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Research Paper

Highly Efficient Baobab (*Adansonia digitata*) Fruit Seeds and Pulp Extracts as Potential Green Corrosion Inhibitors for Mild Steel in 0.5M HCl Solution

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Abstract: The methanolic extracts of *adansonia digitata* (baobab) fruit pulp (ADPE) and seeds (ADSE) for mild steel corrosion inhibition in 0.5M HCl solution was studied by gravimetric, potentiodynamic polarisation, electrochemical impedance spectroscopic (EIS) and SEM methods. The results revealed that both ADSE and ADPE act as efficient mixed-type corrosion inhibitors. The weight loss and polarisation studies reveal that the corrosion inhibition efficiency increases with increase in the concentrations of inhibitors ADSE and ADPE in acidic medium. ADSE exhibited high corrosion inhibitor efficiency (91.12%) for mild steel. Tafel plots show that baobab fruit extracts act as efficient mixed-type corrosion inhibitors. The double layer capacitance (C_{dl}) and charge transfer resistance (R_{ct}) values derived from Nyquist plots proved the anticorrosive nature of extracts. The inhibition of corrosion is possibly due to adsorption of the extracts on mild steel surface. The adsorption obeys Langmuir adsorption isotherm. The low free energy of adsorption (ΔG_{ads}) values for both the extracts confirmed physisorption on mild steel surface. The SEM images confirmed severe surface deterioration of mild steel exposed to HCl solution in the absence of inhibitors. The ADSE exhibited high efficiency as green and eco-friendly corrosion inhibitor for mild steel in acidic medium due to specific interaction between functional groups containing heteroatoms like nitrogen, sulfur, oxygen having free lone pair of electrons, and the metal surface.

Keywords: Mild steel, Green inhibitor, *Adansonia digitata*, EIS, SEM, Acid corrosion.

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Introduction

Mild steel (MS) has wide spread applications in chemical and allied industries due to its low cost, ease of fabrication and good tensile strength in addition to its other desirable properties. MS corrosion has been a serious problem of global concern since many decades with the enhancement of its application in various fields such as automobiles, aviation, agriculture, building construction, power plants, oil and gas industry. The MS corrosion in acidic media has gained significance in the recent past, due to increased industrial applications of mild steel in acidic solutions such as acid pickling, acid descaling, industrial cleaning and oil well acidizing¹. Degradation of mild steel during service conditions has created limitation in industries. Therefore the protection of mild steel from corrosion is of paramount significance.

The corrosion damage of MS on exposure to acidic environment and consequent environmental pollution can be retarded considerably by the use of corrosion inhibitors². The corrosion inhibition method of protecting mild steel has gained much importance recently among all the other protection methods for economical and practical reasons³. The use of inhibitors has been well documented as an effective method of protecting metallic materials from corrosion⁴. Synthetic organic inhibitors have shown efficiency in corrosion inhibition, but they have high cost of production, toxicity, and non-biodegradability properties which stimulates search for green corrosion inhibitors⁵.

Green corrosion inhibitors are biodegradable and do not contain heavy metals or other toxic compounds. In recent times there has been serious search for better green corrosion inhibitors for MS so that the environment is protected. A large number of researchers have explored the natural plant extracts as effective corrosion inhibitors such as, *Hunteria umbellata*⁶, *Ligularia fisheri*⁷, *African perquetina*⁸, *Nicotiana tabacum*⁹, *Psidium guajava*¹⁰, *Aquilaria crassna*¹¹, *Aloe Barbadensis*¹², *Adenopus breviflorus*¹³, *Musa paradisiaca*¹⁴, *Hibiscus sabdariffa*¹⁵, etc.

The phytochemical investigation of *Adansonia digitata* (baobab) fruit seed and pulp revealed the presence of organic components such as flavonoids, terpenoids, phytosterols, amino acids, carbohydrates, lipids, vitamins and minerals. Methanol extract of the pulp of the fruits of *Adansonia digitata* contain catechin and various epicatechins¹⁶ while the seed oil contains the compounds such as campesterol, cholesterol, isofucosterol, β -sitosterol, stigmasterol and tocopherol¹⁷. The presence of these effective organic compounds in baobab fruit, which contain N, O heteroatoms, -OH group and π -electrons in their structures show their ability to be corrosion inhibitors. However, this baobab fruit pulp and seed extracts have not yet been investigated for their corrosion inhibition properties. The present work was aimed to investigate the efficiency of methanolic extracts of *Adansonia digitata* fruit pulp and seeds as green and ecofriendly corrosion inhibitors for MS in 0.5M HCl solution by gravimetric, polarisation, electrochemical impedance and SEM techniques.

Material and Methods

Materials and sample preparation

The MS plate of grade JIS G 3132 having the composition (wt.%) of C (0.18), Si (0.35), Mn (0.60), P (0.040), S (0.040), Cr (0.14) and remaining Fe, was used to prepare the coupons for this study. The MS coupons of dimension 76.2 mm x 22.23 mm x 3.18 mm with a hole drilled 6 mm from one side were used for weight loss measurements and for electrochemical studies the square rod of the same material with dimension 10 mm x 10 mm x 30 mm coated with epoxy resin to give an exposed area of 1cm² was used. For surface studies by scanning electron microscopy (SEM), the MS coupons of dimension 30 mm x 30 mm x 3 mm were used. Prior to each experiment, the coupons were mechanically polished with emery papers of grades 600, 800 and 1000 rinsed with distilled water, degreased in acetone, air dried and stored in desiccators. The corrosive medium 0.5M HCl solution was prepared by diluting analytical grade sulphuric acid with distilled water.

Preparation of plant fruit extracts

Dry baobab (*Adansonia digitata*) fruits were collected from the villages around the University of Dodoma. The fruit pulp was separated from the seeds by manual grinding and sieving to remove the fibers. The collected powder was allowed to dry at room temperature and then stored in airtight polythene bags. The baobab fruits, pulp and seeds are shown in Figure 1.



Figure 1: Baobab fruits (a) pulp (b) and seeds (c)

After removing the pulp, the seeds were washed properly with running tap water, sun dried, ground into powder and stored in dry air tight containers. 500 g each of dried pulp powder and seeds powder were each extracted separately with 2.5 L of 80 % (V/V) aqueous methanol for 24 h at room temperature. Selection of the solvent was based on efficiency of extraction. When compared to aqueous ethanol, aqueous methanol is more effective in extraction of polar and moderately polar components from different plant material as discussed elsewhere[18,19]. After double filtration, cleaned first with a fabric and then with Whatman filter papers to remove the residues. The extracts were concentrated using warm air evaporator to get the crude extracts. *Adansonia digitata* pulp extract (ADPE) and *Adansonia digitata* seeds extract (ADSE) were stored in glass bottles for corrosion studies.

Gravimetric method

Gravimetric (weight loss) experiments were carried out as described by ASTM practice standard G-31. The weighed MS coupons (76.2 mm x 22.23 mm x 3.18 mm) were immersed in 200ml of 0.5M H₂SO₄ acid solutions containing different concentrations of ADSE and ADPE inhibitors for immersion periods of 24 h, 48 h and 72 h at room temperature according to reported studies²⁰⁻²³. After the experiments, the coupons were removed from the corrosive acid solution and immersed in 70 °C mixtures of 200 g/L of NaOH and 20g/L of Zinc metal dust and left for the period of 45 minutes to remove the corrosion product from the surface of MS coupons. From the hot solution, coupons were then cleaned using brush in running tap water, rinsed with distilled water, cleaned in acetone, dried and reweighed. The mean of weight loss values of two identical coupons was used to calculate the surface coverage (θ), percentage inhibition efficiency (% IE) and corrosion rate (CR) in millimeters per year (mmpy) using the following formula;

$$\text{Surface coverage } (\theta) = \frac{w_0 - w_1}{w_0} \quad (1)$$

$$\text{Inhibition efficiency } (\% \text{ IE}) = \frac{w_0 - w_1}{w_0} \times 100 \quad (2)$$

$$\text{Corrosion rate } (\rho) = \frac{87.6W}{\rho At} \quad (3)$$

Where:

w_0 = Average weight loss without inhibitor

w_1 = Average weight loss with inhibitor

w = Weight loss (mg)

ρ = Density (gm/cm^3) = 7.86 (mild steel)

A = Area of the mild steel coupon (cm^2)

t = Time (h)

Electrochemical measurements

The Electrochemical measurements were carried out using Autolabpotentiostat/galvanostat model Aut50665 and the data was collected with NOVA 1.11 software. A three electrode cell assembly in which mild steel square rod with exposed area of 1cm^2 as the working electrode, the platinum electrode as an auxiliary (counter) electrode and the saturated calomel electrode as a reference electrode was used. All experiments were conducted at room temperature using 200 ml of 0.5M H_2SO_4 with different concentration of ADSE and ADPE inhibitors. Each experiment was repeated at least three times to check the reproducibility and the good reproducible results were reported. Prior to each experiment, the electrode was allowed to corrode freely for 20 min for potential stabilization^{24,25}. After this time the potential corresponding to the corrosion potential (E_{corr}) of the working electrode, was recorded with applied potential $E = E_{\text{corr}} \pm 200 \text{ mV}$, with a scan rate of 1.0 mV s^{-1} . The Tafel curves were extrapolated to obtain corrosion current densities (i_{corr}), corrosion potential and corrosion rate^{26,27}. The inhibition efficiency was calculated from the measured i_{corr} values using the following formula^{28,29},

$$\text{Inhibition efficiency } (\% \text{ IE}) = \frac{i_{\text{corr}}^0 - i_{\text{corr}}^1}{i_{\text{corr}}^0} \times 100..(4)$$

Where:

i_{corr}^0 = Corrosion current density without inhibitor

i_{corr}^1 = Corrosion current density with inhibitor

In case of electrochemical impedance spectroscopy (EIS) experiments were carried out at open-circuit potential over a frequency range of 0.1 Hz-100 kHz [30] using AC signals of amplitude 10 mV peak to peak at the open circuit potential. The double layer capacitance (C_{dl}) and charge transfer resistance (R_{ct}) values were derived from Nyquist plots which were obtained using the impedance data plotted in EIS analyser software. From the charge transfer resistance values, the inhibition efficiency of the inhibitor was calculated using the equation below;

$$\text{Inhibition efficiency } (\% \text{ IE}) = \frac{R_{\text{ct}}^i - R_{\text{ct}}^0}{R_{\text{ct}}^i} \times 100 \dots (5)$$

Where:

R_{ct}^i = Charge transfer resistance with inhibitor

R_{ct}^0 = Charge transfer resistance without inhibitor

Surface analysis

Surface of polished mild steel coupons immersed in 0.5M H_2SO_4 for 3 hours in the presence and absence of inhibitor were immediately examined using scanning electron microscope (SEM) COXEM MODEL CX200.

Results and Discussion

Gravimetric Measurements

Effect of Inhibitor Concentration

The corrosion inhibition behavior of different concentrations of the extracts (300, 600 and 900 ppm) on MS in 0.5 M HCl was studied for various immersion periods of 24, 48 and 72 hours using weight loss method. The corrosion rate, surface coverage, and inhibition efficiency were calculated using equations (1), (2) and (3). The data obtained are given in Table 1. It is clear from the results that the inhibition efficiency (% IE) increases with increase in concentration of inhibitors.

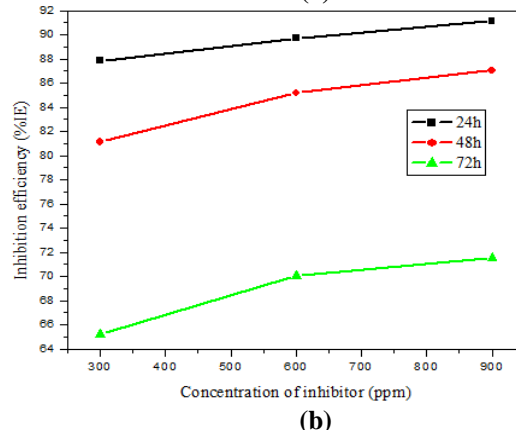
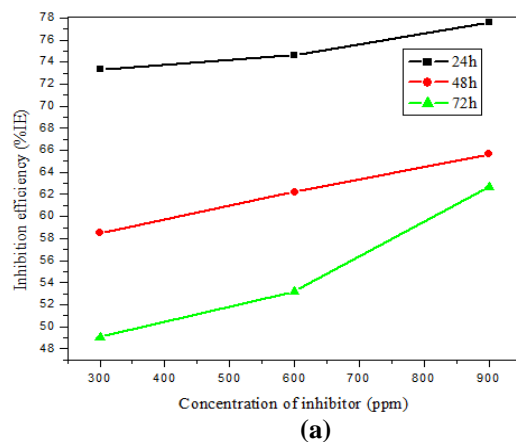


Figure 2: Inhibition efficiency plots against concentration of inhibitor ADPE (a) and ADSE (b) for MS corrosion in 0.5M HCl

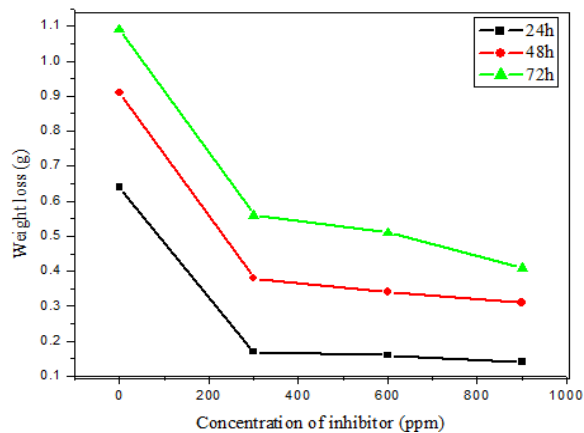
Table 1: The gravimetric parameters for MS in 0.5 M HCl in the presence and absence of *Adansonia digitata* extract with different concentrations at various time of immersion at 298K

Inhibitor	Exposure time (h)	Conc. of inhibitor ppm	W ₁ (g)	Surface coverage	Inhibition Efficiency	Corrosion rate (mmpy) E ⁻³
ADPE	24	Blank	0.642			7.53
		300	0.078	0.8785	87.85	0.90
		600	0.066	0.8972	89.72	0.75
		900	0.057	0.9112	91.12	0.66
	48	Blank	0.911			5.26
		300	0.172	0.8112	81.12	0.92
		600	0.135	0.8518	85.18	0.77
		900	0.118	0.8705	87.05	0.69
	72	Blank	1.092			4.23
		300	0.380	0.6520	65.20	1.49
		600	0.327	0.7005	70.05	1.30
		900	0.311	0.7152	71.52	1.22
ADSE	24	Blank	0.642			7.53
		300	0.171	0.7336	73.36	2.02
		600	0.163	0.7461	74.61	1.92
		900	0.144	0.7757	77.57	1.68
	48	Blank	0.911			5.26
		300	0.378	0.5851	58.51	2.13
		600	0.344	0.6224	62.24	2.07
		900	0.313	0.6564	65.64	1.85
	72	Blank	1.092			4.23
		300	0.556	0.4908	49.08	2.17
		600	0.511	0.5321	53.21	1.94
		900	0.408	0.6264	62.64	1.57

This confirms the dependence of inhibiting effect on phytoconstituents of fruit extracts. When the inhibitor molecules accumulate on the surface of MS, they reduce the interaction between MS surface and aggressive medium by increasing in coverage of MS surface leading to a compact and coherent film on the surface of MS³¹. Increasing the concentration of inhibitor from 300 to 900 ppm, increases % IE from 87.85% to 91.12% for ADPE and 73.36% to 77.57% for ADSE. ADSE exhibited high corrosion inhibitor efficiency (91.12%) for mild steel. The degree of protection increases with the increasing surface coverage by adsorbed molecules³².

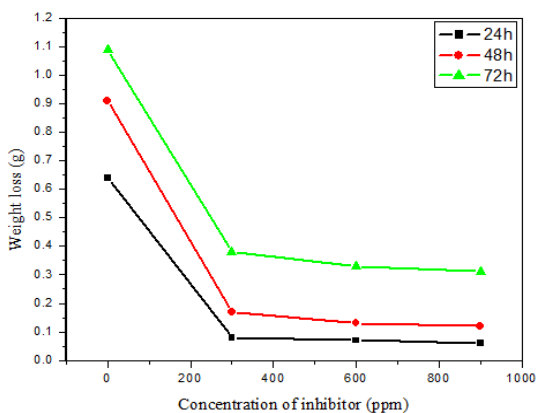
Effect of Immersion Period

The variation of weight loss with (%) IE at various immersion periods is shown in Figure 3. It is obvious from the plots that the weight loss of MS decreases with immersion period which is possibly due to increased thickness of the adsorbed layer containing phytoconstituents and corrosion products at the MS surface.

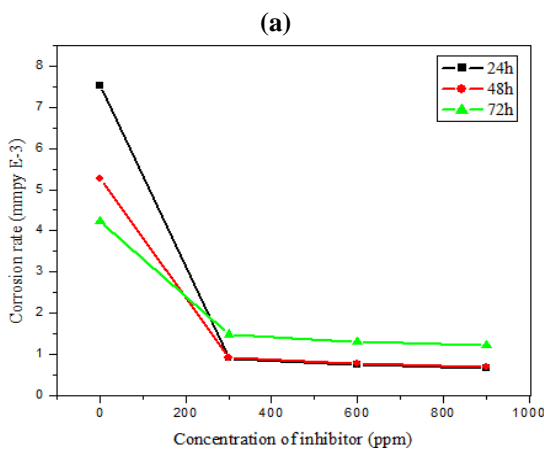
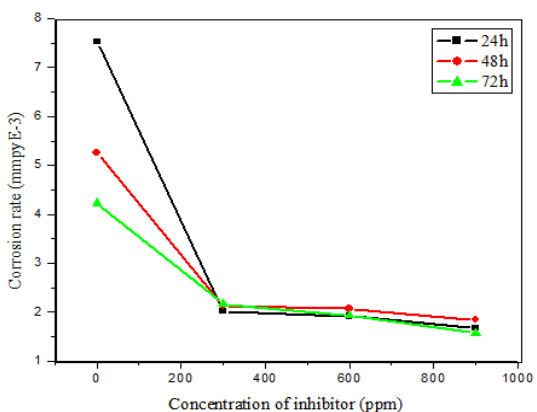


(a)

The interaction of ADPE and ADSE with mild steel may be a result of the presence of polysaccharides and protein molecules in their structures. These molecules form a linkage with the metal surface by donating a lone pair of electrons.



(b)
Figure 3: Plots of weight loss of MS against concentration of inhibitor ADPE (a) and ADSE (b) in 0.5 M HCl



(b) **Figure 4: Corrosion rate plots for mild steel against concentration of inhibitor ADPE (a) and ADSE (b) in 0.5M HCl**

Inhibition efficiency decreases with immersion time possibly due to the formation of insoluble film/corrosion product on the mild steel surface which lowers the interaction of the mild steel with the aggressive medium³³. The decrease in corrosion rate with increasing inhibitor concentration, as shown in Figure 4 suggests that the inhibitor molecules act by adsorption on the metal surface. Consequently the increase in inhibitor efficiency was attributed to the increase in surface coverage by extract molecules³⁴.

Potentiodynamic polarisation measurements

Corrosion inhibition is achieved by altering the anodic process, cathodic process, or both, which result reduced rate of the corrosion process³⁵. The corrosion current density (i_{corr}) and corrosion potential (E_{corr}) were obtained from the intersection point of anodic and cathodic current curves in the Tafel plots. Potentiodynamic polarization parameters for the corrosion inhibition of MS in 0.5M HCl in the presence and absence of inhibitor are given in the Table 2. The corrosion current density i_{corr} values decreases markedly with increasing extract concentration from 175.94 to 19.58 A/cm² for ADPE, similarly for ADSE, i_{corr} decreases from 175.94 to 32.86 A/cm². Tafel constants b_a and b_c markedly altered in presence of extract.

Polarization (Tafel) curves for MS in 0.5 M HCl solution at room temperature in the absence and presence of different concentrations of inhibitors are given in Figure 5. From the figure it is obvious that the two extracts alter the electrochemical processes on mild steel by reducing the anodic reaction rates by reducing the corrosion current densities on both sides of the polarization curves. It can be concluded from Tafel slopes that the green inhibitor follows mixed type inhibition mode³⁶ as the shift in E_{corr} values for blank and inhibitor is less than 85 mV.

It is also seen from the plots that no significant change occurred for cathodic curves when compared with anodic curves which confirms that the inhibitor is more of anodic nature. The interaction between metal surface and lone pair of electrons of oxygen/nitrogen atoms of the extract decreases the anodic dissolution of MS due to adsorption.

Table 2: Potentiodynamic polarization parameters for the corrosion inhibition of MS in 0.5M HCl in presence and absence of inhibitor

Inhibitor	Conc. of inhibitor (ppm)	$-E_{corr}$ (mV)	i_{corr} (A/cm^2)	b_a (mV/dec)	b_c (mV/dec)	Inhibition efficiency (%)	Corrosion rate (mm/year)
ADPE	Blank	456.60	175.94	44.83	81.199		2.044
	300	443.78	46.35	78.435	44.940	73.655	1.956
	600	445.83	38.38	32.012	48.855	78.182	1.095
	900	449.44	32.86	27.78	35.206	81.326	0.915
ADSE	Blank	456.60	175.94	44.83	81.199		2.044
	300	430.71	64.04	35.639	58.865	63.601	1.481
	600	449.38	27.48	28.94	49.630	84.377	0.891
	900	457.23	19.58	32.729	35.846	88.872	0.688

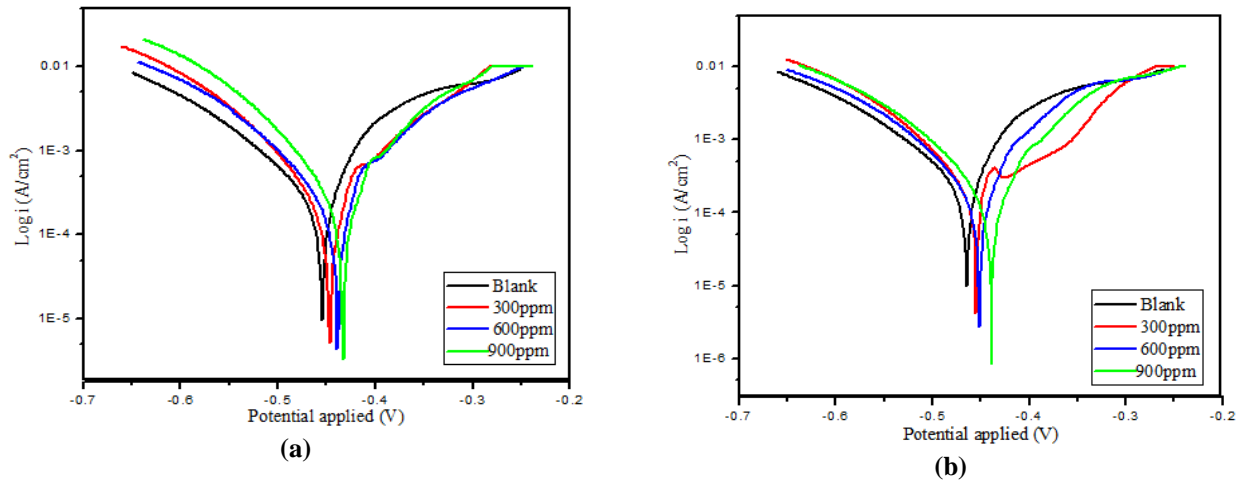


Figure 5: Tafel plots for MS corrosion in 0.5 M HCl solution with different concentrations of inhibitor ADPE (a) and ADSE (b)

EIS Measurements

The inhibition processes of ADPE and ADSE were also studied by electrochemical impedance spectroscopic (EIS) technique. The formation of film on metal surface is proved by impedance spectra. Basically corrosion process involves two steps, at first

metal undergo oxidation and metal ions diffuse into the solution phase in the second step. Extract molecules get adsorbed at the surface of MS and there by prevent the metallic dissolution. Formation of the protective layer on the surface of MS boosts the charge transfer resistance and diminishes the double layer capacitance.

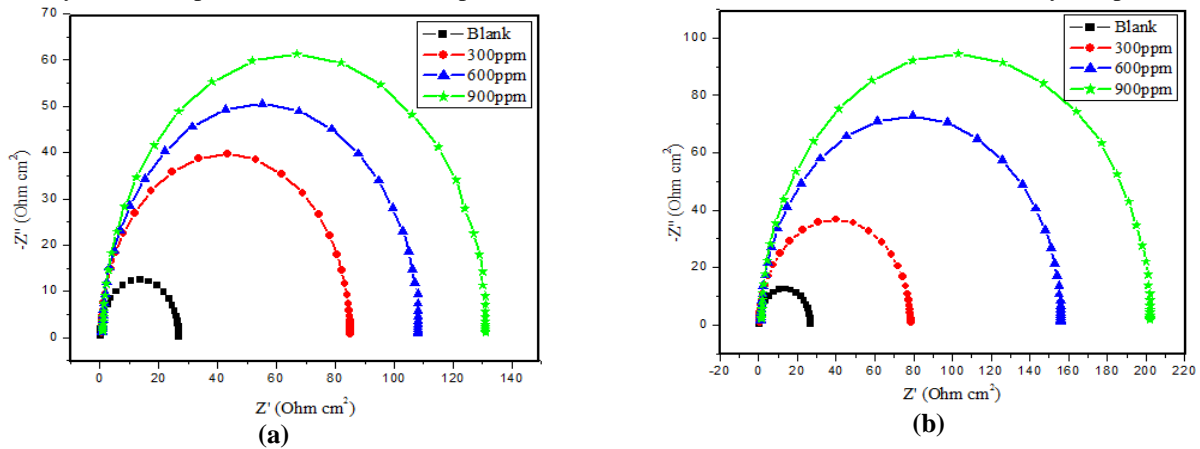


Figure 6: Nyquist plots (EIS) of mild steel in 0.5 M HCl in absence and presence of different concentrations of inhibitor ADPE (a) and ADSE (b)

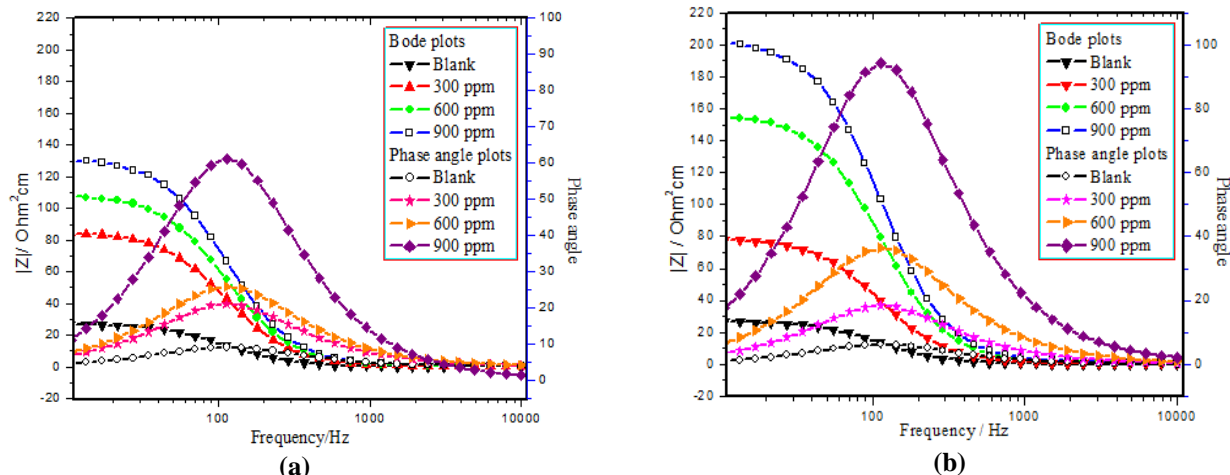


Figure 7: Bode and phase angle plots of mild steel in 0.5 M HCl in absence and presence of different concentrations of inhibitor ADPE (a) and ADSE (b)

It is clear from the Nyquist's plots (Figure 6) that charge transfer resistance and inhibitor efficiency increase with inhibitor concentration. One loop is observed on the Nyquist representation which means one process only occurred. This is in accord with observation of Bode plots representation (Figure 7). The loop's size increases according to ARAE concentration.

All impedance experimental data were tested in different circuit models to get excellent fit with lower error which agreed with the circuit Figure 8. The impedance parameters such as solution resistance (R_s),

charge transfer resistance (R_{ct}), and double-layer capacitance (C_{dl}) were used to calculate the inhibition efficiency (% IE) using the formula (5). The diameter of Nyquist plots increased on increasing the concentration of ADPE and ADSE which shows that these extracts strengthens the inhibitive film.

From the impedance data given in Table 3, the charge transfer resistance (R_{ct}) values increase with inhibitor concentration which shows that a charge transfer process mainly controlling the corrosion of MS in acidic media. The double layer capacitance decreases from 54.634 μFcm^{-2} to 11.168 μFcm^{-2} as the ADPE concentration increases from 0 to 900 ppm.

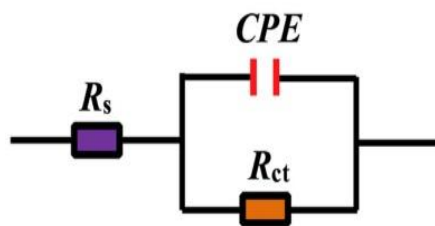


Figure 8: Equivalent circuit model used to fit the impedance spectral data

Table 3: EIS data for corrosion of MS in 0.5M HCl with and without inhibitors

Inhibitor	Conc. of inhibitor (ppm)	C_{dl} (μFcm^{-2})	R_s (Ωcm^2)	R_{ct} (Ωcm^2)	Inhibition efficiency (%)
ADPE	Blank	54.634	0.194	26.076	--
	300	17.256	0.615	82.612	68.431
	600	13.549	0.783	105.180	75.204
	900	11.168	0.948	127.510	79.547
ADSE	Blank	54.634	0.194	26.076	--
	300	18.698	0.568	76.286	65.813
	600	9.410	1.129	151.540	82.790
	900	7.254	1.462	196.360	86.718

The double layer capacitance (C_{dl}) decreases with increase of inhibitor concentration due to the adsorption of the inhibitor on the metal surface leading to the formation of film or complex from acidic solution³⁷. The decrease in C_{dl} values generally related to the adsorption of organic molecules on the metal surface and then leads to a decrease in the local dielectric constant and/or an increase in the thickness of the electrical double layer. The inhibition efficiency (% IE) of the extracts determined by three different methods, gravimetric, polarization and electrochemical impedance spectroscopy, as a function of concentration are in coherence with each other.

Adsorption isotherms

Adsorption isotherm is used to provide useful insight into the mechanism of corrosion inhibition. The experimental data from weight loss measurements were applied to different adsorption isotherm equations to fit the values of surface coverage (θ) to get an isotherm with higher regression coefficient. Langmuir isotherm was tested by the plot between C/θ and C according to equation below:

$$\frac{C}{\theta} = \frac{1}{K_{ads}} + C \tag{6}$$

Most commonly applied adsorption isotherms are Temkin, Langmuir and Frumkin isotherms^{38,39}. In Langmuir isotherm it is assumed that all sites have equal possibility⁴⁰ for adsorption and it is not affected by activity at nearby sites.

Langmuir isotherm (Figure 9) gave straight line with the slope of the unit, where the regression coefficient R^2 values for Langmuir isotherm were 0.9991 and 0.9995 for ADPE and ADSE, respectively as given in Table 4. Adsorption depends on chemical composition of extract which showed the presence of various compounds like flavonoids, terpenoids, phyosterols, amino acids, carbohydrates, lipids and vitamins⁴¹. This inhibitor obeys the Langmuir adsorption isotherm^{42,43}.

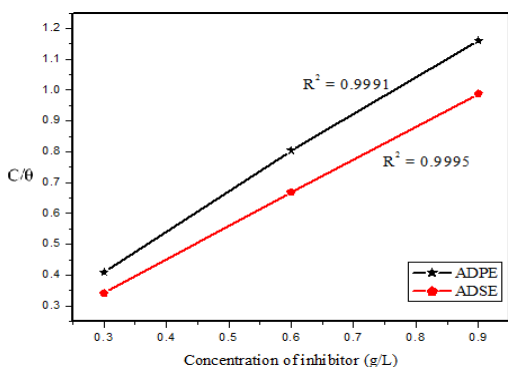


Figure 9: Langmuir adsorption isotherm plot for mild steel in 0.5 M HCl with ADPE and ADSE at 298 K

This explains the monolayer formation of the inhibitor on the surface of MS. Thermodynamic parameters (Table 5) for the adsorption of both extracts on the MS are calculated using the equation given below,

$$\Delta G_{ads} = -RT \ln(55.5K_{ads}) \tag{7}$$

Table 4: Langmuir adsorption isotherm data for mild steel in 0.5 M H₂SO₄ for ADPE and ADSE

Media	Inhibitor conc. (g/L)	Surface coverage (θ)	C/ θ	R ²
0.5M HCl + ADPE	0.3	0.7336	0.408942	0.9991
	0.6	0.7461	0.804182	
	0.9	0.7757	1.160242	
0.5M HCl + ADSE	0.3	0.8785	0.341491	0.9995
	0.6	0.8972	0.668747	
	0.9	0.9112	0.987709	

Table 5: Langmuir thermodynamic parameters for ADPE and ADSE

Inhibitor	K _{ads}	ΔG_{ads} (kJmol ⁻¹)
ADPE	2.857	- 4.5628
ADSE	3.333	- 4.1809

Generally, it is accepted that when ΔG_{ads} values are about 20 kJ/mol or lower, adsorption is regarded as physisorption. For this, the inhibition is said to acts through electrostatic interaction between the charged molecules and the charged metal. Also, for the values around 40 kJ/mol or higher, the interactions are seen as chemisorption in which charge sharing or a charge transfer from the inhibitor molecules to the metal surface occurs to form covalent bond. In the present study the values of free energy of adsorption for both ADPE and ADSE were around -4.5268 kJ mol⁻¹ and -4.1809 kJ mol⁻¹ respectively. This means both inhibitors are physically adsorbed on the surface of mild steel.

SEM analysis

SEM images were recorded to know the surface deterioration before and after MS corrosion on exposure to the 0.5M HCl solution in the absence and presence of ADPE and ADSE inhibitors. SEM images for MS surface before immersion and after immersion in 0.5M HCl without inhibitor are shown in Figure 10. The SEM images show that the MS was heavily corroded in 0.5M HCl as shown in Figure 10 (b) without inhibitors where as in the presence of inhibitors ADPE and ADSE as the surface conditions were comparatively better as seen in Figure 11 (a) and 10 (b) respectively.

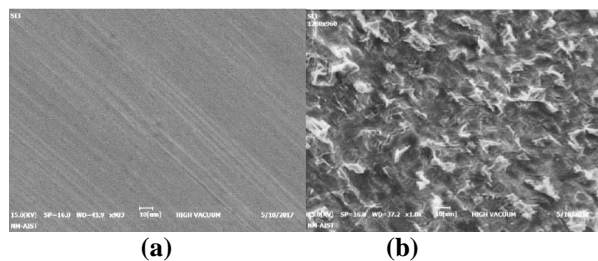


Figure 10: SEM images of MS surface before immersion (a) and after immersion in 0.5M HCl without inhibitor (b)

This shows that the inhibitor molecules hinder the dissolution of MS by forming surface adsorbed layer and thereby reducing the corrosion rate. It also confirms that the inhibitors effectively control the corrosion phenomenon by blocking the active corrosion causing sites on the mild steel surface. Metal surface was highly covered with the protective layer formed by the green inhibitor which prevents the metal from further attack of acid media.

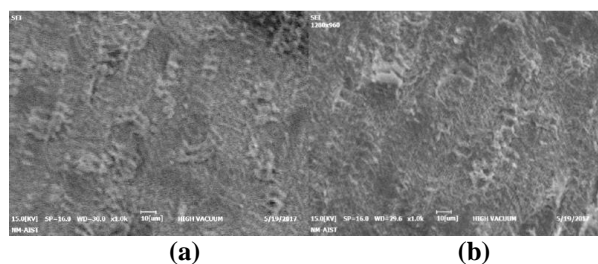


Figure 11: SEM images of MS surface after immersion in 0.5M HCl with inhibitors ADPE (a) and ADSE (b)

It is observed from the Figure 11 that the surface deterioration is more in case of MS exposed to ADPE in acidic solution than that exposed to ADSE which could be attributed to the presence of higher proportions of active phytoconstituents in seeds than in pulp of baobab fruits.

Conclusion

The seeds (ADSE) and pulp (ADPE) extracts from *Adansonia digitata* (baobab) fruits proved to be effective green and eco-friendly inhibitors for MS corrosion in 0.5M HCl medium. The gravimetric analysis revealed that both inhibitors ADSE and ADPE found to follow mixed type inhibition mode even though anodic reaction influence was predominant. The inhibitor efficiency of extracts was found to increase with increase in the inhibitor concentration. ADSE exhibited higher % IE compared to that of ADPE which could be attributed to the presence of higher percentage of active phytoconstituents in baobab seeds. The corrosion current density obtained from

Tafel plots, was found to be lowest for corrosive acid medium with high inhibitor concentration. Corrosion rate of MS was found to decrease with increase in extract concentrations. This inhibitor obeys the Langmuir adsorption isotherm. Adsorption was effective due to the presence of various active compounds like flavonoids, terpenoids, phytosterols, amino acids, carbohydrates, lipids and vitamins in the extracts. The EIS study shows that Charge transfer resistance (R_{ct}) increases and double layer capacitance (C_{dl}) decreases with the increase in the inhibitor concentrations. The surface analysis by SEM confirms the presence of protective film on MS surface in the presence of inhibitors.

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