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Synthesis Pyrazine Compound Derivative from Benzoin Compounds as Environmentally Friendly and Corrosion Inhibitors for Steel

Teba moayad Nahma

Ministry of Education / Diwaniyal Eduction Directorate

Email.teebamouyad@gmail.com

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Abstract:

In this paper the preparation of pyrazine componds derived from homogenous and non homogenous benzoin by degradetion process of x-amino acid alanine with benzoin compounds by the fusion the mixture was then heated in an oil bath 15 min, After the carbon dioxide and ammonia had evolution stopped crystallized by ethanol. the pyrazine compounds inhibitive effrcay of environmental friendly and other importent Biological Activity and Applications dives applications such as organic photovattard and organic light emitting, pyrazine compounds on the corrosion of steel in 0.5M HCl inhibitor is based on its planear structur that can esitty easily adsorbs on metal surface by the two pyrazine derivatives.

key words: pyrazines, carbon steel, hydrochloric acid, corrosion inhibitors, benzoin.

1- Introduction.

It was reported on the effectiveness of five pyrazines derivative 2,5-dimethyl amino-3,6-diphenyl pyrazine and 2,5-dimethyl amino-3,6-di-p-chlorophenyl pyrazine with a view to study its inhibiting properties on corrosion of steel in 0.5M HCl in the range 298-353 K. pyrazine are considered (considered) as important class of heterocyclic compound, it contains two nitrogen atoms at position 1,4 which increases its biological activity that includes neurodegenerative, cardiovascular, antimicrobial and anti-neoplastic, it is also used in manufacture of polymers, photovoltaic and corrosion inhibitor because it contains (π) bonds and two nitrogen atoms give good results inhibitors of metal corrosion.

2- Experimental

2-1 Inhibitors

The pyrazine compound was synthesised from benzoins purified and characterised by melting poind, IR, 1H NMR and 13C NMR spectroscopies and element analysis before use.

2-2 Synthese is of tetra substited pyrazine

prepared by mixing benzoin with α-alanin at ratio 0.01 mole than fusion by using in oil bathe until CO_2 and NH_3 were removed added ethanol refluxed after that solution cold and crystallization by ethanol.

3-2 Measuring corrosion intake for weight loos and Electro chemical

Table(1): chemical composition of steel used for the experiment

Element	C%	Si%	Mn%	P%	S%	Cr%	Ni%	Cu%	Al%	Fe
w%	0.0664	0.0042	0.367	0.0047	0.0077	0.0063	0.0325	0.044	0.0042	Bal

Steel coupons were sectioned into uniform dimensions of 4 × 4 cm. Surface preparation involved meticulous rinsing with distilled water, followed by ultrasonic cleaning in an ethanol bath to eliminate surface impurities. The specimens were subsequently air-dried before experimental immersion. Corrosive media of 0.5M HCl were prepared by diluting analytical-grade hydrochloric acid (37%) with distilled water. Stock solutions of the synthesized inhibitors were subsequently formulated within the acidic medium to achieve working concentrations of 250, 500, and 1000 ppm. The initial masses of the tested steel specimens were precisely recorded as 0.65 g and 0.57 g.

4-2 weight logs test

An image was taken of the steel pieces usings an electron microscope SEM before the corrosion and the weight was calculated befor corrosion (Wo). Then the steel pieces are placed in a solution 0.5 HCl for a period of time (6h, 12h, 21h) and temperature 27 C.

Eq.(1): $\Delta W = Wo - Wcorr$

where w is weight loss (g), A is surface area exposed (cm^2), T is exposure time (h), D is density (g/cm^3), K constant value (3.45×10^6) is calculated rate of corrosion by mils per year (mpy).eg

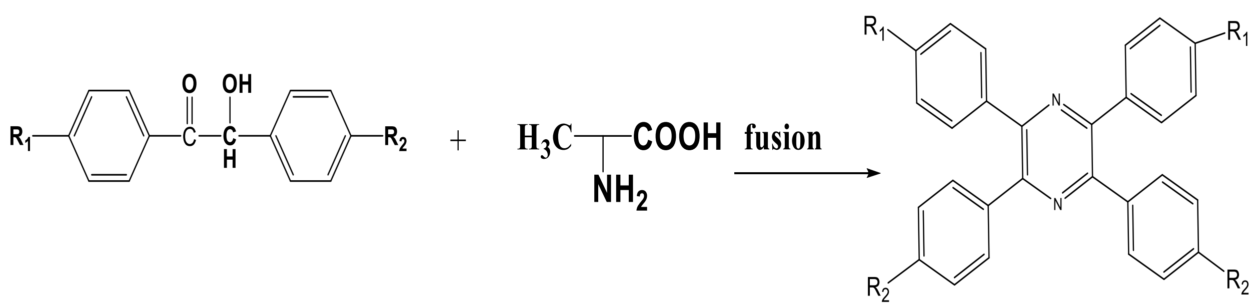
$$\text{Eq.(2): } CR(mpy) = K * \frac{\Delta W}{D} / D * A * T$$

$$\text{Eq.(3): } (\%\ IE) = \left(\frac{\Delta W_o - \Delta W_{inh}}{\Delta W_o}\right) * 100$$

$$\text{Eq.(4): } (\%\ IE) = \left(\frac{CR_o - CR_{inh}}{CR_o}\right) * 100$$

3- Results and discussion

several pyrazine compounds were prepared by degradetion x-amino acid alanine with alanine (scheme 1).



(scheme 1)

R_1= H , $N(CH_3)_2$, Cl , CH_3

R_2= H , CH_3 , Cl

The new pyrazine compounds characterized by melting point, FTIR, 1H NMR, 13C NMR spectral.

FTIR disappearance (OH) group and (C=O) group in 3500 cm^{-1} and 1730 cm^{-1} appear anew group of pyrazine C(C=N) in 1630, CH aromatic (3056 cm^{-1}) and CH alphatic (2989 – 2827 cm^{-1}).

The 1H-NMR and 13C NMR spectrum of pyrazine compounds:

A1 - 2,3,5,6-tetra phenyl pyrazine

1H-NMR (DMSO-d6): in ppm 7.4 - 7.8 of aromatic ring.

13C NMR (DMSO-d6): in ppm 125 - 134 C=C aromatic ring and 152 (C=N).

A2 - 2,3,5,6-tetra tolyl pyrazine

1H-NMR (DMSO-d6): 0.8 (CH_3), 7.25-7.30 (aromatic ring)

13C-NMR (DMSO-d6): 35 (CH_3), 125-134 (C=C aromatic), 153 (C=N)

A3 - 2,5-dimethyl amino-3,6-diphenyl pyrazine

1H-NMR (DMSO-d6): 3.4 N(CH_3)2, 7.5-7.9 (C=C aromatic)

13C-NMR (DMSO-d6): 55 N(CH_3)2, 128-135 (C=C aromatic), 153 (C=N)

A4 - 2,5-dimethyl amino-3,6-di-p-chlorophenyl pyrazine

1H-NMR (DMSO-d6): 3.5 N(CH_3)2, 7.3-7.7 (C=C aromatic)

13C-NMR (DMSO-d6): 56 N(CH_3)2, 127-132 (C=C aromatic), 137 (C-Cl), 152 (C=N)

A5 - 2,3,5,6-tetra-p-chlorophenyl pyrazine

NMR: 7.3-7.8 (C=C aromatic), 137 ppm (C-Cl), 152 ppm (C=N)

The physical corrosion study was then conducted to evaluate the alloy's to corrosion without and with different pyrazines **A3, A4** in an acidic medium at room temperature use weight loss methods results as presented in table 2 and 3.

We observe that the rate of corrosion in an acidic medium increases without the highest corrosion occurring during the (12 h). After that the rate of corrosion decreases because a film form on the alloy surface hindering the corrosion process. Adding inhibitors sequentially leads to decrease in corrosion as shown in the table 2 and 3.

Table (2): Electrochemical parameters of steel in 0.5M HCl without and with pyrazine A3

Conc. of inhib (ppm)	6 h (CR mpy)	6 h (%IE)	12 h (CR mpy)	12 h (%IE)	24 h (CR mpy)	24 h (%IE)
Blank	58	-	145	-	78.7	-
1000	26.5	55.3	92.7	33.27	16.55	84.32
500	36.25	34.4	117.7	15.9	26.15	66.7
250	47.39	21.33	125.63	10.97	36.62	51.91

Table (3): pyrazine A4 at various concentration

Conc. of inhib (ppm)	6 h (CR mpy)	6 h (%IE)	12 h (CR mpy)	12 h (%IE)	24 h (CR mpy)	24 h (%IE)
Blank	42.24	-	124.12	-	-	-
1000	42.24	21.9	18.56	18.7	54.7	30.26
500	52.77	8.27	129.5	7.17	69.4	23.32
250	71.33	13.29	137.05	1.4	73.9	17.81

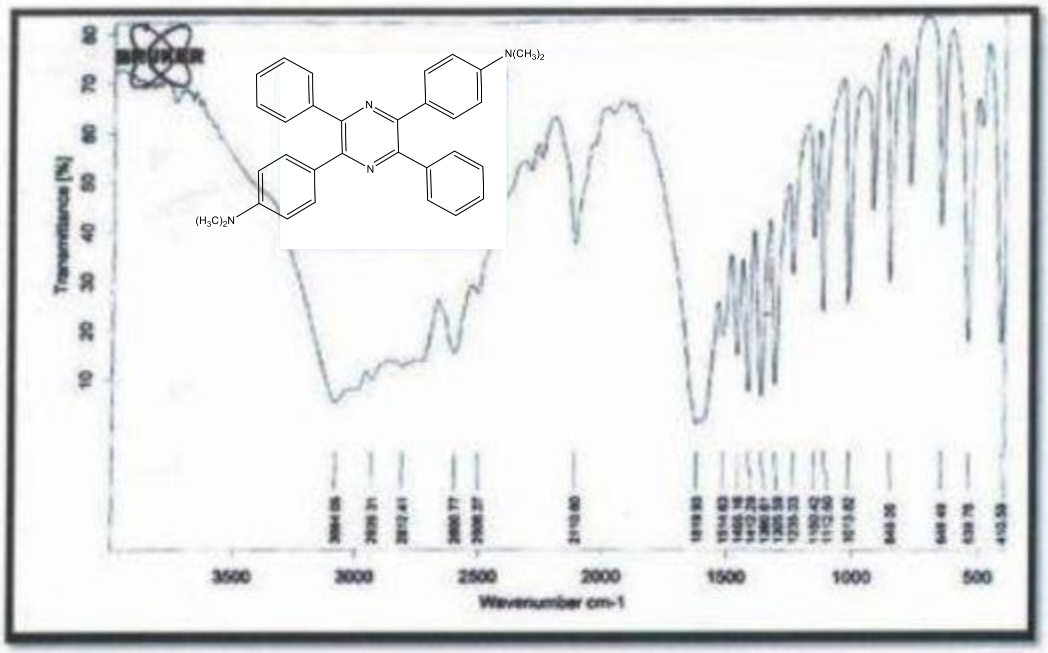
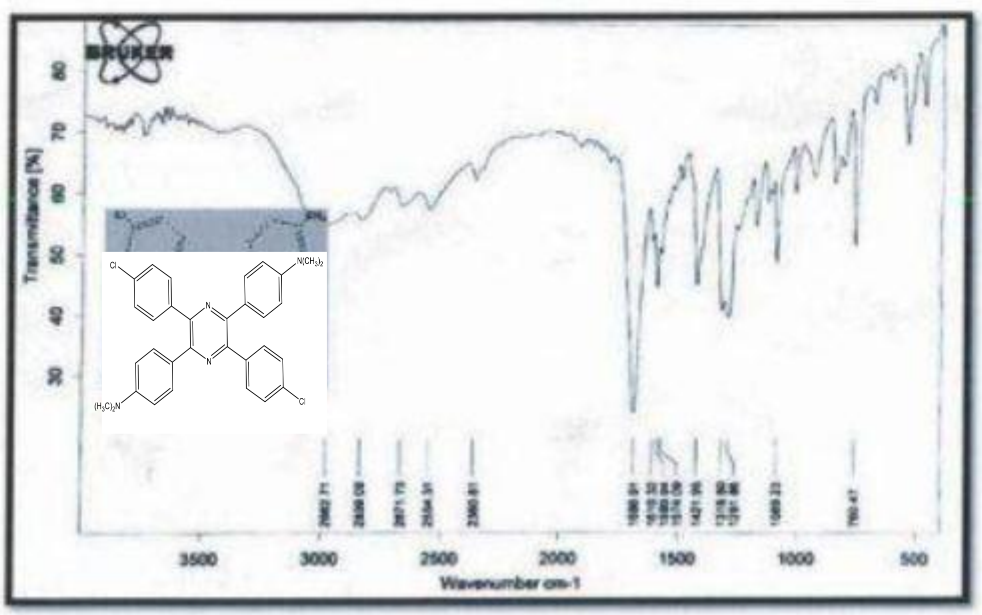
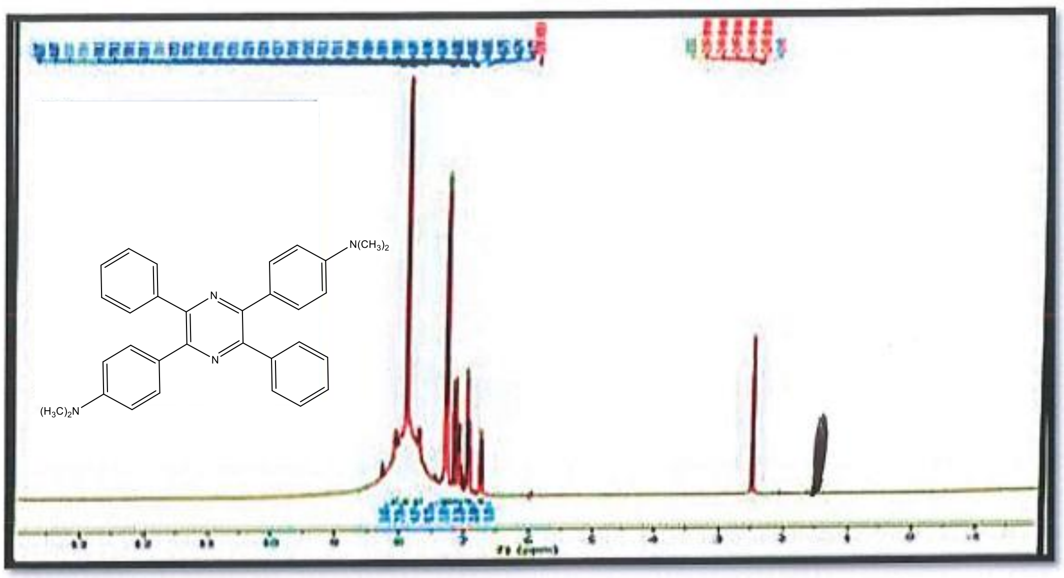

BRUKER
Transmittance [%]
Wavenumber cm-1
N(CH3)2
(H3C)2N
N
N
3500
3000
2500
2000
1500
1000
500

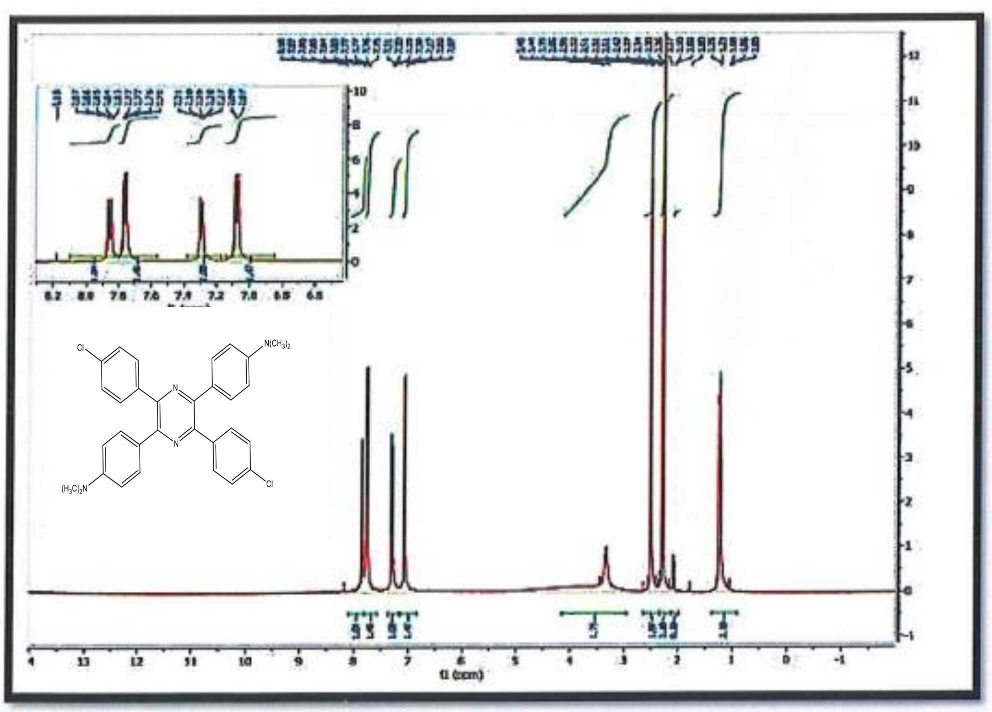
Fig (1)


BRUKER
Transmittance [%]
Wavenumber cm-1
Cl
N(CH3)2
(H3C)2N
N
N
3500
3000
2500
2000
1500
1000
500

Fig(2)



Fig(3)



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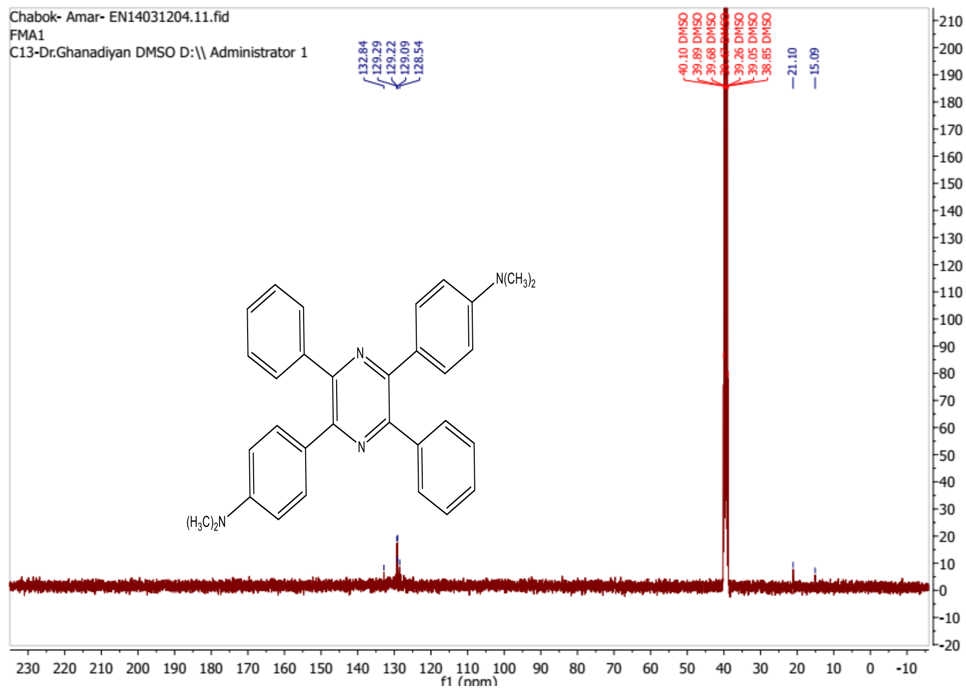
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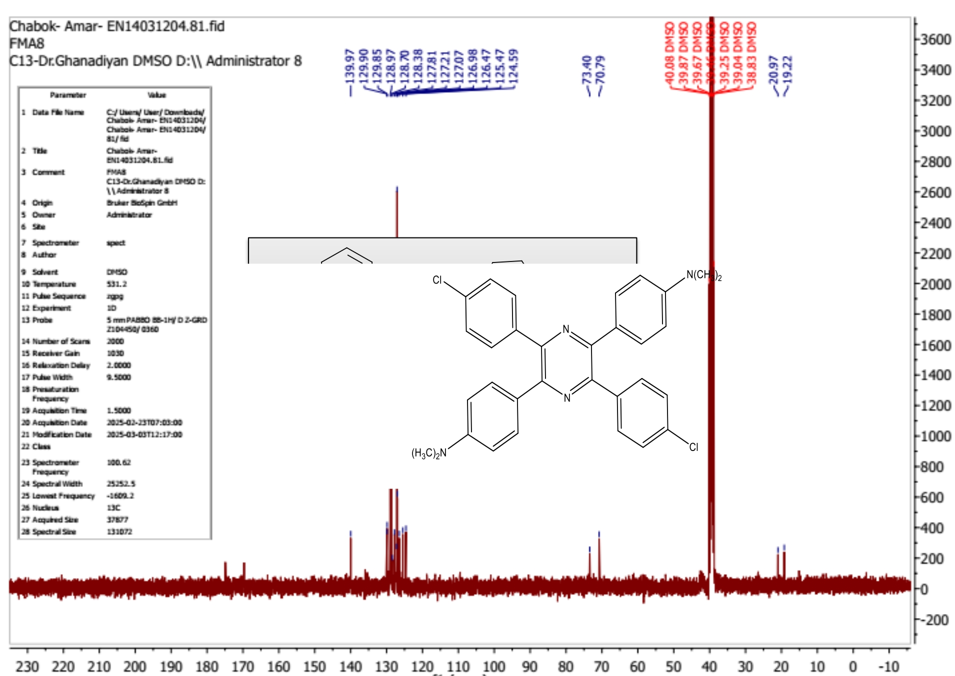
FMA1
C13-Dr.Ghanadiyan DMSO D:\\ Administrator 1
132.84
129.29
129.22
129.09
128.54
40.10 DMSO
39.89 DMSO
39.68 DMSO
39.26 DMSO
39.05 DMSO
38.85 DMSO
21.10
15.09
N(CH3)2
(H3C)2N
N
N
f1 (ppm)

Fig(5)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C13-Dr.Ghanadiyan DMSO D:\\ Administrator 8
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5 Owner Administrator
6 Site
7 Spectrometer spect
8 Author
9 Solvent DMSO
10 Temperature 531.2
11 Pulse Sequence zgpg
12 Experiment 1D
13 Probe 5 mm PABBO BB-1H/ D Z-GRD Z104450/ 0360
14 Number of Scans 2000
15 Receiver Gain 1030
16 Relaxation Delay 2.0000
17 Pulse Width 9.5000
18 Presaturation Frequency
19 Acquisition Time 1.5000
20 Acquisition Date 2025-02-23T07:03:00
21 Modification Date 2025-03-03T12:17:00
22 Class
23 Spectrometer Frequency 100.62
24 Spectral Width 25252.5
25 Lowest Frequency -1609.2
26 Nucleus 13C
27 Acquired Size 37877
28 Spectral Size 131072
139.97
129.90
129.85
128.97
128.70
128.38
127.81
127.21
127.07
126.98
126.47
125.47
124.59
73.40
70.79
40.08 DMSO
39.87 DMSO
39.67 DMSO
39.25 DMSO
39.04 DMSO
38.83 DMSO
20.97
19.22
Cl
N
N
(H3C)2N
Cl
f1 (ppm)

Fig(6)

Fig(7)

fig(8)

fig(9)

Fig(10)

5- Conclusion

a- the two pyrazine derivative investigate as effective corrosion inhibitors on steel in 0.5 HCl.

b- the presence of C=N, N(CH3)2, C=C and aromatic ring provide active sites for inhibitors interaction with surface of the metal.

c- Electro chemical and weight loss indicate the two pyrazine derivative.

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