Study the effect of metformin in different pH of human blood medium using cyclic voltammetric technique

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Abstract
Metformin HCl is a drug to treat different diseases such as ovary, diabetes, and slimming. Present study includes the electrochemical analysis by cyclic blood medium at different pH to evaluate the oxidation – reduction current peaks of the metformin compound which appeared at +750 and -750 mV respectively in acidic blood medium, while the oxidation current peak of the metformin was disappeared in alkaline blood medium with present of reduction one, so metformin acts as antioxidant reagent in alkaline blood medium. The study device the patients whom have taken metformin tablets as a treatment for diabetic disease must take ascorbic acid with metformin tablet to avoid the oxidation stress.

Keywords: metformin, blood, cyclic voltammetry, different pH, redox reaction

1. Introduction

In the resent time scientists have chosen cyclic voltametric technique to study medicines in blood medium [1-6]. Metformin HCl is known in chemical structure (1,1-dimethylbiguanide HCl) as shown in Fig. 1. In the pharmacy market it is traded under the name of Glucophage and it is used as a treatment of type 2 diabetes,[7,8] particularly for people who are overweight, has polycystic ovary syndrome, cardiovascular disease or cancer complications of diabetes [9,10].

Fig. 1 Structure of metformin

A new method was used to determine metformin of pharmaceuticals, serum and urine from volunteers after spiking with metformin. The results were examined by a standard addition method. The number of pharmacological supplements and blood serum or urine matrix did not affect the determination of metformin [11]. The modified electrode, multi-walled carbon nanotubes (CNTs) composites on glassy carbon electrode (GCE) showed an excellent response to the oxidative current to determine metformin compound. In optimal conditions, a good linear peak current with concentrations in a range of 0.5 μm to 25 μm and a detection unit of 0.12 μm, as well as good repetition, was shown. The modified GCE with CNTs were applied successfully to determine metformin in pharmaceutical samples with good accuracy [12]. In 56 cases of lactic acidity strongly associated with metformin, the pH of blood lactate had no predictive value. One can reasonably rule out the accumulation of metformin as a prognostic factor. Ultimately, the determinants of metformin associated lactic acidosis were appeared to be the nature and number of influencing factors. Significantly, most patients survived - although the average pH is not consistent with a positive outcome under other conditions [13]. A newly developed spectral method was used in the present research project to determine the drug metformin hydrochloride, through the complication of copper (II). Color products were measured at 530 nm. The newly developed system for pharmaceutical analysis has been applied [14]. Metformin is an anti-diabetic drug that is widely used. HPLC is the most commonly used method for the analysis of metformin. Other methods include spectroscopy and potentiometric measurements. The drug is analyzed not only in a neat solution but also in pharmaceutical products alone and in combination with other drugs. Studies show that metformin can be successfully used to reduce the risk of cancer. However, a randomized trial is needed to see if the drug is useful among populations at risk for cancer. This review discusses the different methods used to analyze metformin and its potential role in carcinogen resistance [15].

In this work, metformin compound was studied by electrochemical analysis using cyclic voltammetric method in human blood medium at different pH.

2. Experimental methods

2.1 Cyclic voltammetric technique
EZstat (Potentiostat / Glvanostat) series from NuVant Systems (manufactured in the USA) was used to carry out the measurements. The electrochemical analysis cell was connected to the potentio-state and monitored by the program that was...
installed on the computer to perform cyclic voltammetric measurement (CV). Silver / silver chloride (Ag / AgCl in 3 M KCl) as reference electrode and platinum wire (diameter 1 mm) was used as counter electrodes. The glass working carbon electrode (GCE) was used in this study after cleaning by polishing with alumina solution and treated using ultrasonic waterway for ten minutes for measurement performance.

3. Materials

Metformin HCl compound was received from Merk sante s.a.s (Germany). Blood samples from healthy humans obtained from the Baghdad Medical Center were collected for analysis after the serum was completely separated from the blood by an electronic centrifuge of type 8-1 (3,000 cycles / min). Deionized water was used to prepare water solutions. All serum blood samples were diluted with deionized water by 1: 9 ml (serum: deionized water), 10 ml of dilute serum was placed in a cyclic voltammetric cell.

4. Results and discussion

Previous research has addressed the effects of the use of metformin for the treatment of some diseases such as diabetes. In the current study we prove the effects of this treatment from an electrochemical study of the blood through the peaks of oxidation and reduction of metformin compound.

4.1 Effect alkaline pH on metformin in blood medium

According to the results of the pH studies of metformin in alkaline blood medium, Fig. 2 illustrated the cyclic voltammogram of the oxidation – reduction current peaks of metformin in the range of alkaline pH (8-12), it was found the oxidation current peak was disappeared in this pH and the reduction current peak was enhanced in higher pH (12). Also, the oxidation – reduction current peaks of metformin at neutral blood medium pH (7) has appeared at 0.750 and -0.5 V respectively and disappeared the oxidation one at alkaline blood medium (pH=12) as shown in Fig. 3. Thus, the metformin HCl compound act as anti-oxidative reagent in alkaline blood medium [16].

4.2 Effect acidic pH on metformin in blood medium

In the comparing study of metformin HCl compound between acidic and alkaline blood medium, it was found that oxidation – reduction current peaks of metformin have enhanced at acidic blood medium pH (3) as shown in Fig. 4, so the metformin in acidic blood medium acts as a catalyst for oxidation process [17].
It was found from the results of the oxidation – reduction current peaks of metformine in different pH (2-12) that reduction current peak was enhanced in alkaline blood medium with disappearing the oxidation peak as shown in Fig. 5 and 6.

4.3 Effect of different medium on the redox current peaks of metformin

Fig. 7 illustrates the cyclic voltammogram of metformin HCl in each of blood and serum (plasma) at alkaline pH (12) to find the difference between the two electrolytes, which indicated that the blood and its serum have the same properties in electrochemical analysis and the overlapping of the cyclic voltammogram [18].

5. Conclusions

Based on the present research, it can be concluded that the treatment of metformin HCl for all medical use cases need to be taken carefully as results from the electrochemical analysis of this compound in different pH of serum medium. It was found that using metformin in acidic blood medium causes an oxidative stress by enhancing the oxidation current peak which indicated as oxidative medicine, while the metformin acts as anti-oxidative drug in alkaline blood medium by disappearing the oxidation current peak. Thus, an important advice to the users of this medicine is to take the complements as blood alkaline synthesis such as ascorbic acid to make the treatment safer.

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Background

Concrete Solutions 2019 is the 7th in a series of International Conference on Concrete Repair. Previous conferences have attracted a wide range of delegates from practitioners to Clients to Academics and Students.

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- Repair of Fire Damage
- NDT and Diagnosis of Problems
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- Risk Management
- Whole Life Costing
- Surface Protection Methods & Materials
- Repair of Heritage Structures
- Sustainability

Key Dates

Submission of Abstracts 31 January 2019
Notification of Acceptance 28 February 2019
Final papers due by May 31 2019

| Fee GBP | Before 31 May 2019 | After 31 May 2019 |
|---------|-------------------|-------------------|
| Author  | 600               | 650               |
| Delegate| 650               | 700               |
| Student*| 200               | 250               |
| Enhanced Student*| 300 | 350               |
| Single Day Registration | -       | 250               |

*For Students, proof of status will be required