Research Article

Synthesis and De-Tert-Butylation of 2-Arylimino-5-Tert-Butylimino-1,3,4-Thiadiazolidines

NA. Rashidi

Department of Chemistry, Mungasaji Maharaj College,
Darwha, Dist:Yavatmal, Maharashtra, India.

ABSTRACT

New 2-arylimino-5-tert-butylimino-1,3,4-thiadiazolidines (IV) were synthesized by cyclization of N-tert-butyl-N'-arylhydrazine-1,2-dicarbothioamides (III). The key intermediate compounds (III) were obtained by the drop wise addition of hydrazine hydrate to aryl isothiocyanate (I) followed by condensation with tert-butyl isothiocyanate in 1:1 ratio in chloroform medium. All the synthesized compounds (IV) were successfully de-tert-butylated into respective 2-arylimino-5-imino-1,3,4-thiadiazolidines (V). All new compounds were characterized by ^{1}H-NMR, IR spectroscopy and elemental analysis.

Keywords: 1,2-dicarbothioamides, cyclization reaction, 1,3,4-thiadiazolidine, de-tert-butylation.

INTRODUCTION

1,3,4-thiadiazoles and derivatives have been widely studied for analytical and industrial interest[1-4]. Different approaches have been reported for the preparation of 1,3,4-thiadiazoles and it's derivative. The acid catalyzed cyclisation of hydrazine carbothioamide is an excellent strategy for the synthesis of 1,3,4-thiadiazoles[5-7]. Here we reported the synthesis of some new substituted 1,3,4-thiadiazolidines (IV) through the intramolecular cyclisation of N-tert-butyl-N'-arylhydrazine-1,2-dicarbothioamides using Iodine-pot.iodine in basic medium.

EXPERIMENTAL

All melting points were uncorrected. IR spectra were measured using KBr disc plate technique on a Bruker FT-IR spectrophotometer. ^{1}HNMR spectra (DMSO-d_6 and $CDCl_3$) were carried out on a Bruker Advance 400 MHz spectrometer using TMS as internal reference (chemical shifts in ó, ppm).

The reagent required for the synthesis of 1,3,4-thiadiazolidines are aryl isothiocyanates[8], *t*-butyl isothiocyanate[9] and N-aryl thiosemicarbazide[10-11] were prepared by already known procedure. The N-tert-butyl-N'-arylhydrazine-1,2-dicarbothioamides (IIIa-f) were prepared by the reaction of N-aryl thiosemicarbazide and *t*-butyl isothiocyanate in chloroform medium as below

Preparation of N-tert-butyl-N'-(p-tolyl) hydrazine-1,2-dicarbothioamide (IIIa)

The p-tolyl thiosemicarbazide (IIa) (0.01 mole) was refluxed with tert-butyl isothiocyanate (0.01 mole) in chloroform medium for 1.5 h. After completion of reaction, the solvent was distilled off. The solid product obtained was crystallized from ethanol, m.p 116^{0}C. The compound was insoluble in water but soluble in organic solvents and was found to be desulphurizable when boiled with alkaline lead acetate solution indicating the presence of >C=S group.

(**IIIa**): **IR spectra**[12-14] (KBr) cm-1: 3272,3219 (N-H), 2955-2849 (C-H), 1310 (C-N), 1178 (C=S); **1H-NMR** (DMSOd^{6}) ppm: 1.3 (9H, s, t-Bu), 2.2 (3H, s, Ar-CH3), 3.3 (1H, s, t-Bu-NH), 4.5 (1H, s, Ph-NH), 7.0-7.6 (4H, m, Ar-H), 8.7(1H, s, N-H) 9.4 (1H, s, N-H).

On the basis of chemical properties and spectral data, the compound (IIIa) has been assigned the structure as N-tert-butyl-N'-(p-tolyl) hydrazine-1,2-dicarbothioamide.

The other 1,2-dicarbothioamide(IIIb-f) were prepared by extending the above reaction to different thiosemicarbazide (IIb-

f), and the related products were isolated in good yield. (Table -1).

Preparation of 2-(p-tolylimino)-5-tert-butylimino-1,3,4-thiadiazolidine (IVa)

Paste of N-tert-butyl-N'-(p-tolyl) hydrazine-1,2-dicarbothioamide (IIIa) (2 gm) was prepared in ethanol. It was basified with 6N NaOH (0.5 ml).To this mixture a solution of iodine containing 1% potassium iodide was added drop wise under cooled condition (5-7 °C) till the colour of iodine persisted. The reaction mixture was kept overnight at room temperature. The solid mass separated was washed thoroughly with water, dried and crystallized from ethanol to yield 75% of 2-(p-tolylimino)-5-tert-butylimino-1,3,4-thiadiazolidine (IVa), m.p 102 ^{0}C.

(**IVa**) : **IR spectra**[12-14]
(KBr) cm-1: 3393 (N-H), 1514(C=N), 1301 (C-N), 811 (C-S) (Plate 6.1);
1H-NMR (DMSOd^6) ppm: 1.3 (9H, s, t-Bu), 2.2 (3H, s, Ar-CH3), 6.4 (1H, s, N-H), 7.01-7.06 (2H, d, Ar-H) 7.0-7.6 (2H, d, Ar-H), 7.9 (1H, d, N-H). (Plate 6.2);
On extending the above reaction to other (IIIb-f), related products (IVb-f) were isolated in good yield. (Table -1)

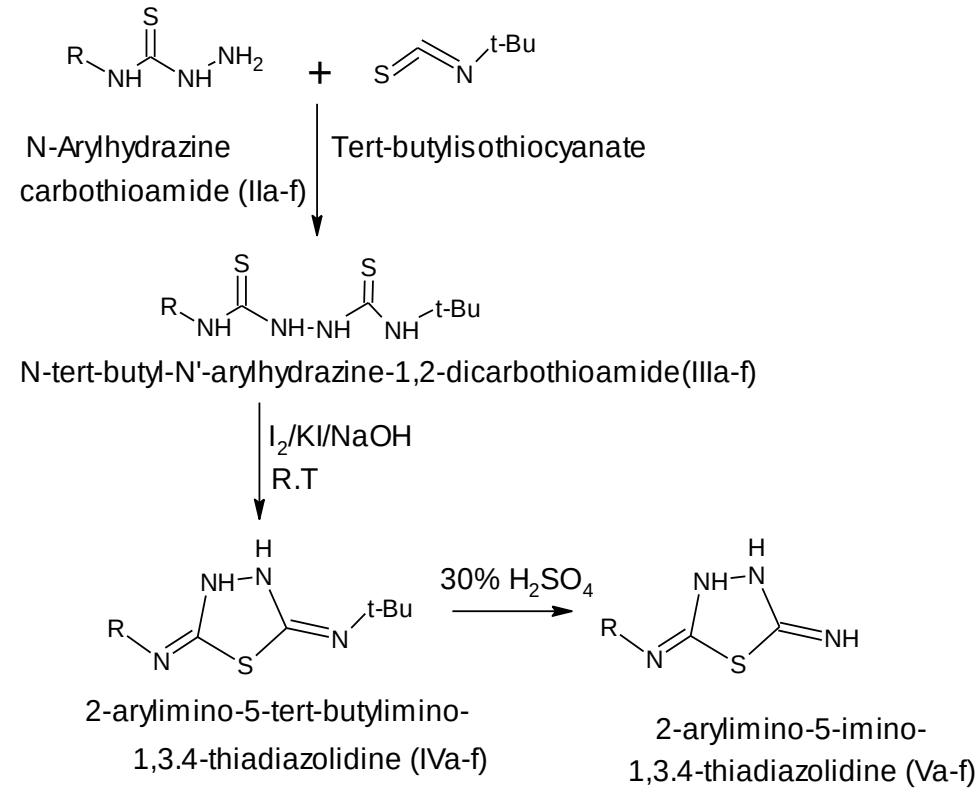
Preparation of 2-(p-tolylimino)-5-imino-1,3,4-thiadiazolidine (Va)

The 2-p-tolylimino-5-t-butylimino-1,3,4-thiadiazolidine (IVa) (0.01 mole) was boiled with 30% sulphuric acid (10 ml) under reflux for 3 hr. The solid gradually went into solution and a clear solution was obtained. After completion of reaction, the reaction mixture was cooled and poured in ice crushed water. The product (Va) separated was collected, dried and crystallized from ethanol to yield 70%, m.p.121°C.

1H-NMR (DMSOd^6) ppm
2.2 (3H, s, Ar-CH3), 7.01-7.06 (2H, dd, N-H), 7.28-7.30 (2H, d, Ar-H), 7.41-7.42 (2H, d, Ar-H), 8.6(1H, s, N-H). (Plate 6.3);
The absence of signal at 1.3 δppm due to proton of t-Butyl group proved that compound (IVa) has been successfully de-t-butylated[15] into compound (Va). Thus, from spectral data compound (Va) has been assigned the structure of 2-p-tolylimino-5-imino-1,3,4-thiadiazolidine . On extending the above reaction to other (IVb-f), related products (Vb-f) were isolated in good yield. (Table -1)

RESULTS AND DISCUSSION

The synthetic route is outlined in *fig:1*. The reagent aryl isothiocyanate(Ia-f), t-butyl isothiocyanate and N-aryl thiosemicarbazide (IIa-f) were prepared as described in literature. The N-tert-butyl-N'-arylhydrazine-1,2-dicarbothioamides (IIIa-f) was prepared by the reaction of N-aryl thiosemicarbazide and *t*-butyl isothiocyanate in chloroform medium. The structure of the compound (IIIa-f) were established on the basis IR and NMR-spectral data.
To the paste of N-tert-butyl-N'-(p-Tolyl) hydrazine-1,2-dicarbothioamide (IIIa) (2 gm) in ethanol, 6N NaOH (0.5 ml) and iodine solution in ethanol containing 1% potassium iodide was added drop by drop with constant stirring. The addition was continued till violet colour of iodine persisted. The mixtures were left over night at room temperature. The separated solids were crystallized from ethanol to yield 75% of compound (IVa), m.p 102^0.
On elemental and IR and H^1-NMR spectral data product (IVa) was found to be 2-(p-tolylimino)-5-tert-butylimino-1,3,4-thiadiazolidine. The other compounds (IVb-f) were prepared by extending the above reaction to other, N-tert-butyl-N'-arylhydrazine-1,2-dicarbothioamides (IIIb-f) and the related products were isolated in good yield. (Table-1).
The 2-p-Tolylimino-5-t-butylimino-1,3,4-thiadiazolidine (IVa) (0.01 mole) was boiled with 30% sulphuric acid (10 ml) under reflux for 3 hr. The solid gradually went into solution and a clear solution was obtained. After completion of reaction, the reaction mixture was cooled and poured in ice crushed water. The product (Va) separated was collected, dried and crystallized from ethanol, yield 70%, m.p.121°C. The absence of signal at 1.3 δppm due to proton of t-Butyl group proved that compound (IVa) has been successfully de-t-butylated[15] into compound (Va). Thus, on the basis of spectral data IR and 1H NMR, the compound (Va) has been assigned the structure as 2-p-tolylimino-5-imino-1,3,4-thiadiazolidine. The other compounds (Vb-f) were prepared by following the similar method (Table 1).



Where (I,II,III,IV,V)= R

a = p-tolyl, b = o-tolyl, c = m-tolyl

d = phenyl, e = o-chlorophenyl, f = p-chlorophenyl

Fig: 1

CONCLUSION

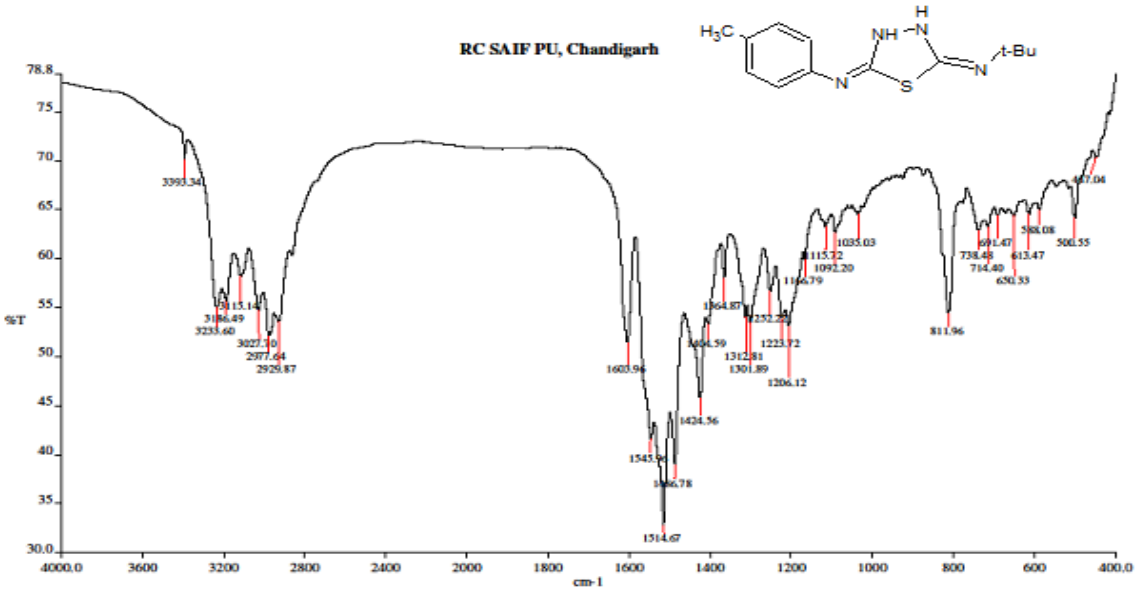
In conclusion, in present work some new 2-arylimino-5-imino-1,3,4-thiadiazolidine derivatives were prepared. The structures of all the synthesized compounds were confirmed on the basis of IR, 1H NMR, and mass spectral data. All the synthesized compounds are expected to show good biological activities.

ACKNOWLEDGEMENT

The author is thankful to the Principal Dr. V. G. Thakare, Shri. Shivaji Science College Amravati, for providing laboratory facilities. Thanks are also due to the Dr. B.N.Berad for his valuable guidance as well as to The Director, RSIC, Punjab University, Chandigarh for providing elemental analysis, IR, PMR and Mass Spectral data.

Table 1: Physicochemical Properties Data

Compound	Molecular Formula	% Yield	M.P ^{0}C
IIIa	$C_{13}H_{20}N_4S_2$	80	116
IIIb	$C_{12}H_{18}N_4S_2$	78	140
IIIc	$C_{13}H_{20}N_4S_2$	72	123
IIId	$C_{13}H_{20}N_4S_2$	75	125
IIIe	$C_{12}H_{17}N_4S_2Cl$	69	115
IIIf	$C_{12}H_{18}N_4S_2Cl$	70	128
IVa	$C_{13}H_{18}N_4S$	75	102
IVb	$C_{13}H_{18}N_4S$	62	116
IVc	$C_{13}H_{18}N_4S$	66	160
IVd	$C_{12}H_{16}N_4S$	71	142
IVe	$C_{12}H_{15}N_4SCl$	69	108
IVf	$C_{12}H_{15}N_4SCl$	72	153
Va	$C_9H_{10}N_4S$	70	121
Vb	$C_9H_{10}N_4S$	52	110
Vc	$C_9H_{10}N_4S$	56	130
Vd	$C_8H_8N_4S$	60	138
Ve	$C_8H_7N_4SCl$	65	114
Vf	$C_8H_7N_4SCl$	62	161



Spectrum Name: Nazia Rashidi-22.sp

Plate No.- 6.1

Date Created: fri feb 17 12:44:06 2012 India Standard Time (GMT+5:30)

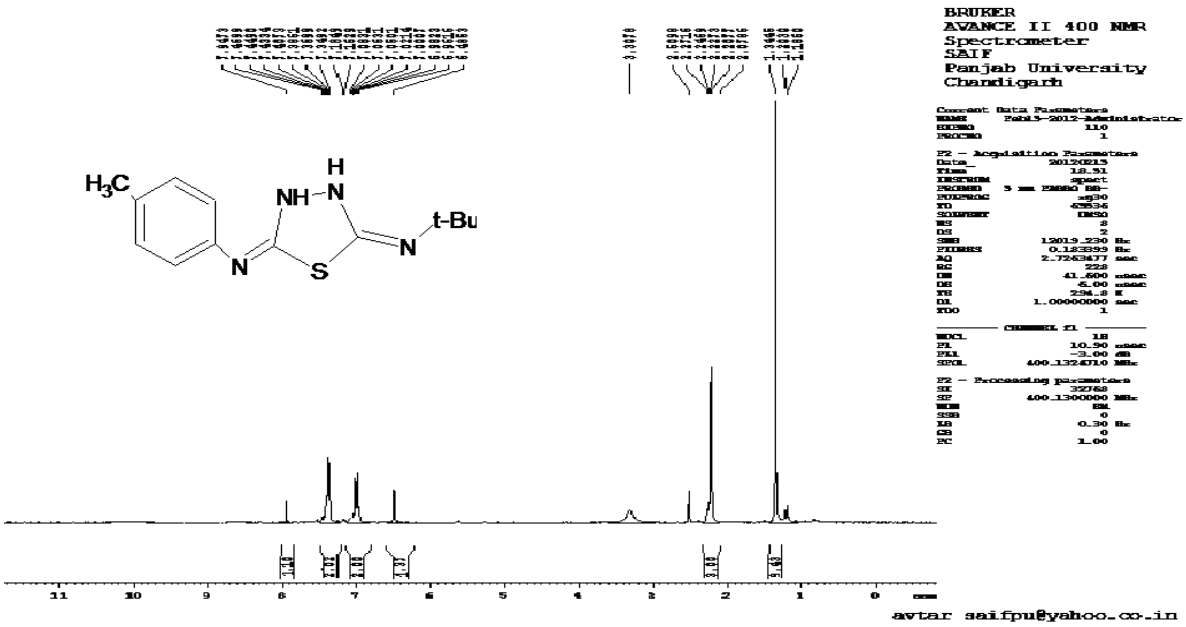


Plate No.- 6.2

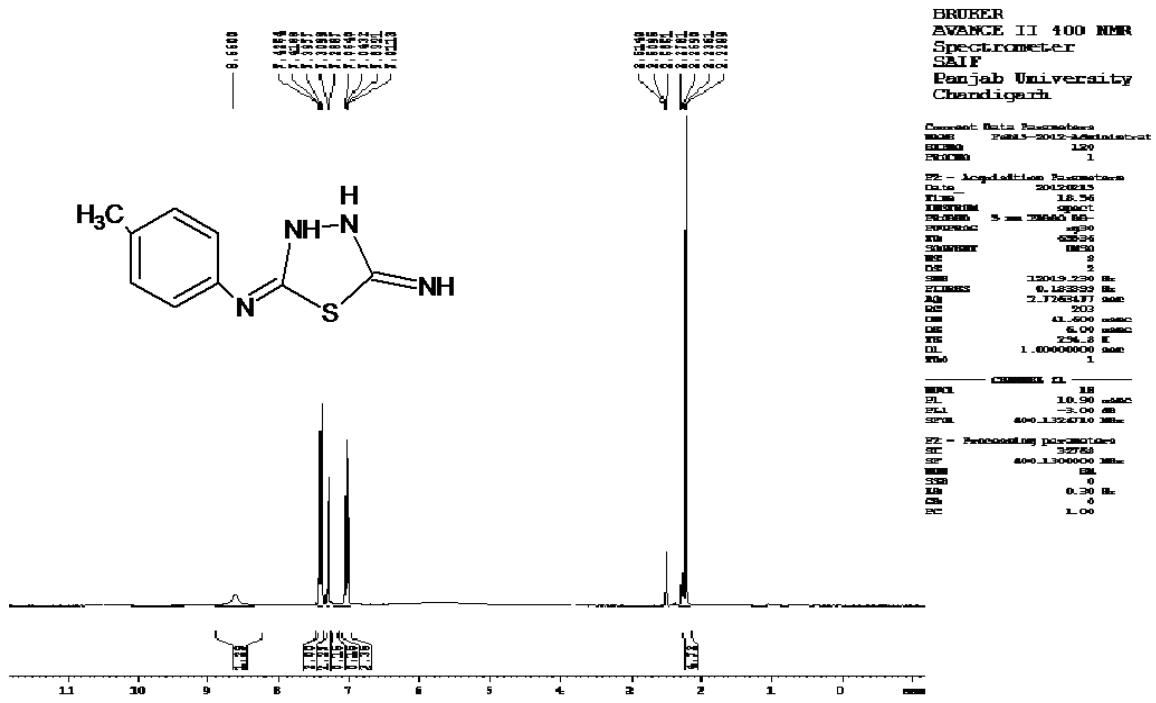


Plate No.- 6.3

REFERENCES

1. Kornis G. 1, 3 ,4-Thiadiazoles, in: Katritzky, A. R.; Rees, C. W. (Eds.)Comprehensive Heterocyclic Chemistry, vol. 6, Pergamon Press, Oxford. 1984;545(4B).
2. Tatsuma T. J Phys Chem.1997;101B:7556.
3. Wang PJ. Electrochem Soc. 2002;149 A:1171.
4. Sangapure SS and Basawaraj R. Synthesis and biological activities of Some 1,3,4-oxadiazoles, thiadiazoles, triazoles, and related compounds posssing benzofuran moiety. Ind J Pharm Sci. 2004;221-225.
5. Ritesh K Sharma. Synthesis and antihelmentic activity of some azole derivative of Hippuric acid. Int J Ph Sci. 2010;2(2):502-507.
6. Zamani K. Synthesis of Some New Substituted 1,2,4-Triazole and 1,3,4-thiadiazole and their derivatives. Turk J Chem. 2003;27:119-125.
7. Kratika Shrivastava. Synthesis and Biological activities of some novel 1,2,4- triazole[3,4-B][1,3,4] thiadiazole derivatives, Journal of Global Pharma Technology. 2010;2(1):72-80.
8. Vogel AI. A Text Book of Practical Organic Chemistry, Including Qualitative Analysis, Longmans, IIIrd Ed, 1958.
9. Schmidte, Striewsky W, Sectender M and Hitzler F. Leibig's Ann. 1960;192:568.
10. Bhaskar CS, Vidhale NN and Berad BN. Asian J Chem. 2002;14:162.
11. Singh T, Bhattacharya A and Verma VK. J Indian Chem Soc. 1992;69:153-156.
12. Dyer JR. Application of Absorption Spectroscopy of Organic Compound, Prentice-Hall, 1974.
13. Kalsi PS.Spectroscopy of Organic Compounds', New Age International (P) Ltd.,Vth edition, 2004.
14. Kemp W. Organic Spectroscopy. Palgrave, IIIth edition. 2002.
15. Lacey RN. Structure and Mechanism of Organic Chemistry. J Chem Soc.1960;1635.