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CORROSION INHIBITION PERFORMANCE OF PINK, ORANGE AND WHITE COLOURED *BOUGAINVILLEA GLABRA* BRACT EXTRACT ON MILD STEEL IN 1N HCl

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ABSTRACT

The present study was undertaken to find out the phytochemicals present in *Bougainvillea glabra* bracts extract and to compare the corrosion inhibition efficiency between *B.glabra* Pink, Orange and White coloured bract extract on mild steel in 1N HCl. Phyto chemical analysis showed the presence of alkaloids, flavonoids, phenolic compounds and tannins in the extract as confirmed by implying different qualitative tests specified for these phytochemical. Corrosion rate, inhibition efficiency, FTIR analysis was determined. The corrosion of mild steel in 1N HCl acid media was significantly reduced upon the additions of BG bract extracts. The inhibition efficiency increased with the increasing concentration of the inhibitor. Maximum inhibition efficiency was observed at an optimum concentration of 2 % v/v.

Keywords: *Bougainvillea glabra* bract, hydrochloric acid, mild steel, weight loss, FTIR.

1. INTRODUCTION

Corrosion is a major problem that must be confronted for safety, environmental and economic reasons. The use of inhibitors is one of the most practical methods for protection against corrosion. The role of inhibitor is to form a barrier of one or several molecular layer against acid attack (Patel 2009). Protective action is often associated with chemical or physical adsorption involving in charge of, adsorbed substance and transfer of charge form one phase to another phase. Most of the efficient corrosion inhibitors used in industries is organic compounds having multiple bonds and hetero atoms like nitrogen, oxygen, sulphur, through which they are adsorbed on the metal surface. They function by interfering with either the anodic or cathodic reactions or both (Vinod Kumar *et al.,* 2010).

Mild steel is severely prone to corrosion in acid medium. Acid solutions are often used in industry for acidification of oil wells, cleaning of boilers, descaling and pickling of mild steel (Raja, 2008, 2009). All these processes are normally accompanied by considerable dissolution of metal. Looking at the increasing use of the metal, the study of corrosion inhibition is of paramount importance and hence several protective measures are being adopted (Putilova 1960). Rate of metallic corrosion can be reduced by the addition of inhibitors. Thus, in the present work mild steel was selected for corrosion inhibition studies.

This study aimed at using three differently coloured bract extracts to inhibit corrosion of mild steel in acidic medium. The inhibition efficiency of Pink, Orange, and White coloured *Bougainvillea galbra* bract extracts in 1N HCl on mild steel, at various inhibitor concentrations, various immersion periods using weight loss method and surface examination analysis by FTIR.

2. BOUGAINIVILLEA GLABRA

Plants have always been a part of medicinal science from the beginning of human civilization to the present modern world of synthetic medicines. Even in the presence of variety of effective synthetic drugs, use of medicinal plants for maintaining human health has acquired a lot of importance in the present era. There is a global interest in non-synthetic, natural drugs derived from plant sources, because of low cost, nontoxic nature and availability. Many plants with antioxidant potential possess flavonoids and phenolic compounds. Free radical reactions have been implicated in the pathology of many human disease including atherosclerosis, ischemic heart disease, the aging process, inflammation diabetes and other conditions. The research for medicinal plants discovered various common plants having distinguishable medicinal properties, among which one is *Bougainvillea glabra*. *Bougainvillea glabra* is an ornamental flowering plant from the genus of bougainvillea; family Nyctaginaceae and a native to Brazil. The genus bougainvillea has eighteen species, of which *B. spectabilis, B. glabra* and *B. Peruvian* are horticultural important. *Bougainvillea glabra* is a woody climber with thorny thin stems and long branches; also it has

papery bracts and smooth leaves, which grows to more than 10 meters of height (Bhaskara Rao *et al.,* 2015).

B. glabra is one that is great for container plantings and produce brilliant colours. The plant is perfect for arbors and draped long fences where it creates a security barrier by its thorns and twiggy growth. Body has itself antioxidant system, which reacts with reactive species and neutralizes them. This natural antioxidant system includes enzymes like catalase, superoxide dismutase and glutathione, which protect the body from free radical species and prevent oxidative stress. Synthetic antioxidant like butylated hydroxyl toluene and butylated hydroxyl anisole are carcinogenic in nature. So, there arises a need for natural antioxidant. The antioxidant activity of the hydroalcoholic, acetone extracts of the leaves have been evaluated for this plant (Mariajancyrani *et al.,* 2013). With this background, the aim of the present study was to determine the possible phytochemical with antioxidant activity of pink, white and orange coloured *Bougainvillea glabra* bract (Figure.1) for the corrosion studies.

Fig. 1. Pink orange and white coloured *Bougainvillea glabra* flower

3. MATERIALS AND METHODS

3.1. Charecterization of plant material

3.1.1. Collection of plant materials

The study was carried out on the pink, orange and white coloured *Bougainvillea glabra* bract extract. The flowers were obtained from Pillur dam, Coimbatore, India. The dried sample was ground into powder using an electronic blender sieved and the fine power was stored in air tight container. Figures 2-4, represents white colour *Bougainvillea glabra* bract powder, pink bract powder and orange bract powder respectively.

Fig. 2. White colour *Bougainvillea glabra* bract powder

Fig. 3. Pink colour *Bougainvillea glabra* bract powder

Fig. 4. Orange colour *Bougainvillea glabra* bract powder

3.1.2. Phytochemical screening

Each extract of *Bougainvillea glabra* bracts was subjected to preliminary photochemical screening to identify the chemical constituents of the plant. The methods of analysis were carried out using standard quantitative methods as described by various researchers Kotate (1999, 2010) and Harborne (1984, 1999).The samples were screened for the presence of bioactive compounds.

3.2. Corrosion studies

3.2.1. Preparation of the inhibitor

25g of dried powder bract was boiled in 500ml of 1N HCl acid with reflux condenser for three hours and was kept overnight to extract its phyto

nutrients (Fig. 5). The extract was filtered and the filtrate volume was made up to 500ml using the 1N HCl acid. The extract so prepared was taken as 5% stock solution and from this other concentration were prepared in similar manner (Rekha, 2010).

Fig. 5. Photograph of experiment set up for obtaining extract using reflex condenser

3.3.2. Corrosion monitoring techniques

The influence of the inhibition on the dissolution of mild steel in acid media was monitored chemically by weight loss method. Rectangular mild steel coupons of size 5x1x0.2cm were cut from a large sheet of mild steel, with a small hole of about 1.0mm diameter near the 1.5cm side end for suspending. The specimens were polished in sequence using silicon carbide emery papers of grade 200, 400, 600 starting with coarse one and proceeding in steps to the finest grade, then washed with distilled water dried with clean tissue paper, degreased with acetone and dried using hot air drier. The specimens were then kept in desiccators to avoid the adsorption of moisture (Hegazy *et al.,* 2011). Weight loss studies were conducted at room temperature. Mild steel specimens were weighed accurately in electronic balance (SHIMADZU model AUW 220D). After initial weighing, the specimens were fully immersed using glass hooks in beakers containing 100 ml of 1N HCl without and with inhibitor of different concentration at various intervals of time. After the specified period of immersion, the specimens were removed, washed with distilled water, dried and reweighed. The loss in weight was determined. The corrosion rate and inhibition efficiency was calculated from weight loss.

4. RESULTS AND DISCUSSION

The results of the phytochemical analysis, inhibition efficiency and surface analysis by FTIR and performance of pink, orange and white colour *Bougainvillea glabra* bracts in 1N HCl as inhibitors of corrosion for mild steel was compared.

4.1. Qualitative phytochemical analysis

Bougainvillea is a tropical and subtropical woody, evergreen, shrubby vine. The true, perfect bract is small, tubular, commonly white, pink, and orange surrounded by showy, vibrantly colourful petaloid bracts**.** Bracts many retain their colour for several months after the bracts have finished, gradually fading to resemble the colour and texture of paper.

Plants have always been a part of medicinal science from the beginning of human civilization to the present modern world of synthetic medicines. The research for medicinal plants discovered various common plants having distinguishable medicinal properties, among which one is *Bougainvillea glabra* (Farzana Rashid, 2013). With this background, the aim of the present study was to determine the possible phytochemical. The qualitative analysis of pink, orange and white *Bougainvillea* bracts extract showed the presence of reducing sugars, alkaloids, saponins, tannins, flavonoids, terpenoids, cycloglycosides, total phenols and sterols. (Table 1).

Table 1. Phytochemical compounds present in white, pink, orange *Bougainvillea glabra* bract extract Analysis

Phyto compounds	BG [white]	BG [pink]	BG [orange]
Carbohydrates	-	-	-
Reducing sugar	++	++	++
Alkaloids	+++	+++	+++
Saponins	-	-	-
Tannins	++	++	++
Flavonoids	+	+	+
Terpenoids	+	+	+
Phlobatannins	-	-	-
Coumarins	-	-	-
Cycloglycoside	++	+	+
Total Phenol	+++	++	++
Quinones	-	-	-
Anthraquinones	-	-	-
Sterols	+	+	+

Key words: '+++' Active compound copiously present, '++' Active moderately present, '+' Active compound present , '–' Active compound absent.

Table 2. Effect of concentration of P.B.G extract on corrosion of mild steel 1N HCl solution.

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	78.37	85.75	89.50	94.35	78.28
0.5	83.78	91.20	92.81	94.98	86.28
1.0	87.11	92.30	93.75	95.02	87.80
1.5	89.18	93.12	94.15	95.92	88.38
2.0	91.89	94.50	94.79	96.98	89.14
2.5	94.59	95.60	95.83	97.17	92.38

Table 3. Effect of concentration of O.B.G extract on corrosion of mild steel in 1N HCl solution

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	58.82	60.56	61.84	68.88	55.42
0.5	64.70	71.50	80.26	92.00	70.28
1.0	70.58	83.39	90.13	93.81	71.88
1.5	76.47	84.33	93.42	95.27	74.29
2.0	82.35	85.28	95.28	96.00	76.30
2.5	88.23	95.39	96.22	97.09	81.92

4.2. Weight loss method

Mild steel was found to corrode in 1N HCl acid solution. This was evidenced by the decrease in the original weight of the metal exposed to acid solution. On the addition of bract extract to the acids, it was found that the weight loss decreases with increase in concentration from 0.1 to 2.5 % v/v due to the adsorption of bracts nutrient which protects the metal surface from dissolution (Shymala Arulanantham, 2009), (Loto, 2011, 2012).

The maximum IE of 97.17% and 97.09% was noticed at 2.5 % v/v concentration of the inhibitor in 1N HCl for 7 h immersion period of mild steel for P.B.G and O.B.G respectively, a maximum IE of 99.33% was observed at 2.5% v/v concentration of W.B.G extract in 1N HCl for 5 h immersion period of mild steel. The inhibitor efficiency BG bract extract increased with an increase in the immersion time, since more adsorption takes place on the metal surface (Saratha and Vasudha, 2009).

4.3. FTIR analysis

FTIR spectra of mild steel treated with 1N HCl with BG bract extracts are displayed in Figure. 6 - 8, showed either a decrease in the transmittance or disappearance of some bands, giving a strong evidence for the functional groups such as OH, NH_2 and C=O leading to the formation of film of large surface coverage which serve as a barrier between the corrosive acid medium and the metal thereby inhibiting corrosion and also revealing the fact that *Bougainvillea glabra* bract extracts nutrients can adsorb on the metal surface on the basis of donor-acceptor interactions between lone-pair electrons of N and the vacant d-orbital of Fe substrate (Deng 2011, Harajothi Mazumdar, 2010a, b).

Table 4. Effect of concentration of W.B.G extract on corrosion of mild steel in 1N HCl solution

Conc. of extract (v/v)%	Inhibition efficiency (IE %)				
	1h	3h	5h	7h	24h
0.1	75.50	95.53	82.70	83.49	73.02
0.5	82.20	96.65	88.30	89.15	86.51
1.0	91.10	97.54	88.80	90.56	87.72
1.5	93.30	97.67	90.00	92.45	88.33
2.0	95.50	98.66	91.60	95.28	89.91
2.5	97.70	99.33	94.40	96.22	91.25

Table 5. Comparison of inhibition efficiency of the B.G bract extracts (pink, orange, and white) in 1N HCl on mild steel.

Conc. of extract (v/v %)	P/O/W B.G.B I.E (%)														
	1h			3h			5h			7h			24h		
	P	O	W	P	O	W	P	O	W	P	O	W	P	O	W
0.1	78	59	76	86	61	96	90	62	83	94	69	84	78	55	73
0.5	84	65	82	91	72	97	93	80	88	95	92	89	86	70	87
1.0	87	71	91	92	83	98	94	90	89	95	94	91	88	72	88
1.5	89	77	93	93	84	98	94	93	90	96	95	93	88	74	88
2.0	92	82	96	95	85	99	95	95	92	97	96	95	89	76	90
2.5	95	88	98	96	95	99	96	96	94	97	97	96	92	82	91

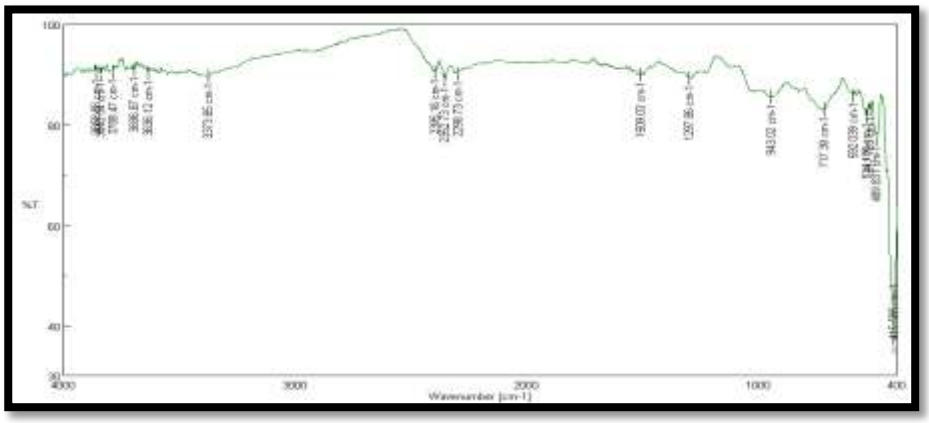

Fig. 6. FTIR spectrums for white colour B.G bract extract

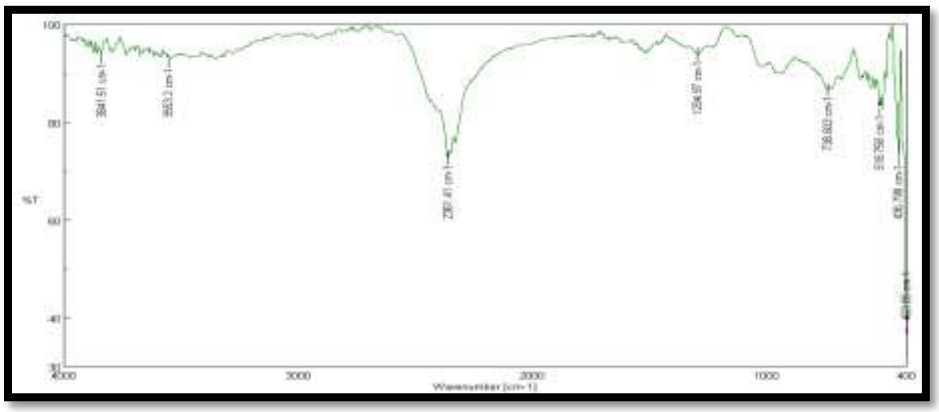

Fig. 7. FTIR spectrums for orange colour B.G bract extract

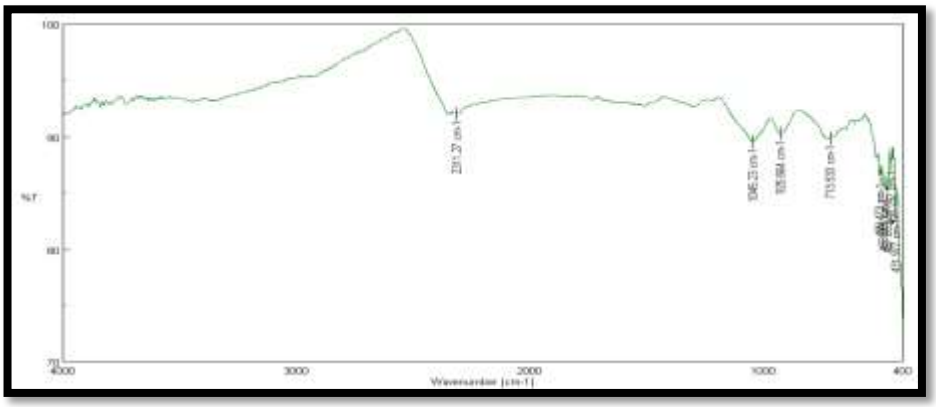

Fig. 8. FTIR spectrum for pink colour B.G bract extract

5. CONCLUSION

The corrosion rate of mild steel was monitored in 1N HCl medium at various concentrations of pink / orange / white *Bougainvillea glabra* bract extracts. Phytochemical analysis, weight loss and FTIR were employed in the present investigation. The following are the conclusions,

- The qualitative analysis of pink, orange and white *Bougainvillea* bracts extracts showed the presence of reducing sugar, alkaloids, saponins, tannins, flavonoids, terpenoids, cycloglycoside, total phenols, and sterols.
- The corrosion of mild steel in the HCl acid medium was significantly reduced upon the additions of BG bract extracts. The inhibition efficiency increased with the increasing

concentration of inhibitor. The maximum inhibition efficiency was observed at an optimum concentration of 2 %

- Maximum efficiency of 97.17%, 97.09 % and 99.33% was exhibited by P.B.G, O.B.G and W.B.G bract extracts in 1N HCl on mild steel 2.5 % v/v concentration respectively.

- Among the three coloured *Bougainvillea glabra bract* extracts (pink/orange/white) P.B.G and O.B.G showed maximum inhibition efficiency at 2.5% v/v for 7 hours of immersion. While W.B.G showed a maximum efficiency up to only 3 hours of immersion.

- FTIR analysis reveals that B.G pink, orange and white bract extracts contain possible function group for corrosion inhibition.

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