

Corrosion Inhibition Potentials Of *Brassica Oleracea Capitata* Extract On Mild Steel And Zinc In Acidic Media.

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Abstract.
Recently, investigations have been made into the inhibition properties of natural plants so as to find alternatives to synthetic inhibitors. In order to contribute the contemporary interests, the inhibition action of *Brassica oleracea capitata* extract on mild Steel and Zinc corrosion in 2.0M H_2S0_4 solution was studied using weight loss technique. The results obtained indicated that as the concentration of *Brassica oleracea capitata* extract increased, the corrosion rate of the metals specimens decreased. Inhibition efficiency was found to increase with *Brassica oleracea capitata* concentration. The result showed that optimum inhibition efficiency (IE) for mild steel and Zinc were 97.1% and 91.3% respectively at 50ml volume of the extract. However, *Brassica oleracea capitata* extract could serve as one of the alternatives to synthetic corrosion inhibitors.
Key words: Corrosion, extract, inhibition, Brassica

1.0 Introduction.

Brassica oleracea capitata is one of the most economically important members of the genus Brassica. It is a biennial or perennial herb, 250cm tall with more or less woody stem. The leaves are fleshy, hairless, lobed, blue green leaves. It contains among others phyto chemical compounds glucosinolates which possess corrosion inhibitive properties (Radojcic 2008).

The corrosion of materials especially metals has been a major industrial problem which had attracted a lot of concern among engineers and scientists who are committed to the study, monitor and control of corrosion (Chandara et al;2013). The use of inhibitors is one of the most practical methods for protective metals against corrosion especially in acidic media (Trabanelli.2001). During the past decades, some commercial inhibitors have been synthesized and successfully used to inhibit corrosion of metals. However, major problems associated with most synthetic inhibitors are that they are not environmental friendly, they are expensive and toxic. Therefore, the study of new non toxic and eco-friendly corrosion inhibitors is essential to overcome these problems (Nnanna et al 2013).

Plant extract are of low cost, ecologically acceptable, readily available, renewable corrosion inhibitors especially in acidic media (Ebensa 2012). Plant extract are usually referred to as organic inhibitors which protect the metals by forming a hydrophobic film on the metal surface. Their effectiveness depends on the chemical composition, molecular structures and their affinities for the metal surface (Oforka 2004).

In this work, the corrosion inhibition potentials of *Brassica oleracea capitata* extract on mild steel and Zinc in an acidic medium would be assayed.

2.0 Methods

2.1 Preparation of the extract

Brassica oleracea capitata were obtained from Afor Egbu market in Uli Anambra state. They were cut into pieces, ground using an electric blender. The ground mix was squeezed to obtain the liquid extract, then filtered using muslin. 500ml of the stock solution was stored in a plastic bottle and 5ml of ethanol was used to preserve the extract.

2.2 Preparation of metal specimens

Zinc and mild Steel sheets were cut into 5*4cm and 4*3cm dimensions respectively suitable for the experiment. A hole was drilled on each plate. Zinc plates were used without further polishing while mild steel plates were washed with HCl to remove rust. Further surface treatment involved degreasing in acetone and drying in an electric oven. Both metals were stored in a desiccators till the time for corrosion study.

2.3 Experimental Procedure

Five different volumes of the liquid extract(50ml, 40ml, 30ml, 20ml and 10ml) were poured into five different plastic bowls containing 100ml of 2M H_2SO_4 each. The sixth plastic bowl had 100ml of 2MH_2SO_4 but no extract (serve as control). The above set up was prepared in two batches each for a particular metal specimen.

Weight loss measurement

The metals were first weighed using an electronic weighing balance and recorded as their initial weight before being immersed into the plastic bowls containing the corrosive media. The metals were tied in triplets using a twine to a smooth stick for easy removal. The immersion period was two days (48 hours) after which the metals were removed, washed with distilled water, and dried before reweighing to obtain the remnant weight. This procedure was carried out for 8days after which four readings were obtained for each metal. The weight loss within the immersion period was taken as the difference between the initial weight prior to immersion and the remnant weight after immersion.
Calculation of Corrosion rate.
From the weight loss measurement, the corrosion rate was calculated using the equation (Akaranta et al 2009)

$$\text{Corrosion rate} = \frac{87.6 * W}{D * A * T}$$

Where mmpy = millimetre per year
W= weight loss (mg)
D= density (g/cm)
A= area of specimen (cm3)
T=time in hours.
Calculation of inhibition efficiency
The inhibition was calculated using the relationship (Akaranta et al 2009)

$$\% \text{ I.E} = \frac{W_1-W_2}{W_1} * 100$$

W_1= corrosion rate in the absence of inhibitor.
W_2= corrosion rate in the presence of inhibitor.

3.0 Discussion.
The weight loss of the two metal specimens (mild Steel and Zinc) in acidic environment (2M H_2SO_4) containing various volumes of *Brassica oleracea capitata* extract were studied at different times(48 hours to 192 hours) as shown in tables 1 and 2 respectively. From the results more weight losses were recorded for the test solutions without the inhibitor (control) and there were remarkable reduction in weight losses for the test solution with inhibitor (extract) which signified corrosion inhibition. The degree of weight loss was found to be dependent on the concentration of the extract (inhibitor), as the concentration of the extract increased from 10ml to 50ml the weight losses of the metals decreased. However, the weight losses of the two metals specimens were found to increase with increase in immersion time. Comparing the weight losses in the two metals (Zinc and mild Steel) it was observed that Zinc recorded higher weight loss than mild Steel.
Tables 4 and 5 showed the corrosion rate of the two metals specimens (mild Steel and Zinc) respectively. The results showed that the control experiment (medium without the extract) recorded higher corrosion rate than the inhibited environment revealing that *Brassica oleracea capitata* extract inhibits corrosion. The corrosion rate of the two metals specimens decreased with increase in the concentration of the extract. Also the corrosion rate decreased gradually with immersion time, which could be attributed to the formation of an oxide film of the inhibitor on the surface of the metal specimens creating a barrier between the metals specimens and the acidic environment thus reducing corrosion rate. (Anuradha 2008). However, Zinc recorded a higher corrosion rate in 2M H_2SO_4 solution than mild steel.
The percentage inhibition efficiency (I.E) of the two metals (mild Steel and Zinc) are shown in tables 6 and 7 respectively. It was observed that inhibition efficiency increased with increase in concentration of the extract

(inhibitor) and decreased with increase in immersion time, that is inhibition efficiency is directly proportional to concentration of the extract and inversely proportional to the immersion time.

4.0 Conclusion

Conclusively, the optimum inhibition efficiency of 97.1% for mild Steel and 91.35% for Zinc showed that *Brassica oleracea capitata* extract could serve competitively with synthetic inhibitors as corrosion inhibitor for mild Steel and Zinc in acidic media.

Table1: Properties of metal specimens.

Metal specimen	Density (g/cm^3)	Area (cm^3)
Mild Steel	7.85	24
Zinc	7.14	40

Table 2: Weight of mild steel specimen in different volume of *Brassica oleracea capitata* extract on 2M H_2SO_4 at different time interval.

Volume of extract (ml)	Volume of 2.0M H_2SO_4(ml)	Initial weight of metal (g) ()specimens (g)	Final weight of metal specimens (g)			
			48 hrs	96 hrs	144 hrs	192 hrs
0	100	17.2	6.84	6.79	6.68	6.65
10	100	17.0	14.72	12.27	10.93	9.73
20	100	17.4	16.58	15.48	14.94	13.77
30	100	17.6	16.92	16.03	15.57	14.94
40	100	17.9	17.58	16.88	16.80	16.65
50	100	17.4	17.19	16.87	16.72	16.63

Table 3: Weight of Zinc specimen indifferent concentration of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time intervals.

Volume of Extract (ml)	Volume of 2.0M H_2SO_4(ml)	initial weight of metal specimens (g)	Final weight of metal specimens (g)			
			48 hrs	96 hrs	144 hrs	196 hrs
0	100	5.37	-	-	-	-
10	100	5.49	3.90	1.22	-	-
20	100	5.82	5.22	4.58	3.42	2.46
30	100	5.76	5.09	4.50	3.55	2.74
40	100	5.39	4.83	4.65	4.51	4.50
50	100	5.24	4.75	4.77	4.46	4.09

Table 4. Weight loss of mild steel specimen in different volumes of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time interval.

Volume of extract(ml)	Weight loss(mg) Weight loss (g)			
	48 hrs	96 hrs	144 hrs	196 hrs
0	10.36	10.36	10.52	10.55
10	2.28	4.73	6.07	7.27
20	0.82	1.92	2.46	3.63
30	0.68	1.57	2.03	2.66
40	0.32	1.02	1.10	1.25
50	0.21	0.53	0.68	0.77

Table 5. Weight loss of Zinc specimen in different volumes of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time interval.

Volume of extract (ml)	Weight loss(mg) Weight of loss (g)			
	48 hrs	96 hrs	144 hrs	196 hrs
0	5.37	5.37	5.37	5.37
10	0.99	1.90	2.40	2.98
20	0.60	1.24	2.40	3.36
30	0.67	1.26	2.21	3.02
40	0.56	0.74	0.88	1.34
50	0.49	0.47	0.78	1.15

Table 6. Corrosion rate of mild steel specimen in different volumes of brassica oleracea capitata extract in 2M H_2SO_4 at different time interval.

Volume of extract (ml)	Corrosion rate(mmpy) (10^{-3})			
	48 hrs	96 hrs	144 hrs	196 hrs
0	100.36	50.42	33.94	25.55
10	22.08	22.91	19.31	17.60
20	7.94	9.30	7.94	8.74
30	6.59	7.60	5.91	6.44
40	3.10	4.94	3.55	3.03
50	2.03	2.57	2.20	1.86

Table7. Corrosion rate of Zinc specimen in different volumes of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time interval.

Volume of extract (ml)	Corrosion rate (mmpy) (10^{-3})			
	48 hrs	96 hrs	144hrs	196 hrs
0	34.31	17.16	11.43	8.58
10	10.16	13.64	11.69	8.77
20	3.83	3.94	5.11	5.37
30	4.28	4.03	4.71	4.82
40	3.58	2.36	1.87	2.14
50	3.13	1.50	1.66	1.83

Table8. Percentage Inhibition efficiency of mild Steel specimen in different volumes of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time interval.

Volume of extract(ml)	Inhibition efficiency (%)			
	48 hrs	96 hrs	144 hrs	196 hrs
10	77.1	54.6	42.3	31.1
20	92.1	81.6	79.6	65.6
30	93.4	84.9	85.6	74.8
40	96.9	90.2	89.5	88.1
50	97.1	94.9	93.5	92.7

Table 9. Percentage Inhibition efficiency of Zinc specimen in different volumes of *Brassica oleracea capitata* extract in 2M H_2SO_4 at different time interval.

Volume of extract(ml)	Inhibition efficiency (%)			
	48 hrs	96 hrs	144 hrs	196 hrs
10	70.3	20.9	2.6	2.21
20	88.8	76.1	55.2	37.4
30	87.5	76.6	58.7	43.8
40	89.6	86.3	83.6	75.1
50	90.9	91.3	85.4	78.7

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