SS 316 L alloy- The best candidate for implantation of orthodontic wire for people desirous of drinking Maaza

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Abstract- Corrosion resistance of two orthodontic wires made of SS 316 L alloy in artificial saliva in the absence and presence of soft drink namely maaza has been evaluated by AC impedance spectra. It is observed that in the presence of artificial saliva, the corrosion resistance of SS 316 L alloy decreases. In presence of soft drink maaza alone corrosion resistance of SS 316 L alloy increases However interesting the corrosion resistance of SS 316 L alloy increases in presence of artificial saliva and maaza. when corrosion resistance increases, the R_t value increases and the C_{dl} value decreases.Tthe present study reveals that the corrosion resistance of SS 316 L alloy decreases in the following order: maaza only > maaza + Artificial saliva > Artificial saliva. Hence it implies that people implanted with orthodontic wire made of SS 316 L alloy are not harmed by taking the soft drink maaza orally.

Keywords-Orthodontic wires, SS 316 L alloy, Artificial saliva, soft drink, AC impedance.

I. INTRODUCTION

Our human civilization cannot exist without metals and yet corrosion is their Achilles heel. Corrosion of metallic implants is of vital importance, because it can adversely affect the mechanical integrity and bio-compatibility of implants. Many metals and alloys have been used in dentistry as orthodontic wires. Their corrosion behavior in artificial saliva has been investigated by several researchers. Impact of modified acidic soft drinks on enamel erosion was studied by T Attin et al., [1]. The corrosion resistance of SS 316 L in artificial saliva in presence of a Tablet Ciprofloxacin Hydrochloride IP has been evaluated by polarization study and AC impedance spectra by Mohamed Kasim Sheit et al., [2]. H. Devlin et al., have determined the rate of change in indentation hardness of enamel in permanent teeth exposed to Coca-Cola® [3]. Rajendran et al., have evaluated the corrosion resistance of three metals namely, SS 316L, mild steel (MS) and mild steel coated with zinc (MS-Zn) in artificial saliva in the absence and presence of spirulina. The order of corrosion resistance of metals in artificial saliva, was rate is SS 316L > MS > MS-Zn [4]. Two types of gold alloys and one type of pure titanium have been subjected to corrosion in artificial saliva for periods of up to about 2 months have been investigated by Dag Brune et al ., [5] The present work is undertaken to investigate the corrosion resistance of orthodontic wire made of SS 316 L alloy in artificial saliva in the absence and presence of soft drink .

II. MATERIALS AND METHODS

Preparation of Artificial saliva solution

Artificial saliva is prepared in laboratory and the composition of artificial saliva is as follows: KCl - 0.4 g/lit, NaCl - 0.4 g/lit, $CaCl_2.2H_2O$ - 0.906 g/lit, $NaH_2PO_4.2H_2O$ - 0.690 g/lit, $Na_2S.9H_2O$ -0.005 g/lit, Urea – 1 g/lit.

Composition of maaza

Water, mango pulp (19.5%), sugar, acidity regulator (330), antioxidant (300), preservative (202), colour (110). It contains permitted class II preservative synthetic food colour & added flavours, (natural, identical, artificial flavouring substances) and fruit.

AC impedance measurements

A CHI 660A electrochemical impedance analyzer model was used to record AC impedance measurements. The cell set up was the same as that used for polarization measurements. The real part (Z') and imaginary part (Z") of the cell impedance were measured in ohms for various

frequencies. The Rt (charge transfer resistance) and Cdl (double layer capacitance) values were calculated.

III. RESULTS AND DISCUSSION

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 [6-13].

The AC impedance spectra of SS 316 L alloy immersed in Artificial Saliva (AS) in the absence and presence of soft drink maaza, obtained from AC impedance spectra are shown in Fig.1.The impedance – bode plots and phase bode plots for artificial saliva are shown in figure Fig.2 for Maaza only in Fig.3 and for Artificial saliva + Maaza is shown in Fig .4. The AC impedance parameters namely charge transfer resistance (R_t) and double layer capacitance (C_{dl}) derived from Nyquist plots are given in Table 1. It is observed that when maaza is added to artificial saliva, the charge transfer resistance (R_t) increases from 6141 ohm cm^2 to 13223 ohm cm^2 for (maaza only) and 11039 ohm cm^2 for (AS + maaza) respectively and the (C_{dl}) decreases from 8.31 x 10^{-10} F/ cm^2 to 3.86 x 10^{-10} F/ cm^2 and 4.62 x 10^{-10} F/ cm^2 for (maaza) (AS + maaza) respectively. All these observations lead to the conclusion that when we are adding maaza to artificial saliva, corrosion resistance of the SS 316 L alloy is increased and there is formation of protective film on the metal surface. Though corrosion resistance value for AS + maaza is lesser than maaza only value, when compared to Artificial saliva the corrosion resistance value for AS + maaza increases, thus it is concluded that in presence of AS + maaza protective film is formed on the metal SS 316 L alloy. Hence, people implanted with orthodontic wires made of SS 316 L alloy are not harmed by taking the soft drink maaza orally.

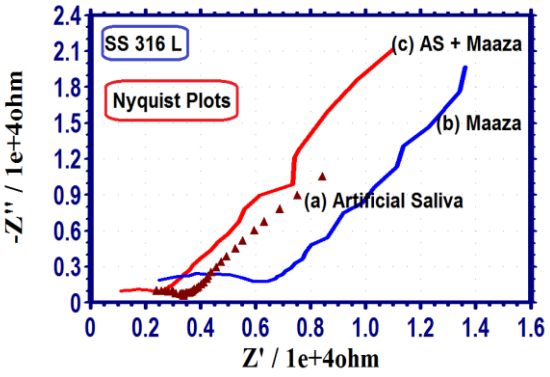

Fig 1: AC impedance spectra of SS 316 L alloy immersed in Artificial Saliva (AS) in the absence and presence of maaza (Nyquist Plots) : (a) Artificial Saliva (AS) ; (b) Maaza

(c) AS + Maaza

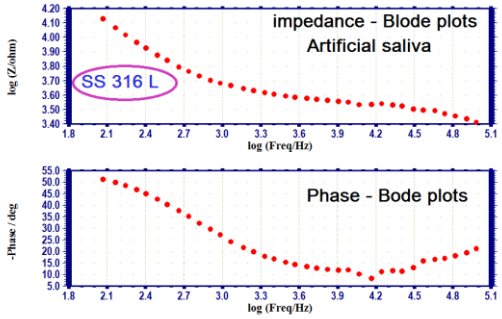

Fig 2: AC impedance spectra of SS 316 L alloy immersed in Artificial Saliva (AS) (Impedance – Bode plots), (Phase – Bode plots)

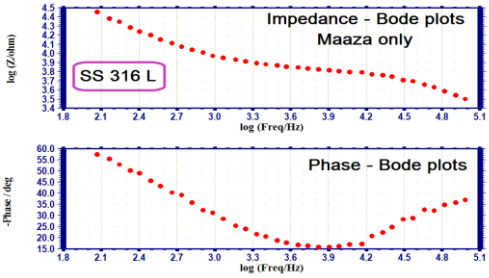

Fig 3: AC impedance spectra of SS 316 L alloy immersed in Maaza only (Impedance – Bode plots), (Phase – Bode plots)

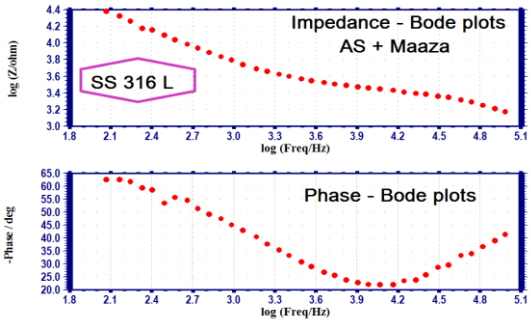

Fig 4: AC impedance spectra of SS 316 L alloy immersed in Artificial saliva + Maaza (Impedance – Bode plots), (Phase – Bode plots)

Table 1: AC impedance parameters of SS 316 L alloy immersed in Artificial Saliva (AS) in the absence and presence of Maaza, a soft drink, obtained by AC impedance spectra.

System	R_t ohm cm^2	C_{dl} F/ cm^2	Impedance Log(z/ohm)
AS	6141	8.31 x 10^{-10}	4.135
Maaza	13223	3.86 x 10^{-10}	4.462
AS + Maaza	11039	4.62 x 10^{-10}	4.378

IV.CONCLUSIONS

The present study reveals that;

1. The corrosion resistance of SS 316 L alloy decreases in the following order: Maaza only > Maaza + Artificial saliva > Artificial saliva.

2. It is concluded that people who have been implanted with orthodontic wires made of SS 316 L alloy are not affected when they take the soft drink maaza orally.

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