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Inhibitive Action Of Non-Aerial Part (Root) Of *Sarcostemma Intermedium* And *Pergularia Deamia* As Green Corrosion Inhibitor In Acidic Media : A Comparative Study

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ABSTRACT:

Mass loss and Thermometric method have been used to evaluate the corrosion inhibition efficiency of mild steel in H_2SO_4 solution by using root (non-aerial part) extract of *Sarcostemma intermedium* and *Pergularia deamia*. The results show that Corrosion inhibition efficiency increases with increasing concentration of inhibitor and it also increases with increasing concentration of H_2SO_4 solution. Inhibition efficiency was found maximum up to 82.51% for mild steel with 0.8% root extract of *Sarcostemma intermedium*.

KEYWORDS:

Corrosion, Mild steel, Mass loss method, Thermometric method, Inhibition efficiency.

INTRODUCTION:

The deterioration of metal through chemical attack or reaction with the environment is known as corrosion. It is an ongoing issue that is challenging to completely eradicate. It would be more feasible to focus on prevention rather than total elimination. The corrosion process accelerates after the protective barrier is compromised and involves various reactions that alter the composition and properties of both the metal surface and the local environment, such as oxide formation, metal cation diffusion into the matrix, local pH changes, and electrochemical potential. Mild steel is highly susceptible to corrosion in aggressive acidic environments and during the pickling process. Compounds with hetero atoms like N, S, and O have been identified as effective inhibitors due to their high basicity and electron density, which helps in preventing corrosion[1]. The active centers for adsorption on the metal surface are O, N, and S. The molecule's size, orientation, shape, and electric charges also influence its effectiveness in inhibiting corrosion. Corrosion not only results in significant economic losses but also poses a significant threat to human safety.

Eco-friendly green inhibitors have attracted several researchers. Corrosion control of metals is of technical, economic, environmental and aesthetic importance. A large number of synthesize organic compound have been studied and are still being studied to assess their corrosion inhibition potential but most of these substances are not only expensive but also hazards to living being and environment. The plant extracts are considered as an incredibly rich source of environmentally acceptable corrosion inhibitor. There are numerous naturally occurring substances like *Eugenia jambolans*[2], *Prospis juliflora*[3] , *Datura Stromonium*[4], Brahmi[5], *Hibiscus Cannabinus*[6], Garlic[7], *Cordia dichotoma*[8] have also been reported. Recently the use of naturally occurring substances like Pennisetum glaucum[9], Molasses[10], Pumpkins[11], Black tea[12], Bhringaraj[13], Araucaria columnaris[14], Leptadenia pyrotechnica[15], Phoenix dactylifera[16] and Lemon verbena[17] have been evaluated as effective green corrosion inhibitors. Recently inhibitory effect of some green corrosion inhibitor have been studied and reported that the plant extracts are renewable source for a wide range of effective green corrosion inhibitors[18-21]. In the present studies the inhibitive effects of alcoholic extract of non-aerial part of *Pergularia daemia* and *Sarcostemma intermedium* have been evaluated.

EXPERIMENTAL:

Non-aerial part (root) of *Sarcostemma intermedium* and *Pergularia daemia* were collected and dry in shade, then finely powdered and extracted with boiling ethanol. The solvent is distilled off and the residue is treated using inorganic acid, where the bases are extracted as their soluble salt. The free bases are liberated by the addition of any bases and extracted with various solvents, e.g. ether, chloroform etc. Specimen coupons used in the mass loss experiments were mechanically cut from commercially available mild steel samples into coupons of 2.5cm x 1.55cm x 0.02cm with a small hole of about 2mm diameter near the upper edge. Specimens were cleaned by buffing to produce spotless finish and then degreased. Different concentration solutions of sulfuric acid were prepared using double distilled water. Each specimen was suspended by a glass hook and immersed in a beaker containing 50 mL of test solution with or without inhibitor at room temperature and left exposed to air. Evaporation losses were made up with distilled water. Duplicate experiments were done for each and mean values of mass loss were calculated.

The percentage inhibition efficiency was calculated as-

$$\text{Inhibition Efficiency } (\eta\%) = \frac{100(\Delta M_u - \Delta M_i)}{\Delta M_u}$$

Where, ΔM_u and ΔM_i is the mass loss of the specimen in uninhibited and in inhibited solution respectively.

The degree of surface coverage (θ) can be calculated as

$$\text{Surface coverage } (\theta) = \frac{(\Delta M_u - \Delta M_i)}{\Delta M_u}$$

The corrosion rates in mmpy can be obtained by the following equation

$$\text{Corrosion rate (mmpy)} = \frac{Mass\ loss\ x\ 87.6}{Area\ x\ Time\ x\ Metal\ density}$$

Where mass loss is expressed in mg, area is expressed in cm^2, exposer time is expressed in hours and metal density is expressed in gm/cm^3.

Inhibition efficiency was also calculated using thermometric method. Specimen (dimension 2.5cm x 1.55cm x 0.02cm) were immersed in an insulating reaction chamber having 50 mL of test solution at an initial room temperature. Temperature change was observed at regular intervals using a thermometer with a precision of 0.10 C. Initially the increase in temperature was slow, then rapid, attaining a maximum value and then decreased. The maximum temperature was noted.

The inhibition efficiency was calculated as

$$\text{Inhibition efficiency } (\eta\ \%) = 100(RN_f - RN_i)/RN_f$$

Where RN_f and RN_i are the reaction number in the free solution and inhibited solution respectively. Reaction number RN ($K\ min^{-1}$) is given as:

$$RN = \frac{T_m - T_i}{t}$$

Where, T_m and T_i are the maximum temperature of solution and in initial temperature of solution respectively. t is time required (in minutes) to attain maximum temperature.

Table-1

Mass loss data for mild steel in H_2SO_4 with alcoholic extracts of plant *Sarcostemma intermedium and Pergularia daemia* at 299 ± 0.1K.

Area of exposure – 7.75cm^2 Time-72 hrs

	0.5N H_2SO_4			**1.0N H H_2SO_4**			**1.5N H_2SO_4**		
Inhibitor Concentration (%)	Mass Loss (Δm) Mg	Inhibition Efficacy (η %)	Corrosion Rate (mmpy)	Mass Loss (Δm) mg	Inhibition Efficacy (η %)	Corrosion Rate (mmpy	Mass Loss (Δm) mg	Inhibition Efficacy (η %)	Corrosion Rate (mmpy)
Blank	487	-	9.7382	674	-	13.4775	1162	-	23.2357
Root extract of *Sarcostemma intermedium*									
0.2	101	69.12	3.0194	177	73.78	3.5393	366	68.45	7.3186
0.4	143	70.76	2.8595	160	76.27	3.1994	348	70.00	6.9587
0.6	120	75.46	2.3996	143	78.81	2.8595	300	74.14	5.9989
0.8	105	78.53	2.0996	118	82.51	2.3596	267	76.98	5.3390
Root extract of *Pergularia daemia*									
0.2	188	61.40	3.7593	215	68.10	4.2992	346	70.22	6.9187
0.4	171	64.89	3.4194	195	71.07	3.8993	328	71.77	6.5588
0.6	145	70.23	2.8995	182	73.00	3.6393	302	74.01	6.0389
0.8	113	76.80	2.2596	155	77.00	3.0994	261	77.54	5.2190

Table- 2

Reaction Number (RN) and Inhibition efficacy (η %) for mild steel in H_2SO_4 at 299±0.1 K with alcoholic extracts of plant *Sarcostemma intermedium and Pergularia daemia.*

[Area of exposure- 7.75 cm^2]

Inhibitor concentration	**3N H_2SO_4**		**2N H_2SO_4**		**1N H_2SO_4**	
	(RN)	(η%)	(RN)	(η%)	(RN)	(η%)
Blank	0.2103	-	0.1929	-	0.1836	-
Root extract of *Sarcostemma intermedium*						
0.2	0.0689	66.80	0.0675	65.01	0.0679	63.02
0.4	0.0597	71.61	0.0619	67.91	0.0618	66.34
0.6	0.0461	78.08	0.0547	71.64	0.0547	70.21
0.8	0.0340	83.83	0.0395	79.52	0.0430	76.58
Root extract of *Pergularia daemia*						
0.2	0.0722	65.67	0.0627	67.50	0.0585	68.14
0.4	0.0552	73.75	0.0522	72.94	0.0506	72.44
0.6	0.0475	77.41	0.0440	77.19	0.0425	76.85
0.8	0.0314	85.07	0.0310	83.93	0.0339	83.83

RESULTS AND DISCUSSION:

The corrosion rate and inhibition efficiency obtained by mass loss method are given in table 1. It is observed that the inhibition efficiency increases with increase in the concentration of inhibitor from 0.2% to 0.8%. Root extract of *Sarcostemma intermedium* exhibit maximum inhibition efficiency up to 82.51% while root extract of *Pergularia daemia* shows maximum inhibition efficiency up to 77.54%.

Reaction numbers (RN) and inhibition efficiency measured by thermometric method are given in table - 2. The results indicate that reaction number decreases with increasing concentration of inhibitor. The maximum inhibition efficacies observed by thermometric measurement are 83.83% for the root extract of *Sarcostemma intermedium* and 85.07% for the root extract of *Pergularia daemia* in 3.0 N H_2SO_4 solution.

CONCLUSIONS:

Root extract of *Sarcostemma intermedium* and *Pergularia daemia* are found to be effective inhibitor in acid media giving inhibition efficiency up to 82.51% and77.54% respectively and can safely be used without any toxic effect and pollution.

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