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ELECTROCHEMICAL BEHAVIOUR OF 22 CARAT GOLD WITH ARTIFICIAL SALIVA IN PRESENCE OF ACECLOFENAC 100 mg TABLET

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Abstract

The corrosion behavior of 22 carat gold in the presence of artificial saliva with and without Aceclofenac100 mghas been evaluated by AC impedance spectra and Polarization studies. Commonly orthodontic wires made of many metals and alloys. After treatment of many food items such as glucose, sambar,rasam,buttermilketc are taken orally. Many tablets are also orally taken. Aceclofenac100 mgis non-steroidal and anti-inflammatory drug. It is used to treat pain, and inflammation. In the oral environment these orthodontic wires undergo many types of corrosion. In the present study the corrosion behavior of 22caratgold orthodontic wire in presence artificial Saliva with a tablet namely, Aceclofenac100 mgorally takenhas been investigated by AC impedance spectra and polarization study. Nyquist plots and Bode plots have been drawn. Charge transfer resistance (R_t), double layer capacitance (C_{dl}) and Impedance values have been calculated. It is observed from electrochemical studies, the corrosion resistance of22 carat gold electrode increases in presence of artificial saliva with Aceclofenac100 mg. So, people having orthodontic wire made of 22 carat gold need not hesitate to take Aceclofenac100 mg tablet.

Keywords: Orthodontic wires, dentistry, 22 carat gold, AC impedance spectra, polarization study, Aceclofenac100 mg.

Introduction

Currently dentistry, metallic materials are used as implants in reconstructive oral surgery to replace a single tooth or an array of teeth or in the construction of dental prostheses such as metal plates for complete and partial dentures crowns, and bridges. Corrosion of metallic implants is of vital importance, because it can adversely affect the bio-compatibility and

mechanical integrity of implants. Many metals and alloys have been used in dentistry. The corrosion behavior of artificial saliva has been investigated. The corrosion resistance of the commercial metallic orthodontic wires in a simulated intra-oral environment has been evaluated by Ziebowicz*et.al.*[1].The corrosion resistance of 18 ct gold in artificial saliva in the presence of Almox 250 DT has been investigated byKrishnaveni[2].Rajendran et al., have been evaluated the corrosion resistance of various electrodes such as stainless steel 316L, mild steel (MS), and mild steel coated with zinc (MS-Zn) has been evaluated in artificial saliva in the absence and presence of spirulina, and electrol[3-4]. Five non-precious Ni-Co based alloys have been analyzed with respect to their corrosion behavior in artificial saliva [5]. The effect of different concentrations of eugenol in artificial saliva on titanium corrosion has been investigated by Kinani and Chtaini[6]. Madhumitha et al., have been investigated the corrosion resistance of 22 ct gold and Thermo active Super elastic shape memory alloy in presence of Syzygium cumin Fruit juice [7]. Saranya et al., have been investigated the corrosion resistance of 18 ct gold in artificial saliva in the absence and presence of D-Glucose [8]. Aceclofenac100 mgis non-steroidal anti-inflammatory drug. Which is used to treat pain, and inflammation. Many researchers have been reported that the 22ct gold with different tablets in presence of artificial saliva.The present study leads to investigate the corrosion behavior of orthodontic wire made of 22 carat gold in artificial saliva with a tablet namely, Aceclofenac100 mgorally taken**.** Electrochemical spectra such as polarization studies and AC impedance spectra have been used. The composition of Aceclofenac100 mgis given Scheme1.

Scheme 1: The composition of Aceclofenac100 mg

AceclofenacIP	100mg

Materials and Methods:

The composition of 22 carat gold is 91.6% of gold, 2.8% of Cu and 5.5% of Ag. The orthodontic wire was encapsulated in Teflon. The wire was polished to a mirror finish and degreased with trichloroethylene. The electrochemical studies were carried out in a three electrode cell assembly. The three electrodes were immersed in Fusayama Meyer artificial saliva (AS), whose composition is given in Table 1.

Table 1: Composition of Artificial saliva

Name of salt	Weight (g/lit)
KCl	0.4
NaCl	0.4
$CaCl_2.2H_2O$	0.906
$NaH_2PO_4.2H_2O$	0.690
$Na_2S.9H_2O$	0.005
urea	1

The pH of the solution was 6.5. In electrochemical studies, the metal specimens were used as working electrodes. Artificial saliva (AS) was used as the electrolyte. The temperature was maintained at 37 ± 0.1°C.

Potentiodynamic Polarization

Polarization studies were carried out in a CHI-electrochemical workstation with impedance, Model 660A. A three-electrode cell assembly was used (Fig 1). The working electrode was 22 ct gold. A saturated calomel electrode (SCE) was the reference electrode and platinum was the counter electrode. From the polarization study, corrosion parameters such as corrosion potential (E_{corr}), corrosion current (I_{corr}), and Tafel slopes (anodic = b_a and cathodic = b_c) were calculated.

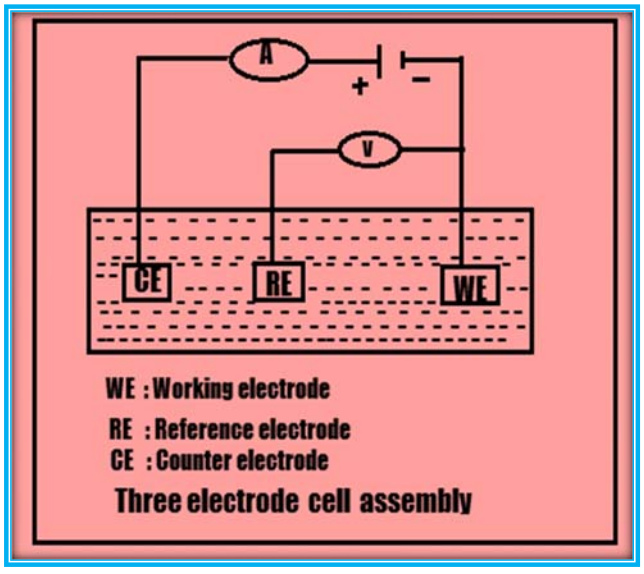

Fig 1: Three electrode cell assembly

AC Impedance Spectra

The instrument used for polarization study was also used to record AC impedance spectra. The cell setup was also the same of potentiometric polarization. The real part (Z') and imaginary part (Z") of the cell impedance were measured in ohms at various frequencies. The values of the charge transfer resistance (R_t) and the double layer capacitance (C_{dl}) were calculated from Nyquist plotImpedance: log (z/ohm) value was calculated from Bode plots.

Analysis of potentiodynamic polarization studies

Electrochemical polarization studies have been used to confirm the formation of protective film formed on the metal surface during corrosion inhibition process [9-15]. If a protective film is formed on the metal surface, the corrosion current value (I_{corr}) decreases and corrosion potential value (E_{corr}) increases. The potentiodynamic polarization curves of 22 ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg, obtained from polarization study are shown in Fig-2.The corrosion parameters, namely, corrosion potential (E_{corr} mV vs SCE),Tafel slopes(b_cmV/decade; b_amV/decade), linear polarization resistance(LPR ohm cm^2), and corrosion current(I_{corr} A/cm^2) values are given in Table 2.0

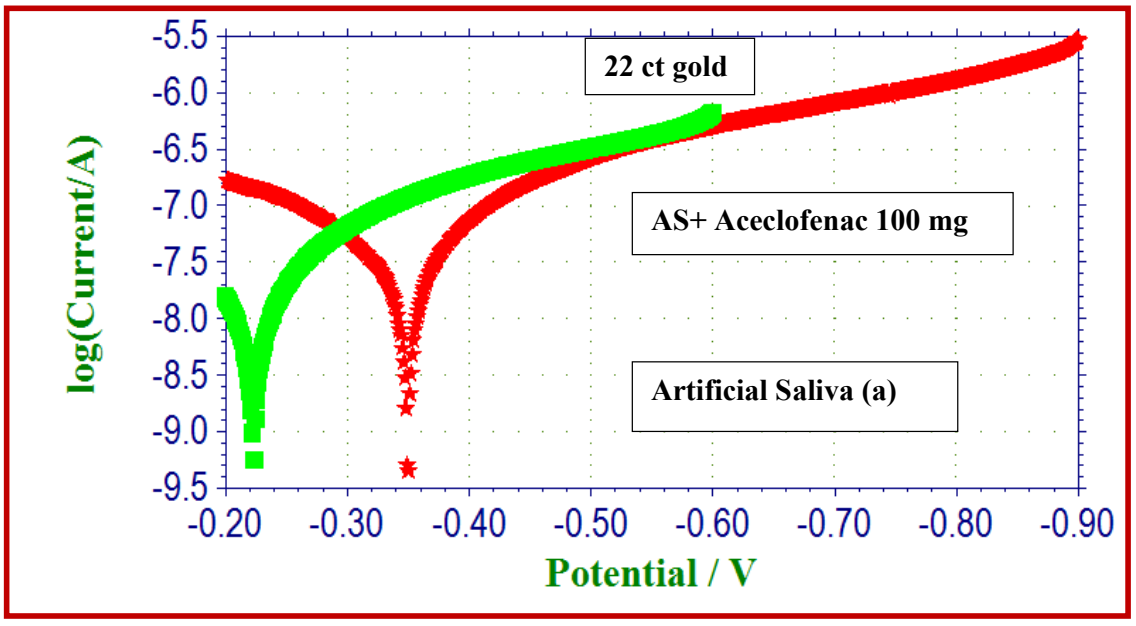

Fig.2: Polarization curves of 22 ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg

(a) Artificial Saliva (AS); (b) AS + Aceclofenac 100 mg(200 ppm)

When 22 ct gold is immersed in Artificial Saliva (AS), the corrosion potential is -350 mV vs SCE. When Aceclofenac 100 mg (200 ppm) is added to the above system the corrosion potential is shifted to the anodic side (-163 mV vs SCE). This indicates that the anodic reaction is controlled predominantly.The LPR value increases from 753428.2 ohmcm^2 to 1435172.0 ohm cm^2,the corrosion current decreases from 5.397x10^{-8}A/cm^2 to 2.860x10^{-8}A/cm^2. All these observations lead to the conclusion that in presence of Aceclofenac 100 mg(200 ppm) the corrosion resistance of 22 ct gold increases. Hence polarization study leads to the conclusion that people having orthodontic wires made of 22ct gold need not hesitate to take Aceclofenac 100 mgtablets. The active ingredients of the tablets have not corroded the orthodontic wires made of 22 ct gold.

Table 2: Corrosion parameters of 22 ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg, obtained from polarization study

System	E_{corr}(mV vs SCE)	b_c (mV/ decade)	b_a(mV/ decade)	LPR (ohm cm^2)	I_{corr} (A/cm^2)
AS	-350	181	193	753428.2	5.397 x 10^{-8}
AS + Aceclofenac 100 mg (200 ppm)	-223	166	218	1435172.0	2.860 x 10^{-8}

Analysis of AC Impedance spectra

AC impedance spectra (electro chemical impedance spectra) have been used to confirm the formation of protective film on the metal surface. If a protective film is formed on the metal surface, charge transfer resistance (R_t) increases; double layer capacitance value (C_{dl}) decreases. Impedance value increases. The AC impedance spectra of 22 ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg, obtained from AC impedance spectra are shown in Figs.3.0-3.2.The AC impedance parameters namely charge transfer resistance (R_t) and double layer capacitance (C_{dl}) derived from Nyquist plots (Fig 3.0) are given in Table 3. The impedance value derived from Bode plots (Figs 3.1 and 3.2) are also given in this Table 3. It is observed that when Aceclofenac 100 mg (200 ppm) is

added to artificial saliva, the charge transfer resistance (R_t) increases from 5582 Ω cm^2 to 6726 Ω cm^2. The C_{dl} value decreases from $9.136x10^{-10}$ F/cm^2 to $7.58x10^{-10}$ F/cm^2.The impedance value increases from 4.175 to 4.352.These results lead to the conclusion that there is protective film formed on the metal surface.

All these observations reveal that in presence of Aceclofenac 100 mg(200 ppm) the corrosion resistance of 22ct gold in contact with artificial saliva increases. Hence AC impedance spectra lead to the conclusion that people having orthodontic wires made of 22 ct gold need not hesitate to take Aceclofenac 100 mgtablets. The active ingredients of the tablets have not corroded the orthodontic wires made of 22 ct gold; they haveprotected the wire by formation of protective film on the surface of the wires.

Table 3: AC impedance parameters of 22ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg,obtained by AC impedance spectra.

System	R_t ohm cm^2	C_{dl} F/ cm^2	Impedance Log(z/ohm)
AS	5582	$9.136 x10^{-10}$	4.175
AS + Aceclofenac 100 mg (200 ppm)	6726	$7.58x10^{-10}$	4.352

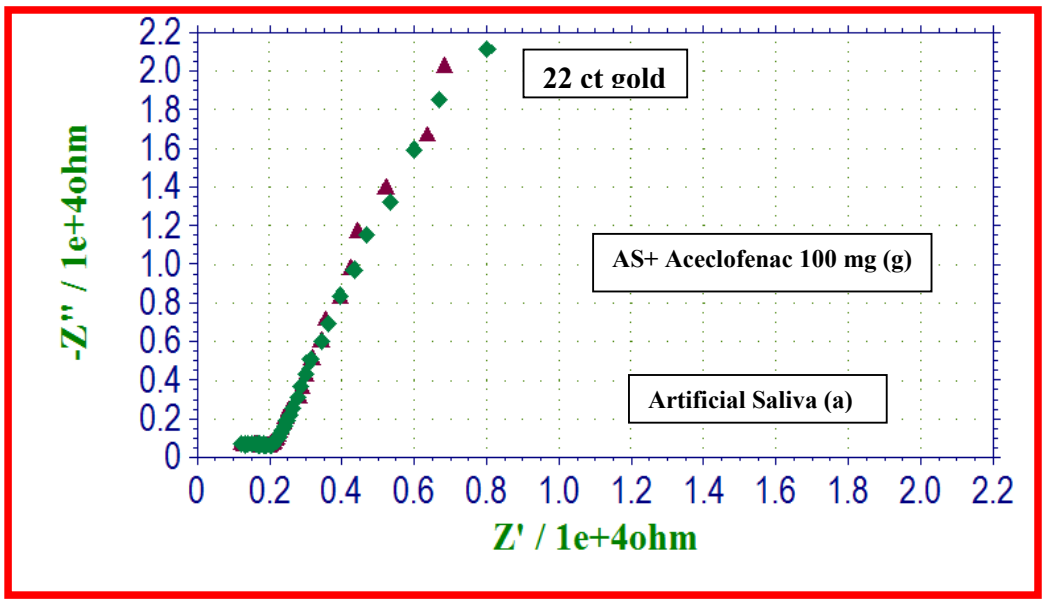

Fig3.0: **AC impedance spectra (Nyquist Plots) of 22 ct gold immersed in Artificial Saliva (AS) in the absence and presence of Aceclofenac 100 mg**

(a) Artificial Saliva (AS) ; (g) AS + Aceclofenac 100 mg (200 ppm)

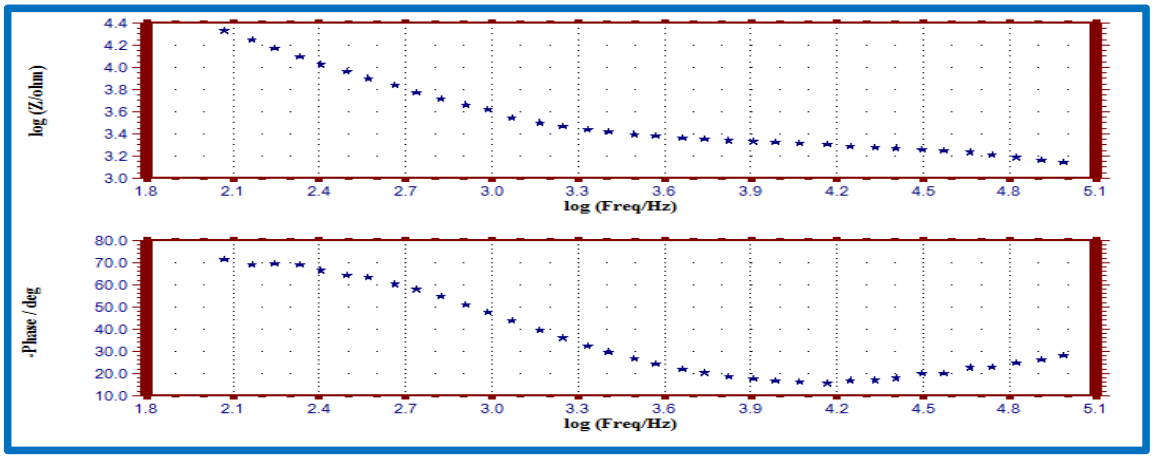

Fig 3.1:AC impedance spectra (Bode Plots)of 22 ct gold immersed in Artificial Saliva (AS) in the absence of Aceclofenac 100 mg

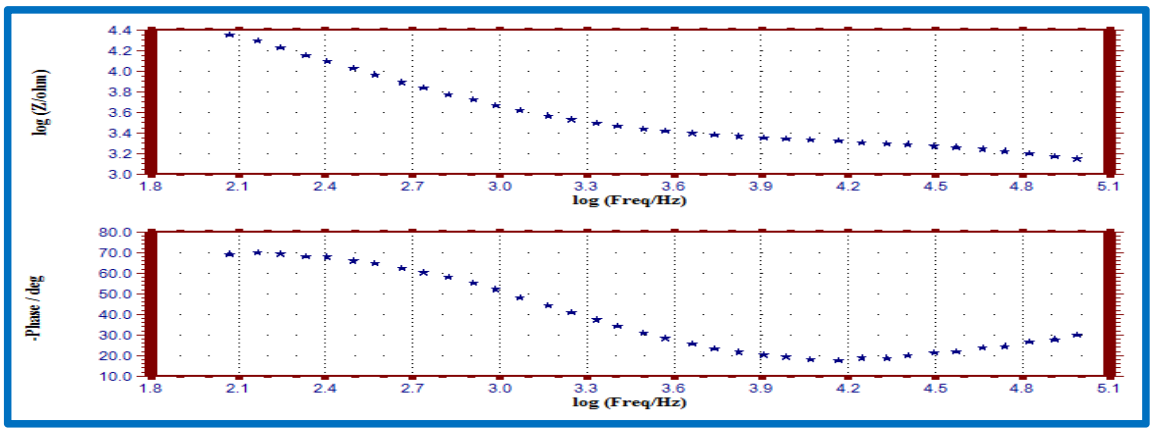

Fig 3.2:AC impedance spectra (Bode Plots)of 22 ct gold immersed in Artificial Saliva (AS) in the absence of Aceclofenac 100 mg

Conclusion:

Results of the electrochemical studies lead to the conclusion that in presence of **Aceclofenac 100 mg**(200 ppm) the corrosion resistance of 22ct gold in contact with artificial saliva increases.

Implication:

The outcome of the study is that people having orthodontic wires made of 18 ct gold need not hesitate to take **Aceclofenac 100 mg**tablets. The active ingredients of the tablets have not

corroded the orthodontic wires made of 22ct gold; Indeed They have protected the wire by formation of protective film on the surface of the wires.

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REFERENCES

[1] A. Ziebowicz, W. Walke, A. Barucha-Kepka, and M. Kiel, "Corrosion Behavior of Metallic Biomaterials Used as Orthodontic Wires", *Journal of Achievements in Materials and Manufacturing Engineering*, **27**(2008), pp. 151–154.

[2] A. Krishnaveni,S.Rajendran,andM.Pandiaraja ''The corrosion resistance of 18 carat gold in artificial saliva in presence of Almox 250 DT'', Eur. Chem. Bull**.** 2(8) (2013), 558- 561.S. Rajendran, P. Chitradevi, S. Johnmary, A. Krishnaveni, S. Kanchana, Lydia Christ,

[3] Rajendran, J. Paulraj, P. Rengan, J. Jeyasundari, and M. Manivannan, "Corrosion Behavior of Metals in Artificial Saliva in Presence of Spirulina Powder", *Journal of Dentistry and Oral Hygiene*, 1(2009), pp. 1–8.

[4] R.Nagalakshmi, B. Narayanasamy, "Corrosion behaviour of SS 316 L in artificial saliva in presence of electoral, ZAŠTITA MATERIJALA 51 (2010) 149-158S.

[5] D. Mareci, NemtoiGh, N. Aelenei, and C. Bocanu, "The Electrochemical Behavior of Various Non-Precious Ni and Co Based Alloys in Artificial Saliva", *European Cells and Materials*, 10 (2005), pp.1–7.

[6] L. Kinani and A. Chtaini, "Corrosion Inhibition of Titanium in Artificial Saliva Containing Fluoride", *LeonardoJournal of Sciences*, 11(2007), pp. 3340.

[7] S,Madhumitha , V.Priyadharshini , A.Sheela , M.Sangeetha and S.Rajendran Int.J.NanoCorros.Sciand Engg. 3(4) (2016) - 80 - 87.

[8] R. Saranya, SusaiRajendran, A. Krishnaveni,andJ. Jayasundari ''The corrosionresistance of 18 carat gold in artificial saliva in presence of D-Glucose'', Eur. Chem. Bull**.** 2(6) (2013), 389-392.

[9] Chenglong Liu, K. Paul Chu, Guoqiang Lin, and Dazhi Yang, "Effects of Ti/TiN Multilayer on Corrosion Resistance of Nickel-Titanium Orthodontic Brackets in Artificial Saliva", *Corrosion Science*, 49(2007), pp. 3783–3796.

[10] L. Joska, M. Marek, and J. Leitner, "The Mechanism of Corrosion of Palladium–Silver Binary Alloys in Artificial Saliva", *Biomaterials*, 26(2005), pp. 1605–1611.

[11] M. A. Christopher Brett and Florin Trandafir, "The Corrosion of Dental Amalgam in Artificial Salivas: An Electrochemical Impedance Study", *Journal of Electroanalytical Chemistry*, 52 (2004), pp. 347–354.

[12] S.S. Syed Abuthahir, A. Jamal Abdul Nasser and S. Rajendran ''Inhibition Effect of Copper Complex of 1-(8-Hydroxy Quinolin-2-ylMethyl) Thiourea on the Corrosion of Mild Steel in Sodium Chloride Solution'',The Open Materials Science Journal, 2014, 8, 71-80.

[13] M. A. Christoper Brett, Iulia Ioanitescu, and Florin Trandafir, "Influence of the Biological Fluid on the Corrosion of Dental Amalgam", *Corrosion Science*, 46(2004), pp. 2803–2816.

[14] V. Sribharathy, SusaiRajendran ,P. Rengan, R. Nagalakshmi Eur. Chem. Bull. 2(7) (2013), 471-476.

[15] R.Epshiba ,A.Peter Pascal Regis and S.RajendranInt.J.NanoCorros.Sci and Engg. 1(1) (2014) - 1 - 11.