Effect of Inhaling of Perfume on the Blood of Human Healthy Male Using Electrochemical Method by Cyclic Voltammetry

Abstract

All people in the world were used perfume in different manufactures and marker, in this study, we wanted to be found the effect of continues using of perfume and still inhaling these compound on the human healthy by electrochemical analysis using cyclic voltammetry. In the scientific knowledge, the inhaling of perfume by breathed and then reach to the blood stream through lungs and pulmonary alveoli passing to the blood vessels. The study focused on the oxidation – reduction peaks current of the cyclic voltammogram which can be found from the perfume in healthy blood of male samples. It was found from the results that many oxidation peaks current appeared in the cyclic voltammogram in the blood medium with presence of the perfume, also, in different concentration, and different temperatures were studied, so all perfume compound were effected on the blood components of the male. The oxidative effect of the perfume on blood medium which may be caused the damage of blood components through the continuance of using it and appeared a risk cases of different diseases. the advices for correct using of the perfume in a little amount and in limited using every day, also avoid using the perfume to the patients with high fever.

Keywords: cyclic voltammetry, perfume, blood of male, oxidation – reduction, temperature, concentration.

1. Introduction

Cyclic voltammetric technique has a good method for identified the toxicity of the contained materials in blood media by the oxidation – reduction reaction, different studies depended these methods [1-5].

“Oxidative stress plays a pivotal role in the pathogenesis of many diseases, but there it is no accurate measure of oxidative stress or which antioxidants are of benefit in the clinical setting. Cyclic voltammetry is a widely used electrochemical technique for redox state analysis in industrial and research settings. It has also been recently applied to assess the antioxidant status of biological samples in vivo” [6].

"Electrochemical nanosensors have been developed from composite metal oxide (MO) particles by supporting them on a gold (Au) electrode. The activity of the developed nanosensor towards detection of a malaria biomarker (β-hematin) was determined and the optimal conditions under which maximum detection and quantification occurred were determined" [7].

"A cyclic voltammeter was used to study the electrochemical behavior of ascorbic acid on a carbon paste electrode. Ascorbic acid showed an irreversible oxidation peak at around +470 mV. While the peak change observed with pH in the range from 0.5 to 6.0 indicated the participation of protons during the oxidation of ascorbic acid, the peak potential shift with the scan rate in the range 10–300 mV/s confirmed the irreversibility of the oxidation reaction" [8].

"An electrochemical method for the determination of 2-naphthylamine (2NAP) in perfumes by differential voltammetry (DPV) using a cathodic boron-doped diamond (BDD) electrode. A simple dilution of the sample in a supporting electrolyte was performed prior to electrochemical analysis. A buffered borate solution of pH 10.0 had a 20% (volume/(LOD) of 0.0046 µmol L with a linear range of 0.5–90 µmol L and RSD <2.9%, respectively. The recovery values for samples spiked with 2NAP were between 102 And 104% the proposed method is feasible to be applied for 2NAP detection and quantification of perfume samples with simple sample preparation" [9].

"The voltammetric oxidation of five semi-substituted acetophenone derivatives (containing nitro, chloro, bromo, methyl and hydroxyl groups as substituents) and those of benzophenone on a platinum and glassy carbon electrode in acetonitrile medium was studied. Electrode passivation is observed in the case when all selected compounds are on a glassy carbon electrode; The oxidation peak appeared between 2.5 and 3 eV. The voltamogram of 4′-hydroxyacetophenone showed an additional peak around 2 eV, which may be associated with oxidation of the phenolic moiety" [10]

In this study, cyclic voltammetric method was used to identified the effect of perfume in blood medium through inhaling the fume of perfume.

2. Experimental

2.1. Materials

Samples of perfume from different company, healthy male blood samples received from Baghdad medical city center in Iraq, and deionized water.

2.2. Methods

2.2.1. Apparatus

Adapted by NuVant Systems Inc. Pioneering Electrochemical Technologies, USA, In this study to evaluate the electrochemical properties of rifampicin in vitro using an EZstat (potentiostat/glvanostat) series device. In order to output the cyclic voltammogram test, the electrochemical workstations of the integrated analytical system are connected to a personal computer with a potentistat operated by electrolysis software. In addition to using Ag/AgCl (3 M KCl) to calculate the reference while using Platinum wire (1 mm diameter) as a counter electrode as shown in Fig. 1.

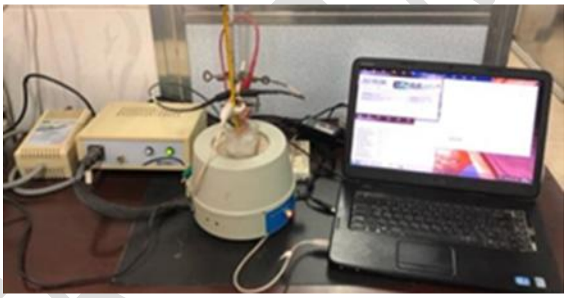

Fig. 1: setup of cyclic voltammetry

2.2.2. *Procedure*

Glassy carbon electrode (GCE) was used after cleaning with alumina solution and treated with ultrasonic pathway water for 10 minutes. The three electrodes (reference electrode, silver / silver chloride (Ag / AgCl) at 3M KCl, platinum wire auxiliary electrode with a diameter of 1 mm and glassy carbon electrode as working electrode) were immersed in a cyclic voltammetic cell (15 ml) contain (1 ml of blood:9 ml of distilled water) as shown in Fig.2. All three electrodes were connected with the potentio stat and with personal computer [11].

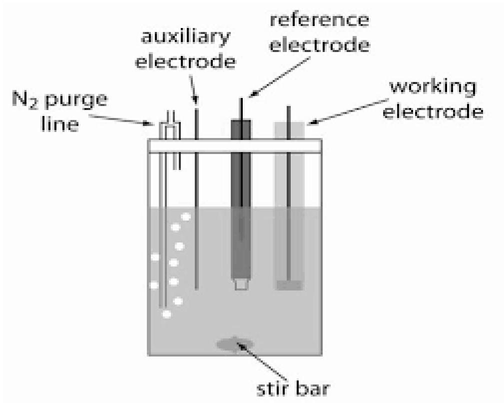

Fig. 2: Scheme of cyclic voltammetric cell

3. Results and Discussion

3.1. Effect different concentrations

Perfumes one of the derivatives of aldehydes and ketones of different chemical compounds. The electrochemical properties was studied by cyclic voltammetric method, one of these study is the effect of different concentrations of the perfume in the blood medium of male samples, Fig. 3 shows the cyclic voltammogram of the effect different concentration of perfume on the oxidation – reduction peak current, it was found one peak of oxidation current at potential of 750 mV and one peak of reduction current at potential of -750 mV. the oxidation peak was enhanced by increasing of the concentration of perfume injected in the serum blood medium, while the reduction peak was still in the same density of current value. The calibration curve of the relationship between the oxidation peak current has a good linear line with equation of Y= 19.657X+46.86 and high sensitivity of R^2=0.9851 as shown in Fig. 4**,** it means that the different concentraions of perfume effected on the components of blood with homogeneous reaction between the perfume and blood [12].

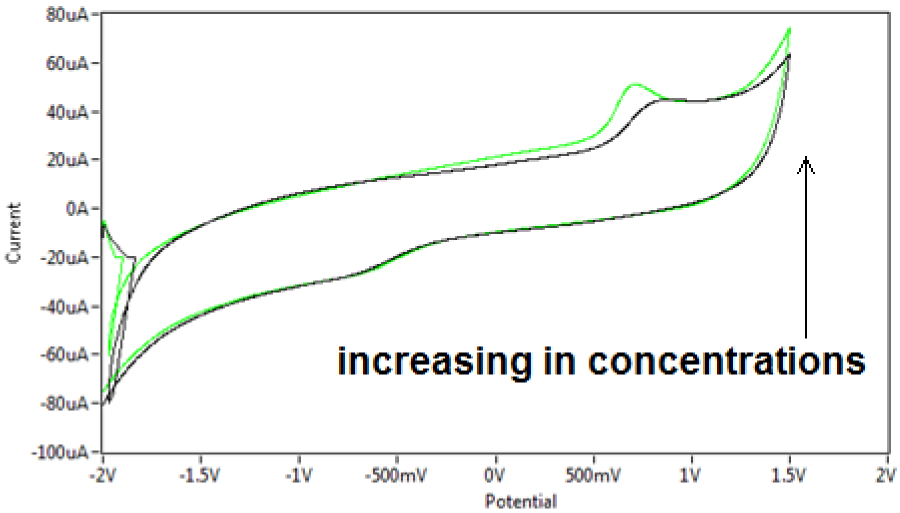

Fig. 3: Cyclic voltammogram of perfume in human blood medium for healthy male at different concentrations on GCE (working electrode) and Ag/AgCl (reference electrode).

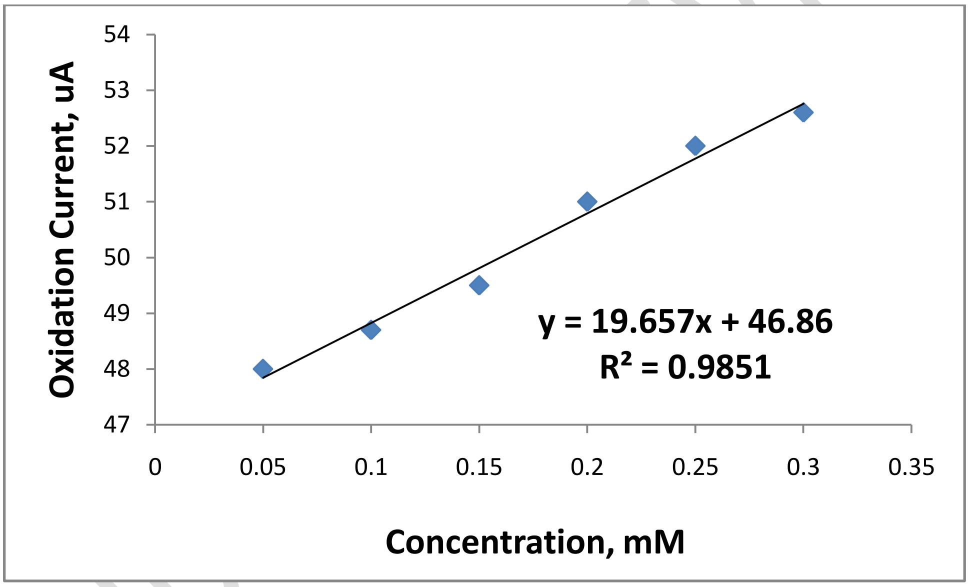

Fig. 4: relationship between oxidation peak current of perfume in human blood medium of healthy male against to different concentrations at scan rate 0.1 Vsec-1.

3.2. Effect Different Scan Rates

Fig. 5 illustrated the cyclic voltammogram of perfume in blood medium at different scan rates from 0.01 to 0.1 Vsec-1, there are homogeneous relationship in both oxidation and reduction peaks current of perfume in blood medium against to increasing the scan rates as shown in Fig. 6 and Fig. 7, respectively [13].

The oxidation – reduction peaks current equations with sensitivity in the following:

Oxidation peak: Y = 476.35X + 8.468 with high sensitivity R^2 = 0.9815

Reduction peak: Y = 252.32X + 7.7747 with high sensitivity R^2 = 0.9889

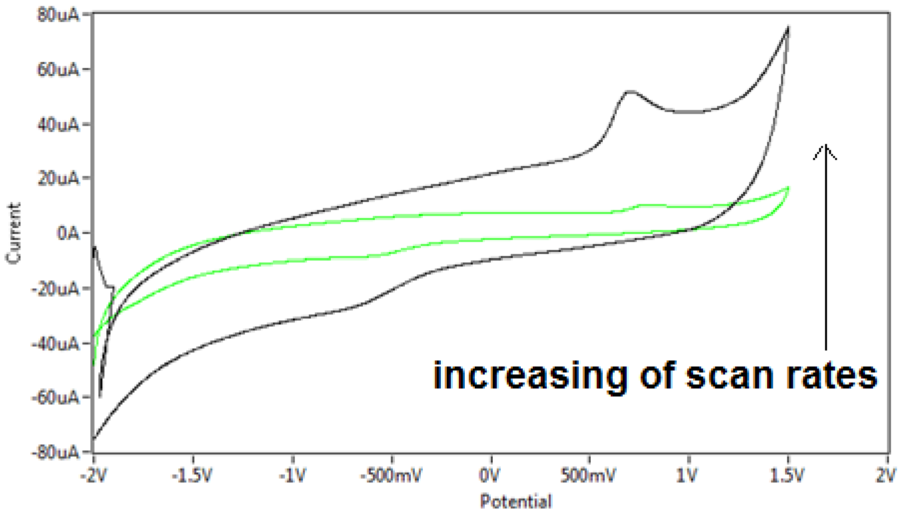

Fig. 5: Cyclic voltammogram of perfume in human blood medium for healthy male at different scan rates (0.01 – 0.1 Vsec-1) on GCE (working electrode) and Ag/AgCl (reference electrode).

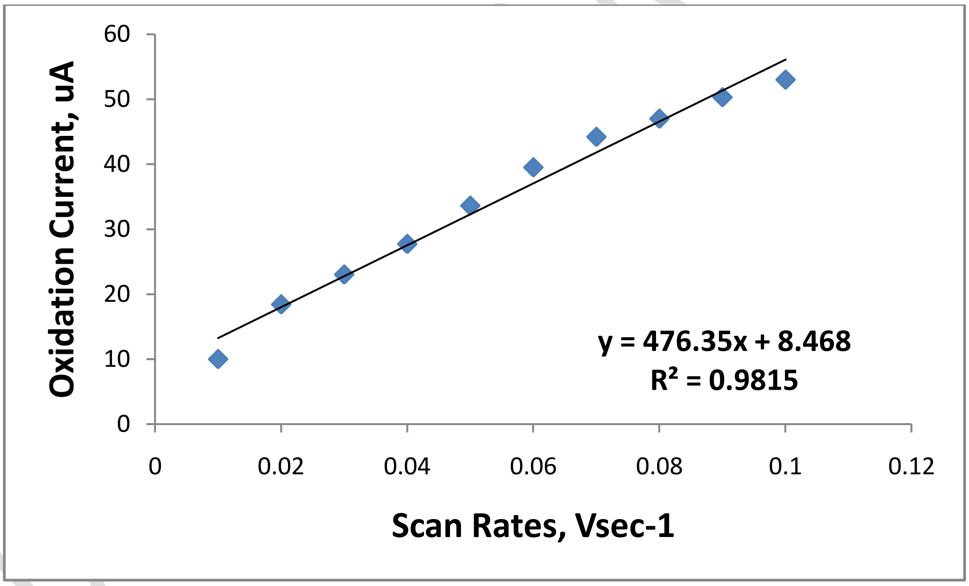

Fig. 6: relationship between oxidation peak current of perfume in human blood medium of healthy male against to different scan rates (0.01 – 0.1 Vsec-1).

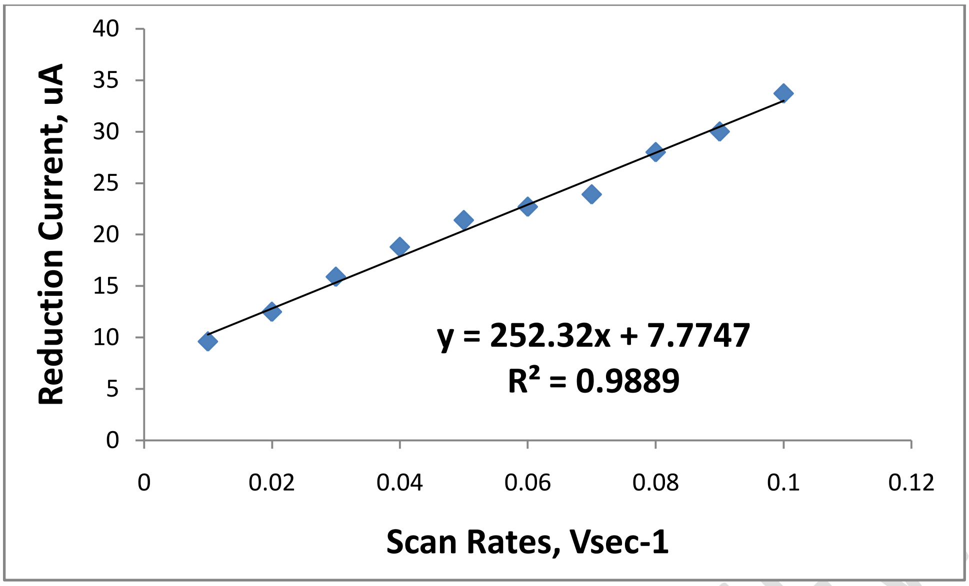

Fig. 7: relationship between reduction peak current of perfume in human blood medium of healthy male against to different scan rates (0.01 – 0.1 Vsec-1).

3.3. Effect Different Temperatures Study

The behavior of perfume in blood medium in different temperatures from 36 C^o to 52 C^o was studied by cyclic voltammetry. Fig. 8 illustrated the cyclic voltammogram of perfume in blood medium at low and high temperatures to evaluate the effect the fever for patients on the using of perfume, it was found from the results the higher temperature cause to enhancement the oxidation peak current which became two peaks [14].

The relationship between logarithm of oxidation peak current (Ln (Ipa)) and for reduction peak (Ln (I_{Pc})) of perfume in blood medium against to the inverse temperatures as shown in Fig. 9 and 10. .

The oxidation – reduction equations was found from the Fig. and respectively as in the following:

Oxidation: Y = -83.953X + 316.03 with high sensitivity of R2 = 0.9081

Reduction: Y = -71.867X + 268.25 with high sensitivity of R2 = 0.9317

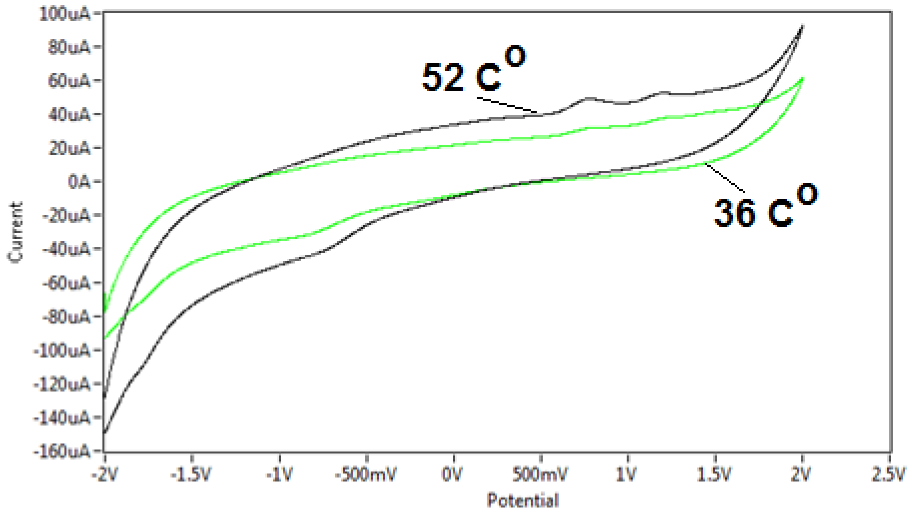

Fig. 8: Cyclic voltammogram of perfume in human serum blood medium for healthy male at different temperatures (36 – 52 ^{o}C) on GCE (working electrode) and Ag/AgCl (reference electrode) at scan rate of 0.1 Vsec^{-1}.

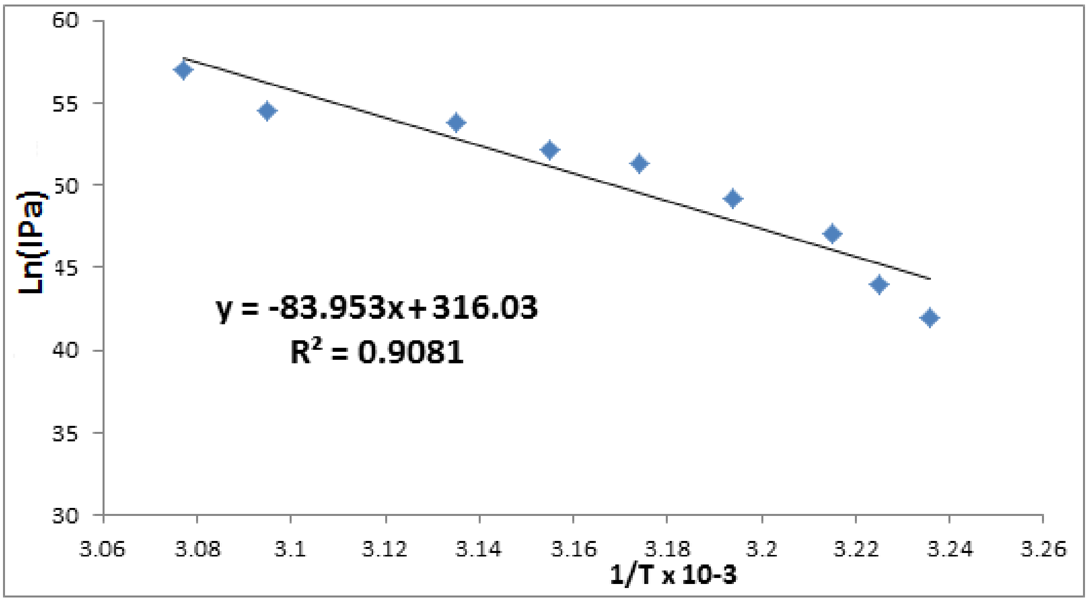

Fig. 9: relationship between oxidation peak current of perfume in blood medium against to different temperatures

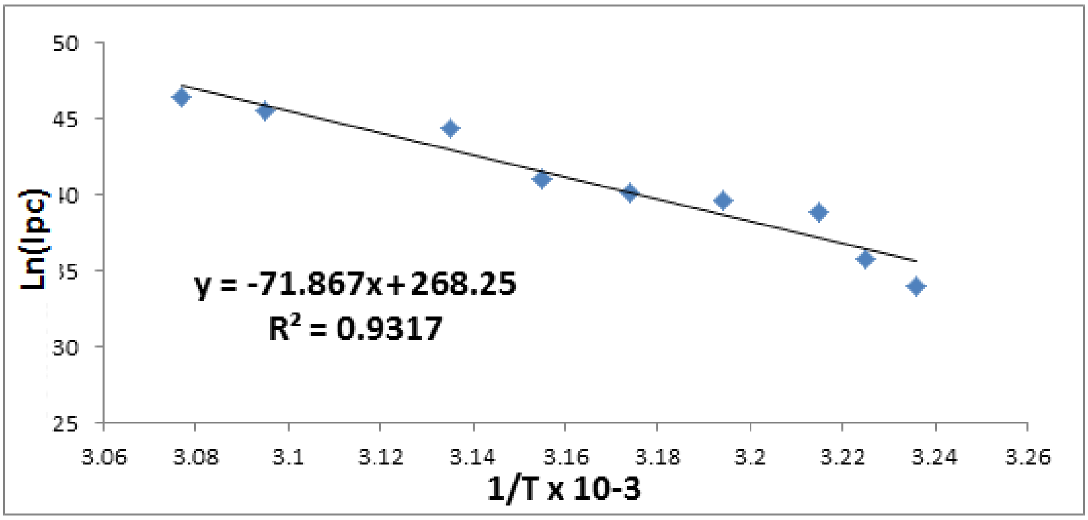

Fig. 10: relationship between reduction peak current of perfume in blood medium against to different temperatures

3.3.1. Calculation of Activation Energy (Ea)*

Activation energy was determined using Arrhenius equations 1, 2, and 3 [15,16]

σ = σoExp (- E*/ RT) …………….(1)

D = DoExp (-E*/ RT) …………….(2)

where σ / D refer to conductivity / diffusibility

while σo /Do represent standard conductivity / the initial diffusibility

Ip = Exp(-Ea*/RT)……… (3)

Where:

Ip: Current peak. (µA)

Ea*: Activation energy (kJ/mol).

R: Ideal gas constant (8.314 J/mol·K).

T: Temperature in K.

The activation energy of oxidation – reduction peaks current of perfume in blood medium was determined from the Arrhenius equations as in the following:

Oxidation: Ea* = 697.96 $J.mol^{-1}.K^{-1}$

Reduction: Ea* = 597.50 $J.mol^{-1}.K^{-1}$

3.4. Reliability and Stability Study

The reliability and stability for studying in the cyclic voltammetric technique is needed to prove the results, so the cyclic voltammogram repeated for ten times scanning to show the overlapping of these voltammoram. Fig. 11 shows the cyclic voltammogram for ten times scanning of perfume in blood medium which have totally overlapping the scanning to prove the correct results from these technique [17].

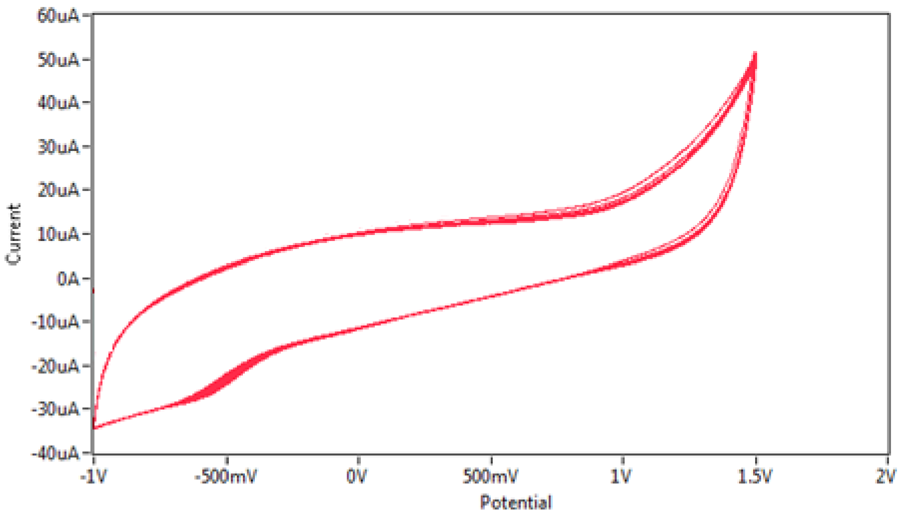

Fig. 11: cyclic voltammogram of perfume in blood medium at ten scanning on GCE and Ag/AgCL as reference electrode at scan rate of 0.1 $Vsec^{-1}$

4. Conclusion

In this study, the electrochemical method by cyclic voltammetric technique success to evaluate the effective of perfume fume on the human blood samples at different temperatures and concentrations as in the following:

1.the high dose of perfume exposed the male every day causes an oxidative stress to the blood components that make a damage and risk for all organs body .

2.the patient which has high fever must be avoid inhaling the perfume because the high temperatures causes appearing many oxidation peaks with high intensity.

3. perfumes are chemical compounds, these compounds have different effected on the health of human, so need to take care of using these materials in extreme necessities.

Ethical Approval:

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

References

1. Muhammed R, Hanaa NA, Sura AA, Emad AA. Electrochemical oxidation effect of ascorbic acid on mercury ions in blood sample using cyclic voltammetry, Int J Ind Chem (2015) 6:311–316

2. Muhammed R, Hanaa NA, Majid SJ, Emad AA, Electrochemical Effect of Ascorbic Acid on Redox Current Peaks of $CoCl_2$ in Blood Medium, Nano Biomed. Eng., 2017, 9, 2:103-106.

3. Muhammed R, Emad AJ. Use of a grafted polymer electrode to study mercury ions by cyclic voltammetry, Research on Chemical Intermediates, 2015, 41, 3:1413-1420

4. Muhammed R, Firas KM, Noor JR. Voltammetric Characterization Of Grafted Polymer Modified With ZnO Nanoparticles On Glassy Carbon Electrode, Russian Journal of Electrochemistry, Russian Journal of Electrochemistry, 2018, 54, 1:27–32

5. Muhammed R, Tan WT, Rahman MZ, Kassim AB. Electrochemical characterization of the redox couple of $[Fe(CN)_6]^{3-}$/$[Fe(CN)_6]^{4-}$ mediated by a grafted polymer modified glassy carbon electrode, Journal of chemical engineering of Japan, 43 (11): 927-931

6. Hsiang W, Cameron B, Anthony JR, John AW, Paul AK, Anthony RJ. Cyclic Voltammetry in Biological Samples: A Systematic Review of Methods and Techniques Applicable to Clinical Settings, Signals 2021, 2:138–158

7. Olaoluwa R, Abolanle SA, John AO, Oyekunle TS, Thabo TI, Bhekie BM. Development of Electrochemical Nanosensor for the Detection of Malaria Parasite in Clinical Samples, Front. Chem., 2019, 7: 89

8. Zelalem B, Meareg A. Electrochemical Determination of Ascorbic Acid in Pharmaceutical Tablets using Carbon Paste Electrode, Organic and Medicinal Chemistry, 2019, 8, 5: 2019

9. Guilherme N. Rodrigues WP, Silva DP, Rocha EM, Richter RA, Munoz AD. Batista, electrochemical determination of 2-naphthylamine in perfume samples using boron doped diamond electrode, Artigo Quím. Nova, 43 (3):2020

10. László K, Sándor KM. Voltammetric oxidation of acetophenone derivatives and benzophenone in acetonitrile on a platinum and glassy carbon electrode, Comptes Rendus Chimie, 2019, 22, 4:316-320.

11. Farhana H, Rahman MS, Etmina A. A Cyclic Voltammetric Study of the Redox Reaction of Cu(II) in Presence of Ascorbic Acid in Different pH Media. Dhaka Univ J Sci. 2013, 61(2):161-166.

12. Alaa L, Muhammed MR, Intesar NKh, Eman NN, Nano-ceftriaxone as Antibiofilm Agent, International Journal of Psychosocial Rehabilitation, 2022, 24, 02:1475-7192.

13. Radhi M, Mulla EA, Voltammetric characterization of grafted polymer electrode self- modification with carbon nanotubes (GPESMCNT). Portugaliae Electrochimica Acta, 2016, 34(2): 97-103.

14. Amidi S, Ardakani YH, Amiri AM. Sensitive electrochemical determination of rifampicin using gold nanoparticles/poly-melamine nanocomposite. RSC Adv., 2017, 7: 40111.

15. Sura A, Muhammed MR, Wisam HH, Thermodynamic Properties of Rifampicin Redox Current Peaks in Human Blood Samples Using Nano-Sensor (Carbon Nanotubes / Glassy Carbon Electrode), J.Chem.Soc.Pak., 2021, 43: 01.

16. Tan W, Goh J. Electrochemical oxidation of methionine mediated by a fullerene-C60 modified gold electrode, Electroanalysis, 2008, 20:2447.

17. Muhammed M, Anfal II, Majid SJ, Emad AJ, Wisam HH. Nano Cinnamon: A Study in Human Blood Medium Using Cyclic Voltammetry on Glassy Carbon Electrode (GCE), Nano Biomed. Eng., 2022, Vol. 14, 2:167.