**Bulletin of Environment, Pharmacology and Life Sciences**
Bull. Env. Pharmacol. Life Sci., Vol 13[6] May 2024: 30-34

Online ISSN 2277-1808
Journal's URL: http://www.bepls.com
CODEN: BEPLAD


**ORIGINAL ARTICLE** **OPEN ACCESS**

# Effective Corrosion Inhibitive Nature of *Mimosa pudica Leaves* Extract (MPLE) on Mild Steel In 1M Sulphuric Acid Media

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**ABSTRACT**
*The corrosion inhibitory action of mild steel in 1M $H_2SO_4$ acid solution by Mimosa pudica leaves extract (MPLE) was inspected by the weight loss and phytochemical method. phytochemical result of leaves of Mimosa pudica shows the presence of tannin, protein, steroid, alkaloids, phenol like components. The presence of this phytochemicals make the Mimosa pudica leaves to provide 97% IE against 1M $H_2SO_4$ for mild steel specimens.*
***Keywords:*** *Mimosa pudica, Green inhibitor, Phyto chemical analysis, Weight loss method.*

Received 11.03.2024 Revised 23.04.2024 Accepted 25.05.2024

## INTRODUCTION

*Mimosa pudica* L. (Mimosaceae) also referred to as touch me not, live and die, shame plant and humble plant. Is a prostrate or semi-erect subshrub of tropical America and Australia, also found in India heavily armed with recurved thorns and having sensitive soft grey green leaflet that fold and droop at night or when touched and cooled. Digitately compound with one or two pairs of sessile, hairypinnae, alternate, petiolate, stipulate, linear lanceolate; leaflets10–20 pairs, 0.6–1.2-cm long, 0.3–0.4-cm broad, yellowish green leaves [1] as shown in Fig.1. The roots and leaves of this plant have been usually used by tribal people for headache, migraine, dysentery, fever, piles, insomnia, epilepsy, etc. Also this plant was used as bitter, astringent, acrid, cooling vulnerary, febrifuge, alexipharmic, diuretic, emetic and tonic [2]. Mild steel is an important part of buildings, construction tools, manufacturing and engineering industries due to its low cost and stability. But mild steel often loses its structural integrity due to corrosion [3]. Corrosion of metals can be controlled by coating chemical compounds on their surfaces. Instead of using toxic organic inhibitors, green inhibitors which are biodegradable, inexpensive, renewable, and readily available. Plant extracts contain many organic compounds, having polar atoms such as O, P, S, and N. These are adsorbed on the metal surface by these polar atoms, and protective films are formed [4]. The mimosa is very usefulness at displacing native plant material, which revolve affects native wildlife. When the flowers drop, they form a brown slimy residue that sticks to cars, plants or paved areas. Mimosa is a category 1 invasive plant according to the Florida Exotic Pest Plant Council and is also on the invasive list for UF/IFAS. [5]. But, the presence of crocetin, crocin, jasmonic acid, L-mimosine , caffeic acid, ethyl gallate, and gallic acid in the ethyl acetate fraction of the Mimosa plant extract has showed antibacterial activity [6] against Gram-positive bacteria (*Staphylococcus aureus* and *Bacillus cereus*) and Gram-negative bacteria (Escherichia coli and Klebsiella pneumoniae). Also, *Mimosa pudica* is a readily obtainable plant and it contains many phytochemical constituents in which makes its corrosion inhibitor. Thus, in this study the aim of our work is investigating the phytochemical constituents and green corrosion inhibition efficacy of the ethanol extract of MPLE on mild steel in 1M $H_2SO_4$solution.

## MATERIALS AND METHOD

### Collection and preparation of plant sample

Good fresh leaves of *Mimosa pudica* were collected, cleaned, shade dried, and grinded in a mechanical grinder, and then sieved to get fine powder. From that, 30g of this powdered dried sample is successively extracted with 300ml ethanol by using soxhlet apparatus until the decolourisation of the solvent. The prepared stock inhibitor concentration is 10(v/v)% solution. From these various required other concentrations are got by diluting this stock solution [7].

**Preparation of mild steel coupons**

Mild steel test coupons were prepared by cutting mild steel plate into pieces with dimension of 1.0 cm ×4.0 cm ×0.2 cm. The chemical composition 0.026 % sulphur, 0.06 % phosphorous, 0.4 % manganese, 0.1% carbon and the rest iron. Those specimens were then polished with emery paper. After polishing the specimens, rinsed them with distilled water, dried and sealed in zipper bag[8].

**Phytochemical Screening**

To identify the phytochemical constituents in plant extract the following chemical tests were carried out[9].

**Test for phenols and tannins**

MPLE was mixed with 2ml of 2% solution of $FeCl_3$. A blue-green or black coloration indicated the presence of phenols and tannins.

**Test for steroid**

MPLE was mixed with 2ml of chloroform. Then 2ml of each of concentrated $H_2SO_4$ and acetic acid were poured into the mixture. The development of a greenish coloration indicated the presence of steroids.

**Test for terpenoids**

MPLE was dissolved in 2ml of chloroform and evaporated to dryness. To this, 2ml of concentrated $H_2SO_4$ was added and heated for about 2 minutes. A greyish colour indicated the presence of terpenoids.

**Test for alkaloids**

MPLE was mixed with 2ml of 1% HCl and heated gently. Mayer's And Wagner's reagents were then added to the mixture. Turbidity of the resulting precipitate was taken as evidence for the presence of alkaloids.

**Test for protein**

MPLE when boiled with 2ml of 0.2% solution of Ninhydrin, violet colour appeared suggesting the presence of aminoacids and proteins.

**Weight – loss method**

Mild steel specimens were immersed in 1M of Concentrated $H_2SO_4$ in various Concentration of the inhibitor for one day. The Inhibition efficiency (IE%) was calculated using the equation,

$$\text{Inhibition Efficiency (IE \%)} = (1-W_1/W_2) \times 100$$

$$\text{Surface coverage } (\theta) = (1-W_1/W_2)$$

Where $W_1$ and $W_2$ are the weight loss for mild steel in the presence and absence of inhibitor.

**Determination of corrosion Rate**

The corrosion rate (CR) is directly proportional to the weight loss $cm^2$ in a specified time and calculated by this formula,

$$CR = (87.6 \times W) / DAT$$

Where,

W = weight loss in mg.

D = density of mild steel (7.86 g /$cm^2$ for mild steel),

A = Area in $cm^2$,

T = Exposure time in hours,

Trends of CR and IE are graphically evaluated.

**RESULTS AND DISCUSSION**

**Phytochemical studies**

Natural products are the richest of heterocyclic compounds having higher electron density[10]. The ethanolic extract of *Mimosa pudica* leaves (MPLE) was preliminarily screened for phytochemical constituents qualitatively as presented in Table 1. The symbol (+) represents presence of compounds in their ethanolic extract. The results showed in the Fig.2(a-b), shows the presence of tannins, phenols, alkaloids, protein, steroids. Chemical structures of most of the phytochemicals contain electron-rich bonds or heteroatoms which improve their electropositivity [11]. Therefore, the inhibition efficiency of ethanolic extract of *Mimosa pudica* leaves on mild steel can be related to the phytochemicals in the extract [12].

**Study of corrosion inhibition by weight loss method**

Table 2 represent the impact of the rate of corrosion of mild steel in 1M $H_2SO_4$ acid solution in different concentration of MPLE. The corrosion rate (CR) and inhibition efficiency (IE%) values were calculated using weight loss data for various concentration of inhibitor MPLE in 1M sulphuric acid medium. They are presented in Table 2.The rate of corrosion of the mild steel in acid decreases as the concentration of the extracts increases [13]. The values of weight loss reduce with increasing extract concentration. This reflects an increase in the spread of the adsorbed extract molecules, thereby forming a film-like barrier separating the surface of the metal from the acidic solution thereby limiting the corrosive effect [14]. Therefore, we can deduce that the ethanolic extract MPLE is effective in reducing corrosion of mild steel in acidic solution [15]. It is obvious that the IE increased with the increasing inhibitor concentration. This is explained the strong interaction of inhibitor molecule with the metal surface resulting in adsorption. The amount of

adsorption increases from 1.0 to 3.0 (v/v) % concentration of the Inhibitor leading to increased IE and decreased CR which is shown in Figure 3. This indicates the chemical components of the inhibitor are adsorbed on the metal surface. The resulting in the blocking of the reaction sites and protection from the attack of corrosion active ions in the medium [16]. The extent of weight loss in the presence of the inhibitor has found concentration dependent [17]. The maximum IE of 97% was observed at an inhibitor concentration of 3(v/v)% of 33.3ml of crude extract. Generally the inhibitor molecule suppresses the metal dissolution by forming a protective film adsorbed to the metal surface and separating it from the corrosion medium. The corrosion suppressing ability of the inhibitor molecule originates from the tendency to form either strong (or) weak chemical bond of Fe atoms. The lone pair of electrons present on the nitrogen atoms on the *Mimosa pudica* inhibitor. MPLE extract contains nitrogen atoms, which together provide this molecule greater adsorption and film-forming behaviour on the metallic substrate and appreciable anticorrosion behaviour [18].

**Figure 1: Leaves and flower of *M.Pudica* plant**

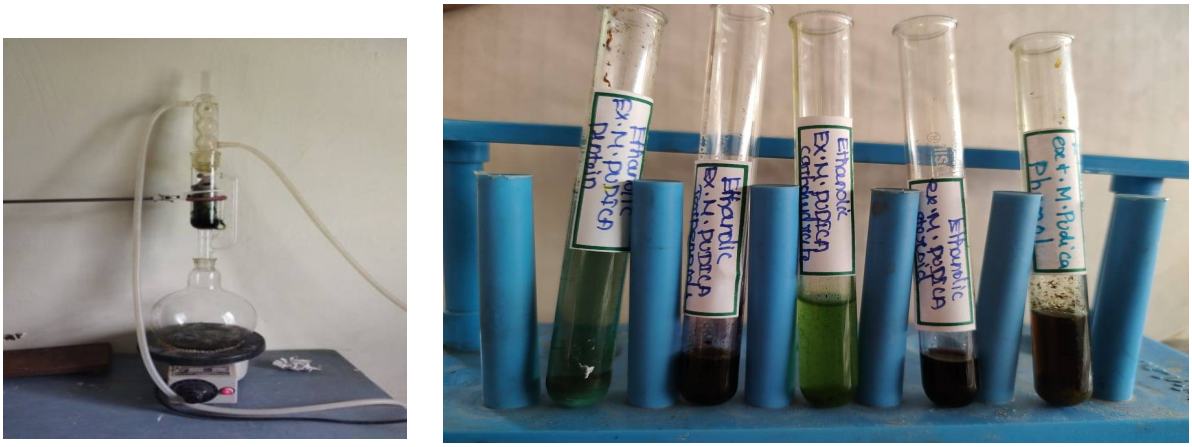

**Figure 2: a) soxhlet apparatus b)Phytochemical analysis**

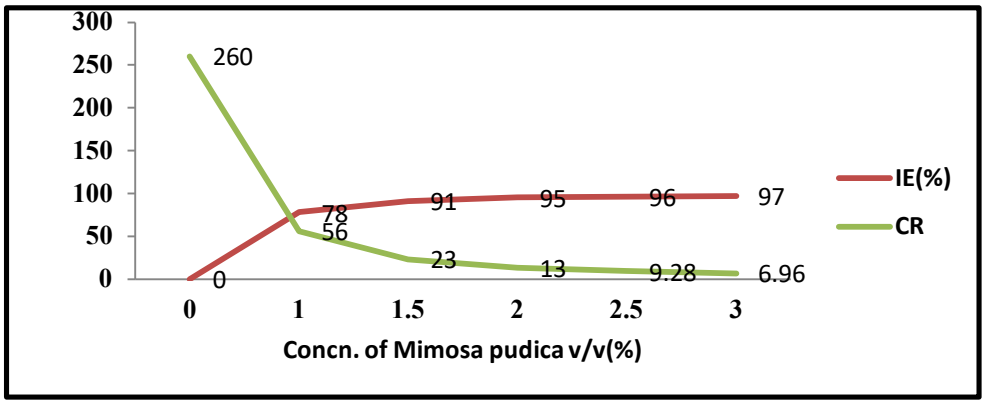


**Figure 3: IE and CR values of inhibitor *M. pudica* leave extract in 1M sulphuric acid**

**Table1: Phytochemical constituents of *M.pudica* leaf extract**

| S.no | Constituents | Ethanolic Extract |
|---|---|---|
| 1. | Tannins | +++ |
| 2 . | Protein | +++ |
| 3. | Alkaloids | +++ |
| 4. | Steroid | +++ |
| 5. | Phenols | +++ |
| 6. | Terpenoids | +++ |

**Table 2: Weight loss data for various concentration of inhibitor *M.pudica* leaf extract in 1M sulphuric acid medium.**

| Inhibitor (v/v)% | Weight Loss (g) | CR X $10^3$ (mmpy) | IE % | Surface Coverage(Ø) |
|---|---|---|---|---|
| 0 | 0.56 | 260 | - | - |
| 1 | 0.121 | 56 | 78 | 0.7839 |
| 1.5 | 0.05 | 23 | 91 | 0.9107 |
| 2 | 0.03 | 13 | 95 | 0.9464 |
| 2.5 | 0.02 | 9 | 96 | 0.9642 |
| 3 | 0.015 | 7 | 97 | 0.9732 |

## CONCLUSION

*M.pudica* leaves extract has been shown by the present study to be a good inhibitor for the corrosion. The ethanol extracts of *M.Pudica* was studied for its role as corrosion inhibitor due to the presence of certain compounds which characteristic to its inhibition properties. The CR was reported to be maximum in blank solution when there is no inhibitor to the corrosion process. While increasing the inhibitor concentration the inhibition efficiency also increased and corrosion rate decreased. The maximum Inhibitor efficiency for M.Pudica was found at room temperature.

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**CITATION OF THIS ARTICLE**

N.Kavitha, R. Krishna leela, S. Afrin. Effective Corrosion Inhibitive Nature Of *Mimosa pudica Leaves* Extract (MPLE) On Mild Steel In 1M Sulphuric Acid Media. Bull. Env.Pharmacol. Life Sci., Vol 13 [6] May 2024: 30-34