introduction, voltammetry and voltammetric techniques. Basic and fundamental principles, theoretical aspects and application of voltammetry, solvents, supporting electrolytes and electrode interaction can be seen in this section. A brief review of cyclic voltammetric investigations of certain organic compounds has been presented. Objective and scope of the present thesis were included in this chapter.
Chapter-2

Experimental

This chapter describes the basic experimental setup which is very much essential for voltammetric technique. The basic equipments like, potentiostat, recording device and electrochemical cell which is composed of three electrodes. The electrode systems with special emphasis on carbon paste electrode, graphite pencil electrode and glassy carbon electrode were used in this research work. The procedure of modified, unmodified electrodes and their characterizations were described in detail. In addition, in this chapter the origin of the above mentioned three electrodes was described.

Chapter-3

Electrocatalytic Oxidation of Dopamine at Murexide and TX-100 Modified Carbon Paste Electrode: A Cyclic Voltammetric Study

Electrochemical oxidation of dopamine at murexide modified carbon paste electrode was studied by cyclic voltammetric technique in 0.2 M phosphate buffer solution at pH 7.4. The modified electrode exhibited strong promoting effect and stability toward the detection of dopamine. From the studies of scan rate effect the overall electrode process was found to be diffusion controlled. The concentration effect reveals that the detection limit and quantification limit of dopamine were $1.496 \times 10^{-7}$ M and $4.988 \times 10^{-7}$ M respectively. The effect of pH suggested that an equal number of protons and electrons were involved in the electrochemical oxidation of dopamine. The presence of Triton X-100 on the murexide modified carbon paste electrode showed excellent electrocatalytic effect toward the detection of dopamine.
Schematic representation shows the interaction of TX-100 / Murexide MCPE with dopamine


Chapter-4

Sodium Dodecyl Sulphate/Polyglycine/Phthalamide/Carbon Paste Electrode Based Voltammetric Sensors for Detection of Dopamine in The Presence of Ascorbic Acid And Uric acid

Sensitive and selective electrochemical method for the determination of dopamine using a Sodium dodecyl sulphate/polyglycine/phthalamide/carbon paste electrode was developed. The Sodium dodecyl sulphate/polyglycine/phthalamide/carbon paste electrode showed excellent electrocatalytic activity towards the oxidation of dopamine in phosphate buffer solution (pH 7.0). Electrochemical parameters such as the heterogeneous rate constant ($k_h$) and detection limit ($LOD$) was calculated in phosphate buffer solutions at pH 7.0. The interference studies showed that the modified electrode exhibited excellent selectivity in the presence of large excess of ascorbic acid and uric acid. The separation of the oxidation peak potentials for
dopamine–ascorbic acid and dopamine–uric acid were found to be 207 mV and 121 mV, respectively. The differences remained large enough to determine ascorbic acid, dopamine and uric acid both individually and simultaneously using cyclic voltammetry and differential pulse voltammetry techniques.

Figure. A. shows Differential pulse voltammograms from $5 \times 10^{-5}$ to $5 \times 10^{-4}$ M, DA in 0.2 M PBS at pH 7.0 in the presence of $9.61 \times 10^{-4}$ M UA and $1.85 \times 10^{-3}$ M AA at the SDS/polyglycine/phthalamide/CPE. Inset figure. B. shows the graph of the anodic peak current versus the concentration of DA in the presence of AA and UA.

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Chapter-5

Pretreated/Carbon Paste Electrode Based Voltammetric Sensors for the Detection Of Dopamine in Presence of Ascorbic Acid and Uric Acid

A voltammetric resolution for the determination of dopamine using a Pretreated/Carbon paste electrode was developed. The Pretreated/Carbon paste electrode showed excellent electrocatalytic activity towards the oxidation of dopamine in phosphate buffer solution (pH 7.0). From the electrochemical studies of scan rate, the overall electrode process was diffusion and adsorption controlled. The pH effect suggested that equal number of protons and electrons were involved in the
electrochemical detection of dopamine. Detection limit (LOD) was calculated in phosphate buffer solutions at pH 7.0 and the interference studies showed that the modified electrode exhibited excellent selectivity in the presence of large excess of ascorbic acid and uric acid. The separation of the oxidation peak potentials for dopamine–ascorbic acid and dopamine–uric acid was found to be 0.187 V and 0.121 V, respectively. These differences were large enough to determine dopamine, ascorbic acid and uric acid individually and simultaneously by using cyclic voltammetry and differential pulse voltammetric techniques.

Cyclic voltammograms for $9.96 \times 10^{-6}$ M DA, $4.9 \times 10^{-4}$ M AA and $2.96 \times 10^{-5}$ M UA at pH 7.0 PBS at a scan rate of 0.05 Vs$^{-1}$ in BCPE (Solid line) and pretreated/CPE (dashed line).

Chapter 6
Electrochemical Oxidation of Dopamine and Serotonin at Graphite Pencil Electrode: A Voltammetric Study

Graphite pencil electrode was used as a working electrode in the investigation of dopamine and serotonin by using voltammetric technique. The electrochemical investigations were carried at graphite pencil electrode at scan rate 0.05 Vs$^{-1}$ in 0.2 M phosphate buffer solution. Electrochemical behavior of dopamine shows two redox pairs. The electrooxidation of serotonin shows irreversible behavior at graphite pencil electrode at scan rate 0.05 Vs$^{-1}$. The effect of concentration of both dopamine and serotonin were investigation individually. Effect of scan rate and effect of pH were carried out electrochemically. Graphite pencil electrode shows excellent investigation of dopamine and serotonin in their mixture. This graphite pencil electrode acts as very good sensor for dopamine in presence of serotonin.

![Cyclic Voltammograms](image)

Figure. A. shows the cyclic voltammograms for variation of dopamine concentration at graphite pencil electrode in phosphate buffer solution pH 7 at scan rate of 0.05 Vs$^{-1}$. Inset figures B and C shows the graph of anodic peak current vs concentration of dopamine.

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Poly(Alizarin) Modified Glassy Carbon Electrode for the Electrochemical Investigation of Omeprazole: A Voltammetric Study

Poly (alizarin) modified glassy carbon electrode was fabricated for the electrochemical investigation of omeprazole in 0.1 M sodium hydroxide solution. The formation of poly (alizarin) film on the surface of glassy carbon electrode was confirmed by electrochemical characterization using 1mM potassium ferrocyanide in 1M potassium chloride solution. A well enhanced redox peaks were observed for potassium ferrocyanide at poly (alizarin) modified glassy carbon electrode. Electrooxidation of omeprazole at poly (alizarin) modified glassy carbon electrode shows two irreversible voltammetric peaks. Further investigation of electrooxidation of omeprazole was carried by varying the concentration of sodium hydroxide. The effect of concentration of omeprazole and scan rate was discussed. The proposed method was applied to the detection of omeprazole in tablet.

Cyclic voltammograms of 1mM omeprazole in 0.1 M NaOH at poly (alizarin) modified glassy carbon electrode at scan rate 0.05 Vs⁻¹.

Communicated to Chemical Sensors.