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RESEARCH ARTICLE

# Synthesis and Characterization of Some new 2,4-Thiazolidinedione Derivatives

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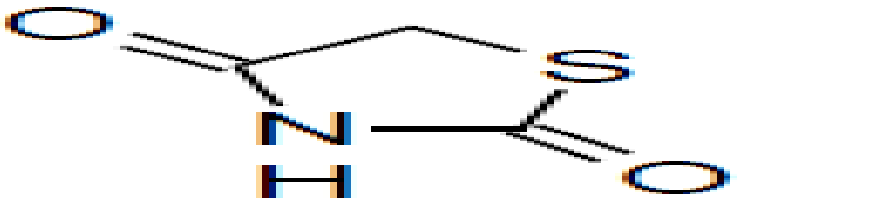
## Abstract

The synthesized thiazolidinedione compounds were prepared from the condensation reaction between chloroacetic acid with thiourea in the presence of water. The yield of product was found to be in the range of 75-95%. The second-pot synthesized 2, 4-thiazolidinedione derivatives were prepared from the condensation reaction between thiazolidine ring with series of aldehydes aromatic (4-(Dimethylamino) benzaldehyde, 2, 3-Dimethoxybenzaldehyde, Terephathaldehyde, 2-Thiophenecarboxaldehyde, Isatin, Furfural) and confirmed by spectral data: FTIR and $^{1}$H-NMR Spectra.

**Keywords:** *2, 4- thiazolidinedione; Characterization; Thiourea.*

## Introduction

Thiazolidinediones are five member heterocyclic compounds having sulphur, nitrogen and oxygen atom in their ring structure and exhibiting potent as well as wide range of pharmacological activities [1].



2,4-thiazolidenedione

A large number of 2, 4-thiazolidinediones have been reported to be anti-inflammatory [2] and neuroprotective agents [3] 2, 4-Thiazolidinedione is also reported for anti-hyperglycemic activity [4].

## Materials and Methods

All the chemicals used for synthetic work were purchased from CDH and Hamada. Melting points were determined in an open capillary tubes and are uncorrected by using Veego microprocessor based programmable melting point apparatus. The completion of the reaction was routinely determined by thin layer chromatography on glass plates using silica gel G as absorbent and using hexane: ethyl acetate (7:3) solvent system. Spots were visualized by iodine chamber. IR spectra were recorded in cm-1 using KBr pellets on Shmadzu spectrophotometer. 1H NMR spectra (δ, ppm) was recorded on BRUKER AVANCE II 400 NMR spectrophotometer using DMSO- d6 solvent (TMS as internal standard).

### Procedure

### Synthesis of 2, 4-thiazolidinedione 1[5, 6, 7]

In a 250ml three-necked flask, a solution containing 56.4g (0.6M) of chloroacetic acid in 60ml of water and 45.6g (0.6M) of thiourea was dissolved in 60ml of water. The mixture was stirred for 15minute till occurrence of white precipitates. To the contents of flask was now added slowly 60ml of conc. hydrochloric acid from dropping funnel to dissolve the precipitates, after which the reaction mixture was stirred and refluxed for

8-10hrs at 100-110 ˚C, on cooling the contents of flask were solidified to a mass of clusters of white needles. The product was filtered and washed with water to remove traces of hydrochloric acid and dried. It was recrystallised from ethanol, yield 80%, m.p. (124-126˚C).

### Synthesis of 5-(subtitled aromatic aldehyde)-2, 4-thiazolidinedione (8)

A mixture of compound 1 (0.01 mol), 20 mL of methanol, reacted with monoaromatic aldehyde (0.01 mol) and diaromatic aldehyde (0.02 mol) 2(a-f) and 10-15 drops of piperidine were refluxed for 8-10 hr. The solvent was distilled off and the residue poured into crushed ice. The resulting solids were filtered off, dried and purified by recrystallization from alcohol.

(z)-5-(4-dimethylamino benzylidine) thiazolidine-2, 4-Dione (2a) yield=66%,

IR Vmax ($cm^{-1}$) (KBr):1658 (C=O-str), 3178 ($CH_2$-str-aro),2978 (CH-str) $^1$HNMR (400 MHZ, DMSO-d6,δ,ppm):2.99 (S,6H,N-C2H6), 6.79-6.81 (d,2H,Ar-OH), 7.39-7.41(d,2H,Ar OH), 7.48 (S,H, CH), 9.00 (S,1H,NH), 9.22(S,1H,$OH_{TZD}$)

(z) -5-(2, 3-dimethoxy benzylidine) thiazolidine-2, 4-dione (2b)

IR Vmax ($cm^{-1}$) (KBr): 1651 (C=O-str), 1265 (CN-str), 3178 ($CH_2$-str-aro), 2978 (CH-str). $^1$HNMR(400MHZ,DMSO-d6,δ,ppm):2.99(S,6H,2(0-CH3)),7.39-6.82(d,S,3H,Ar OH), 7.48 (S, 1H, CH), 8.95(S,1H, NH), 9.18 (S,1H,$OH_{TZD}$)

(z)-4-((2, 4-dioxothiazolidine-5-ylidene) methyl) benzaldehyde (2c)

IR Vmax (cm-1) (KBr): 1705 (C=O-str), 1288 (CN-str), 3163 (CH2-str-aro), 2954 (CH-str). $^1$HNMR (400MHZ, DMSO-d6,δ,ppm):7.61-8.04(m,4H,ArOH),7.59 (S, 1H, CH), 10.05 (S, 1H, CHO),12.68(S,1H,OHTZD)

(z)- 5-(thiophen-2-ylmethylene) thiazolidine -2, 4-Dione (2d)

IR V max ($cm^{-1}$) (KBr): 1689 (C=O-str), 1327 (CN-str), 3124 ($CH_2$-str-aro), 2800 (CH-str). $^1$HNMR(400MHZ,DMSO-d6,δ,ppm):7.29-8.06(m,3H,Ar-OH),7.28(S,1H,CH),12.56(S,1H,$OH_{TZD}$)

(z)- 5-(2-oxoindolin-3-ylidine) thiazolidine -2, 4-Dione (2e)

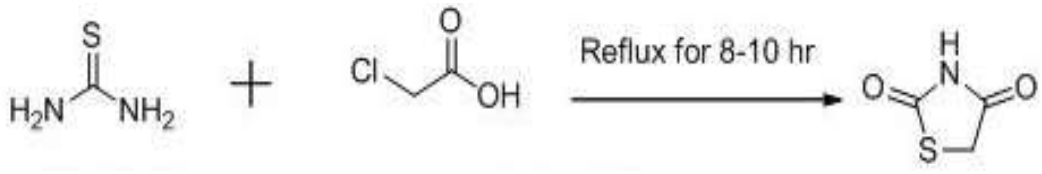
IR V max ($cm^{-1}$) (KBr): 1697 (C=O-str), 1300 (CN-str), 3147 ($CH_2$-str-aro), 2939 (CH-str). $^1$HNMR(400MHZ,DMSO-d6,δ,ppm):6.47-7.35(m,4H,ArOH),9.05 (S,1H,NH-Isatin), 9.06 (S, 1H, NH-TZD),10.89(S,1H,OH-TZD)

(Z) - 5-(furan-2-ylmethylene) thiazolidine -2, 4-dione (2f)

IR V max ($cm^{-1}$) (KBr): 1728 (C=O-str), 1334 (CN-str), 3140 ($CH_2$-str-aro), 2800 (CH-str). $^1$HNMR (400MHZ,DMSO-d6,δ,ppm):7.09-8.05(m,4H,Ar-OH), 6.74(S,1H,CH),12.46(S,1H,OH-TZD)

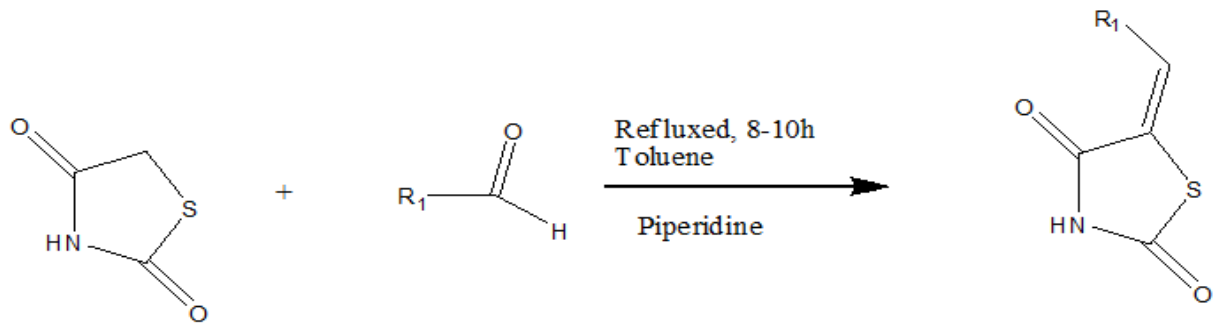
## Results and Discussion

2, 4-Thiazolidinediones have been prepared by react chloroacetic acid with thiourea in water as shown in (Scheme 1):



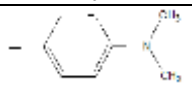
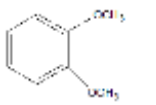
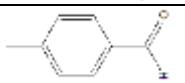
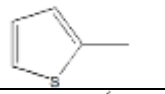
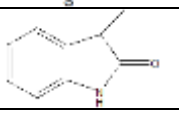
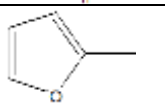

**Scheme 1**

Also the 2, 4-Thiazolidinediones 1 reacted with series of aromatic aldehyde 2(a-f) in methanol as shown in Scheme 2 and Table 1.



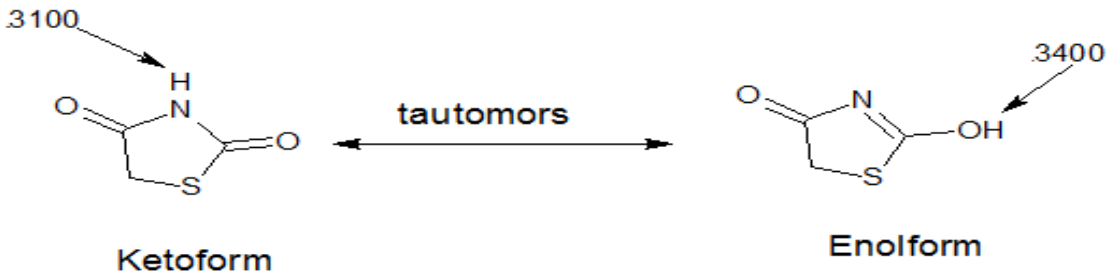

**Scheme 2:**

**Table 1: physical properties of substituted 2, 4-thiazolidinedione 2(a-f):-**

| S.N | Symbol | Mol. formula | R1 | Mol. wt. | Yield (%) | m.p ˚C |
|---|---|---|---|---|---|---|
| 1 | 2a | $C_{12}H_{12}N_2O_2S$ |  | 248 | 68 | 254-256 |
| 2 | 2b | $C_{12}H_{11}NO_4S$ |  | 265 | 81 | 312-314 |
| 3 | 2c | $C_{11}H_7NO_3S$ |  | 233 | 78 | 253-255 |
| 4 | 2d | $C_8H_5NO_2S_2$ |  | 211 | 59 | 249-251 |
| 5 | 2e | $C_{11}H_6N_2O_3S$ |  | 246 | 80 | 275-277 |
| 6 | 2f | $C_8H_5NO_3S$ |  | 195 | 62 | 210-212 |

## Analysis of Infrared Spectra

The IR spectra of thiazolidinedione 1 in KBr disk show six band groups correspond to the stretching vibration of the aromatic C-H, aliphatic C-H, carbonyl amide group, aromatic C=C , the C-N and bending vibration of S-C bonds, occur within the ranges 3128, 2982, 1678,1389,741,and 888 $cm^{-1}$ respectively as shown in (Scheme 3).

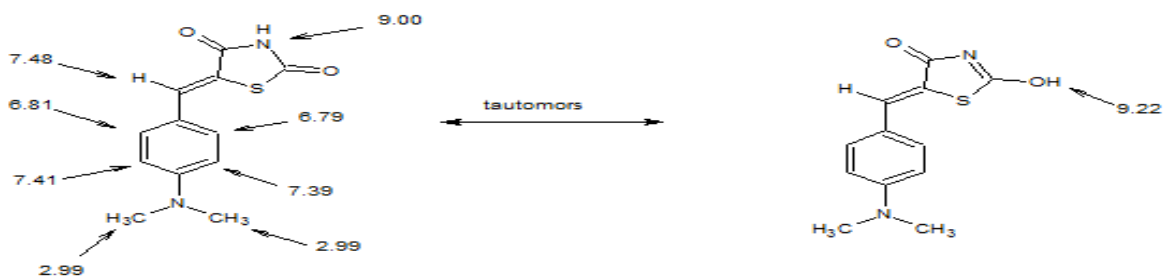



**Scheme 3:**

A series of N-substituted-5-benzylidene-2, 4-thiazolidinedione derivatives were synthesized using different substituted aromatic aldehydes. Synthesized compounds were characterized by chromatographic methods, IR spectroscopy and 1HNMR spectra's. The chemical and physical characteristics of the compounds are shown in Tables 1. The IR and NMAR characteristic of the compounds were as follows:

IR spectra of the 2, 4- thiazolidinedione derivatives show the following peaks: 3178 $cm^{-1}$ (N-H), 2978 $cm^{-1}$ (aliphatic C-H stretching), 1658 $cm^{-1}$ (C=O-str), 1373 $cm^{-1}$ (C-N), 1419 $cm^{-1}$ (aromatic C=C).

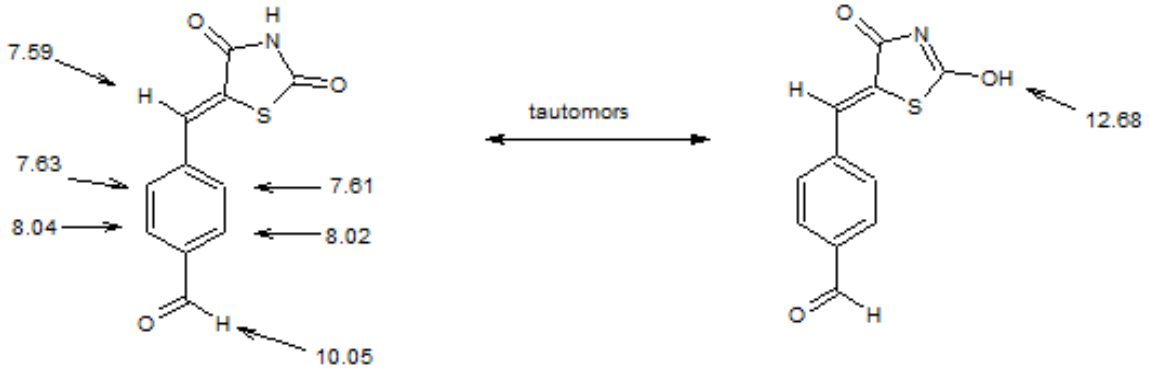
The $^1$H-NMR spectra of the 2, 4-thiazolidinedione derivatives are shown in Figures (1-6). The structure of 5-(4-dimethylamino benzylidine) thiazolidine-2, 4-dione (2a) showed singlet peak for NH also singlet peak for OH.



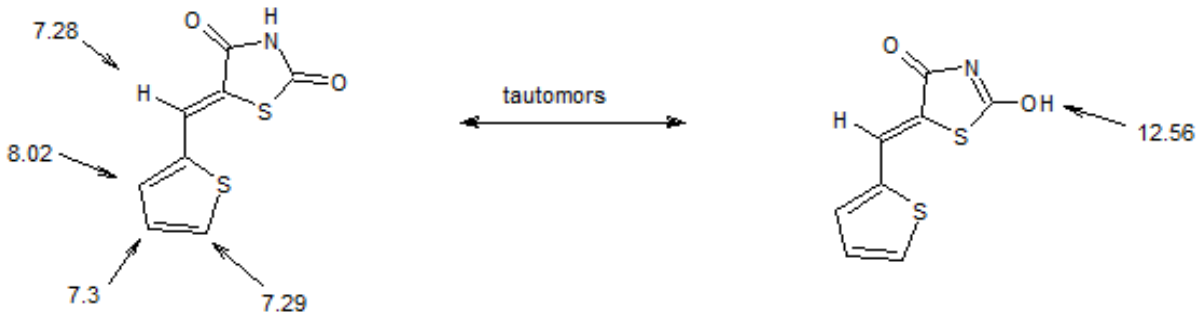

The structure of 5-(2, 3-dimethoxy benzylidine) -2, 4-thiazolidinedione (2b) showed singlet peak for NH also singlet peak for OH

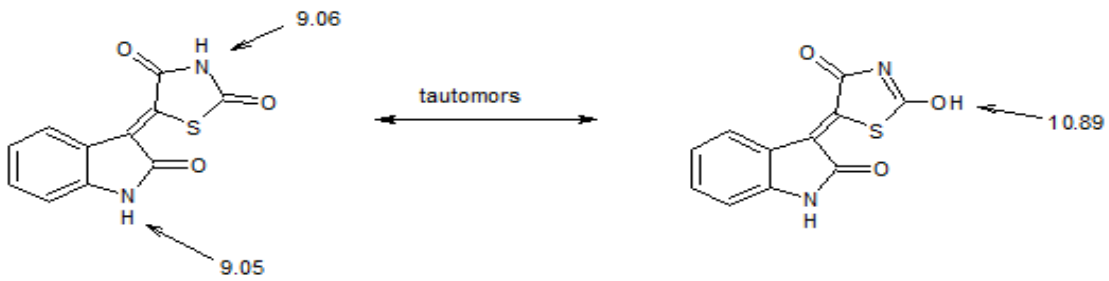

The structure of 4-((2, 4-dioxothiazolidine-5-ylidene) methyl) benzaldehyde (2c) showed singlet peak for NH also singlet peak for OH




The structure of 5-(thiophen-2-ylmethylene) thiazolidine -2, 4-dione (2d) showed singlet peak for NH also singlet peak for OH

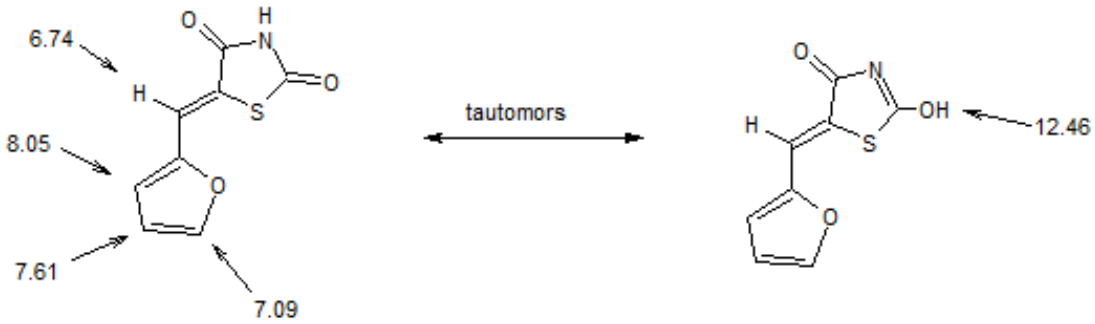



The structure of 5-(2-oxoindolin-3-ylidine) thiazolidine -2, 4-dione (2e) showed singlet peak for NH also singlet peak for OH




The structure of 5-(furan-2-ylmethylene) thiazolidine -2, 4-dione (2f) shows showed singlet peak for NH also singlet peak for OH



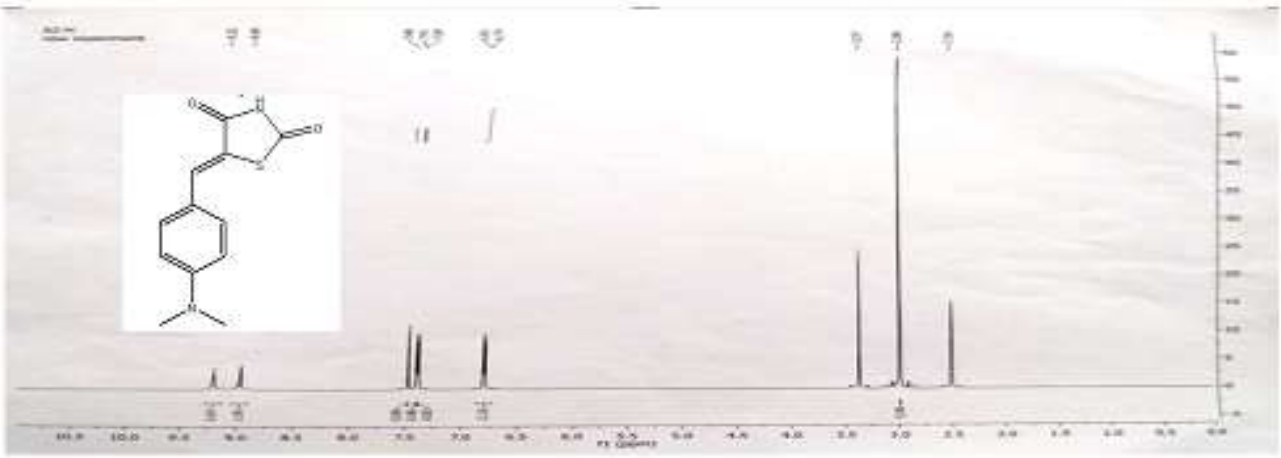



**Figure 1: 5-(4-dimethylamino benzylidine) thiazolidine-2, 4-dione (2a)**

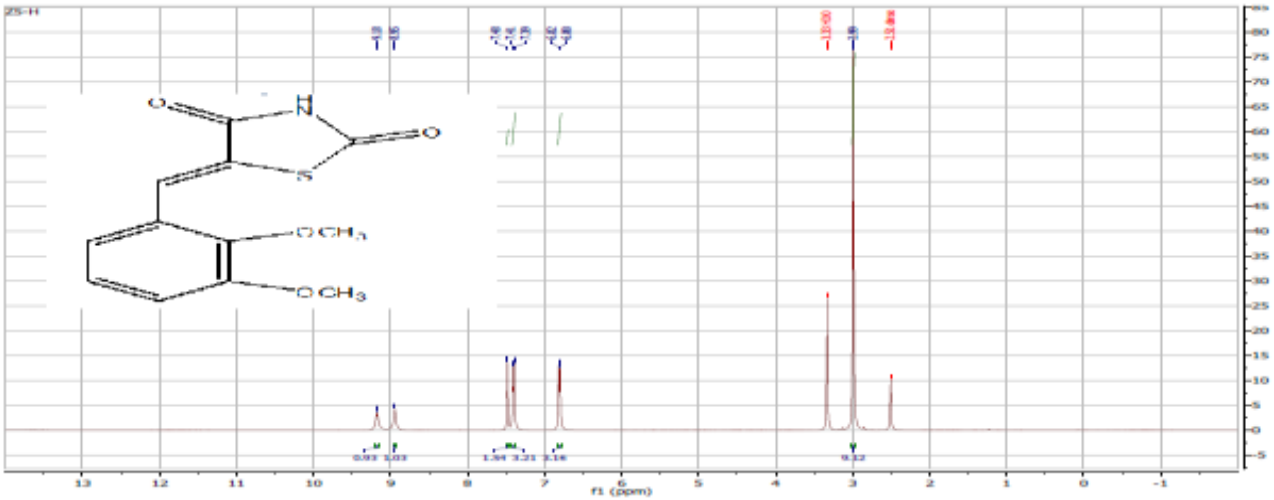


**Figure 2: 5-(2, 3 – dimethoxy benzylidine) thiazolidine-2, 4-dione (2b)**

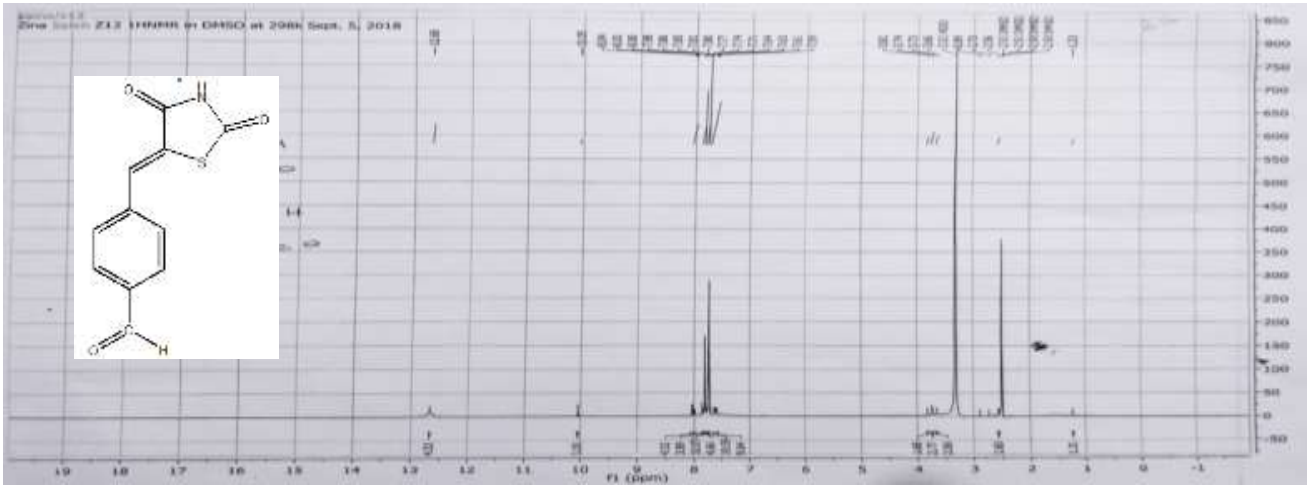


**Figure 3: 4-((2, 4-dioxothiazolidine-5-ylidene) methyl) benzaldehyde (2c)**

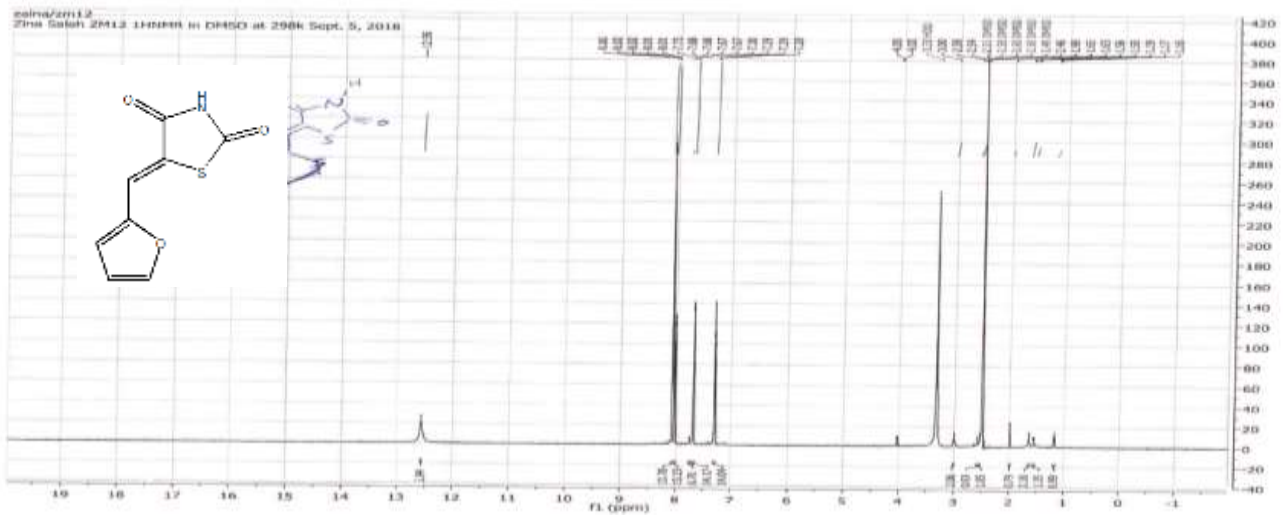


**Figure 4: 5-(thiophen-2-ylmethylene) thiazolidine -2, 4-dione (2d)**

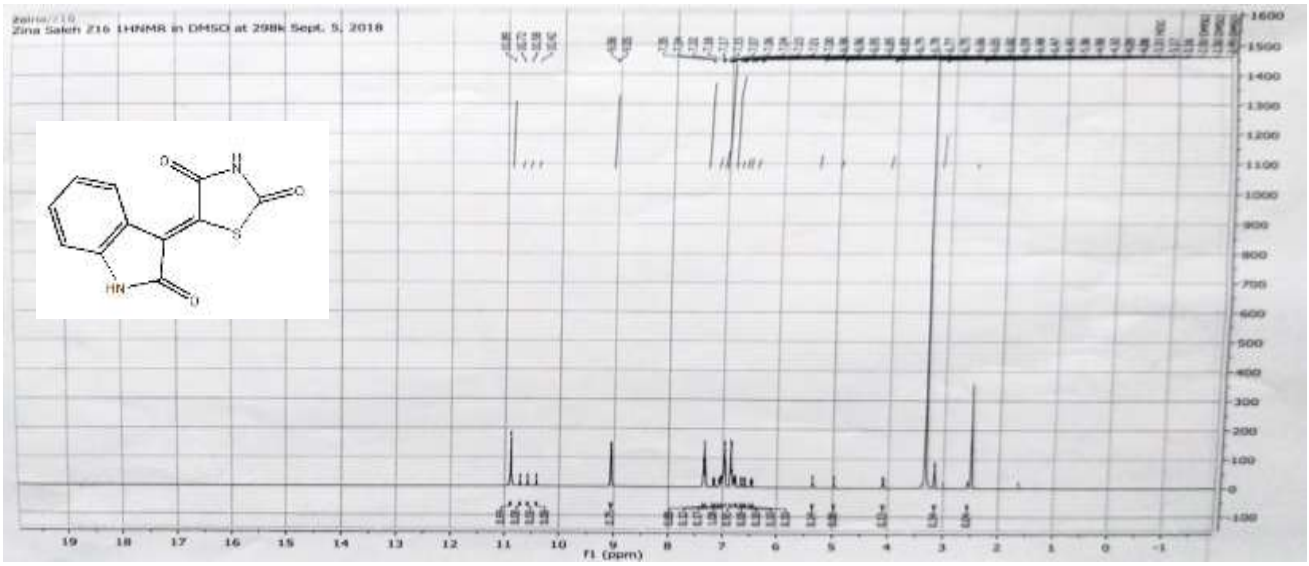


**Figure 5: 5-(2-oxoindolin-3-ylidine) thiazolidine -2, 4-dione (2e)**

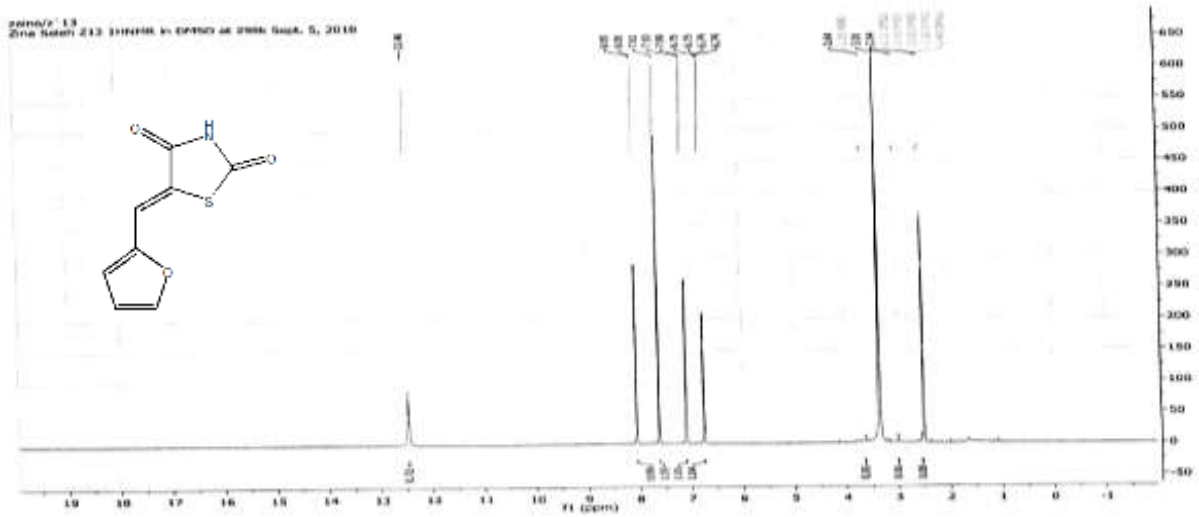


**Figure 6: 5-(furan-2-ylmethylene) thiazolidine -2, 4-dione (2f)**

## Conclusion

The six compounds were synthesized with the standard chemicals and procedure. The compounds were characterized through their respective IR, $^1$H NMR and TLC.

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