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Electrochemical Effect of Acetylsalicylic Acid (Aspirin) in Present of Each Ascorbic Acid (AA) and Folic Acid (FA) in Normal Saline and Human Blood Samples

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Keywords

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It is well known for using acetylsalicylic acid (ASA) as tablets of aspirin, one of medicines for chronic diseases and for the benefit of the desired of this medicine and in particular the older ages in life to prevent blood clotting and for stroke. The aim of the study was to finding the affected of aspirin as chemical composition in blood medium using cyclic voltammetric method by glassy carbon electrode. It was found that the oxidative current peaks of ASA in both normal saline and blood medium appeared in voltammograms, also many reduction current peaks in normal saline and blood medium was found. The oxidation current peak of ASA in blood and normal saline medium was reduced in present with each of AA and FA, also enhanced the reduction current peaks by these reagents (AA and FA). The chemical composition of both AA and FA acts as antioxidant reagent in blood medium in present with ASA, so patient can be taken aspirin in safety using with these reagents.

Introduction

In the last ten years ago scientists was changed the electrochemical studies of the chemical and pharmaceutic compounds by cyclic voltammetric method in blood medium to finding the oxidation and reduction properties and studying the effect of oxidative current peaks on the blood decomposition [1-6].

Acetylsalicylic acid (ASA), or aspirin, was introduced in the late 1890s and has been used to treat a variety of inflammatory conditions. The electrochemical method for indirect determination of ASA has been utilized to analyses pharmaceutical drug. It was found that all determination of detected salicylates directly without any pre-treatment, hydrolysis and so on at high resolution values [7].

Cyclic voltammetry was used to investigate the oxidation of salicylic acid at a planar glassy carbon electrode. The electrode reaction was found to be dependent on the pH and ionic strength of the acetate buffer, which contained 35% methanol. The developed stripping voltammetric method was successfully applied for quantitative analysis method in pharmaceutical formulations and spiked human serum, without the necessity for samples pretreatment and/or time-consuming extraction steps prior to the analysis [8].

Antioxidant activity of a number of small (low molecular weight) natural compounds found in spices, condiments or drugs

(gallic acid, sesamol, eugenol, thymol, carvacrol, vanillin, salicylaldehyde, limonene, geraniol, 4-hexylresorcinol, etc.) has been evaluated using electrochemical measurements [9].

A novel electrochemical sensor based on molecularly imprinted polymer film has been developed for aspirin detection. The molecularly imprinted sensor was characterized by electrochemical impedance spectroscopy (EIS), differential pulse voltammetry (DPV), and cyclic voltammetry (CV) [10].

Differential pulse voltammetry and chronoamperometry were used to detect and determine acetylsalicylic acid (ASA) at a mildly oxidized boron-doped diamond electrode in a neutral sodium sulphate solution as supporting electrolyte. The limits of detection were situated around 1 μM. The association of differential pulse voltammetry and chronoamperometry techniques with standard addition method represented a suitable option for the determination of ASA in real samples such as pharmaceutical formulations [11].

The use of an amperometric biosensor for the salicylate determination in blood serum is described. The biosensor is based on salicylate hydroxylase electropolymerized onto a glassy carbon-working electrode with polypyrrole and glutaraldehyde, to improve the biosensor lifetime. Blood serum samples analyzed by this biosensor showed a good correlation compared to the spectrophotometric method (Trinder) used as reference, presenting relative deviations lower than 7.0% [12].

The electrochemical oxidation of salicylic acid (SA) has been studied on a glassy carbon electrode using cyclic voltammetry and differential pulse voltammetric (DPV) method. SA gives a single irreversible oxidation wave over the wide pH range studied. The method was successfully applied for the analysis of SA as a hydrolysis product, in solid pharmaceutical formulations containing acetylsalicylic acid (ASA) [13].

The developed stripping voltammetric method was successfully applied for quantitation of irbesartan in pharmaceutical formulations and spiked human serum, without the necessity for samples pretreatment and/or time-consuming extraction steps prior to the analysis. Moreover, pharmacokinetic parameters of irbesartan in plasma of healthy volunteers followed an oral administration of a single dose of Aprovel [14].

In this study, cyclic voltammetric method was used to finding the effect of ASA as aspirin tablet in blood medium by redox current peaks of ASA appearing in the blood medium.

Experimental

Reagents and Chemicals

Acetyl salicylic acid (ASA) aspirin from, Normal saline (0.9% NaCl W/V) from Alcon Parenterals (India) Ltd, Ascorbic acid (AA) from Technicon chemicals Co. (Oreq. Tournai Belgique), Folic acid (FA) from Actavis, Barnstaple, EX32 8NS, UK, healthy human blood samples and other chemicals and solvents were of annular grade and used as received from the manufacturer. Double distilled water was used for the preparation of aqueous solutions. All solutions were dried with oxygen free nitrogen gas for 10-15 minutes prior to making the measurement.

Apparatus and Procedures

Instruments: EZstat series (potentiostat/glvanostat) NuVant Systems Inc. pioneering electrochemical technologies USA. Electrochemical workstations of Bioanalytical system with potetiostate 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 grand.

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 was connected with potentiostat to finding the results by the cyclic voltammograme using personal computer.

Results and Discussion

Study ASA in Normal Saline

In the study of aspirin in the normal Saline as an electrolyte was found one oxidation current peak at 1.25 V and two reduction current peaks at 0 and -600 mV of the ASA as shown in Figure 1. It is noted that the aspirin acts as an oxidizing agent by the anodic current peak as shown in Figure 2. In addition to consider that aspirin compound as antioxidative reagent in normal saline. Many studies confirm that there is an oxidation and reduction peaks of ASA in the neutral medium [15].

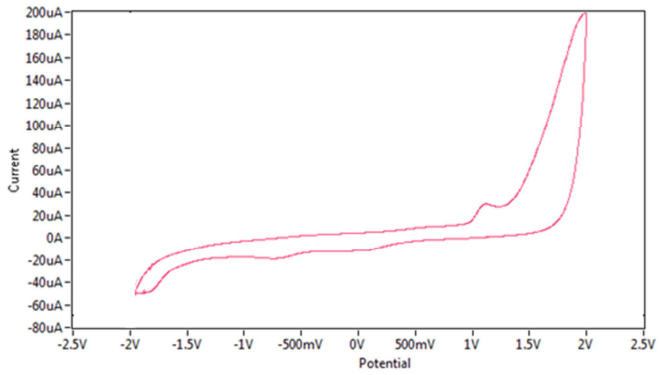

Figure 1. *Cyclic voltammogram of ASA in normal saline using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

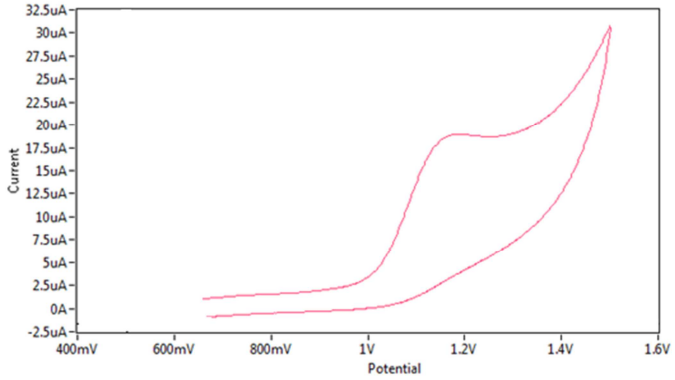

Figure 2. *Voltammogram of oxidative current peak of ASA in normal saline using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Study the Effect of AA on ASA in Normal Saline

Figure 3 shows that it can be seen the effect of oxidation current peak of ascorbic acid at 750mV [16, 17] on each of the oxidation and reduction current peaks of aspirin in normal saline by enhancement the oxidative current peak of ASA about three times and causes to reducing the two reduction current peaks of ASA to single reduction current peak at -600mV.

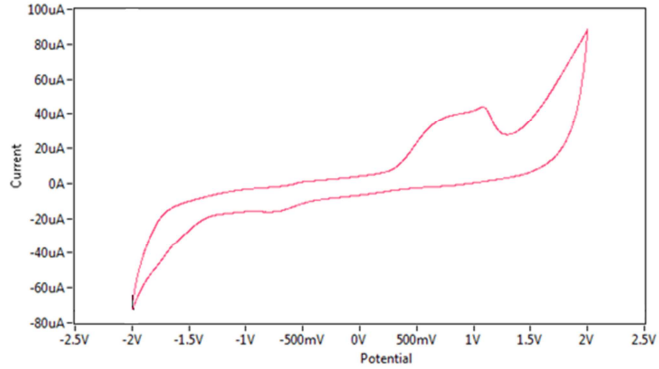

Figure 3. *Cyclic voltammogram of ASA in present of AA in normal saline using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Study the Effect of FA on ASA in Normal Saline

The results showed that ASA in presence of folic acid with normal Saline didn't affect the oxidation and reduction current peaks of aspirin as evident in Figure 4.

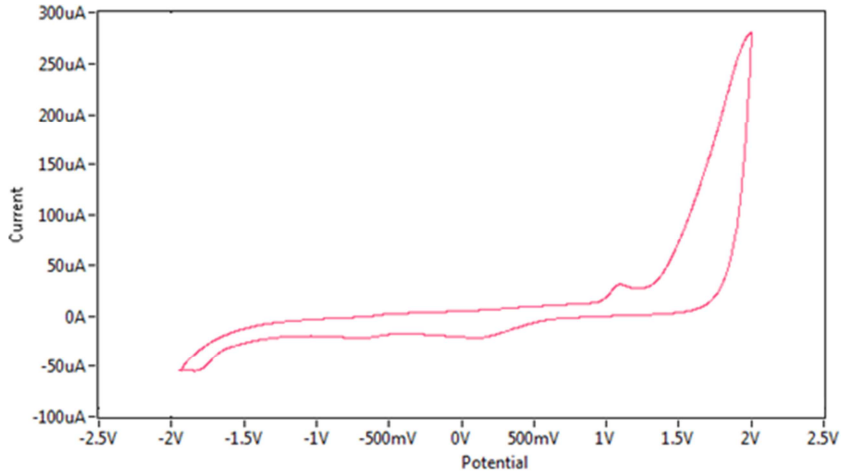

Figure 4. *Cyclic voltammogram of ASA in present of FA in normal saline using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Study ASA in Blood Medium

By studying the composition of aspirin in the blood medium in vetro studying by electrochemical method and its effect, which shown that aspirin acts as oxidizing agent effective on the blood component with appearing the oxidation current peak at 1.5V and also acts as antioxidative agent by reduction current peak at -600mV as shown in Figure 5. In all studies of aspirin in blood medium, we do not get the results of a study in this regard.

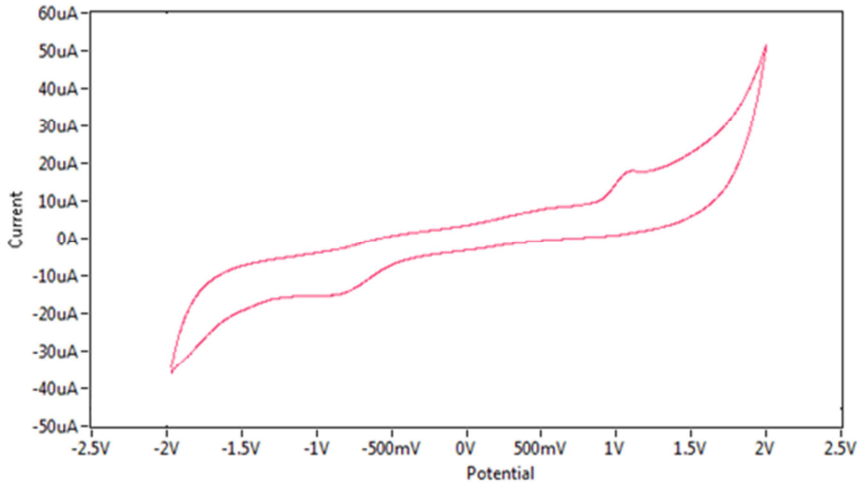

Figure 5. *Cyclic voltammogram of ASA in blood medium using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Study the Effect of AA on ASA in Blood Medium

It is known scientifically that AA is antioxidative agent to the human body and in particular its effect on blood composition. AA not only possesses antioxidant activity, but also can generate cytotoxic activity at higher concentrations [18]. The current study has been adopted using AA as an important factor with the presence of aspirin in blood medium to see its impact on the oxidation-reduction current peaks of the ASA. Figure 6 and 7 show the oxidation current peak of AA at 600mV enhanced both of oxidation –reduction current peaks at 1.5mV and -750mV respectively.

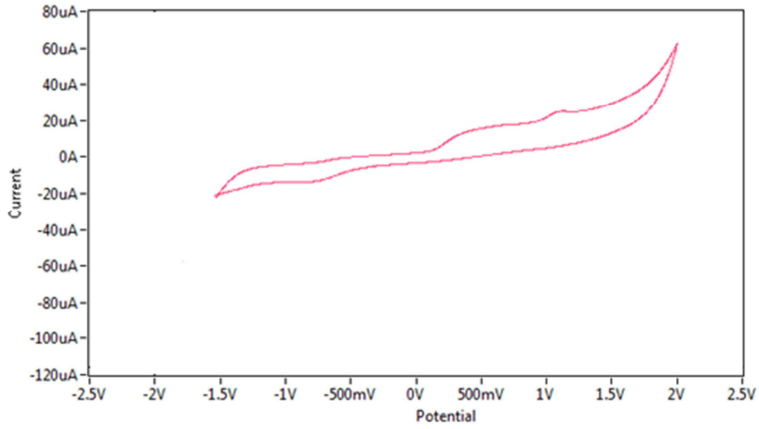

Figure 6. *Cyclic voltammogram of ASA in present with AA in blood medium using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

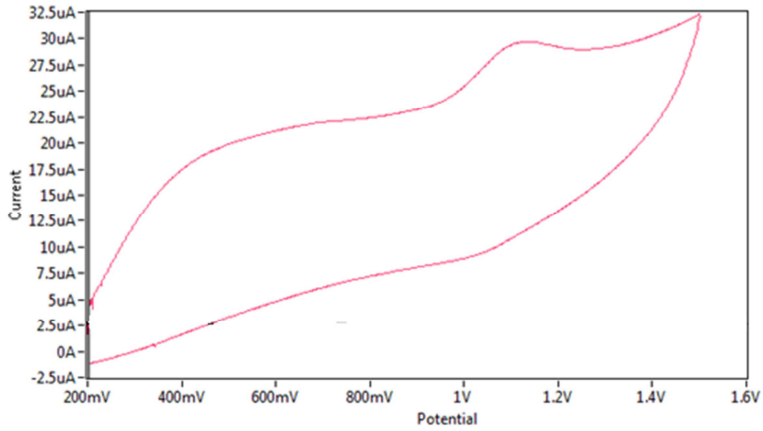

Figure 7. *Cyclic voltammogram of ASA in present with AA in blood medium using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Study the Effect of FA on ASA in Blood Medium

It was found in clear as shown in Figure 8 the effect of folic acid on the redox current peaks of the ASA compound in the blood medium. It was noted that the FA reduce the oxidative current peak of aspirin and enhancement the reduction current peak, so FA is giving importance to using with aspirin tablet.

FA appears to reduce the risk of stroke, which may be due to the role FA plays in regulating homocysteine concentration. It was indicated the risk of stroke appears to be reduced only in some individuals. It was observed stroke reduction is consistent with the reduction in pulse pressure produced by folic acid tablet of 5 mg per day, since hypertension is a risk factor for stroke [19].

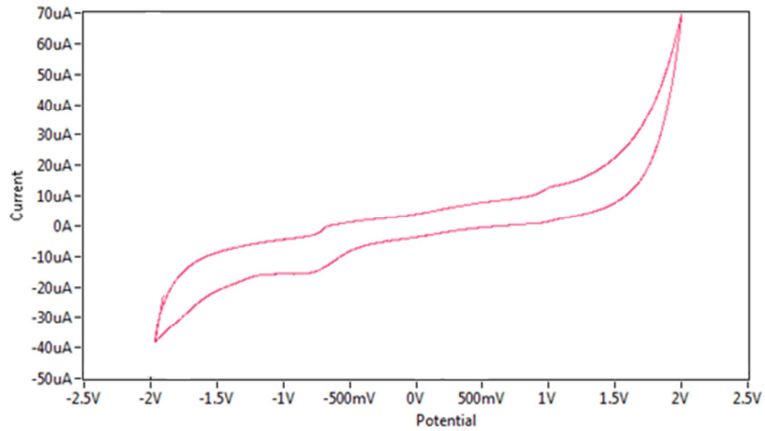

Figure 8. *Cyclic voltammogram of ASA in present with FA in blood medium using GCE at scan rate 100 mVsec^{-1} versus Ag/AgCl as reference electrode.*

Analysis of ASA in Blood Medium

The determination of AA concentration in blood samples with ASA using GCE. Recoveries experiment were evaluated using direct calibration of 99.6 ± 2.09% was obtained after the addition of 0.02 mM AA in to blood sample with ASA as in table 1 while recovery of 99.03 ± 2.1% was obtained after the addition of 0.03 mM AA into blood sample with ASA as in table 2.

Table 1. *Recovery rate of 0.02 mM of AA added in to the blood sample with ASA.*

No. of sample	Concentration of AA (mM)	Recovery Rate%	Mean Recovery%	Relative Standard Deviation%
1	0.0205	102.5	99.6	2.09
2	0.0199	99.6		
3	0.0198	99.0		
4	0.0195	97.5		

Table 2. *Recovery rate of 0.03 mM of AA added in to the blood sample with ASA.*

No. of sample	Concentration of AA (mM)	Recovery Rate%	Mean Recovery%	Relative Standard Deviation%
1	0.0305	101.6	99.03	2.1
2	0.0290	96.6		
3	0.0295	98.3		
4	0.0299	99.6		

Conclusion

The electrochemical study was used for aspirin compound in human blood medium in presence of both AA and FA. The results were given that aspirin has oxidation and reduction current peaks in blood medium. It was considered that aspirin compound interest of human body during the impact on the blood medium as antioxidative by the cathodic current peak and in the same time aspirin has oxidation current peak which causes an oxidative the blood component. The importance of aspirin compound to the human body especially in the prevention of stroke, so it was address the impact of oxidative stress of aspirin in blood medium by using AA or FA with aspirin tablet. It was noted that each of AA and FA effected on the oxidative and antioxidative currenr peaks of aspirin in blood medium by reducing the anodic peak and enhancement of cathodic peak. ■

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As assistant professor, Dr. Muhammed Mizher Radhi received his Ph.D from university Putra of Malaysia (UPM) at 2010 in Electrochemistry, Nanotechnology. He has publications in electrochemistry (cyclic voltammetry) and grafted polymer with nanodeposit. Also, he has one international patent and eight Iraqi patents. His research is focused the high conductivity of grafted polymer with nano deposit and fabrication sensors by nano materials to study the drugs in blood medium by electrochemistry analysis.
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