

Effect of Iron, Aluminum and Zinc (as Anoda) on Metformin Deconcentration and Aspirin Deconcentration with Electrolysis Method

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Abstract. Aspirin and metformin are drugs that function as an analgesic-antiseptic, anti-inflammatory, and antiplatelet. Ferrous metal, aluminum metal and zinc metal are easily found and often used by the public. This study aims to reduce the two drugs by electrolysis method, using three different metals, namely iron metal, aluminum metal and zinc metal as an anode. The success of the electrolysis process was seen with a decrease in the sample COD index. In situations without the addition of electrolytes using ferrous metals, aluminum metals and zinc metals the COD index decreases in the sample very low (10-15%). This study aims to increase the success of the electrolysis process, by adding various types of electrolytes, such as acetic acid (weak electrolytes), sodium chloride (strong electrolytes), sodium chloride and fenton reagents. The addition of electrolytes can significantly increase electrolysis results. Interactions between drugs during electrolysis are tracked with possible changes in the chromophore group (with UV-Visible spectrum) and functional groups (with FTIR spectrum) of the sample. From the research data obtained information that there is a decrease and shift in the UV-Visible spectrum and changes in the functional group after the electrolysis process occurs. The electrolysis process of Metformin and Aspirin occurs optimally at a distance of 1 cm (in iron, aluminum and zinc as an anode and carbon as an anode) and a processing time of 30 minutes. The voltage used in the electrolysis process of Metformin is optimal at 3 volts and 9 volts in the Aspirin electrolysis process (in iron and aluminum as an anode and carbon as an anode). The best electrolysis percentage is obtained, after adding NaCl solution and Fenton's reagent in the range of 65 - 70%.

Keywords: Aspirin, Metformin, Electrolysis, NaCl Solution, Fenton Reagents.

1 Introduction

Aspirin is a class of Non-Steroid Anti-Inflammatory Drugs (NSAIDs), which have analgesic, antipyretic, anti-inflammatory effects that work peripherally and antiplatelet. This drug is used in symptomatic therapy of rheumatic diseases (osteoarthritis, gout arthritis) in relieving or reducing pain. This drug is also often used for the treatment of headaches, suppress pain in inflammation due to wounds and inflammation that arises after surgery, gynecological pain and neurological pain [1][2][3].

Metformin is an oral anti-diabetes that belongs to the biguanid class. Metformin is the first choice drug for sufferers of Diabetes Mellitus (DM) type 2, especially for people who are

overweight and obese as well as people with normal kidney function. In reducing high blood sugar levels, metformin works by inhibiting the process of gluconeogenesis, glycogenolysis, slowing the absorption of glucose in the intestine, and increasing insulin sensitivity in the body [4].

Good treatment is usually oriented to the symptoms of the disease. Therefore, there is often a variety of treatments for each symptom that appears so that it causes the administration of drugs of various kinds and tends to encourage drug interactions. The effects of drug interactions that occur can be beneficial or even detrimental [1]. Research about conducted at Dr. Moewardi Regional Hospital in Outpatient Installation in 2014-2015 showed that there were 4 drug interactions that occurred, namely the interaction of metformin with nifedipine of 7.14%, sulfonylureas with ACEI of 28.57% , metformin with acarbose at 28.57% and the most frequently encountered interaction was between sulfonylurea and CCB at 35.71%. Other studies have shown the results of prescribing profiles of the dosage forms most often given to DM patients with hypertension are tablets (94.5%) was reported [5]. The most commonly used class of diabetes drugs are sulfonylureas (21.1%) and beta blocker hypertension drugs (12.2%). The most commonly used type of diabetes drug is glimepiride (14.9%) and hypertension is bisoprolol (9.6%). Patients with diabetes mellitus with hypertension in the outpatient installation of Dr. Moewardi Regional Hospital in the Outpatient Installation in 2014 - 2015 mostly experienced drug interactions [6].

The content of drugs/organic compounds in water if thrown directly into the gutter is quite dangerous to the environment. The electrochemical method can be used as a deconcentration of organic compounds. Actually, a lot of research has been done to treat wastewater in the pharmaceutical industry and liquid waste from the pesticide industry, one of which is by the electrolysis method. Electrolysis methods such as those carried out, using graphite and composite electrodes as electrodes to remove organic pollutants in water and desalination water [7].

Electrocoagulation methods have also been tried to reduce components of organic waste. The carbon felt (CF) is also best used as an electrode in the electrochemical process using the Fenton reagent [8]. In their report, Le, et al (2017) emphasized that carbon felt (CF) can reduce the quantity of pollutants to 82% with the voltage used to a minimum. The use of carbon felt (CF) was further strengthened and widely. These electrodes to extract organochlorine pesticides in ground water satisfactorily, at a minimal cost was reported [9].

This research aims to deconcentrate metformin and aspirin by electrolysis method with variations of anode (ferrous metal, aluminum metal and zinc metal) and carbon as the cathode optimally. To optimize the results of electrolysis, it is necessary to add electrolyte solutions, such as acetic acid, sodium chloride and sodium chloride mixed with Fenton's reagent with a concentration of 0.2 M as much as 100 ml. The data obtained showed that the addition of sodium chloride mixed with Fenton's reagent showed the best results (increased by 50-60%). Electrolysis process Metformin and Aspirin occurs optimally at a distance of 1 cm (in iron, aluminum and zinc as an anode and carbon as an anode) and a processing time of 30 minutes. The voltage used in the electrolysis process of Metformin is optimal at 3 volts and 9 volts in the electrolysis process of Aspirin (in iron and aluminum as an anode and carbon as an anode).

2 Theoretical Framework

Aspirin is a class of Non-Steroid Anti-Inflammatory Drugs (NSAIDs), which have analgesic, antipyretic, anti-inflammatory effects that work peripherally and antiplatelet. This drug is used in symptomatic therapy of rheumatic diseases (osteoarthritis, gout arthritis) in relieving or reducing pain. This drug is also often used for the treatment of headaches; suppress pain in inflammation due to wounds and inflammation that arises after surgery, gynecological pain and neurological pain. In mild therapy, NSAIDs are used to reduce pain during menstruation and fever. In the selection of therapy, NSAIDs are classified into drugs with mild, moderate and severe potential, where the selection of drugs based on their potential must be adjusted to the level of pain caused. While antiplatelet is a type of blood-thinning medication. This drug is used by people with stroke and heart disease, especially coronary heart disease [1][2][3].

Aspirin has the molecular formula $C_9H_8O_4$; Mr 180,157 g / mol; density 1.40 g / cm^3 ; melting point $135^\circ C$ ($275^\circ F$); boiling point $140^\circ C$ ($284^\circ F$) and water solubility of 3 mg / mL ($20^\circ C$). Aspirin has several other names, for example: 2 hydroxy benzoic acid, salicylic acid and acetosal. The reaction of aspirin compound synthesis is on Figure 1.

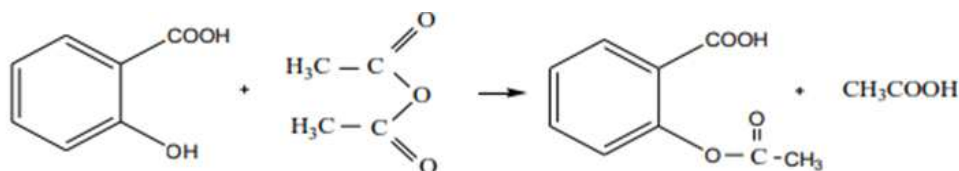


Fig. 1. Synthesis Aspirin/ Salisilic Acid [10].

Metformin is an oral anti-diabetes that belongs to the biguanid class. Metformin is the first-choice drug for sufferers of Diabetes Mellitus (DM) type 2, especially for people who are overweight and obese as well as people with normal kidney function. In reducing high blood sugar levels, metformin works by inhibiting the process of gluconeogenesis, glycogenolysis, slowing the absorption of glucose in the intestine, and increasing insulin sensitivity in the body [4]. Diabetes Mellitus (DM) is a disease or chronic metabolic disorder with multiple etiologies characterized by high blood sugar levels accompanied by carbohydrate, lipid and protein metabolism disorders and produces chronic complications such as microvascular, macrovascular, and neuropathic disorders as a result of insulin function insufficiency [1].

Metformin has the molecular formula $C_4H_{12}N_5$ has the name IUPAC 3-(diaminomethylidene)-1,1-dimethylguanidine- hydrochloride, Mr 165.62 g / mol; pKa = 12.4, melting point: $232^\circ C$, boiling point: $218 - 220^\circ C$, Quite soluble in water (Metformin hydrochloride solubility in water by 3 mg / mL ($20^\circ C$)); slightly soluble in alcohol, insoluble in ether, chloroform, acetone, methylene chloride. Other names for metformin are metformin hydrochloride, 1,1-Dimethylbiguanide hydrochloride 1,1-Dimethylbiguanide and Dimethylbiguanid [11]. The chemical structure of the metformin compound is as Figure 2.

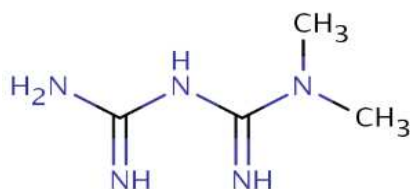


Fig. 2. Structural Formula of Metformin Hydrochlorida [1].

The content of drugs/organic compounds in water if thrown directly into the gutter is quite dangerous to the environment. The electrochemical method can be used as a deconcentration of organic compounds. Actually, a lot of research has been done to treat wastewater in the pharmaceutical industry and liquid waste from the pesticide industry, one of which is by the electrolysis method. Electrolysis methods such as those conducted by [7] using graphite and composite electrodes as electrodes to remove organic pollutants in the water medium and desalination of water [7]. Electrocoagulation methods have also been tried to reduce components of organic waste. The carbon felt (CF) is also best used as an electrode in the electrochemical process using the Fenton reagent was reported [8]. In their report [8] emphasized that carbon felt (CF) can reduce the quantity of pollutants to 82% with the voltage used to a minimum. The use of carbon felt (CF) was further strengthened by [9] who reported the use of these electrodes to extract organochlorine pesticides in ground water satisfactorily, at a minimal cost. Other electroquagulations such as those conducted by The magnetic fabrication of Co / BiFeO₃ composites and continued processing of pharmaceutical waste by activation of peroxysulphate as a catalyst. In this study, cobalt-di-composite "doped" ferrite bismuth (Co / BiFeO₃) was prepared by the sol-gel method was reported [12]. The results of Co / BiFeO₃ were applied to eliminate tetracycline, the results obtained were that Co / BiFeO₃ had a fairly high efficiency, ie 81.09% of tetracyclines could be decomposed [12]. The another research was done to reinforce the opinion of [12] about the ability of the electrolysis method combined with the ozonation method to degrade organic waste (antrazine) [13]. The success of degrading organic waste (antrazine) by combining two methods, namely the combination/combination of electrolysis and ozonization which varies with the pH conditions on the liquid medium was emphasized [14].

In summary, if there is an organic material subject to electrolysis, the organic material must be reduced to a simpler material and tends to have reduced toxicity, while certain metals that function as anodes, will undergo oxidation to produce cations. The series of tools needed in the process of electrolysis, electrocoagulation / electrodecomposition / electrosorbtion, can be described as in the picture as Figure 3 [15].

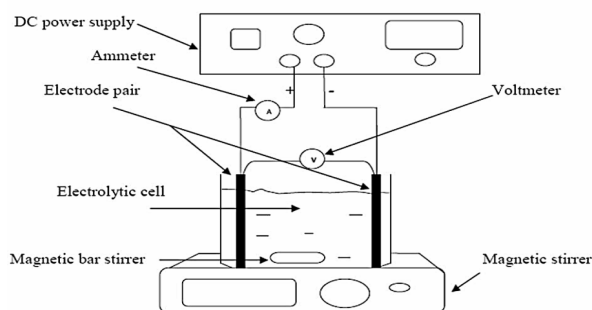


Fig. 3. Image of electrolysis apparatus [15].

3 Research Method

3.1 Equipment and Materials

a) Equipment

The equipment used is a set of titration devices (Erlenmeyer, burette and statif), glassware, electrochemical waste treatment reactor, adaptors, aluminum, iron and zinc metals (anodes) and carbon (cathode).

b) Materials

The materials used were artificial liquid waste (aspirin/mefenamic acid dissolved in water), Na₂SO₄, NaOH, H₂SO₄, K₂Cr₂O₇, HgSO₄, Ag₂SO₄, ferro ammonium sulfate, ferroin indicator, Whatman 40 paper and distilled water

c) Instrument Design

The electrolysis reactor consisted of an adaptor, Aluminium (Al), Iron (Fe) and Zinc (Zn) (as anode) placed parallel to the carbon plate (cathode), with varying distances of 0.5; 1; 1.5; 2; 2.5; 3; 3.5 and 4 cm. The setup was then mounted on a 1000 mL glass container and connected to a DC current source.

Effects of Voltage, Electrode Distance, pH, and Time on Decreasing COD Value.

The sample, 500 ppm mefenamat acid dissolved in 500 mL water, was put into the reactor. HCl and NaOH were added into the solution to regulate acidic and alkaline atmospheres of the solution. In this study the pH of the solution, voltage, electrode distance and electrolysis time were varied.

Aluminium (Al) and carbon electrodes were immersed into the reactor with a distance of 1 cm. The solution was electrolyzed at a time variation of 0 to 100 minutes with an interval of 10 minutes at a voltage of 4 V and a current density of 7.5 mA/cm². COD values are determined before and after electrolysis. The same procedure was performed for voltage variations of 2, 4, 6, 8, 10 and 12 Volt, electrode distance of 0.5; 1; 1.5; 2; 2.5; 3; and 3.5 cm. The same procedure was also carried out for Iron and Zinc (as anode) and carbon electrodes.

3.2 COD Analysis (APHA, 1995)

COD determination was carried out using the iodometric titration method. As much as 5 mL distilled water as blank solution and 5 mL of sample were put into Erlenmeyer 250 mL. They were added with 2.5 mL K₂Cr₂O₇ - HgSO₄ and 5 mL H₂SO₄ - Ag₂SO₄. The solutions were covered and heated for 2 hours in an oven at 150°C. They were then cooled and the lids were rinsed with 2 mL of distilled water. 1 mL of concentrated H₂SO₄ and 3 drops of ferroin indicator were added. Titration was done with ferrous ammonium sulfate standard solution of 0.025 N until the equivalence point (colored red brown) was reached. Determination of COD levels is calculated by the following formula:

$$\text{COD Concentration (ppm)} = (A - B) \times N \times 8000 \text{ mL sample}$$

Descriptions:

A = Volume (mL) of titrant for blank solution

B = Volume (mL) of titrant for sample solution

N = Solution normality of Fe (NH₄)₂SO₄

4 Result and Discussion

The electrolysis method is carried out using four different anodes, namely magnesium metal, ferrous metal, aluminum metal and zinc metal. Theoretically all of these metals are capable of functioning as an anode. But in reality, magnesium metal is less able to work optimally. So that only ferrous metals, aluminum metals and zinc metals are selected and used as electrodes (anodes) in the electrolysis of metformin.

4.1 Optimization of the Electrolysis Method

In this research, an optimization study of the electrosorption process of a pharmaceutical industry waste has been carried out by varying the electrode distance, voltage and contact time to the electrolysis percentage. Indicators of the success of the electrolysis process are measured by looking at the decrease in the value of COD between before and after undergoing the electrolysis process [16][17] or by measuring COD along with BOD [18].

Voltage Optimization, time optimization and addition of electrolyte solutions. In this electrolysis research voltage variations have been carried out for various types of anodes. For ferrous metals (as an anode) the voltage is given from 3; 6; 9; 12; and 15 volts. The results obtained are quite optimal at 9 volts. For aluminum metal (as an anode) the voltage is given from 3; 6; 9; 12; and 15 volts. The results obtained are quite optimal at 9 volts. For zinc metal (as an anode) the voltage is given from 3; 6; 9; 12; and 15 volts. The results obtained are quite optimal at 9 volts. The optimal voltage results from each anode, then used to look for optimization of other variables that affect the percentage of electrolysis.

4.2 Time Optimization

After the optimal voltage is obtained, then the optimal time for electrolysis is determined. The time variations chosen are from 10, 20, 30, 40, 50, 60 and 70 minutes. It turns out that the optimal time obtained for the electrolysis of metformin is 30 minutes, even with different results, as shown in Figure 4.

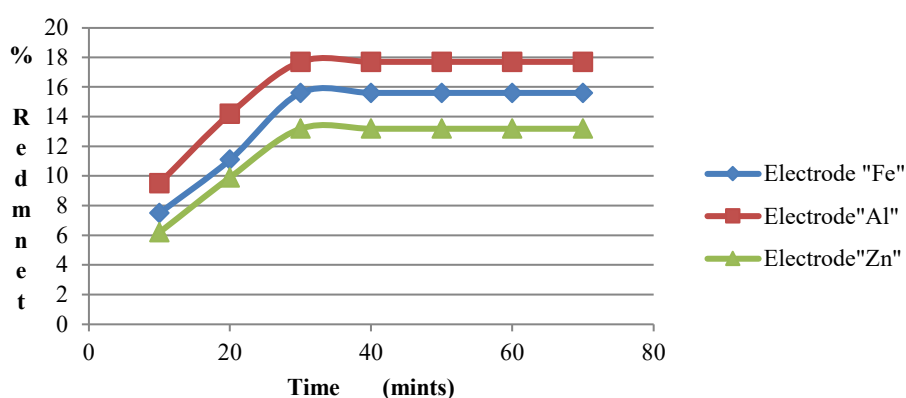


Fig. 4. Relationship between Time and Synthesis Yield in Metformin Electrolysis without addition of electrolyte solution.

After the optimal voltage is obtained, then the optimal time for electrolysis is determined. The time variations chosen are from 10, 20, 30, 40, 50, 60 and 70 minutes. It turns out that the optimal time obtained for the electrolysis of aspirin is 30 minutes, even with different results, as shown in Figure 5.

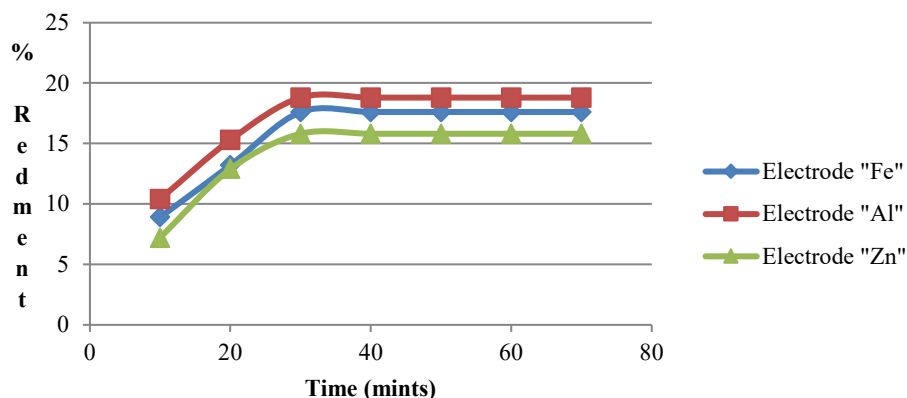


Fig. 5. Relationship between Time and Synthesis Yield in Aspirin Electrolysis without the addition of an electrolyte solution.

4.3 Optimization of Electrolyte Solutions

From the electrolysis variable data obtained (voltage, time and distance) it was concluded, the electrolysis without the help of electrolyte solution obtained very small results (under 17%). Therefore to enhance the electrolysis yield is done by adding a weak electrolyte solution (0.1 M acetic acid), strong electrolytes (0.1 M NaCl), and with strong electrolytes (0.1 M NaCl and 0.1 M Fenton reagent reagent) obtained a significant increase in electrolysis results. The existence of an electrolyte solution is thought to be able to help the mobility of electric current during the electrolysis process, so that the oxidation process of the anode can run well.

As a test of the effectiveness of the performance of the three electrodes used Aspirin samples carried out in various conditions of the atmosphere of the solution, in a state of the sample dissolved in distilled water without electrolytes (presented in the graph in the notation of Fe, Al & Zn), with strong electrolytes (NaCl 0.1 M) (presented in graphs in Fe *, Al * & Zn * notation as well as with strong electrolytes (0.1 M NaCl and 0.1 M Fenton reagents) (presented in graphs in Fe **, Al ** & Zn ** notation) as in figure 6.

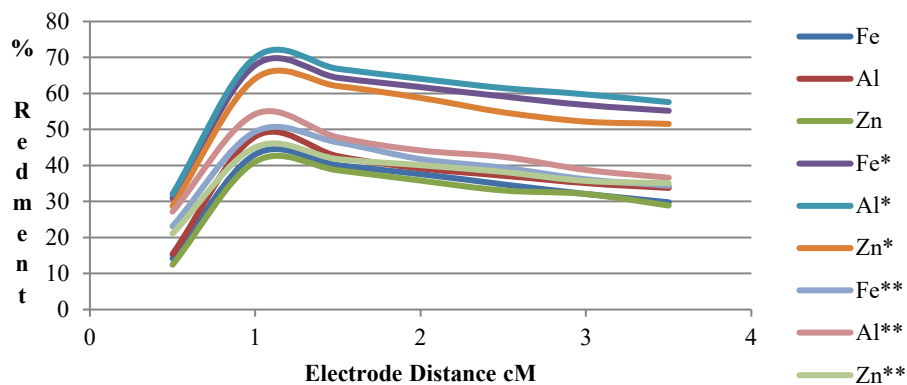


Fig. 6. Relationship of Electrode Distance, addition of electrolyte solution and Percentage of Rendement to Aspirin Electrolysis in the solution under conditions without the addition of an electrolyte solution (Fe, Al & Zn), added 0.1 M Acetic Acid electrolyte (Fe*, Al* & Zn*) and strong electrolyte (0.1 M NaCl with 0.1 M Fenton reagent) (Fe**, Al** & Zn**).

Furthermore, the test of the effectiveness of the performance of the three electrodes used Metformin samples carried out in various conditions of the atmosphere of the solution, in a state of the sample dissolved in distilled water without electrolytes (presented in the graph in the notation of Fe, Al & Zn), with strong electrolytes (NaCl 0.1 M) (presented in graphs in Fe*, Al* & Zn* notation as well as with strong electrolytes (0.1 M NaCl and 0.1 M Fenton reagents) (presented in graphs in Fe**, Al** & Zn** notation) as in figure 7.

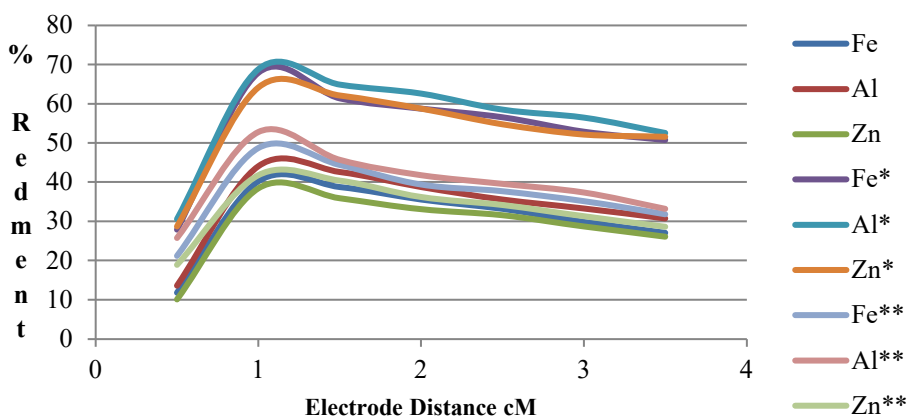


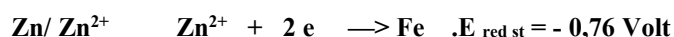
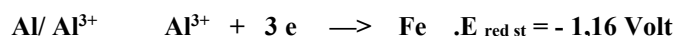
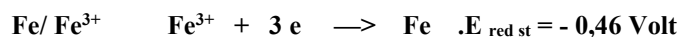
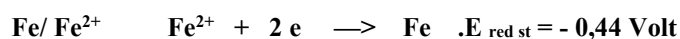
Fig. 7. Relationship of Electrode Distance, addition of electrolyte solution and Percentage of Rendement to Electrolysis of Metformin in the solution under conditions without the addition of electrolyte solution (Fe, Al & Zn), added 0.1 M Acetic Acid electrolyte (Fe*, Al* & Zn*) and strong electrolyte (0.1 M NaCl with 0.1 M Fenton reagent) (Fe**, Al** & Zn**)

Thus, the addition of electrolyte solutions can in fact affect the electrolysis ratio. The ion activity in the solution will increase if there is an addition of electrolyte solution. Acetic acid

is able to increase the electrolysis rate, hydrochloric acid is higher than acetic acid because of its greater acid strength. The addition of the Fenton Reagent combined with Sodium chloride salts provides the best results. This is due to Fenton's reagent being able to supply sufficient oxygen, while the electrolysis process is in progress.

4.4 Analysis of the Effectiveness of Fe, Al and Zinc Electrodes in the Electrolysis Process

By attention to Figure 6 and Figure 7 there are 2 interesting facts, namely: first the problem of the effectiveness of the Fe, Al and Zinc Electrodes and then the problem of the impact of adding electrolyte solution to the electrolysis yield. The experimental conditions carried out under the same relatively electrolysis conditions (same electrode distance, same time and addition of the same electrolyte solution), turned out to give results that have a similar trend. Fe, Al and Zinc electrodes (as an anodes) undergo oxidation reactions. The reactions of ferrous metal, aluminum metal and zinc metal (as an anode) are as follows:



From the standard reduction potential data, we can expect that the greater the potential reduction price, the more difficult it will be to experience oxidation. So, the existence of metal cations that are difficult to experience oxidation is also increasingly limited. And the possibility of hydroxide deposition from the cation is also relatively small. But this will be broken if the metal cations that are difficult to undergo oxidation can exceed the Ksp value of the hydrogen salts.

Theoretically the standard reduction potential of aluminum metal is $E_{\text{red st Al}} = - 1.16$ Volts, the standard reduction potential of ferrous metals is $E_{\text{red st Fe}} = - 0.44$ Volts and the standard reduction potential of zinc metal is $E_{\text{red st Zn}} = - 0.76$ volts. Theoretically it can be understood why the number of $[\text{Al}^{3+}]$ is greater than $[\text{Fe}^{2+}]$ and then $[\text{Zn}^{2+}]$. But for $[\text{Zn}^{2+}]$ which should be greater than $[\text{Fe}^{2+}]$, so $\text{Zn}(\text{OH})_2$ deposits should be more than $[\text{Fe}(\text{OH})_3]$ deposits. However, due to the influence of Ksp $[\text{Fe}(\text{OH})_3] = [3.1 \times 10^{-36}]$ is smaller than Ksp $\text{Zn}(\text{OH})_2 = [3.1 \times 10^{-17}]$, the hydroxide deposits of $\text{Fe}(\text{OH})_3$ are more easily formed than the $\text{Zn}(\text{OH})_2$ hydroxide precipitate. This is thought to be the cause that electrolysis with ferrous metal (as an anode) obtains a higher yield than electrolysis with zinc metal (as an anode). This is slightly different from aluminum electrodes (as an anode). The price of $E_{\text{red st Al}} = - 1.16$ Volts, and the price of $E_{\text{red st Fe}} = - 0.44$ Volts. Theoretically means the number of $[\text{Al}^{3+}]$ is greater than $[\text{Fe}^{2+}]$ and then $[\text{Zn}^{2+}]$. The yield of electrolysis with aluminum metal (as an anode) yields a higher yield than electrolysis with ferrous metal (as an anode) and with zinc metal (as an anode), because the price of Ksp $\text{Al}(\text{OH})_3$ is 2.0×10^{-31} , because theoretically the number of $[\text{Al}^{3+}]$ is greater than $[\text{Fe}^{2+}]$ and then $[\text{Zn}^{2+}]$. so it is very natural that the amount of deposits of $\text{Al}(\text{OH})_3$ is greater than $\text{Fe}(\text{OH})_3$ and $\text{Zn}(\text{OH})_2$ [15][19].

The results of the comparison of the percentage degradation of aspirin and metformin due to the electrolysis process due to the addition of electrolyte solution results are increasing, because by adding electrolyte solution, the interaction that occurs between the cation

(oxidation results from the anode metal) and the electrolyzed sample (aspirin and metformin) becomes faster and faster. This is due to the increase in ionic strength during the electrolysis. Ion strength is $\mu = \frac{1}{2} \sum c_i \times Z_i^2$ where μ = ionic strength, C_i = ion concentration I and Z_i = ion charge i [11] [20]. As a result of the increased strength of ions in solution, the formation of aluminum hydroxide Al (OH)₃, salt Ferri hydroxide Fe(OH)₃ and zinc hydroxide Zn(OH)₂ also becomes rapid. The highest yield of aluminum electrodes, allegedly because the price of Ered st Al = - 1.16 Volts, and the price of E red st Fe = - 0.44 Volts. Theoretically means the number [Al³⁺] is greater than [Fe²⁺]. Even though the Ksp salt value of Ferric hydroxide [Fe (OH)₃] is the smallest compared to the two other hydroxide salts (aluminum hydroxide Al (OH)₃ and zinc hydroxide Zn (OH)₂). Al (OH)₃ precipitates are easier to occur than Fe (OH)₃ precipitates and Zn (OH)₂ precipitates. These three cation hydroxide precipitates will become adsorbents for metformin and aspirin [18][21][22][23].

4.5 Characterization of Results with Spectrophotometry

Analysis of UV Metformin Spectra

Measurement of absorbance or transmittance in UV-Visible spectroscopy is used for qualitative and quantitative analysis of chemical species. The absorption of this species takes place in two stages, the first stage being:

$M + h\nu \rightarrow M^*$, is a species excitation due to absorption of photons ($h\nu$) with a limited life time (10^{-8} - 10^{-9} seconds). The second stage is relaxation by changing M^* into a new species by photochemical reactions. Absorption in the UV -Vis region causes excitation of bonding electrons. The absorption peak (λ_{max}) can be related to the type of bond present in the species. Therefore, absorption spectroscopy is useful for identifying functional groups in a molecule and for quantitative analysis. Absorption species can make transitions including (a) electrons π , σ , n (b) electrons d and f (c) electron charge transfers.

4.6 Analysis of the metformin chromophore group

Metformin chromophore group analysis was performed with Ultra Violet-Visible (UV-Visible) Spectrometry. The measurement method used is the KBr pellet. The spectrum of the UV-Visible spectra will show peaks with specific wavelengths, which will provide information about the chromophore groups present in Metformin. In this study, there are 3 spectra results of UV-visible spectra from electrolyzed metformin (with Fe metal, Al metal and Zn metal as an anode), compared with Metformin spectra before electrolysis, as shown in Figure 8.

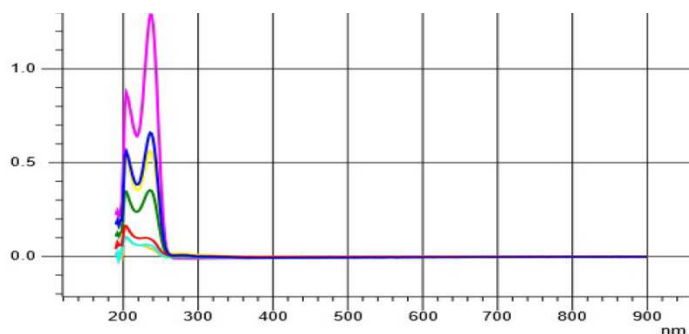


Fig. 8. Spectrum results of UV-Visible spectra from electrolyzed metformin (with Fe metal, Al metal and Zn metal as an anode), compared with Metformin spectra before electrolysis

Decreased uptake of Metformin after electrolysis provides information that Metformin levels have decreased; meaning that in the electrolysis process there has been a deconcentration due to the decomposition or precipitation of the metformin compound [18] [21] [22] [23].

λ_{maks} (nm)	Type Absorbance	Choromofore Group
248	Sharp	Amina group (σ to σ^*)
205	Weak	Amina group (π to π^*)

Sharp spectra are produced from Metformin from UV-Visible before being electrolyzed. However, after the electrolysis process there is a slight difference in the spectra of the UV-Visible Metformin spectra. Electrolysis treatment can reduce absorbance. The results of the qualitative analysis obtained from UV-Visible ensure that the quality and efficiency of the drug have dropped and are no longer effective and have dangerous consequences for consumption [11].

4.7 Analysis of the Aspirin chromophore group

Aspirin chromophore group analysis was performed with Ultra-Violet-Visible (UV-Visible) Spectrometry. The measurement method used is the KBr pellet. The spectrum of the UV-Visible spectra will show peaks with specific wavelengths, which will provide information about the chromophore groups present in Aspirin. In this study, there are 3 spectra results of UV-spectra results from Aspirin electrolysis results (with Fe metals, Al metals and Zn metals as anodes), compared with Aspirin spectra before electrolysis, as shown in Figure 9.

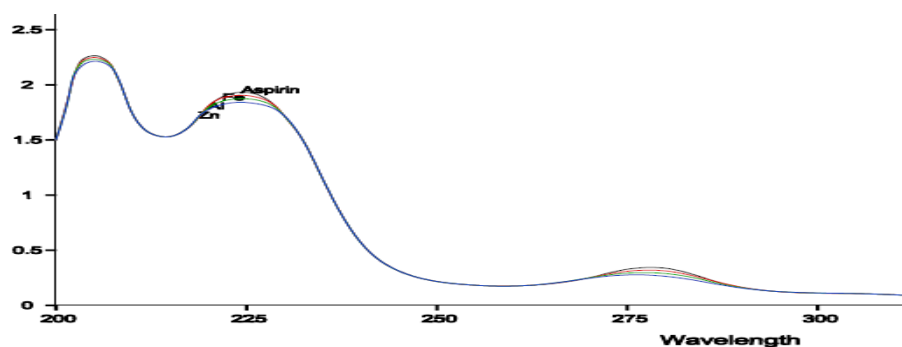


Fig. 9. Spectra of UV-Visible spectra from Aspirin electrolyzed (with Fe metal, Al metal and Zn metal as anodes), compared to Aspirin spectra before electrolysis.

Decreased uptake of Metformin after electrolysis provides information that Aspirin levels have decreased, meaning that in the electrolysis process there has been a deconcentration due to the decomposition or precipitation of the metformin compound [18][21][22][23].

λ_{maks} (nm)	Type Absorbance	Choromofore Group
208 - 210	Sharp	Carboxylate group

Sharp spectra are produced from Aspirin from UV-Visible before being electrolyzed. However, after the electrolysis process there is a slight difference in the spectra of the UV-Visible Aspirin spectra. Electrolysis treatment can reduce absorbance. The results of the qualitative analysis obtained from UV-Visible ensure that the quality and efficiency of the drug have dropped and are no longer effective and have dangerous consequences for consumption [11].

5 Conclusion

Metformin electrolysis process occurs optimally at a distance of 1 cm (iron, aluminum and zinc as an anode and carbon as an anode), 3 Volt voltage and 30 minutes. Whereas Aspirin electrolysis (iron and aluminum as an anode and carbon as an anode), 9 Volt voltage and 30 minutes. Addition of electrolyte solutions (especially Fenton's reagents) can improve the results of the electrolysis process of Metformin and Aspirin. There was no structural change in Metformin and Aspirin.

5.1 Acknowledgements

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