

Voltammetric Analysis of Zn (II) in Present of Each Ascorbic Acid (AA) and Folic Acid (FA) in Human Blood Samples

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The importance of zinc oxide (ZnO) in the human body was studied of electrochemical properties through its effect on human blood medium as oxidative or antioxidant reagent using cyclic voltammetric (CV) technique by glassy carbon electrode (GCE). The results found the oxidation-reduction current peaks of zinc oxide appeared in the blood medium at -1 and -1.35 V respectively. The effect of ascorbic acid and folic acid on the zinc oxide was studied in blood medium. It was found that the oxidation current peak of ascorbic acid (AA) acts for reducing the oxidation current peak of zinc oxide and absent the reduction current peak. While Folic acid (FA) was affected on the both oxidation – reduction current peaks of zinc oxide in blood medium by enhancement the cathodic current peak and reducing the anodic current peak. So, folic acid acts as a good antioxidant agent using with zinc ions in human body.

Introduction

In a recent studies, the researchers were studied the important elements for the human body and also, the effected of pollutant elements in human blood medium by cyclic voltammetric technique [1-6].

A platinum electrode placed in human blood serum responds to cyclic voltammetric polarizations in an anodic double wave. By means of comparison of the response to various components of the serum it is shown that this double wave is mainly due to oxidation of cysteine partly bound in a complex with proteins. To some extent the oxidation process is inhibited by adsorption of proteins and cholesterol at the electrode [7].

The underpotential deposition of Zn on polycrystalline Pt was studied in three different acid solutions for different Zn^{2+} concentrations. The voltammetric charges and the inhibition promoted by the maximum coverage of Zn in the hydrogen adsorption and evolution reactions were used to postulate adsorption models. A negligible inhibition of the hydrogen evolution reaction was recorded in sulfuric and perchloric acid solutions while a strong inhibition was found for fluoride medium [8].

Zinc (Zn) homeostasis is required for a functional immune system. Critically ill patients often exhibit decreased Zn serum

concentrations and could potentially benefit from Zn supplementation as a therapeutic strategy. However, the conventional approaches to monitoring Zn are time consuming and costly. Conditions critical to sensing, such as preconcentration potential, preconcentration time, and buffer pH, was optimized for Zn detection. The results of this work show that Zn detection in serum is possible with smaller sample volumes (μL vs. μL) and faster turnaround time (hours vs. days) as compared with the conventional spectroscopic methods [9].

Electrochemical methods provide high potential for investigation of antioxidant compounds, assessment of antioxidant capacity, and measurement of electrochemical index. Different types of electrodes can be used for the assay purposes. The devices can be stationary or flow through, and based on cyclic or differential pulse voltammetry as well as potentiostatic analysis. The methods are known for their suitability for food control and monitoring the levels of antioxidant capacity in other biological samples and matrices. [10].

The study on fishes and their diseases has importance in life of human being because it has nutritive value. Freshwater fishes, *Channa orientalis* were exposed to chronic dose of Endosulfan without and with ascorbic acid. Total count Blood Glucose level content was recorded. Remarkable decreases in Blood Glucose level were observed in Endosulfan exposed fishes. Fishes were exposed to Endosulfan with L-ascorbic acid showed less present variation in the Blood Glucose level. Pre-exposed Fishes to pesticides showed fast recovery with ascorbic acid as compared to cured naturally. [11].

In the United States Pediatric septic shock is a major health problem with about 42,000 cases per year and a mortality rate of about 10%. Studies have indicated that children with pediatric septic shock have demonstrated critically low levels of serum zinc (Zn) and supplementation of Zn is being suggested as a therapeutic strategy. However, to protect patient safety, it is vital that Zn levels be monitored during supplementation to insure the Zn concentration levels remain at or near physiologic normal levels. Currently Atomic Absorption Spectroscopy (AAS) is used to quantify Zn levels in serum samples. Unfortunately, AAS frequently involves sending serum samples to external laboratory facilities which yields measurement turnaround time that range from hours to days. Thus, timely monitoring of Zn levels is critical to preventing over supplementation that could result in critical conditions such as heavy metal (Zn) toxicity. The devices are based on a three electrode sensor which uses Anodic stripping voltammetry (ASV) for sensing Zn levels. The ASV electrode sensor is read using a reader that has been developed using commercially available embedded system components and custom analog circuitry [12].

In this work, a new study in cyclic voltammetric technique using blood medium as an electrolyte to determine the effect of each of AA and FA on the redox current peaks of ZnO as important element of human body.

Experimental

Reagents and Chemicals

Zinc Oxide (ZnO) powder from SCRC (China), Ascorbic acid (AA) from Technicon chemicals Co. (Orege, Tournai Belgique), Folic acid (FA) from Actavis, Barnstaple, EX32 8NS, UK, healthy human blood samples and other chemicals and solvents were of analytical grade and used as received from the manufacturer. Double distilled water was used for the preparation of aqueous solutions. All solutions were treated with oxygen free nitrogen gas for 10-15 minutes prior to making the measurement.

Apparatus and Procedures

Instruments: EZstat series (potentiostat/galvanostat) Nu Vant Systems Inc. pioneering electrochemical technologies USA. Electrochemical workstations of Bioanalytical system with potentiostat driven by electroanalytical measuring softwares was connected to personal computer to perform Cyclic Voltammetry (CV), an Ag/AgCl (3M NaCl) and Platinum wire (1 mm diameter) was used as a reference and counter electrode respectively. The glassy carbon working electrode (GCE) was used in this study after cleaning with alumina granules.

Procedure: cyclic voltammetric cell was used in this technique by adding 10ml of electrolyte (human blood samples) in the quartz cell and immerse three electrodes in the blood medium (GCE as working electrode, Ag/AgCl reference electrode and counter electrode), then the electrodes were connected with potentiostat to find the results by the cyclic voltammogram using personal computer.

Results and Discussion

Effect ZnO on Blood Medium

Figure 1 shows the voltammogram of oxidation - reduction current peaks of ZnO in blood medium. It was found the Zn(II) ions have oxidation current peak at -900 mV in blood medium, that ZnO is an oxidative reagent in blood media as shown in Figure 2 and also, can be considered that the zinc ions as an antioxidant reagent by appearing the reduction current peak at -1.35 mV.

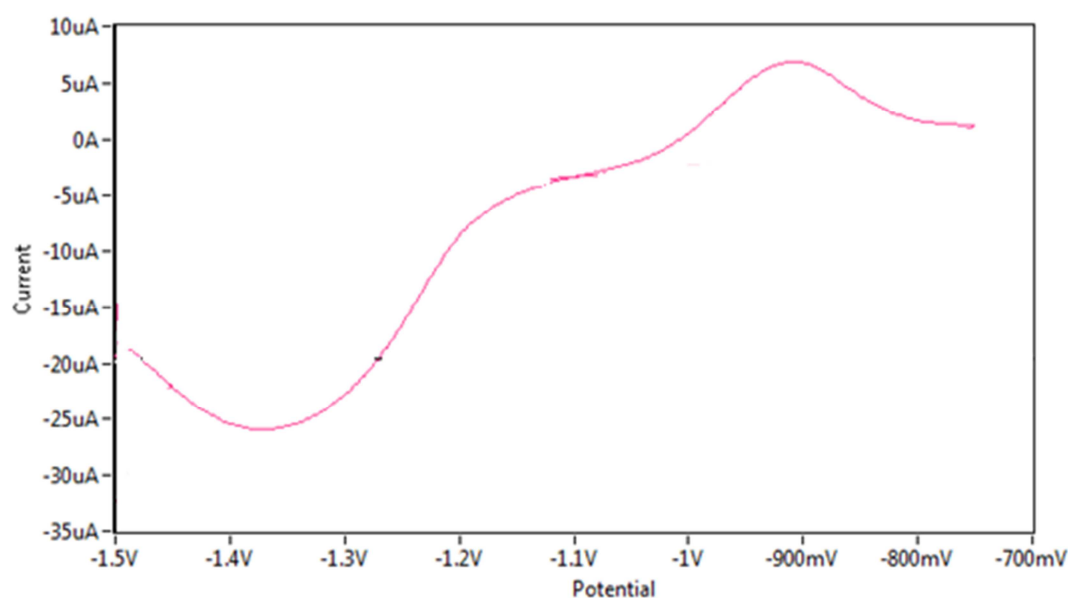


Figure 1. Voltammogram of ZnO in blood medium using GCE as working electrode at 100mVsec^{-1} versus Ag/AgCl as reference electrode.

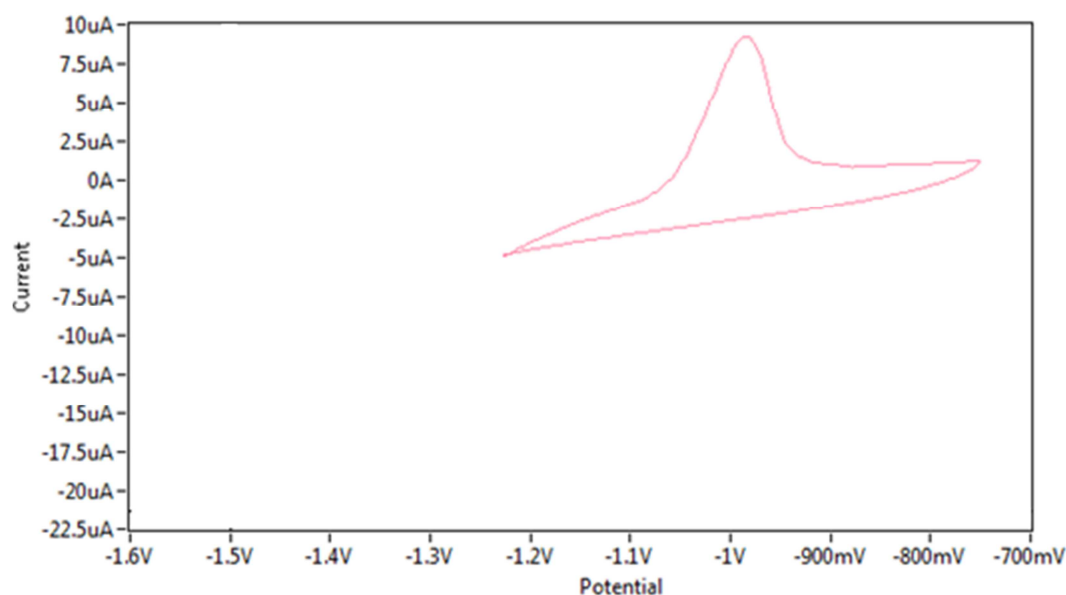


Figure 2. Cyclic voltammogram of ZnO in blood medium using GCE as working electrode at scan rate 100mVsec^{-1} versus Ag/AgCl as reference electrode.

Effect AA on ZnO in Blood Medium

From the cyclic voltammogram in Figure 3, the big oxidation current peak of AA was found at -1V which affected on the oxidation and reduction peaks of zinc ions in blood medium. It was found that the oxidation current peak of AA make

gradually decreasing the oxidation current peak of Zn(II) at -1V as shown in Figure 4. The relationship between the oxidation current peak and the different concentration of zinc oxide ions in blood medium was good linear equation $X = -19.456Y + 17.517$ with good sensitivity $R^2 = 0.833$. Also, Figure 3 shows the affected of the oxidation current peak of AA on the reduction current peak of zinc ions in blood medium was disappeared. It was observed when compare the different concentrations of AA which are added to the mercury ions enhanced the oxidation current peak by raising the formation of decomposition complex in blood composition [13].

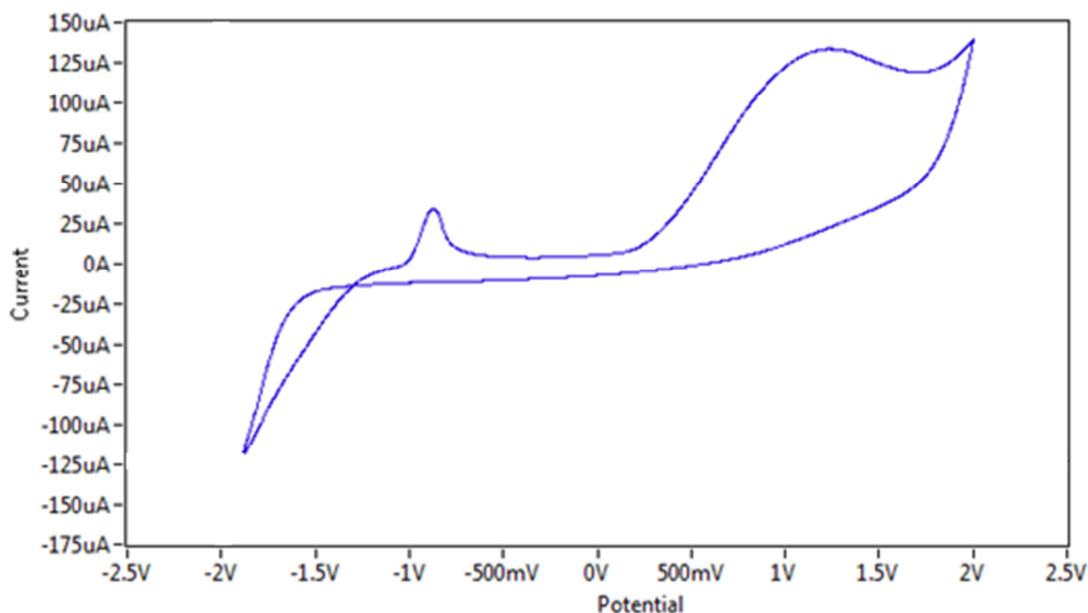


Figure 3. Cyclic voltammogram of ZnO in blood medium in presence of AA using GCE as working electrode at 100mVsec^{-1} versus Ag/AgCl as reference electrode.

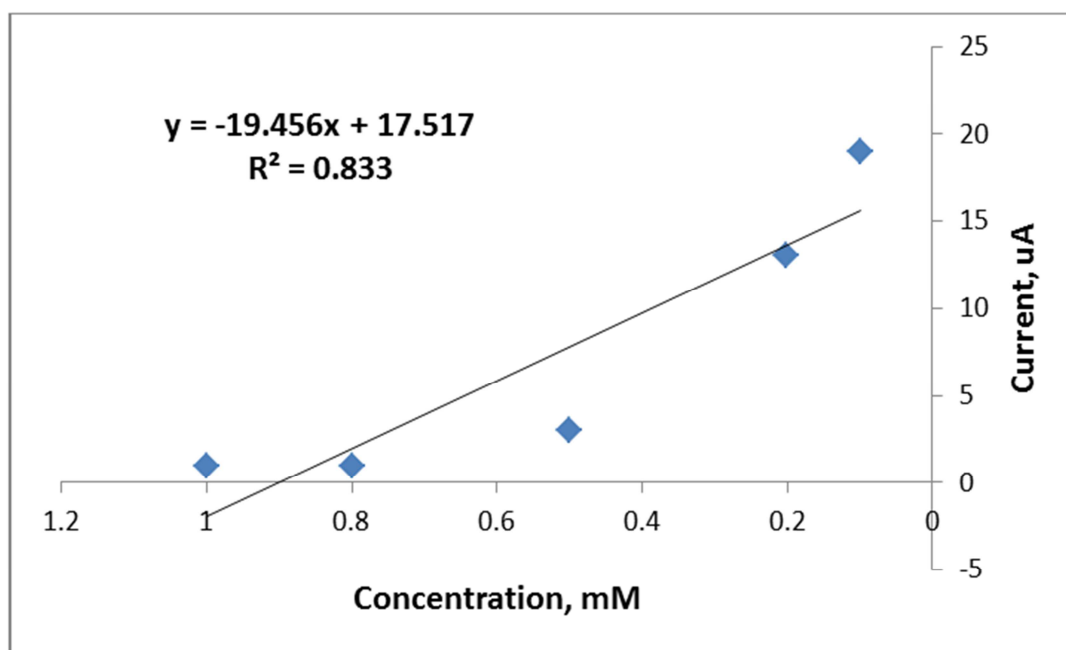


Figure 4. The relationship between anodic current peak of Zn(II) against the different concentrations.

Effect of FA on ZnO in Blood Medium

Figure 5. Shows the cyclic voltammogram of redox current peaks of zinc oxide ions in blood medium in presence with FA, which acts enhancement the both oxidation reduction current peaks of Zn(II). The effect of FA in this study has new properties about effecting in blood medium comparing with other studies [14].

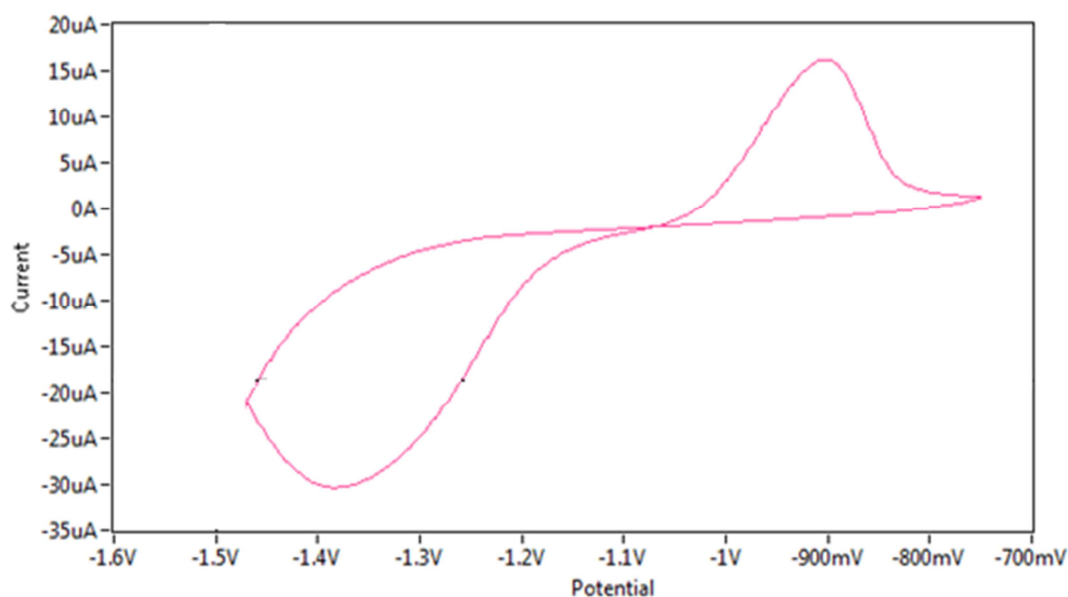


Figure 5. Cyclic voltammogram of ZnO in the presence of FA in blood medium using GCE as working electrode at scan rate 100mVsec^{-1} versus Ag/AgCl as reference electrode.

Conclusion

Zinc ions are very important especially in the human body, so studies in this field have indicated that children with pediatric septic shock have demonstrated critically low levels of serum Zn and supplementation of Zn in healthy values. In the study of Zn in human blood medium was affected in electrochemical study by cyclic voltammetric technique which acts as zinc as oxidant and antioxidant in the human body. Other studies were used AA and FA that affected on the Zn in blood medium by using FA enhancement both oxidation and reduction of current peaks, but AA acts to decrease the oxidation current peak of Zn and disappearing the reduction current peak. ■

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