

CORROSION BEHAVIOUR OF 22KARAT GOLD BRACKET WITH ARTIFICIAL SALIVA INCIDENCE OF TWO TABLETS

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Abstract: The inhibition and surface protection of inhibitors (Limcee, Shelcal) on 22karat gold bracket evaluated by polarisation and AC-Impedance spectra. The electrochemical test analysis showed corrosion resistance increases incidence of Limcee tablet due to LPR (Linear Polarisation Resistance), Rct (Charge transfer resistance) values increases and corrosion current (I-corr) density, Cdl (Double layer capacitance) values decreases. But corrosion resistance decreases incidence of Shelcal tablet due to LPR, Rct values decreases and I-corr, Cdl values increases (compare with artificial saliva). Decrease or increase inhibition efficiency of 22karat gold brackets is due to the presence components of tablets (Limcee, Shelcal). Polarisation test reveals, Limcee and Shelcal perform is mixed (anodic & cathodic) type inhibitors. Its result of studies suggest corrosion resistance of 22karat gold bracket in artificial saliva order is Limcee > AS > Shelcal.

Keywords: 22karat gold bracket, Artificial saliva, Corrosion resistance, Tablets, Polarisation and AC-impedance

I. INTRODUCTION

Corrosion behaviour of metals and alloys for dental application is very important properties because biocompatibility, cytotoxicity of the product formed by the corrosion process [1]. The archwire, ligatures, bands and brackets used for orthodontics purposes are prepare using SS alloy (Stainless Steel) [2-3]. The biomaterial is subject to corrosive medium after introducing to human body. Hence corrosion resistances are one of the main features for dental materials [4]. SS316L alloy has acceptable corrosion resistances, strength, biocompatibility, fatigue that make it desirable material as biomaterial [5]. Fluoride ion is aggressive ion that degrades the passive oxide film formed on SS alloy surface [6]. Fluoride are widely use in toothpastes, mouth rinses, orthodontic gels and dental product order to protect dental caries [7]. The corrosion behaviour of three alloys in artificial saliva incidence of spirulina measured [8] D-glucose, soft drink [9-10]. Corrosion perform of SS18/8 alloy and SS316L alloy incidence of Vicco toothpaste, both are corrosion resistance increases and 1 % of toothpaste with artificial saliva, corrosion resistance more than SS316L alloy [11].

Natural product (caffeine) has been used corrosion inhibitor [12-13]. Kinani et al. has been analyzed to influence of eugenol, on corrosion behaviour of titanium alloys with artificial saliva [14]. The nature of beverage and salt content food is corrosive, which play an important role in accelerate corrosion [15-16]. 18karat gold wire in synthetic saliva with Almox-250mg tablet [17] influence of protein with two different alloys (Ni-Ti, stainless steel). Increase in proteins concentration increase corrosion resistance of alloys [18]. The aim of this research to evaluated the inhibition and surface protection of inhibitors (Limcee, Shelcal) on 22karat gold bracket by polarisation study and AC-Impedance spectra.

II. MATERIALS AND METHODS

Table.1 Tablets with composition

Tablets	Composition	Represented by
Limcee-500mg (Vitamin-C Chewable)	1.Ascorbic acid-100mg 2.Sodium ascorbate-450mg	Tablet-B
Shelcal-500mg (Calcium with Vitamin-D3)	1.Calcium carbonate-1250mg 2.Vitamin D3-259Iu	Tablet-C

Table.2 Artificial saliva with composition

Composition	KCl	CaCl ₂ .2H ₂ O	Na ₂ S.9H ₂ O	Urea	NaCl	NaH ₂ PO ₄ .2H ₂ O
g/L	0.4	0.906	0.005	1.0	0.4	0.690

2.1. Potentiodynamic Polarization spectra

Polarisation study carried out electrochemical CHI-work station with AC-Impedance model-660A. It was provide with iR compensation facilities. It is consist of three type electrodes cell assembly. The working electrodes was 22karat gold bracket, SCE (Saturated Calomel Electrode) was reference electrode (RE), Counter Electrode (CE) was platinum electrode (Pt) used. From these studies, corrosion values such as corrosion current, potential, Tafel slopes (bc, ba) were measured. It is used to confirm the defending layer form on (22karat gold) metal surface in corrosion process [19-20]. Stipulation, a defending layer is formed on metal surface the corrosion (I-corr) current decreases and polarisation resistance (L PR) increases.

2.2 AC-Impedance Spectra

AC-Impedance analyzer model-CHI660A is using to record impedance measurement. The impedance set up is same for polarization method. The real part (Z' -ohm) and imaginary part (Z'' -ohm) of impedance were calculated for varies frequency. The Rct (charge transfer resistance) value bode plots (impedance), Cdl (double layer capacitance) value were measured. Stipulated, defending layer formed on metal alloy surface, Rct increase and also Impedance increases, Cdl value decreases [21-22].

III. RESULT AND DISCUSSION

3.1. Polarization Study

The polarization curves (E-Corr), Tafel slope (bc, ba mV/decade), linear polarization resistance, and corrosion current values of 22karat gold bracket immersed with artificial saliva incidence of two tablets (inhibitor) shown Fig.1 and polarization data in given Table.3. This study used to confirm, defending layer formed on metal (22karat gold) surface. If a defending layer is formed on the 22karat gold bracket surface, the corrosion current value (I-corr) decreases, linear polarisation resistance (LPR) value increases.

Table.3 Polarisation parameters of 22karat gold bracket with artificial Saliva (AS), absence and presence of Tablets (300ppm)

Systems	LPR ohm cm ²	I-corr A/cm ²	E-corr mV vs SCE	b _c mV/ decade	b _a mV/ decade
AS	7168773	6.004 x 10 ⁻⁹	-258	186	212
AS + Tablet-B	13426398	3.018 x 10 ⁻⁹	-238	177	195
AS + Tablet-C	3704090	11.14 x 10 ⁻⁹	-302	175	206

When 22karat gold bracket immerse in AS (Artificial Saliva) E-Corr (potential) is -258 mV vs SCE. When tablet Limcee (300ppm) added to above solution of the system, the E-Corr shift to -238 m V vs SCE (anodic side) Fig.1a, Table.3. It is indicates that formulation controlled in anodic reaction preference. But Shelcal tablet (300ppm) added to above solution of the system, the E-Corr shift to -302 m V vs SCE (cathodic side) Fig.1b, Table.3. It is indicates that formulation controlled in cathodic reaction preference. Incidence of Limcee tablet system, I-Corr (Inhibitor) decreases 3.018 x 10⁻⁹ A / cm² compared with artificial saliva (6.004 x 10⁻⁹ A/cm²) and LPR (ohm cm²) value increases from 7168773 to 13426398 in Table 3. It indicates corrosion resistance 22karat gold bracket with artificial saliva incidence of Limcee tablet increases Fig.2. Polarisation studies suggest that people having bracket made of 22karat gold bracket need not hesitation, to take Limcee tablet. But Shelcal added to above solution the I-Corr of 22karat gold bracket increases (6.004 x 10⁻⁹ A/cm² to 11.14 x 10⁻⁹ A / cm²) and LPR value (7168773 to 3704090) decreases. This data indicates corrosion resistance of 22karat gold bracket decreases Fig.2. Polarization test that those having orthodontics made of 22karat gold bracket should avoid Shelcal tablet. The active ingredients of the tablets have corroded the orthodontics made of 22karat gold bracket.

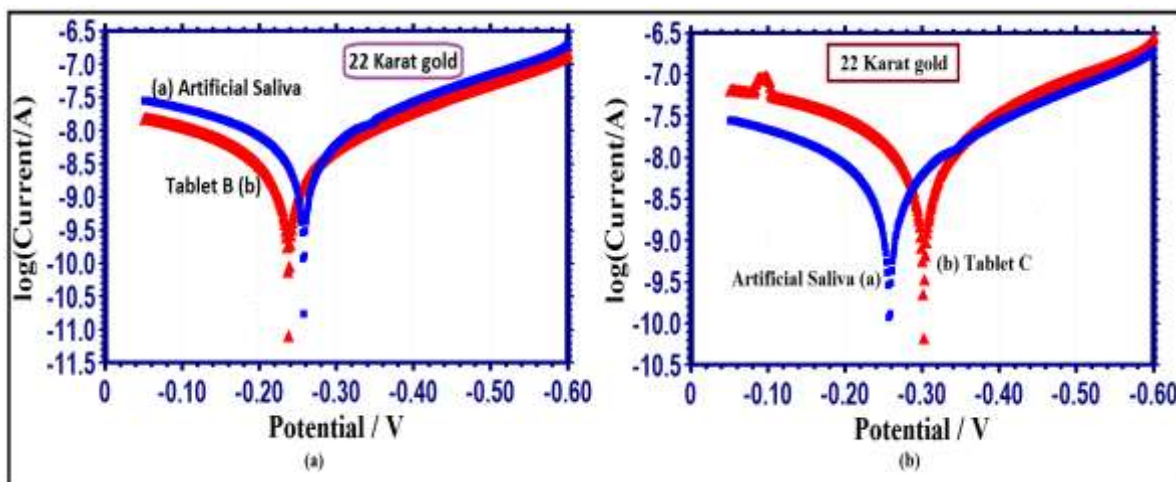


Fig.1 Polarisation (E-corr) curves of 22karat gold bracket with artificial saliva two tablets

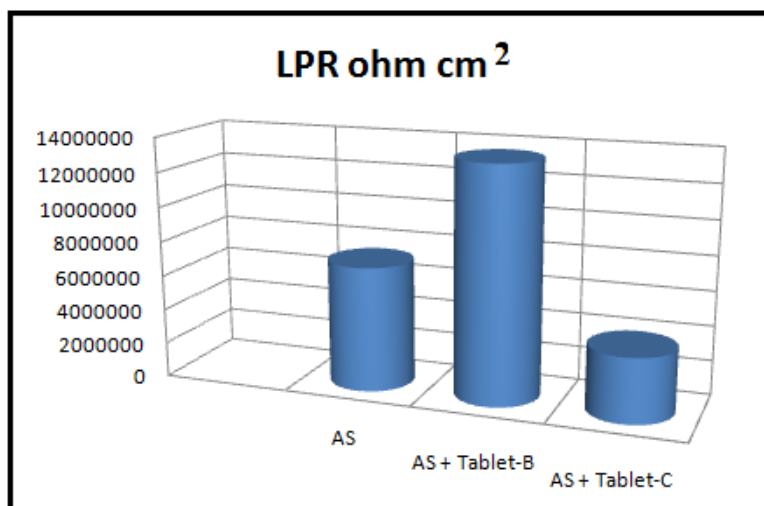


Fig.2 Corrosion resistance (LPR) of 22karat gold bracket with artificial saliva incidence of two tablets

3.2. AC-Impedance Spectra

AC-Impedance parameter namely, charge transfer resistance (R_{ct} ohm cm^2), double Layer Capacitance (C_{dl} F/ cm^2) derived from Nyquist plots Fig.3. The AC-Impedance data derived from the Bode plots Fig.4 and Table.4.

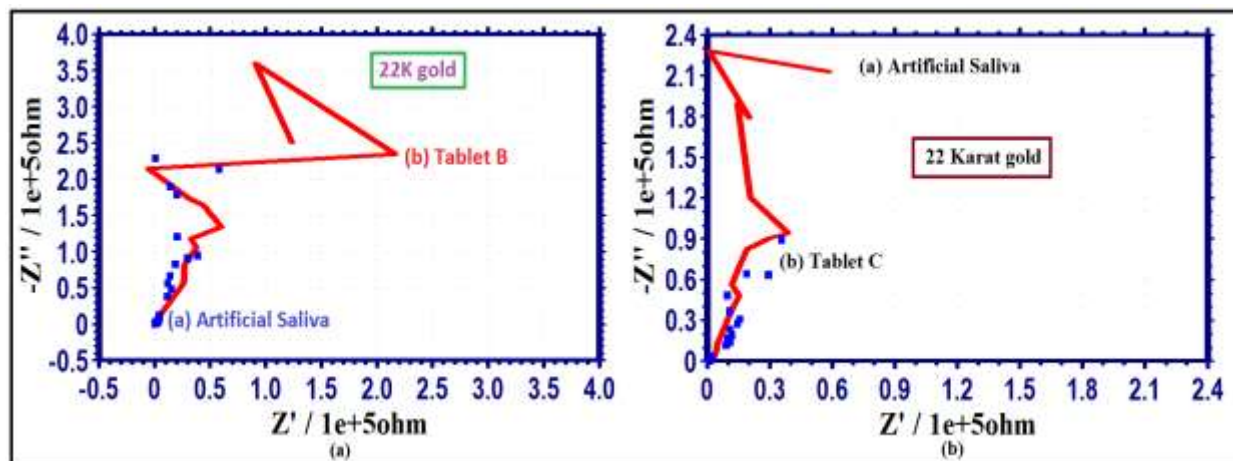


Fig.3 Nyquist (Cdl) plots of 22karat gold bracket with artificial saliva incidence of two tablets

Table.4 AC-impedance parameters of 22karat gold bracket with Artificial Saliva (AS), absence and presence of Tablets (300ppm)

Systems	Rct ohm cm ²	Cdl F/ cm ²	Impedance log(z/ohm)
AS	59710	0.854 x 10 ⁻¹⁰	5.347
AS + Tablet-B	214300	0.2380 x 10 ⁻¹⁰	5.454
AS + Tablet-C	35830	1.423 x 10 ⁻¹⁰	4.846

Incidence of Limcee tablet in Artificial Saliva Rct (ohm cm²) from 59710 to 214300 increases, Cdl (F/cm²) value from 0.854 x 10⁻¹⁰ to 0.2380 x 10⁻¹⁰ decreases and impedance (log z/ohm) values from 5.347 to 5.454 increases, Nyquist plots Fig.3 and bode plots Fig.4. It indicates that defending layer is formed on 22karat gold bracket surface. All these observation that incidence of Limcee tablet the corrosion resistance of 22 karat gold bracket with artificial saliva increases Fig.5. AC-Impedance studies suggest that people having orthodontics made of 22karat gold bracket need not hesitation, to take Limcee tablet. But incidence of Shelcal tablet Rct (ohm cm²) value from 59710 to 35830 decreases, Cdl (F/cm²) value from 0.854 x 10⁻¹⁰ to 1.423 x 10⁻¹⁰ increases. The active ingredients of the tablets have corroded the orthodontics made of 22karat gold bracket. Incidence of Shelcal tablet the corrosion resistance of 22 karat gold bracket with artificial saliva decreases Fig.5. Hence AC-Impedance study indicates that those having orthodontic wire made of 22karat gold bracket should Shelcal tablet.

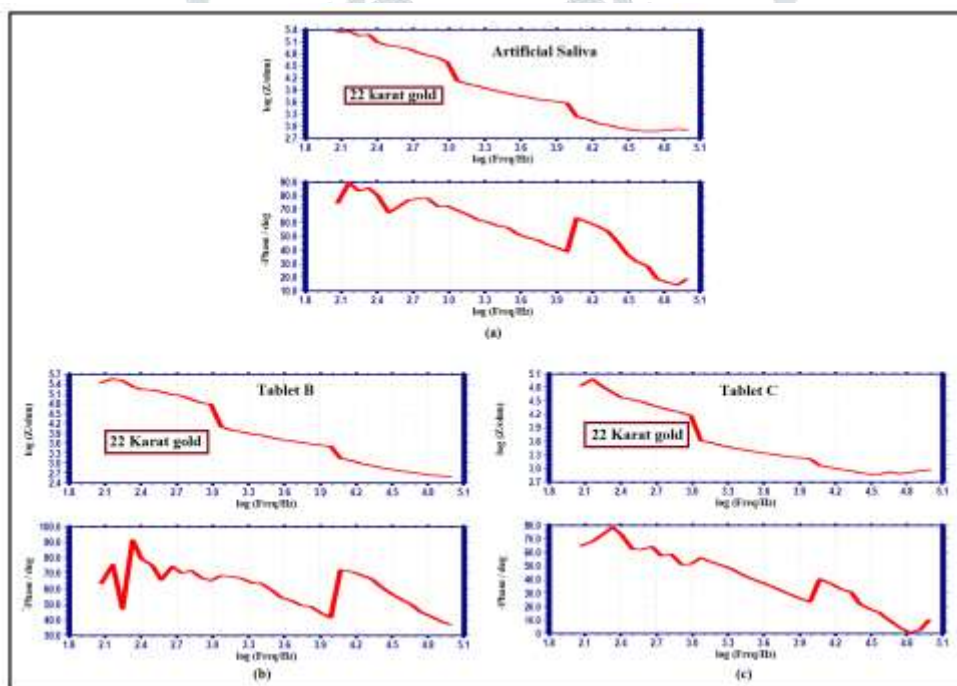


Fig.4 Bode plot (impedance) of 22karat gold bracket with artificial saliva incidence of two tablets

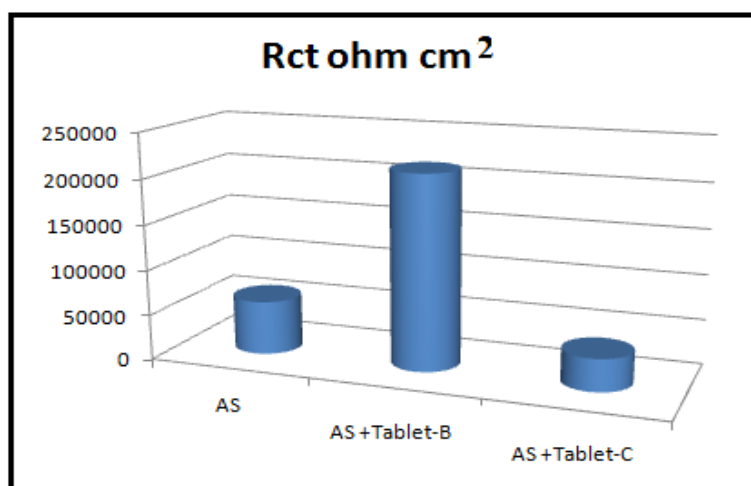


Fig.5 Corrosion resistance (Rct) of 22karat gold bracket with artificial saliva incidence of two tablets

IV. CONCLUSION

Polarisation analysis reveals that Limcee tablet perform as anodic (mixed) of inhibitor and Shelcal perform as cathodic (mixed) of inhibitor. From the electrochemical results, LPR and Rct parameters shows, the defending layer formed on 22karat gold bracket with artificial saliva incidence of Limcee. Hence it concluded that incidence of Limcee tablet, the corrosion resistance of 22karat gold bracket increases. But corrosion resistance of 22karat gold bracket decreases incidence of Shelcal tablet. The electro chemical results suggest (Limcee > AS > Shelcal) that those having orthodontic wire made of 22karat gold bracket need not hesitation to take Limcee tablet and should avoid Shelcal tablet.

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