Synthesis of 1-Phenyl-3-Substituted-2,6-Dithio-4-Amino-[(2-Phenyl-Thiocarbamido)-1,3-Benzothiazolo]-1,3,5-Triazine And Their Effects on Germination Pattern of *Sorghum vulgare*

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Abstract

In this study a simple, novel and one step method have been developed for the synthesis of 1-phenyl-3-substituted-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazinesby isomerisation of 2-substitutedimino-6-phenylimino-4-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-1,3,5-dithiazinesin 7% aqueous ethanolic sodium bicarbonate mixture in ethanol solvent. This method provides easy and rapid access to the obtained products in good yields by maintaining purity of them. The synthesized compounds were screened for investigation of their effects on germination pattern of *Sorghum vulgare.* They showed a remarkable and noticeable germination effects on *Sorghum vulgare.*

KEYWORDS-1-Phenyl-3-substituted-2,6-dithio-4-amino-[(2-pheylthiocrbamido)-1,3-benzothiazolo]-s-triazines, Isomerisazation, Sodium bicarbonate , Ethanol, Germination pattern.

Introduction

Triazine is one of the most complex and intriguing part of organic transformation and triazino compounds constitute the largest and most varied family in organic chemistry. It is an important class of nitrogen containing heterocycles, which is a fundamental unit of natural products and metal-ligand complex formation. They possess a wide range of interesting and important biochemical and pharmaceutical properties present in several bioactive natural products.

The unit combines p-donor and π acceptor nitrogen in an interesting manner hence s-triazino compounds offer a high degree of structural diversity and have proven to be variedly and economically useful as therapeutic agent.s-Triazino molecules are known for their anti-cancer(Patel et. al.,2011), antiviral(Pandey et. al.,2003), anti-HIV(Yuan-Zhen Xiong,et. al.,2008) , bactericidal(Srinivaset. al.,2006**)**, fungicidal Khare et. al.(2005), anti-malarial(Srivastavaet. al.,2011), herbicidal(Gajareet al.,1998**)** and hypolipidemic activities(Atri et. al.,1984).Recently synthesis of 1-substituted-2-thio-6-ethylamino-4-[2-isobutoxy-5(4-methyl-5-carboxy-1,3-thiazo-2-yl)]-phenyl-1,3,5-triazines was reported by Tayadeet al.(2017).Hence, it was thought interesting to synthesize 1-phenyl-3-substituted-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazines (IIa-e) by an isomerisation of 2-substitutedimino-6-phenylimino-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-1,3,5-dithiazines (Ia-e)respectively in 7% ethanolic sodium bicarbonate solution .

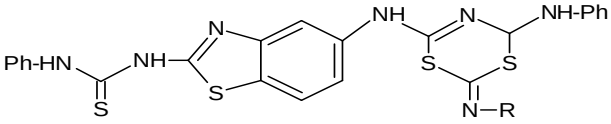
Materials and Method

AR grade Merck and Sigma chemicals were used for synthesis. Follow-up of reactions and checking homogeneity of compounds were made by TLC on silica

Gel-protected glass plates and spots were detected by exposure to UV-lamp at l254 and l365 nm. Unless otherwise noted. Carbon and hydrogen analysis was carried out on Carlo-Ebra-1106 analyser. Nitrogen estimations were carried out on Colman-N-analyser-29, while sulphur estimations were carried out by Carius method. Melting points of all compounds were determined in open glass capillaries with a SGW X-4 digital apparatus and were uncorrected. IR spectra were recorded on Perkin-Elmer spectrometer in range of 4000-400 cm^{-1} in KBr pellets. ^{1}H NMR and ^{13}C NMR spectra were recorded on Bruker ARX-400-4000 Hz spectrometers with tetramethylsilane (TMS) as an internal standard and DMSO-d_6, $CDCl_3$ as a solvent (Chemical shifts in ppm). LC-MS were recorded by Waters Micro mass Q-TOF premier Mass Spectrometer.

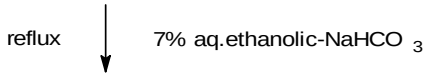
General procedure for the synthesis of 1-phenyl-3-substituted-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazines (IIa-e)

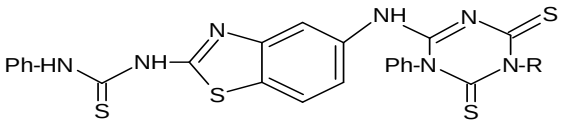
A reaction mixture of 2-substitutedimino-6-phenylimino-4-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-1,3,5-dithiazines**(Ia-e)** and 7% aqueous sodium bicarbonate solution was refluxed on water bath in ethanol medium for 10 minutes. After distillation off excess solvent, brown colour crystals of 1-phenyl-3-substituted-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazines **(IIa-e)** washed several times with petroleum ether to afford brown colour crystals of products, recrystallized from glacial acetic acid.



(Ia-e)

2-Substitutedimino-6-phenylimino-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-1,3,5-dithiazine





(IIa-e)

1-Phenyl-3-substituted-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-1,3,5-triazine

where, R: -phenyl,-ethyl,-*t*-butyl, *p*-chlorophenyl, -*o*-tolyl

Effects on germination pattern of *Sorghum vulgare*

In process of seed germination it requires aspiration of water with cardinal temperatures. Germination pattern of synthesized compounds was investigated against *Sorghum vulgare* seeds. All compounds were tested for their effects on the growth of germinating seeds by a technique similar to that ofFOLKE SKOOGAllen et al.(1950**)**, in this modification: Seeds of *Sorghum vulgare* were germinated on filter paper in Petri dishes. Ten seeds were used in each Petri dish, moistened with 10 ml of a water solution of the compound to be tested. Usually serial concentrations of 1, 2.5, 5,

50 and 100 ppm were used and all treatments were in duplicate. The Petri-dishes were placed in incubator with approximately constant temperature (25 ± 2˚C) four days.

Results and Discussion

Spectral data of synthesis compound

1) Synthesis of 1-phenyl-3-phenyl-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazine (IIa):

(5.01g, 84%)Brown solid, melting point 208^{o}C.;FTIR [KBr, ν cm^{-1}]: 3417s, 2983s,

2063s,1651 s, 1408 s,1481s,1292 s,742 s; ^{1}H NMR [($CDCl_3$-$DMSOd_6$) δ ppm]: 9.8045, 8.1173-8.1132,7.7701-7.0009,6.9822-6.6652;^{13}C ($CDCl_3$-$DMSOd_6$): 187.84,132.02-114.20; LC-MS Calcd for $C_{29}H_{23}N_7S_4$, (M^+) 597, found 597.

2) Synthesis of 1-phenyl-3-ethyl-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazine (IIb):

3) (4.92 g, 90%) Brownish yellow solid;melting point 198^{o}C.; FTIR [KBr, ν cm^{-1}]: 3412s, 2972s, 2065s,1639s, 1541s,1589s, 1281s, 756 s;^{1}H NMR[($CDCl_3$-$DMSOd_6$) : 9.1985,8.2146-8.0332,7.7235-7.0796,6.4989-6.4960,4.2300-3.9340,2.9668-2.9583,1.9496-1.3448;^{13}C($CDCl_3$-$DMSOd_6$):182.21,160.16,130.28,74.20,30.32.;LC-MS Calcd for $C_{25}H_{21}N_7S_4$, (M^+) 547, found 547.

4) Synthesis of 1-phenyl-3-*t*-butyl-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3 benzothiazolo]-s-triazine(IIc):

5) (4.60g,80%) Brown solid; melting point 205^{o}C.;FTIR [KBr, ν cm^{-1}]:3430s, 3150s, 2162s, 1662s, 1537s, 1507s, 1254s, 777s.;^{1}HNMR[($CDCl_3$-$DMSOd_6$):9.4265,8.2005,7.0585-6.9777,6.5647,3.4904,1.4466-1.4117;^{13}C($CDCl_3$-$DMSOd_6$):185.21,149.16-125.28,78.20 25.32.;LC-MS Calcd for $C_{27}H_{25}N_7S_4$, (M^+) 575, found 575.

6) Synthesis of 1-phenyl-3-*p*-chlorophenyl-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazine(IId): (4.72g,75%)Ivory solid, melting point 220^{o}C.; FTIR [KBr, ν cm^{-1}]:3429s, 2917 s, 2163s, 1641s, 1575s, 1506s, 1256s,746s.;^{1}H NMR[($CDCl_3$-$DMSOd_6$): 8.9534,8.1491,7.6209-7.3508,6.9769-6.9310.;^{13}C($CDCl_3$-$DMSOd_6$): 180.21, 148.16, 122.14.;LC-MS Calcd for $C_{29}H_{20}N_7S_4Cl$, (M^+) 518.35, found 594.

7) Synthesis of 1-phenyl-3-*o*-tolyl-2,6-dithio-4-amino-[(2-phenylthiocarbamido)-1,3-benzothiazolo]-s-triazine(IIe):

8) (4.10g,82%) Brown solid; melting point 232^{o}C.;FTIR[KBr, ν cm^{-1}]:3374s, 3099s, 1986s, 1691s, 1578s, 1508s, 1273s,728s.;^{1}H NMR [($CDCl_3$-$DMSOd_6$):8.7266,8.1707,7.0653,6.1454,1.4012-1.3687.;^{13}C($CDCl_3$-$DMSOd_6$): 182.30, 156.16-136.28, 28.64; LC-MS Calcd for $C_{21}H_{23}N_7S_4$, (M^+) 500.54, found 501.

Effect on synthesized compound on germination pattern of *Sorghum vulgare*.

After five days of growth in a dark, seedlings were removed and length of the shoots and primary roots were measured (Table1 and 2), the growth effect of tested compounds were evaluated and compared with the control and standards in the same range of concentrations.

Table 1. (Day-1)

System	Root Length(cm)	Shoot Length(cm)	Root /Shoot Ratio	Seedling Height	% Germination	Vigor Index
CS	1.0	2	0.5	3	70	210
IIa	1.3	2.2	0.59	3.5	80	280
IIb	1.2	3	0.4	4.2	90	378
IIc	1.3	2.4	0.52	3.8	80	304
IId	1.6	2.8	0.57	4.4	70	308
IIe	1.4	3.3	0.43	4.6	90	414
	1.2	3.1	0.38	4.3	100	430

*: S:-2,4-D: 2,4-Dichlorophenoxy acetic acid and used as standard and C-control

Table 2.(Day-5)

System	Root Length(cm)	Shoot Length(cm)	Root /Shoot Ratio	Seedling Height	% Germination	Vigor Index
CS	2.2	3.3	0.66	5.5	50	275
IIa	2.5	3.6	0.69	6.1	60	366
IIb	3.5	4.5	0.77	8	80	640
IIc	2.8	4.4	0.63	7.2	70	504
IId	3.4	4.9	0.69	8.3	60	498
IIe	3.8	4.7	0.80	8.5	80	680
	4.0	5.2	0.76	9.2	90	828

Conclusion

An effect of synthesized compound containing -phenyl, -ethyl, -*t*-butyl,-chlorophenyl and -*o*-tolyl moiety increases % of germination of seed of *Sorghum vulgare* and these groups are responsible for increasing % of germination of the seed of *Sorghum vulgare*. Tested analogues were characterized as biologically active substances better than controlled and 2,4-D like growth promoting activity.

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