SYNOPSIS

PHYSICO CHEMICAL STUDIES OF SOME COMPOUNDS

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Summary of the work incorporated in the thesis with the title **"PHYSICO CHEMICAL STUDIES OF SOME COMPOUNDS"** has been described as under.

The present work is divided into three parts.

PART-1 SYNTHESIS AND CHARACTERIZATION

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SECTION-II STUDIES ON 4-ARYL TRIAZOLES

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PART-1

SYNTHESIS AND CHARACTERIZATION

The chemistry of the heterocyclic compounds is as logical as that of aliphatic or aromatic compounds. The variety of heterocyclic compounds is enormous, their chemistry is complex and synthesizing them requires great skill.

This class of compounds have great applicability as drugs due to their specific chemical reactivity. They resemble essential metabolism and they fit biological receptors and block their normal working. Many natural products contain heterocyclic compounds such as alkaloids and glycosides.

Taking in view of the applicability of heterocyclic compounds, the present work was undertaken to synthesize some new heterocycles bearing triazole and pyrazole nucleus.

CHAPTER-1 - STUDIES ON TRIAZOLES DERIVATIVES

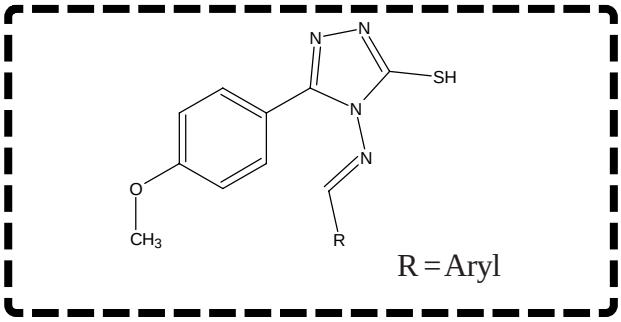
Triazoles are heterocyclic organic compounds having a five-member ring molecular structure containing three nitrogen atoms. Triazoles are of two types: 1, 2, 4-triazole and 1, 2, 3-triazole. The chemistry of 1,2,3-triazoles and 1,2,4-triazoles were well documented. The chemistry of triazole derivatives have been of interest due to its useful application in medicine, agriculture and industry. Further, some of these triazoles are known to be used as analytical reagents, dyes and photographic chemicals and in the preparation of polymers.

Prompted by the biological activities of 1,2,4-triazole and as a part of our general search concerning chemotherapeutically important azoles heterocycles, in present work, an attempt has been made to synthesize some 4-amino-3-mercapto 1,2,4-triazole derivatives.

SECTION-I - STUDIES ON SCHIFF BASES

The azomethine derivatives of 1,2,4-triazole have been found to be potent drug pharmaceutical industries and possess a wide spectrum of biological activity.

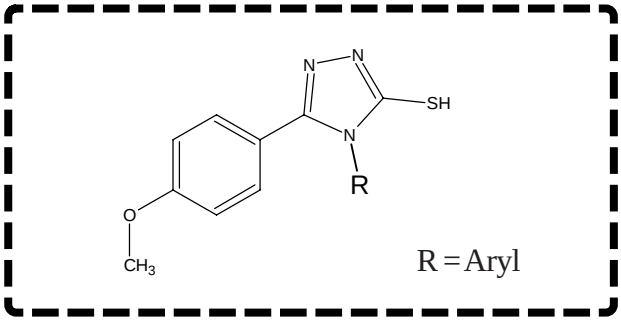
Azomethines can be formed by the reaction of a primary amine with aldehyde with the simultaneous removal of water. The loss of water, give an imine, corresponds to the "Crotonaldehyde stage" of the aldol condensation. Several methods have been reported for the preparation of azomethines. These observations led us to synthesise Schiff bases bearing 1,2,4-triazole moiety to enhance the overall activities of resulting moiety.



SECTION-II- STUDIES ON 4-ARYL TRIAZOLES

1,2,4-triazole and their derivatives constitute an important class of organic compounds. Amongst the five membered nitrogen containing heterocycles, the position of nitrogen atom at 1,2 and 4 activates the ring.

The synthesis of these heterocycles has received considerable attention in recent years. Several methods have been reported in the literatures for the preparation of 4-aryl triazoles.



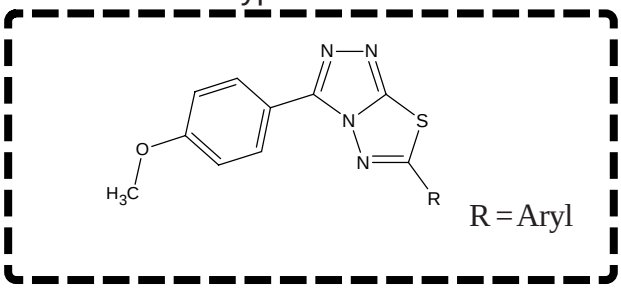
SECTION-III - STUDIES ON 1,3,4-THIADIAZOLO TRIAZOLES

Thiadiazoles are the compounds containing three carbon atoms, one sulphur atom, and one nitrogen atom in five member ring. It is parent material for numerous of chemical compounds including sulfur drugs, biocides, fungicides, dyes, chemical reaction accelerators. Thiadiazoles and its derivatives are important in the industry of dyes, photographic chemicals, sulfa drugs, preservative and rubber.

Such compounds find application for making biological activitive agents.

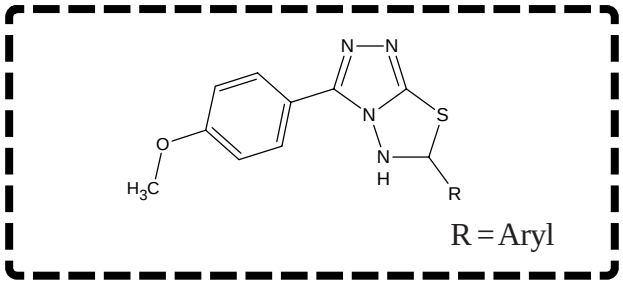
By the reaction of aromatic carboxylic acids with 1,2,4-triazole, compounds of Type-1 can be synthesized.

Type-I



Compounds of Type-2 can be synthesized by the condentation of different aromatic aldehydes with 1,2,4-triaole.

Type-2

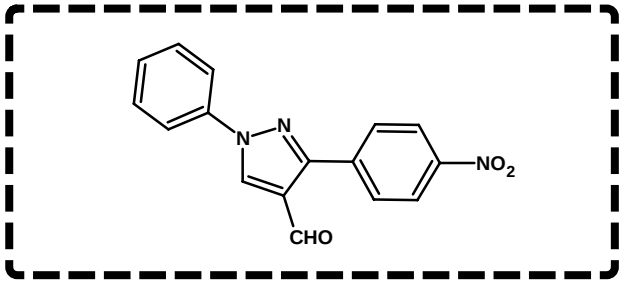


CHAPTER-2 - STUDIES ON PYRAZOLES

One of the most useful class in heterocyclic compounds is Pyrazole. The pyrazole ring consists of a doubly unsaturated five membered ring containing two adjacent nitrogen atoms.

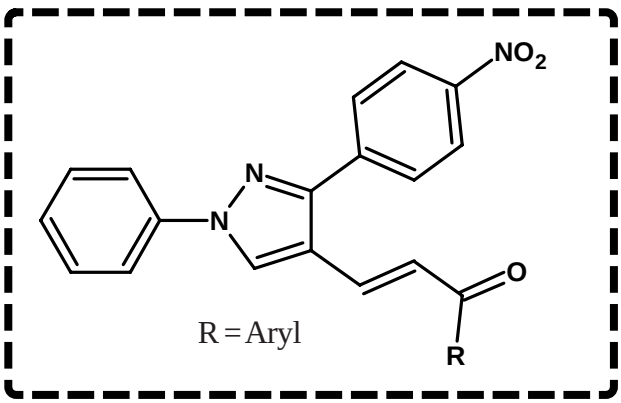
The research on the chemistry of pyrazoles has been a focus of attention for chemists for a long time, due to their wide spread diversified biological activities like antitubercular, antimicrobial, hypnotics, anti-inflammatory, antitumor, plant growth regulators and are also used as herbicidal and fungicidal.

Considering the increasing importance of pyrazole nucleus, the synthesis of some new chalcones, pyrazolines, cyanopyridines, thiazolidinones has been undertaken.



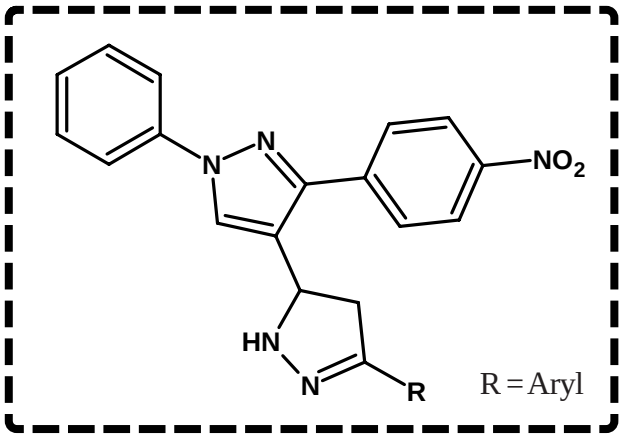
SECTION-I- STUDIES ON CHALCONES

The chemistry of chalcones has generated intensive scientific studies throughout the world. Specially interest has been focused on the synthesis and biodynamic activities of chalcones. In chalcones two aromatic rings are linked by an aliphatic three carbon chain. Presence of α,β-unsaturated carbonyl group gives good biological activity.



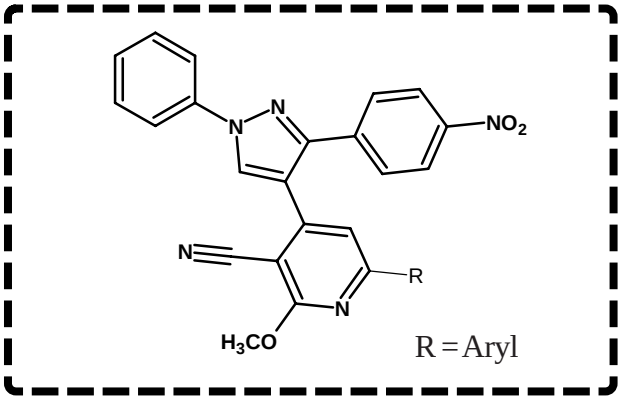
SECTION-II- STUDIES ON PYRAZOLYLPYRAZOLINES

Pyrazolines are well known for their varied applications in the field of medicine. Amongst nitrogen containing five membered heterocycles, pyrazolines have proved to be the most useful framework. These pyrazoline derivatives have been prepared by the reaction of chalcones with hydrazine hydrate.



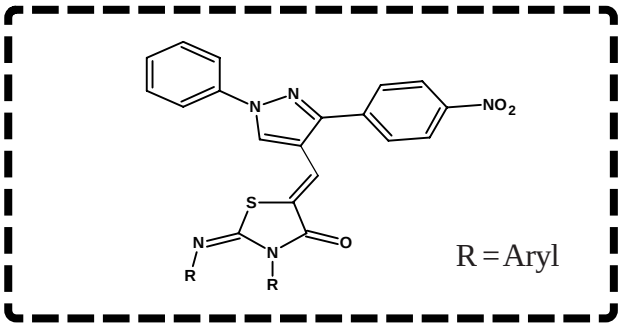
SECTION-III- STUDIES ON CYANOPYRIDINES

Pyridine is belonging to an important class of heterocyclic compounds with applications in the field of medicine, agriculture and industrial chemistry. Some pyridine derivatives are active in the metabolism of body and also used as a denaturant for antifreeze mixtures, as a dyeing assitant in textiles and fungicides.



SECTION-IV- STUDIES ON THIAZOLIDINONES

It has been reported that compounds bearing thiazolidinones nucleus show wide range of biological activities such as antitumor, antileprosy, antitubercular and anti-bacterial etc. By considering these valid observations, we have synthesized some new 5-arylidine-4-thiazolidinones shown as under.

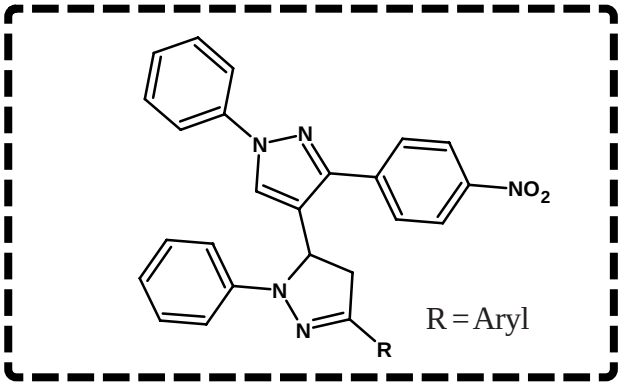


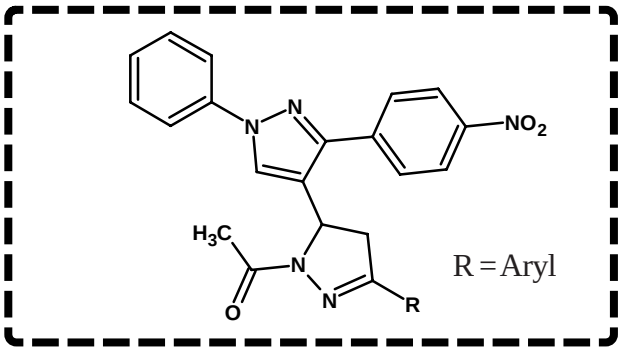
CHAPTER-3- COMPARISION OF DIFFERENT SYNTHESIS METHODS

In the last few years Microwave-induced Organic Reaction Enhancement (MORE) chemistry has gained popularity as a non-conventional technique for rapid organic synthesis. Many researchers have reported the synthetic utility of MORE chemistry in routine organic synthesis. Compared to traditional processing of organic synthesis, microwave-enhanced chemistry saves significant time and very often improves conversions, clean product formation.

Ultrasound waves are known for their wide applications in various fields like life sciences, medical, cleaning, sonar, electronics, agriculture, oceanography, material science etc(. Further, these waves prove to be important in synthetic organic chemistry by lowering the reaction temperature and reaction time. By using these waves, yield can be increased and one can avoid the use of phase transfer catalysts in chemical reactions.

This prompted us to synthesize various substituted pyrazoline derivatives using the Microwave-assisted (MW) method, Ultrasound irradiation (US) and Conventional thermal (Con.) method.





PART-2

PHYSICO CHEMICAL PROPERTIES

CHAPTER-1- ACOUSTICAL PROPERTIES

In this chapter, sound velocity studies of some triazole derivatives in dimethylformamide (DMF) and tetrahydrofuran(THF) solution were done at 308.15 K with a view to understand the molecular interactions in these solutions. From these experimental data, various acoustical parameters such as isentropic compressibility, Rao's molar sound function, specific acoustical impedence, internal pressure, Vander Waals constant, free volume etc. were evaluated and results are discussed.

CHAPTER-2- DENSITY AND REFEACTIVE INDEX

In this chapter, the density and refractive index of all triazole Schiff bases have determined in Dimethylformamide (DMF) and Tetrahydrofuran (THF) solutions at 308.15 K. Refractive index is a property of the material and is extremely useful in chemical analysis.

CHAPTER-3- CONDUCTANCE

The solutions of different concentrations were prepared for each Schiff base in DMF and DMSO and the conductance of each solution was measured and equivalent conductance at infinite dilution for different schiff bases was evaluated.

CHAPTER-4- THERMAL PROPERTIES

This chapter describes the thermal properties of Schiff bases. The Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA) and Thermo Gravimetric Analysis (TGA) measurements were made. Thermal method of analysis like TGA is employed in the study of the thermal behaviour of compounds and more particularly about their thermal stability.

CHAPTER-5- HEAT OF SOLUTIONS

The molar heat of solution and melting temperature of a substance can be deter mined from the solubility measurement at different temperatures. In the present work, heat of solutions for all the Schiff bases were determined at different temperatures (35-55°C) in THF and 1,4-dioxane.

PART-3

BIOLOGICAL ACTIVITIES

Biological Activity Spectrum of a compound represents the pharmacological effects, physiological and biochemical mechanisms of action, specific toxicity which can be revealed in compound's interaction with biological system. Further, it describes the intrinsic properties of the compound which depends on its structure. Most of known biologically active substances have many different biological activities such as antibacterial, anti-inflammatory,antifungal,anti-HIV,antipyretic,antitumoretc.

A literature survey shows that a number of triazole derivatives have good antibac terial and antifungal activities. Considering these properties of triazole derivatives, in the present chapter, antibacterial and anti-fungal activities of some triazole derivatives were studied.

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Signature of the Student

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GENERAL INTRODUCTION

The chemistry of the heterocyclic compounds is as logical as that of aliphatic or aromatic compounds. The variety of heterocyclic compounds is enormous, their chemistry is complex and synthesizing them requires great skill.

A heterocyclic compound is one which possesses acyclic structure with at least two different kinds of atoms in the ring. Among large number of heterocycles found in nature, nitrogen heterocycles are the most abundant than those containing oxygen or sulfur. The number of atoms in the heterocyclic ring can range from three to many i.e. ethylene oxide to crown ethers. Heterocyclic compounds can contain more than one ring system either heterocyclic or homocyclic.

Heterocyclic systems are encountered in many groups of organic compounds possessing great applicability in industry as well as in our life in various ways. Most of the sugars and their derivatives contain hetero atoms. Many members of the vitamin B group possess heterocyclic ring containing nitrogen.

This class of compounds have great applicability as drugs due to their specific chemical reactivity. They resemble essential metabolism and they fit biological receptors and block their normal working. Many natural products contain heterocyclic compounds such as alkaloids and glycosides. Many antibiotics including penicillin, cephalosporin, norfloxacin, streptomycin etc. also contain heterocyclic ring.

Taking in view of the applicability of heterocyclic compounds, the present work was undertaken to synthesize some new heterocycles bearing triazole and pyrazole nucleus.

INTRODUCTION

Triazoles are heterocyclic organic compounds having a five-member ring molecular structure containing three nitrogen atoms. Triazoles are of two types: 1, 2, 4-triazole and 1, 2, 3-triazole. The chemistry of 1,2,3-triazoles and 1,2,4-triazoles were well documented[1-9]. The chemistry of triazole derivatives have been of interest due to its useful application in medicine[10], agriculture[11] and industry[12]. Further, some of these triazoles are known to be used as analytical reagents[13], dyes and photographic chemicals[14] and in the preparation of polymers[15].

The first 1, 2, 4-triazole derivative was synthesized by Bladin in 1885. Synthesis of various triazole derivatives have been reported[16-22]. Alkinson and Polya[23] synthesized 1,3-diphenyl 1,2,4,triazole. From diaroylhydrazines, Klingsberg[24] prepared triaryl-s-triazoles. Kurzer and Canelle[25] synthesized some 4-substitutetd 3-amino-5-mercapto-1,2,4-triazoles. Beresneva et al.[26] reported synthesis of 3-(1,2,4-trazole-4-yl)-5-amino 1,2,4-triazole. Preparation and characterization of four isomeric oxodihydro s-triazolo pyrimidines was studied by Reimlinger and Peiren[27]. Synthesis of various new triazoles have also been reported by several workers.[28-30] Preparation and reactivity of some mesoionic 1,2,4-triazolo-[4,3-b]-1,2,4-triazole derivatives have been documented by Molina et al[31]. Szilagyi et al[32] reported the preparation of new 1,5-diaryl-3-alkylthio-1H-1,2,4-triazoles and corresponding sulfoxides and sulfones. Reid and Heindal synthesized triazoles by the reaction of aryl acid hydrazide with CS_2/KOH and Hydrazine hydrate [33]. Yasin and co-workers synthesized new triazoles via conversion of 1-[á-aracyl-β-(2-thienyl)] acrocyl semicarbazides into 1, 2, 4-triazoles.[34] Kee-Jung Lee et al. prepared 1,2,4-triazoles from the elctrocyclic reaction of conjugated heterocumelenes.[35]

Literature survey reveals that 1,2,4-triazole nucleus is associated with diverse pharmacological activities such as anti-inflammatory [36,37], diuretic[38], antiviral[39,40], antihypertensive[41,42], anthalmentic[43], bactericidal [44,45], anticonvulsant[46-48], herbicidal[49], insecticidal and acaricidal [50], fungicidal [51,52], antimicrobial [53,54], anticancer and anti-HIV[55,56], plant growth regulator[57], antileishmanial[58], antitumor[59], antidepressant and anxiolytic[60,61], anti tuberculosis[62], mycobacterial activity[63,64], A_{2A}

receptor antagonists[65], corrosion inhibitor[66-68], analgesic[69] and antifungal activity [70,71]. Atsuo et.al. have reported triazoles as antiheumatic agents[72]. Mohammad has also reported anti-inflammatory activity of 1, 2, 4-triazole derivatives[73]. Jag Mohan et. al have synthesized thiazolo triazoles and studied their antimicrobial activity[74]. Slawanski have prepared some triazoles and studied their potent cardiovascular agent[75]. 1, 2, 4-triazoles are also known to inhibit Erisyphegraminis on barley [76]. Carla have investigated antigestative immuno suppressant and antitumor activity of some triazoles[77]. Uesaka et al. also documented triazoles as adrenergic $\propto_2$C receptor antagonists[78].

Various drugs have already been synthesized of the medicinal uses which contains the 1, 2, 4-triazole nucleus. Some of the drugs are: Fluconazole (antifungal), Rifavirin (antiviral, antiinfections), Diniconazole (agriculture- fungicide), Itraconazole (antifungal), Bitertanol (fungicide), Triazophose (pesticide), Letrozole (estrogen inhibitor- antineoplastic), Diclobutrazole (plant growth regulator) and Rilmazafone (sedative-hypnotic).

Prompted by the biological activities of 1,2,4-triazole and as a part of our general search concerning chemotherapeutically important azoles heterocycles, in present work, an attempt has been made to synthesize some 4-amino-3-mercapto 1,2,4-triazole derivatives.

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INTRODUCTION

Azomethines are generally known as Schiff bases to honour Schiff, who synthesized such compounds[1]. These are the compounds containing characteristic –C=N- group. Lots of works have been done on this class compounds due to its multi applicability. They are well known intermediate for the preparation of azetidinones, thiazolidinones, aryl acetamides and many other derivatives. The reaction between amine and formaldehyde followed by further reaction with compounds having active hydrogen gives mannich bases.

Azomethines can be formed by the reaction of a primary amine with aldehyde with the simultaneous removal of water. The loss of water, give an imine, corresponds to the "Crotonaldehyde stage" of the aldol condensation. Several methods have been reported for the preparation of azomethines. Sampat and Mehta gave the detail study report on heterocyclic Schiff bases legends derived from pyrazole 2-caboxy aldehyde and pyridine-2-carboxy aldehyde with o-toludine, p-toludine and aniline. Chang and Pan reported some Schiff bases derived from amino phenols and aromatic aldehydes[2]. More et al.[3] have marked the biological activity of Schiff bases synthesized from aminothiazoles. Selvam et al. have prepared sulfonamide and its derivatives as anti-HIV agents[4].

The azomethine derivatives of 1,2,4-triazole have been found to be potent drug pharmaceutical industries and possess a wide spectrum of biological activity[5-8]. Wei et al.[9] have synthesized new type of Schiff bases containing triazole ring which are observed to be potential fungicides. Yadawe and Patil have reported some azomethines which were screened for their antibacterial and antifungal activities[10] Khalafallah and Hasan have also suggested some styryl Schiff's bases as potential antibacterial and antifungal agents[11]. Holla et al. have documented azomethine bearing triazole moiety which possess good antibacterial activity[12]. Owing to their characteristic properties like, manifestations of novel structures, thermal stabilities, abnormal magnetic properties, relevant biological properties, high synthesis flexibility, varied coordinating ability and medicinal utility, a wide range of these compounds have been synthesized[13-19] and extensively studied[20-30].

These observations led us to synthesise Schiff bases bearing 1,2,4-triazole moiety to enhance the overall activities of resulting moiety.

EXPERIMENTAL

The following Schiff bases of triazoles have been synthesized for physico chemical properties.

1: 4-({[3-Mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl (HAS-1)

2: 4-[{4-Methoxybenzylidene} amino]-5-(4-methoxyphenyl)-4H-1, 2, 4-triazole-3-thiol (HAS-2)

3: 4-[(4-Fluorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1,2,4-triazole-3-thiol (HAS-3)

4: 5-({[3-Mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)

5: 4-[(4-Chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol (HAS-5)

6: 4-{[4 -(Dimethylamino) benzylidene] amino}-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-6)

7: 5-(4-methoxyphenyl)-4-[(3-nitrobenzylidene) amino]-4*H*-1, 2, 4-triazole-3-thiol (HAS-7)

8: 4-[(2-Chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-8)

9: 2-({[3-Mercapto-5-(4-methoxyphenyl)-4*H*-1,2,4-triazolyl]imino}methyl) phenol (HAS-9)

10: 5-(4-Methoxyphenyl)-4-{[(1*E*)-phenylmethylene] amino}-4*H*-1, 2, 4 triazole-3-thiol (HAS-10)

Synthesis of 4-amino-5-(4-methoxyphenyl)-4H-1, 2, 4- triazole-3-thiol (HAS-E)

All the reactions were carried out using following literature methods.

(1) Synthesis of 4-methoxy benzoate (HAS-B)[31]

4-Methoxy benzoic acid (0.01M) in 20 ml of methanol and 0.5 ml conc. sulfuric acid was refluxed for 12 hrs. and poured into ice. The product was isolated and treated with saturated sodium bicarbonate solution. Yield 92%, M.P. 219 ^{o}C

(2) Synthesis of 4-methoxy benzoic acid hydrazide (HAS-C)[31]

A mixture of 4-methoxy benzoate (0.01 M) and hydrazine hydrate (0.5g, 0.01 M) was heated for 9 hrs. and poured into ice. The product was isolated and crystallized from ethanol. Yield 71%, M.P. 156 ^{o}C

(3) Synthesis of potassium 4-methoxy benzoic acid hydrazide dithiocarbamate(HAS-D)[32]

A mixture of 4-methoxy benzoic acid hydrazide(0.01 M), KOH (0.84 g, 0.015 M) and 1.5 ml CS_2 in absolute alcohol was stirred for 21 hrs. and product isolated from diethyl ether. Yield 85%, M.P. 196 ^{o}C

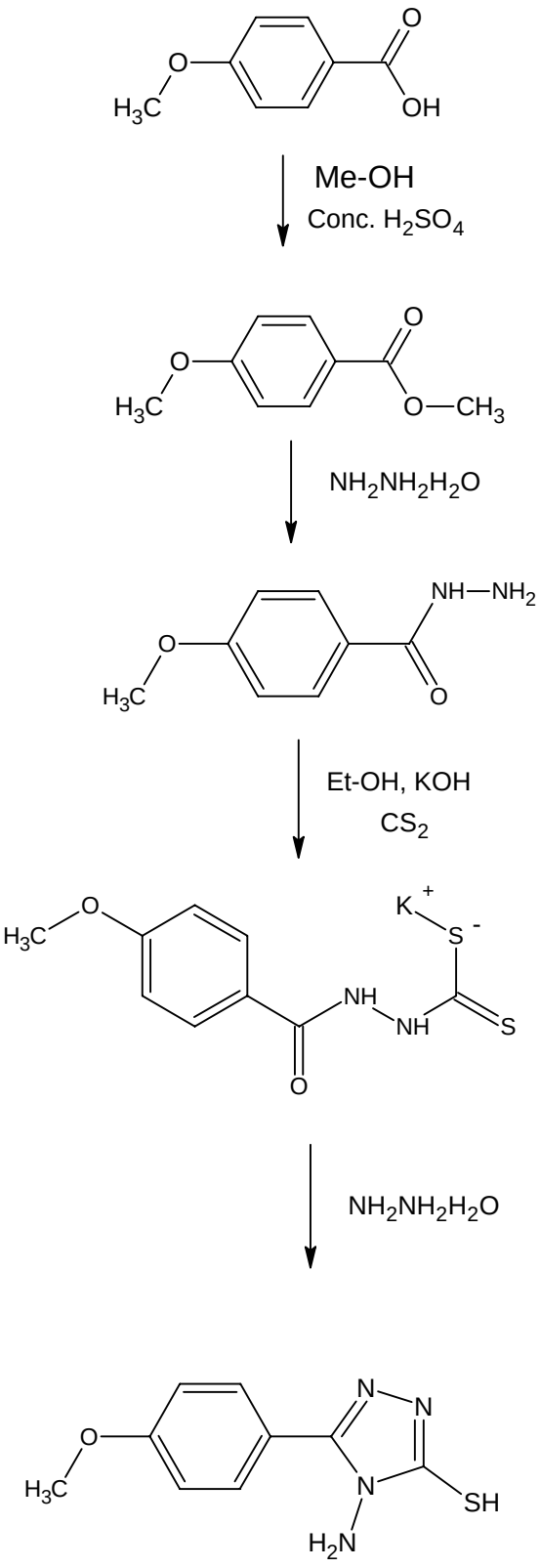
(4) Synthesis of 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (HAS-E)[32]

Potassium salt (0.01 M) was taken in hydrazine hydrate and heated up to the evolution of H_2S gas caused nearly 5 hrs. in oil bath. The reaction mixture was poured onto crushed ice and treated with gla. acetic acid. The product was filtered and purified by KOH treatment and crytallised from ethanol. Yield 65%, M.P. 215 ^{o}C

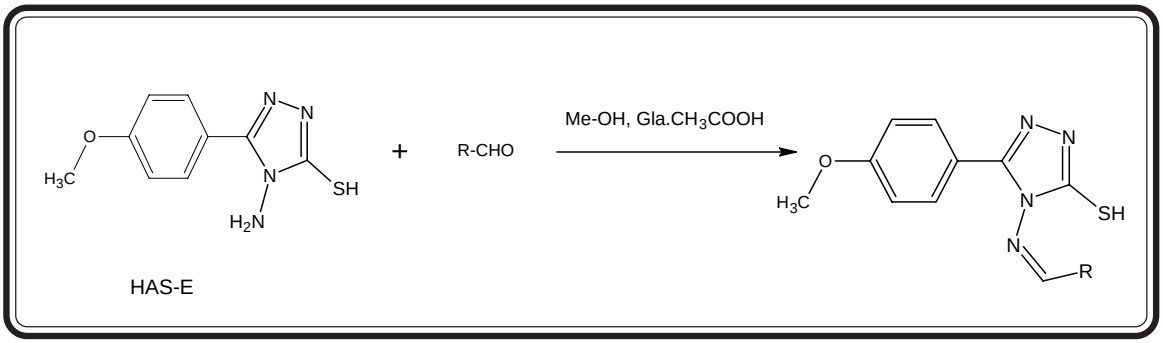
(5) Synthesis of Schiff bases (HAS-1 to 10)[33]

A mixture of HAS-E (0.01M, 2.22gm) and different aromatic aldehydes was taken in ethanol and 2-3 drops of gla. acetic acid was added and the reaction mixture was refluxed for 10 hours. The product was isolated and crytallised by absolute alcohole.

REACTION SCHEME



Reaction scheme of Schiff bases



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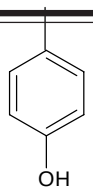
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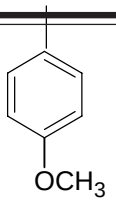
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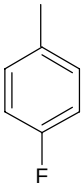
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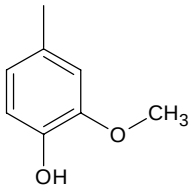
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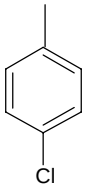
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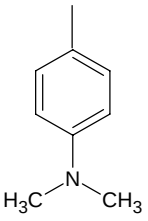
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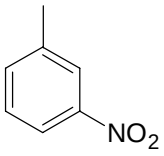
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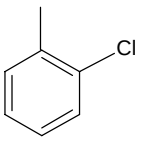
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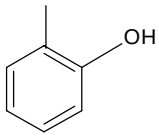
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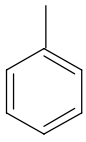

HAS-10

SPECTRAL STUDIES OF SCHIFF BASES

INFRA RED SPECTRA

An invaluable tool in organic structure determination and verification involves the class of electromagnetic (EM) radiation with frequencies between 4000 and 400 cm^{-1} (wave numbers). The category of EM radiation is termed infrared (IR) radiation, and its application to organic chemistry known as IR spectroscopy. Radiation in this region can be utilized in organic structure determination by making use of the fact that it is absorbed by interatomic bonds in organic compounds. Chemical bonds in different environments will absorb varying intensities and at varying frequencies. Thus IR spectroscopy involves collecting absorption information and analyzing it in the form of a spectrum.

The region of the infrared spectrum which is of greatest interest to organic chemists is the wavelength range 2.5 to $\approx$15 micrometers (μ). In practice, units proportional to *frequency*, (wave number in units of cm^{-1}) rather than wavelength, are commonly used and the region 2.5 to 15 μ corresponds to approximately 4000 to 600 cm^{-1}. Absorption of radiation in this region by a typical organic molecule results in the excitation of vibrational, rotational and bending modes, while the molecule itself remains in its electronic ground state.

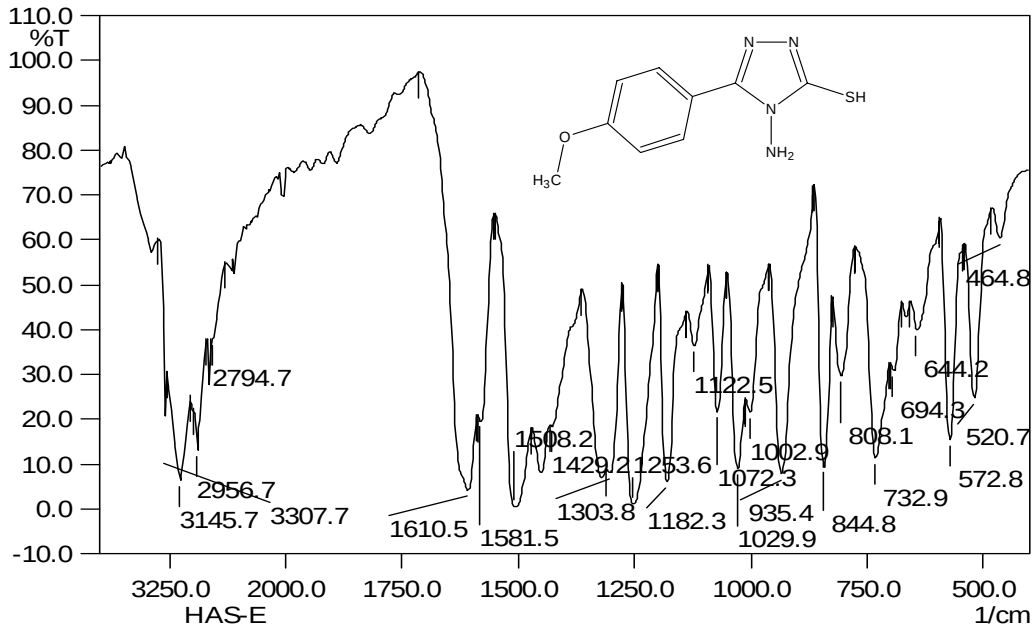
For the purpose of routine organic structure determination, using a battery of spectroscopic methods, the most important absorptions in the infrared region are the simple stretching vibrations. For simple systems, these can be approximated by considering the atoms as point masses, linked by a 'spring' having a force constant *k* and following Hooke's Law.

Instrument: SHIMADZU-FT-IR 8400 Spectrophotometer

Frequency range: 4000-400 cm^{-1}

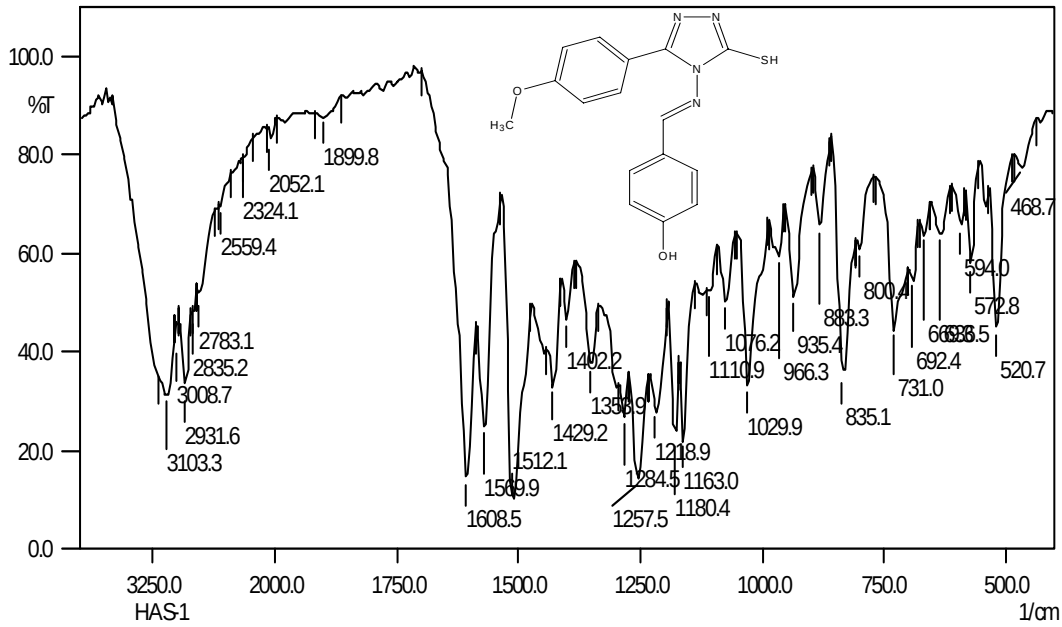
Sample technique: Kbr disc

Table 1: IR spectral study of 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole - 3 - thiol (HAS - E)



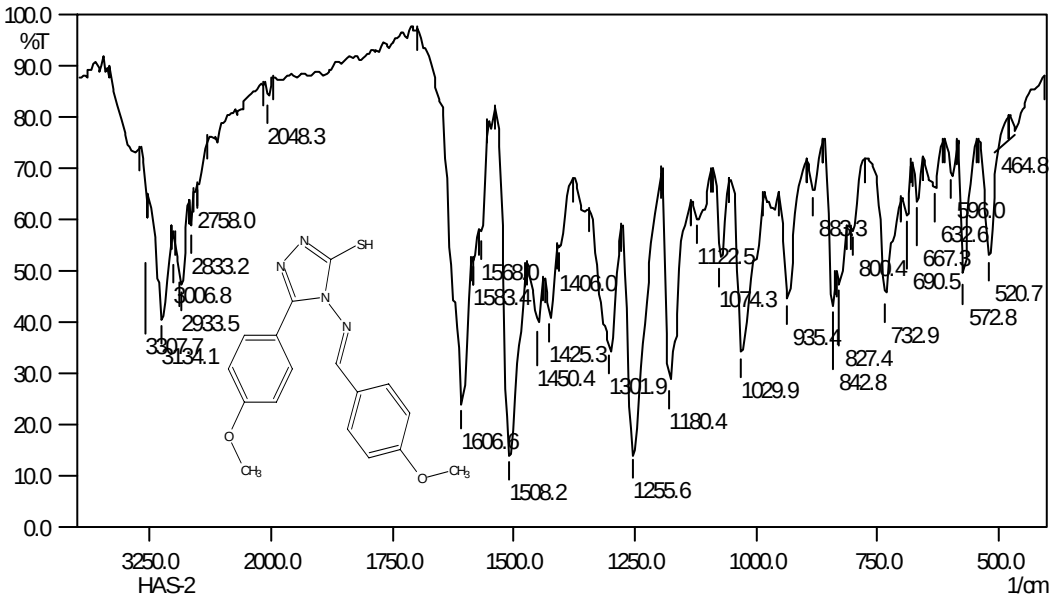
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2956	2975 - 2950
	C-H str.(sym.)	2794	2880 - 2860
	C-H def.(asym.)	1429	1470 - 1420
	C-H def.(sym.)	1303	1385 - 1300
Aromatic	C-H str.	3145	3150 - 3030
	C=C	1508	1585 - 1480
	C-H i.p. def.	1122	1125 - 1090
		1072	1070-1000
	C-H o.o.p. def.	808	835 - 810
Triazole	C=N str.	1610	1650 - 1580
	C-N str.	1253	1350 - 1200
	C-O-C str. (sym.)	1029	1050-1010
	N-H str. ($-NH_2$)	3307	3400-3250
	C-S str.	732	740-640

Table 2: IR spectral study of 4-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazol-4-yl] imino} methyl (HAS-1)



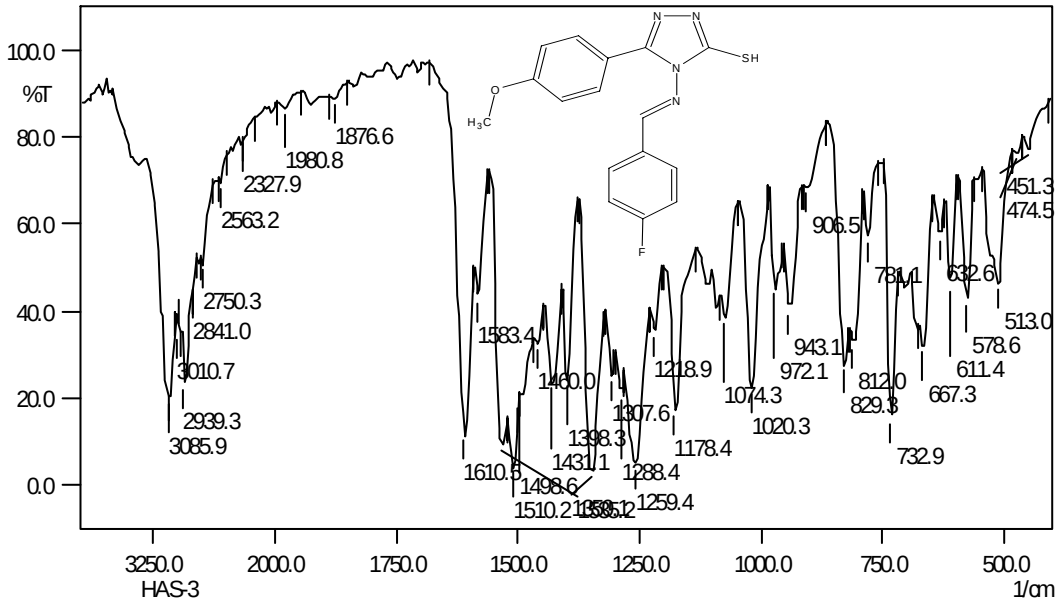
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2931	2975 - 2950
	C-H str.(sym.)	2835	2880 - 2860
	C-H def.(asym.)	1429	1470 - 1435
	C-H def.(sym.)	1358	1385 - 1350
Aromatic	C-H str.	3008	3100 - 3030
	C=C	1512	1585 - 1480
	C-H i.p. def.	1110	1125 - 1090
		1076	1070-1000
	C-H o.o.p. def.	835	835 - 810
Triazole	C=N str.	1608	1650 - 1580
	C-N str.	1257	1350 - 1200
	C-O-C str.(sym.)	1029	1050-1010
	C-S str.	692	700-600
	S-H str.	2324	2400-2300

Table 3: IR spectral study of 4-[{4-methoxy benzylidene} amino]-5-(4-methoxy phenyl)-4H-1, 2, 4- triazole-3-thiol(HAS-2)



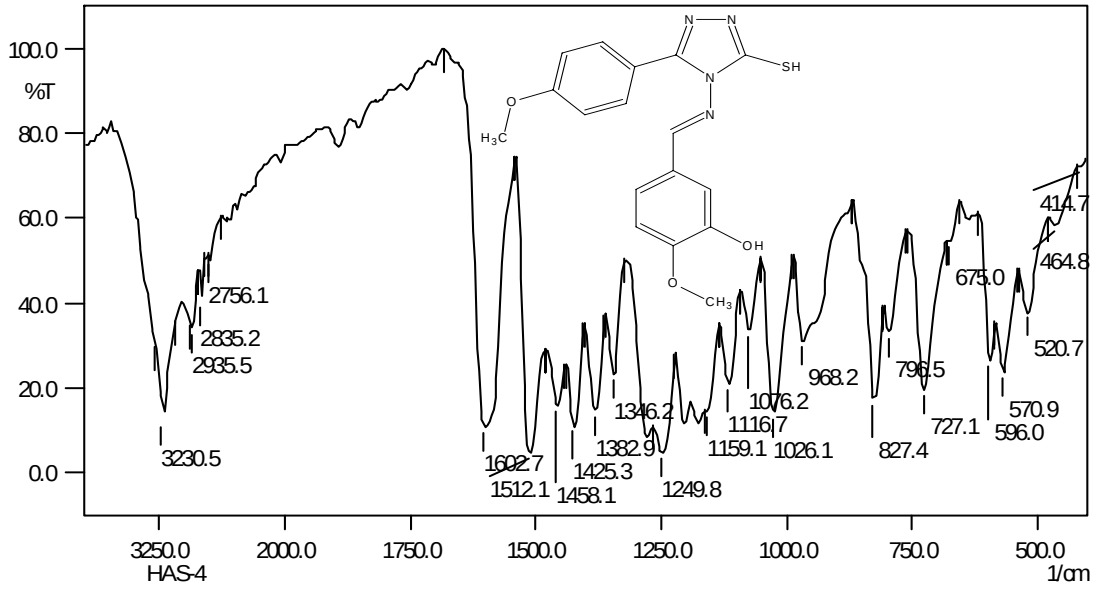
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2933	2975 - 2950
(Methyl)	C-H str.(sym.)	2833	2880 - 2860
	C-H def.(asym.)	1450	1470 - 1435
	C-H def.(sym.)	1301	1385 - 1350
Aromatic	C-H str.	3006	3100 - 3030
	C=C	1508	1585 - 1480
	C-H i.p. def.	1122	1125 - 1090
		1074	1080-1000
	C-H o.o.p. def.	824	835 - 810
Triazole	C=N str.	1606	1650 - 1580
	C-N str.	1255	1350 - 1200
	C-O-C str.(sym.)	1029	1075-1010
	C-S str.	690	700-600

Table 4: IR spectral study of 4-[(4-fluorobenzylidene) amino]-5-(4-methoxy phenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-3)



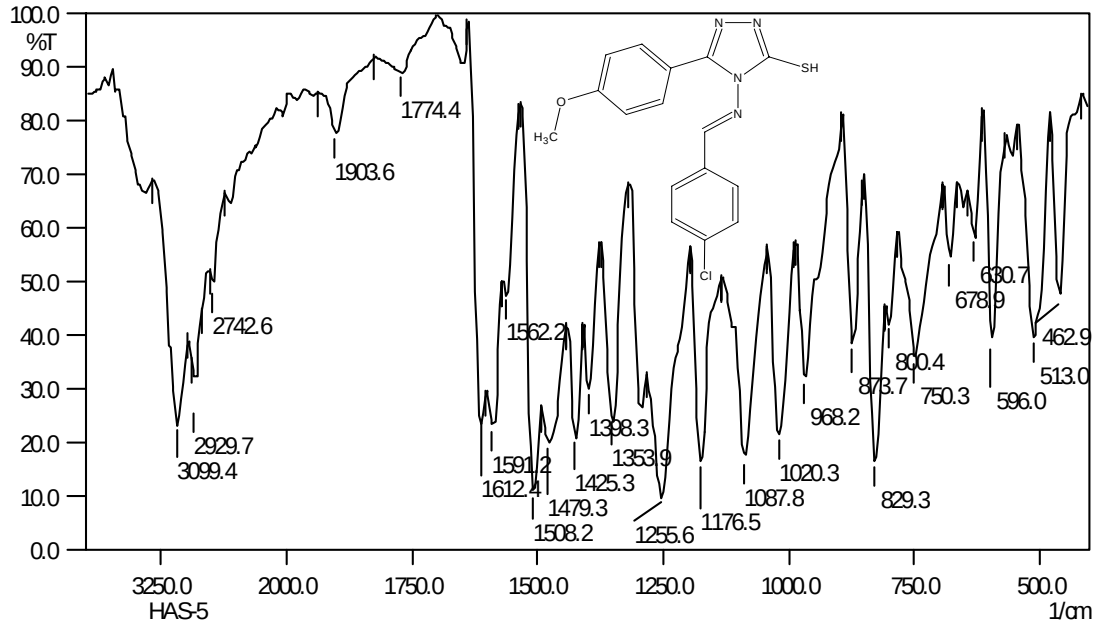
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2939	2975 - 2950
	C-H str.(sym.)	2841	2880 - 2860
	C-H def.(asym.)	1431	1470 - 1435
	C-H def.(sym.)	1398	1385 - 1350
Aromatic	C-H str.	3010	3100 - 3030
	C=C	1510	1585 - 1480
	C-H i.p. def.	1178	1125 - 1090
		1074	1070-1000
	C-H o.o.p. def.	829	835 - 810
Triazole	C=N str.	1610	1650 - 1580
	C-N str.	1288	1350 - 1200
	C-O-C str.(sym.)	1020	1075-1010
	C-S str.	667	700-600
	S-H	2327	2300-2400

Table 5: IR spectral study of 5-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)



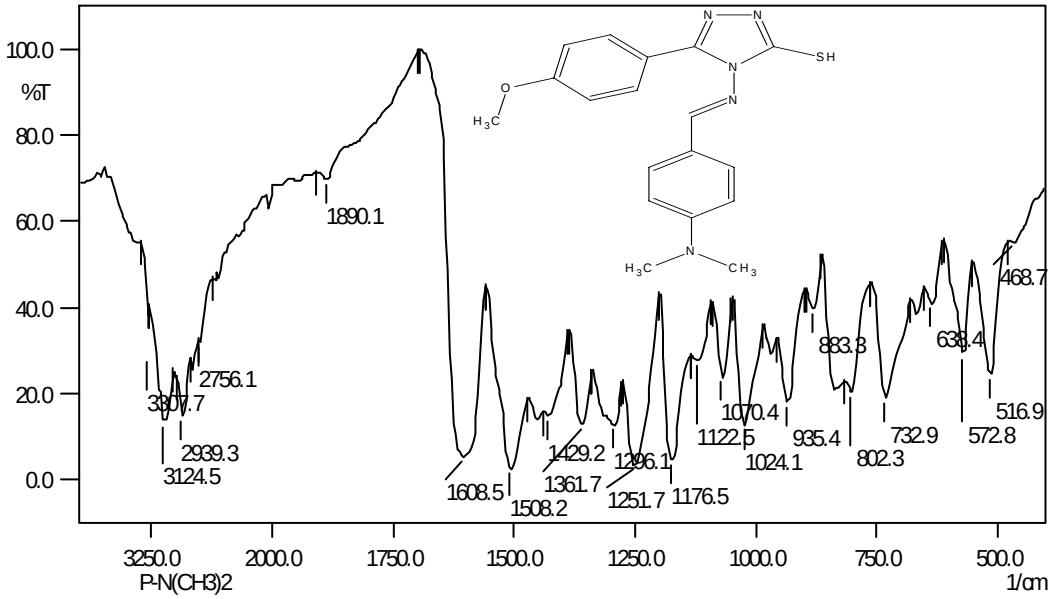
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2935	2975 - 2950
	C-H str.(sym.)	2835	2880 - 2860
	C-H def.(asym.)	1458	1470 - 1435
	C-H def.(sym.)	1382	1385 - 1350
Aromatic	C=C	1512	1585 - 1480
	C-H i.p. def.	1116	1125 - 1090
		1076	1070-1000
	C-H o.o.p. def.	827	835 - 810
Triazole	C=N str.	1602	1650 - 1580
	C-N str.	1249	1350 - 1200
	C-O-C str.(sym.)	1026	1075-1010
	C-S str.	675	700-600

Table 6: IR spectral study of 4-[(4-chlorobenzylidene) amino]-5-(4-methoxy phenyl)-4*H*-1, 2, 4-triazol (HAS-5)



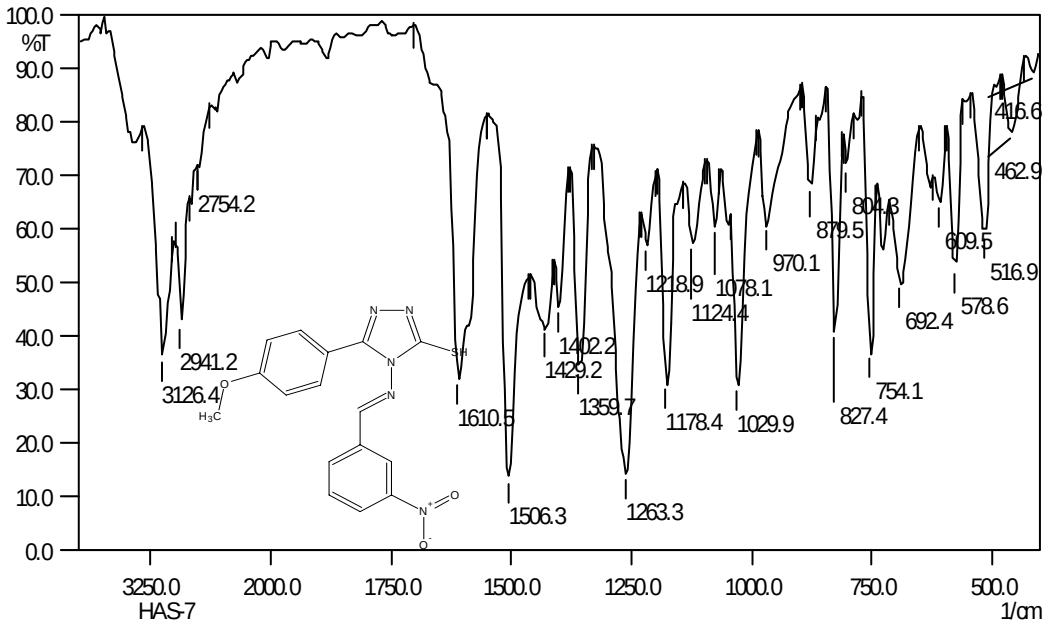
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2929	2975 - 2950
	C-H str.(sym.)	2839	2880 - 2860
	C-H def.(asym.)	1425	1470 - 1435
	C-H def.(sym.)	1353	1385 - 1350
Aromatic	C-H str.	3099	3100 - 3030
	C=C	1508	1585 - 1480
	C-H i.p. def.	1176	1125 - 1090
		1087	1070-1000
	C-H o.o.p. def.	829	835 - 810
Triazole	C=N str.	1612	1650 - 1580
	C-N str.	1255	1350 - 1200
	C-O-C str.(sym.)	1020	1075-1010
	C-S str.	678	700-600

Table 7: IR spectral study of 4-{[4-(dimethylamino) benzylidene] amino}-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-6)



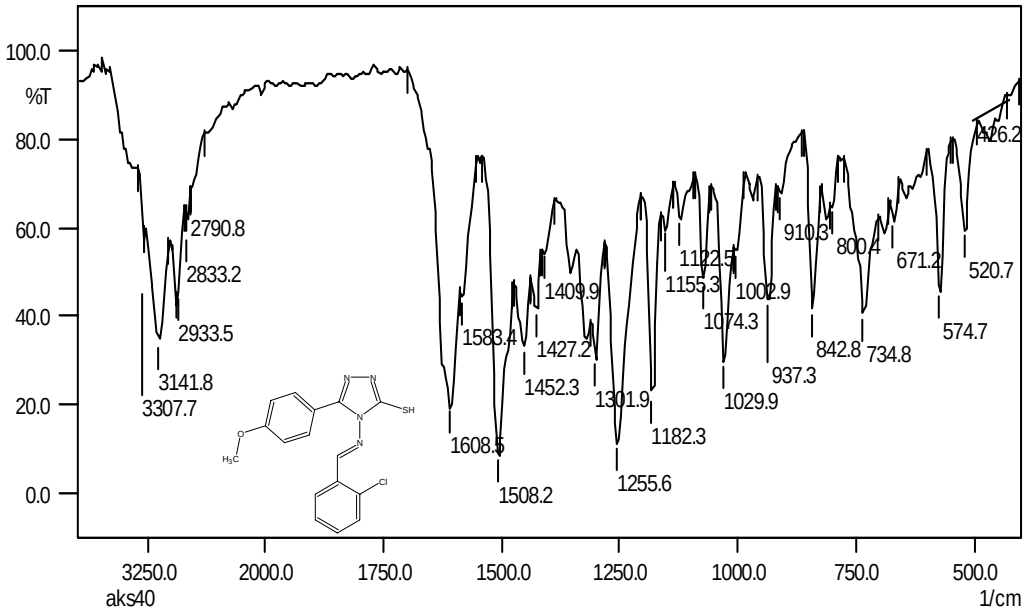
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2939	2975 - 2950
	C-H def.(asym.)	1429	1470 - 1435
	C-H def.(sym.)	1361	1385 - 1350
Aromatic	C=C	1536	1585 - 1480
	C-H i.p. def.	1122	1125 - 1090
		1070	1070-1000
	C-H o.o.p. def.	802	835 - 810
Triazole	C=N str.	1608	1650 - 1580
	C-N str.	1251	1350 - 1200
	C-O-C str.(sym.)	1024	1075-1010
	C-S str.	638	700-600

Table 8: IR spectral study of 5-(4-methoxyphenyl)-4-[(3- nitrobenzylidene)amino]-4*H*-1, 2, 4-triazole-3-thiol (HAS-7)



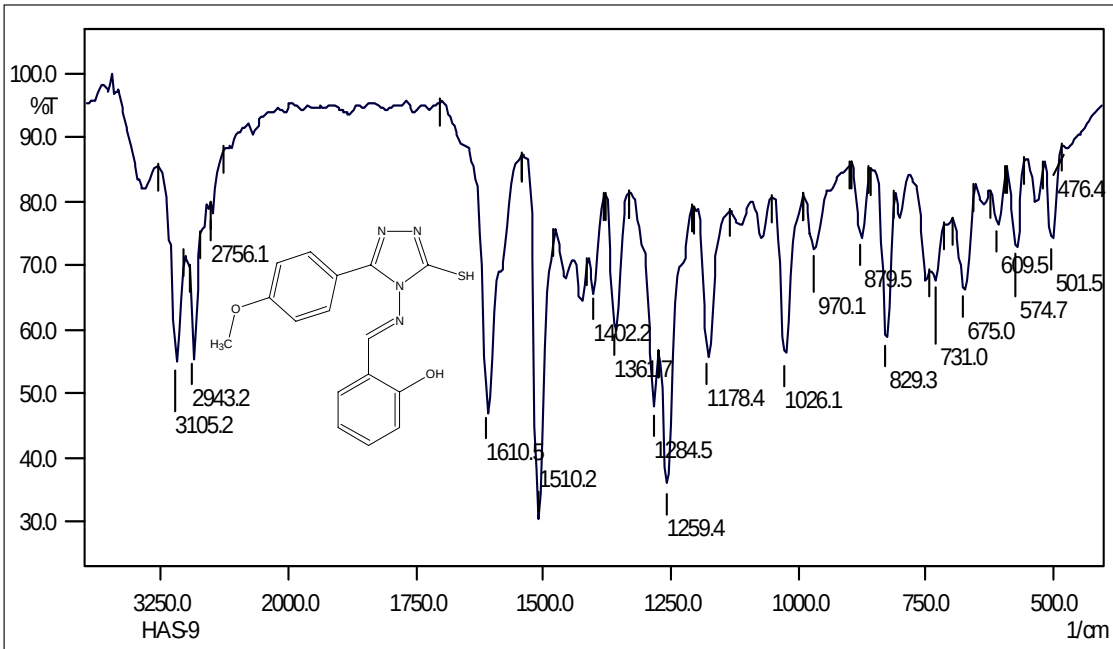
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2941	2975 - 2950
	C-H str.(sym.)	2839	2880 - 2860
	C-H def.(asym.)	1429	1470 - 1435
	C-H def.(sym.)	1359	1385 - 1350
Aromatic	C=C	1506	1585 - 1480
	C-H i.p. def.	1124	1125 - 1090
		1078	1070-1000
	C-H o.o.p. def.	827	835 - 810
Triazole	C=N str.	1610	1650 - 1580
	C-N str.	1263	1350 - 1200
	C-O-C str.(sym.)	1029	1075-1010
	C-S str.	692	700-600

Table 9: IR spectral study of 4-[(2-chlorobenzylidene) amino]-5-(4-methoxy phenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-8)



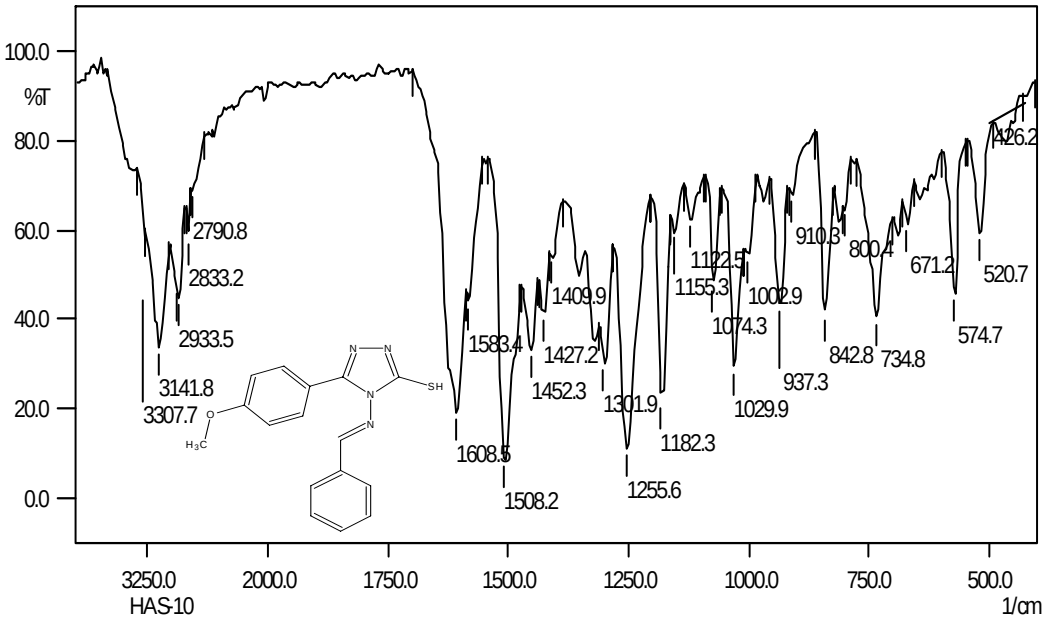
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2933	2975 - 2950
	C-H str.(sym.)	2833	2880 - 2860
	C-H def.(asym.)	1452	1470 - 1435
Aromatic	C=C	1508	1585 - 1480
	C-H i.p. def.	1122	1125 - 1090
		1074	1070-1000
	C-H o.o.p. def.	842	835 - 810
Triazole	C=N str.	1608	1650 - 1580
	C-N str.	1255	1350 - 1200
	C-O-C str.(sym.)	1029	1075-1010
	C-S str.	671	700-600

Table 10: IR spectral study of 2-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol yl] imino} methyl) phenol (HAS-9)



Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2943	2975 - 2950
	C-H def.(sym.)	1361	1385 - 1350
Aromatic	C-H str.	3105	3100 - 3030
	C=C	1510	1585 - 1480
	C-H i.p. def.	1178	1125 - 1090
	C-H o.o.p. def.	829	835 - 810
Triazole	C=N str.	1610	1650 - 1580
	C-N str.	1259	1350 - 1200
	C-O-C str.(sym.)	1026	1075-1010
	C-S str.	675	700-600

Table 11: IR spectral study of 5-(4-methoxyphenyl)-4-{[(1*E*)-phenylmethylene] amino}-4*H*-1, 2, 4-triazole-3-thiol (HAS-10)



Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2933	2975 - 2950
	C-H str.(sym.)	2833	2880 - 2860
	C-H def.(asym.)	1452	1470 - 1435
Aromatic	C=C	1508	1585 - 1480
	C-H i.p. def.	1122	1125 - 1090
		1074	1070-1000
	C-H o.o.p. def.	842	835 - 810
Triazole	C=N str.	1608	1650 - 1580
	C-N str.	1255	1350 - 1200
	C-O-C str.(sym.)	1029	1075-1010
	C-S str.	671	700-600

^{1}H NMR SPECTRA

The effect was first noticed in 1902 by P. Zeeman, a physicist, who won a Nobel Prize for noticing that nuclei of certain atoms behave strongely in a magnetic field. Fifty years later F. Bloch and E. Purcell, both physicists put this idea to good use by constructing the first NMR spectrometer. They too received a Nobel Prize for this work.

Nuclear Magnetic Resonance (NMR) spectroscopy is the absorption of radiofrequency radiation by a nucleus in a strong magnetic field. Absorption of the radiation causes the nuclear spin to realign or flip in the higher-energy direction. After absorbing energy the nuclei will reemit RF radiation and return to the lower-energy state.

This introduction is designed to explain Nuclear Magnetic Resonance spectroscopy, which is now the main structure determination tool used by organic chemists. This technique can be used to determine the structures of virtually all organic compounds, no matter how complex. It is even being used to determine very complex structures such as enzymes and proteins.

NMR produces a spectrum containing a number of peaks. The heights and positions of these peaks enables a chemist to very accurately determine what the carbon-hydrogen framework of an organic molecule is.

Proton Nuclear Magnetic Resonance (^{1}H NMR) Spectroscopy is a powerful method used in the determination of the structure of unknown organic compounds.

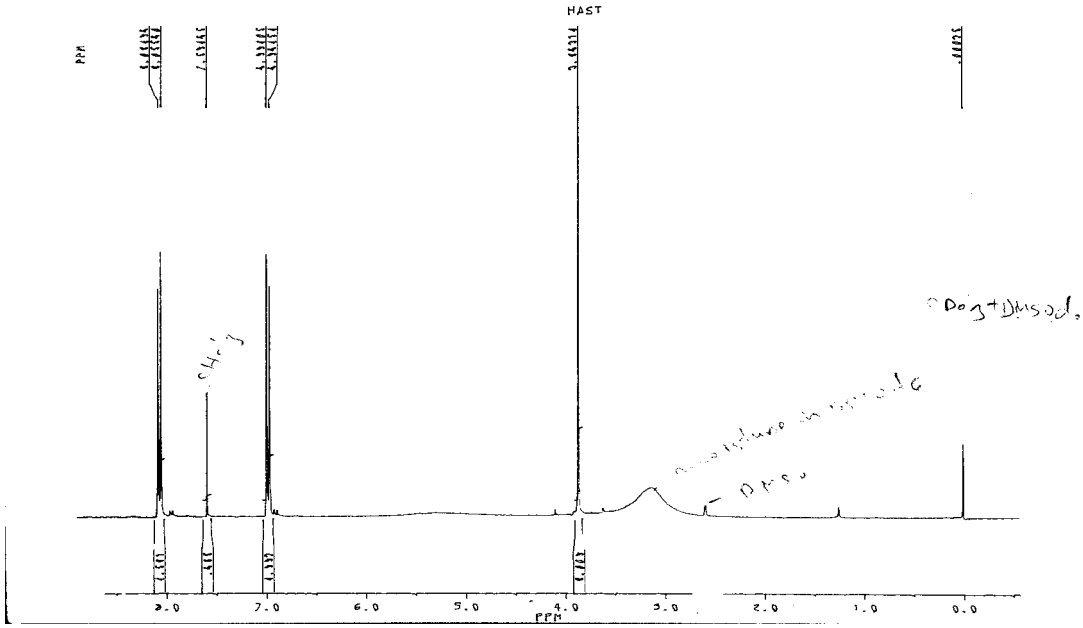
The principle of NMR is based upon the spin of atomic nuclei in an external magnetic field. Not all nuclei possess this ability. The main two which are used are the proton (^{1}H) and an isotope of carbon (^{13}C).

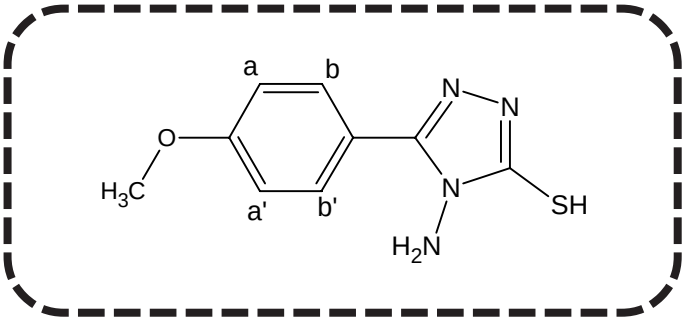
Instrument : BRUKER Spectrometer (300 MHz)

Internal reference : TMS

Solvent : $CDCl_3$/DMSO

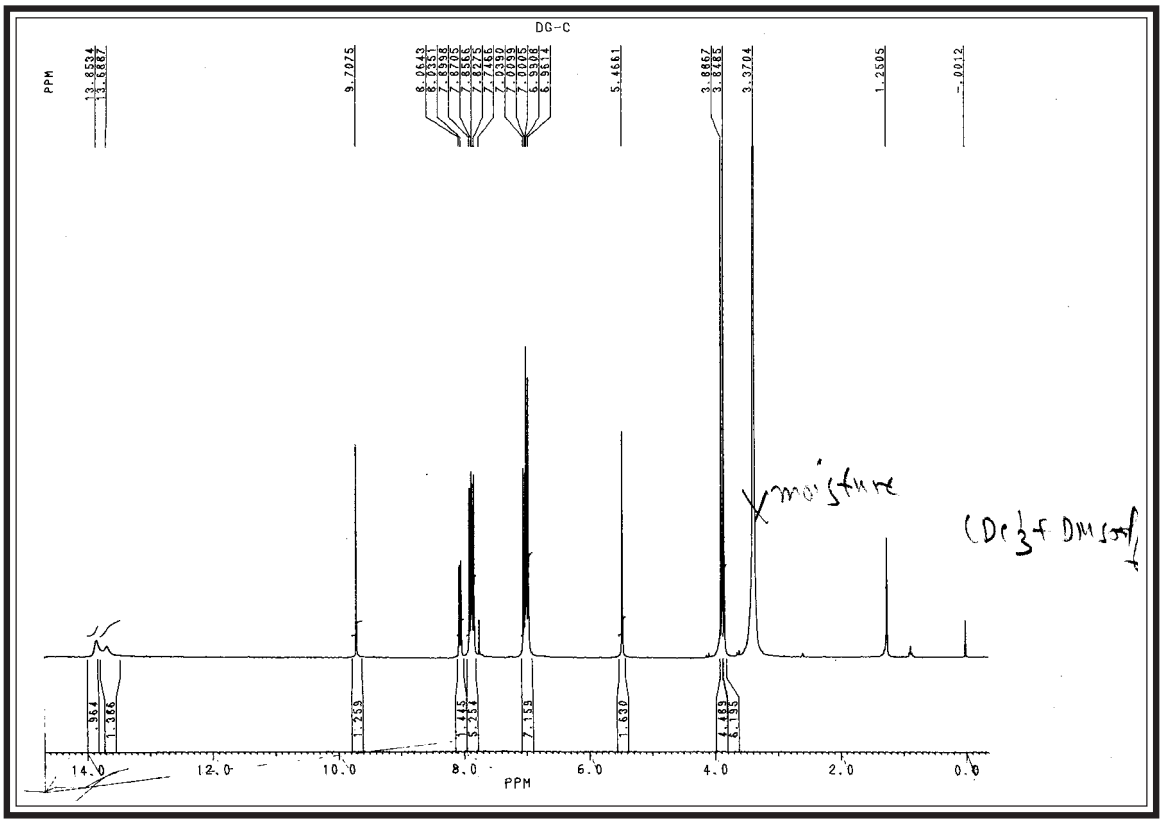
Table 12: 1H NMR spectral study of 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (HAS-E)

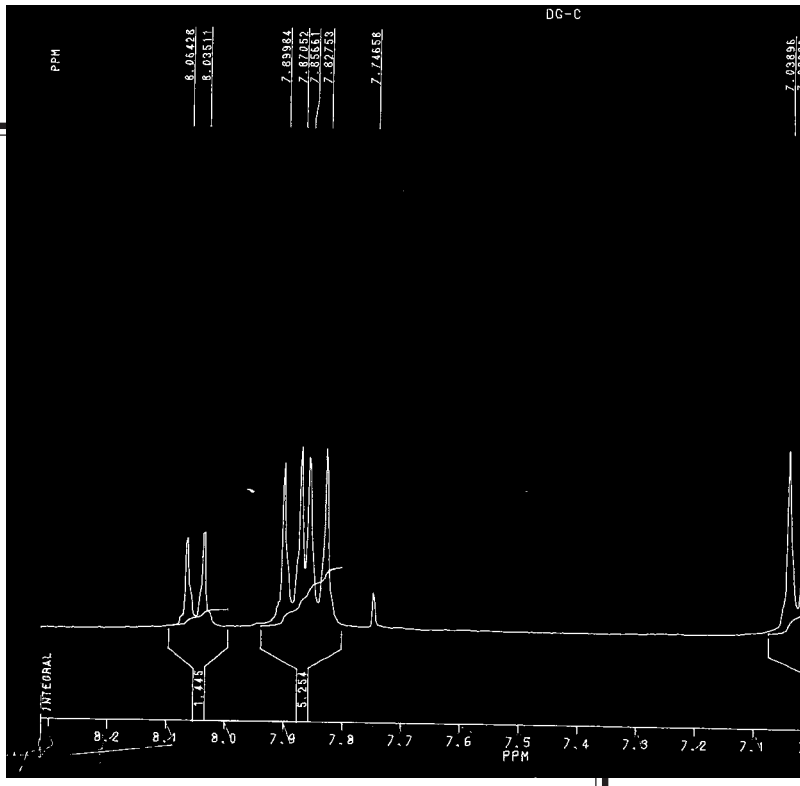




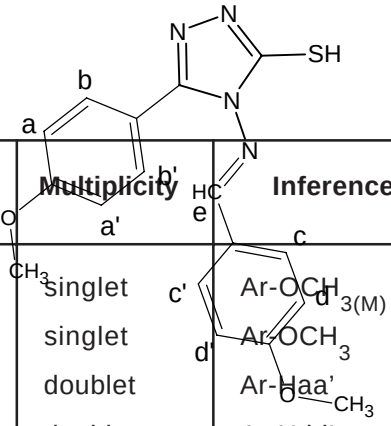
Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.84	3H	singlet	Ar-OCH_3	-
2.	6.94-6.99	2H	doublet	Ar-H(aa')	8.85
3.	8.95-8.98	2H	doublet	Ar-H(bb')	8.86

Table 14: ^{1}H NMR spectral study of 4-[{4-methoxybenzylidene} amino]-5-(4-methoxyphenyl)-4H-1, 2, 4- triazole-3-thiol (HAS-2)



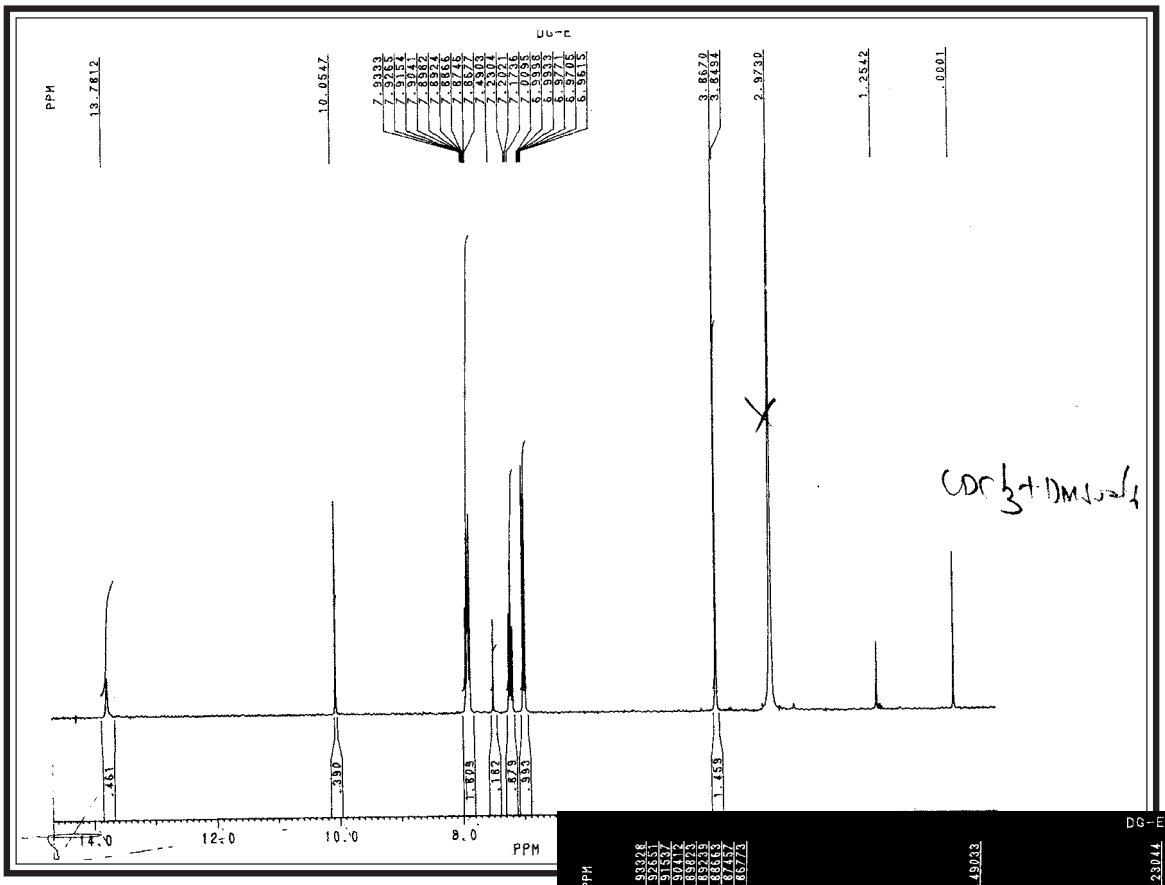


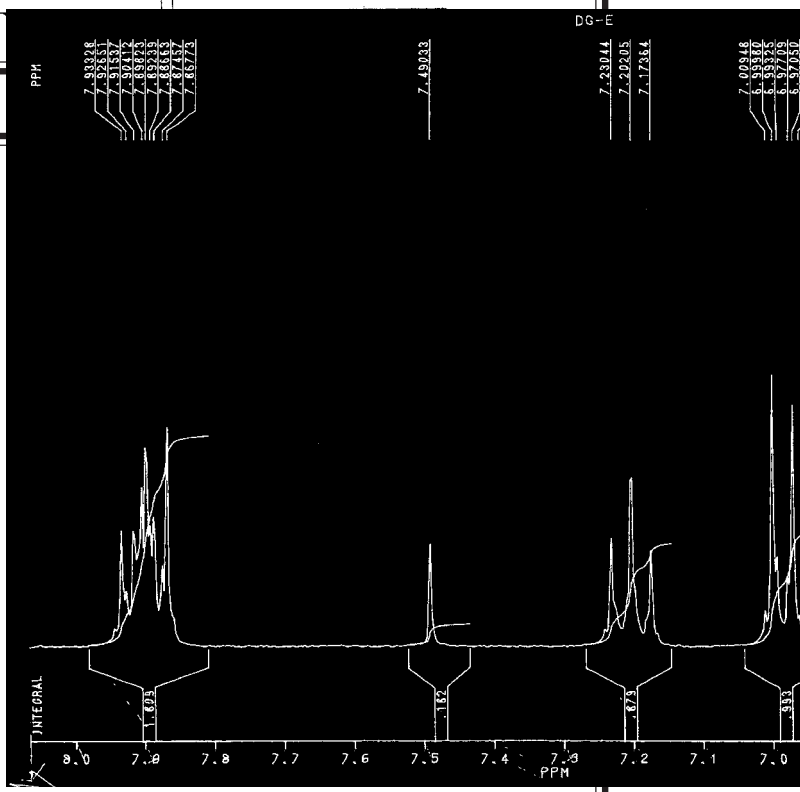
^{1}H NMR spectral data of 4-[{4-methoxy benzylidene} amino]-5- (4-methoxy phenyl) -4H-1, 2, 4- triazole-3-thiol (HAS-2)



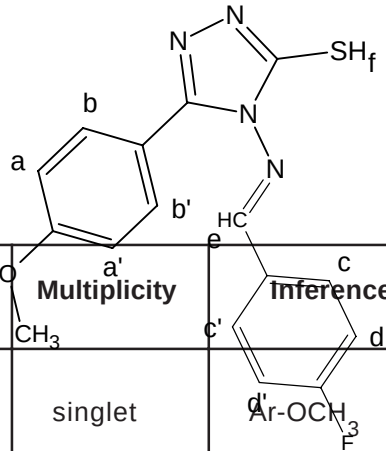
Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.84	3H	singlet	Ar-OCH_3	-
2.	3.88	3H	singlet	Ar-OCH_3	-
3.	6.96-6.99	2H	doublet	Ar-Haa’	8.7
4.	7.00-7.03	2H	doublet	Ar-Hdd’	8.7
5.	7.82-7.85	2H	doublet	Ar-Hbb’	8.7
6.	7.87-7.89	2H	doublet	Ar-Hcc’	8.7
7.	9.70	1H	singlet	-CHe=N-	-
8.	13.68	1H	broad peak	-SH	-

Table 15: ^{1}H NMR spectral study of 4-[(4-fluorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-3)



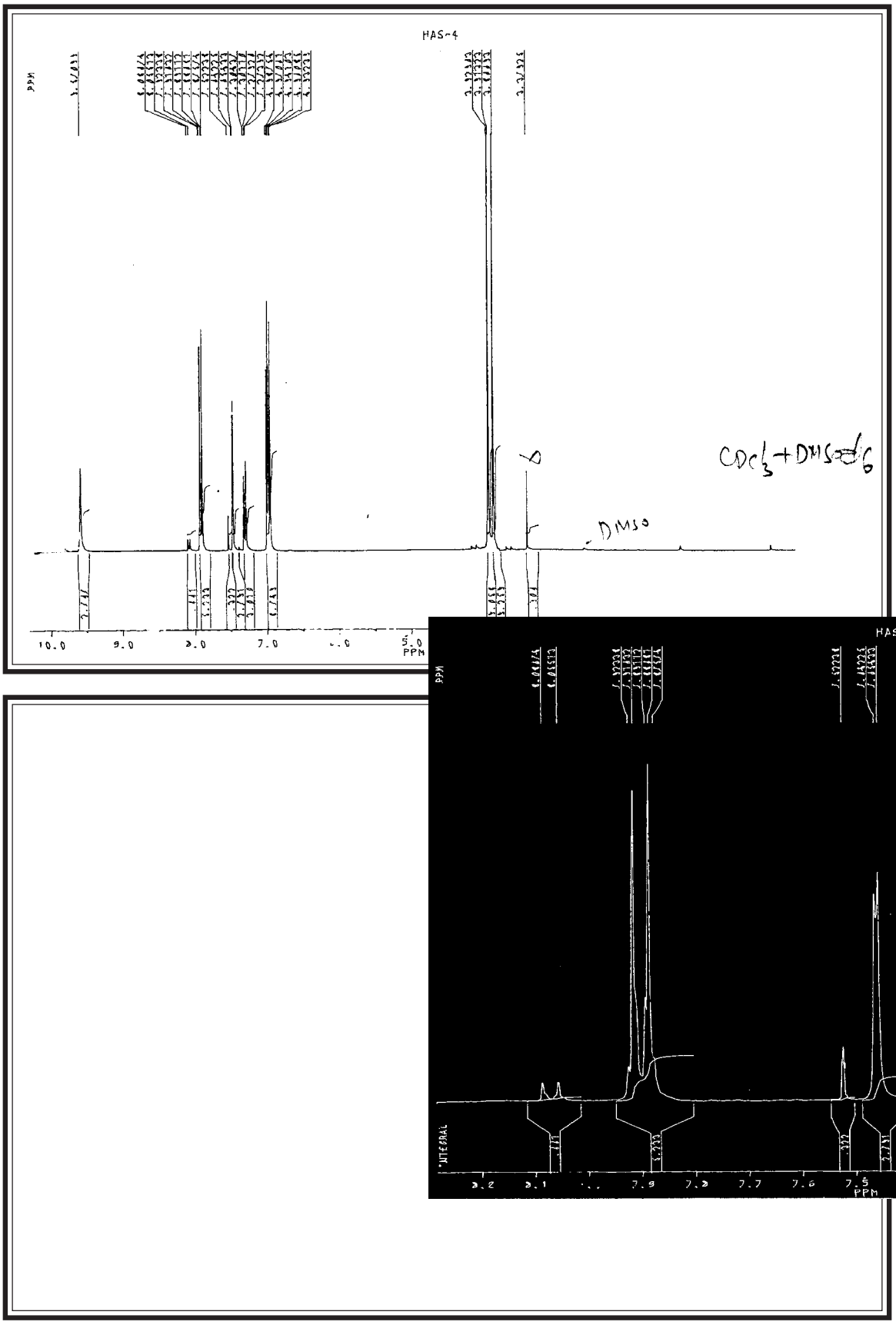


^{1}H NMR spectral data of 4-[(4-fluorobenzylidene) amino]-5-(4-ethoxyphenyl) - 4*H*-1, 2, 4-triazole-3-thiol (HAS-3)

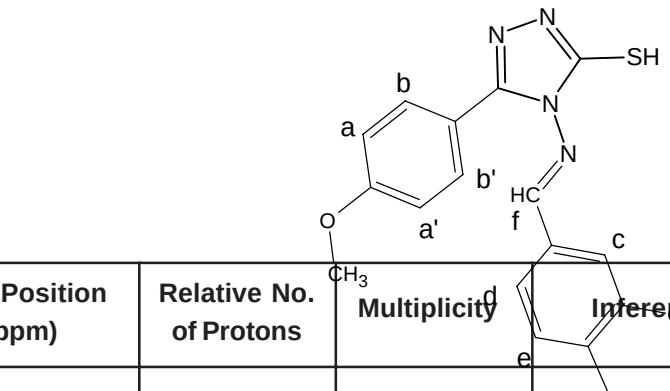


Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.86	3H	singlet	Ar-OCH_3	-
2.	6.97-6.999	2H	doublet	Ar-Haa'	8.7
3.	7.17-7.23	2H	triplet	Ar-Hcc'	-
4.	7.86-7.93	4H	multiplet	Ar-Hbb'+Hdd'	-
5.	10.05	1H	singlet	-CHe=N-	-
6.	13.78	1H	singlet	-SHf	-

Table 16: ^{1}H NMR spectral study of 5-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)

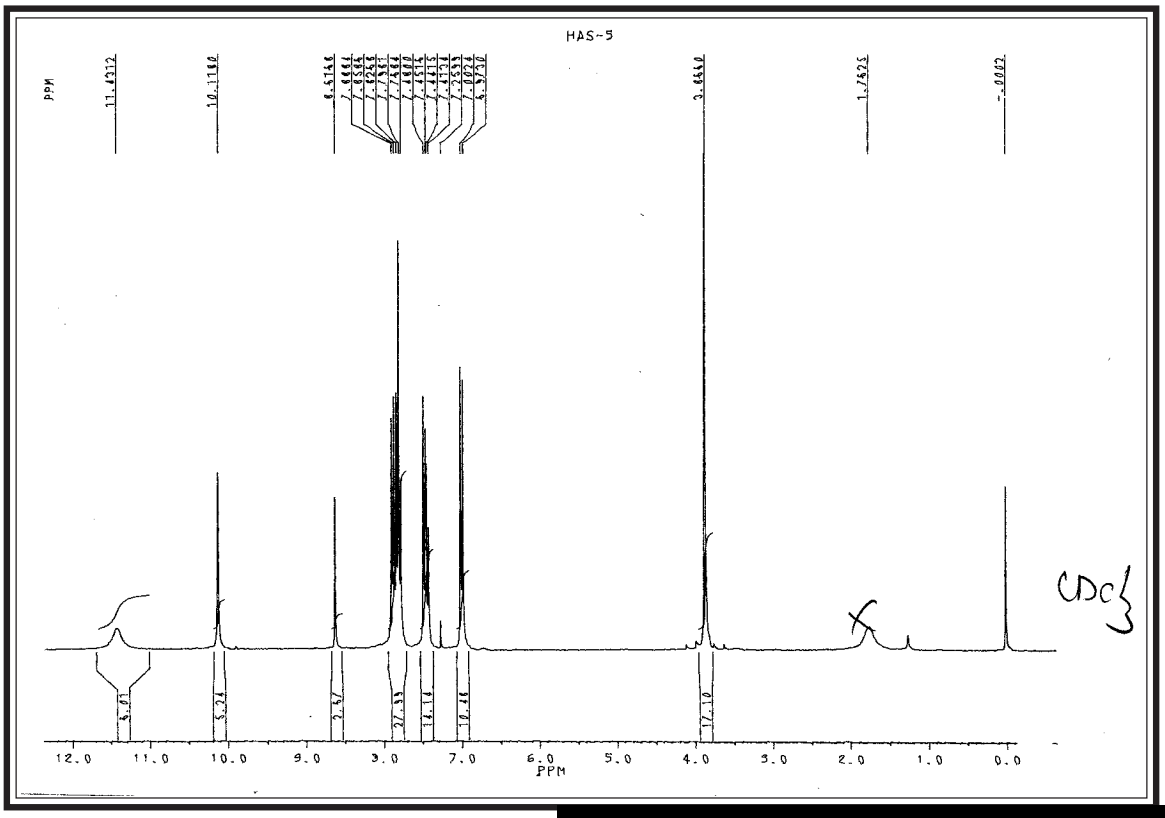


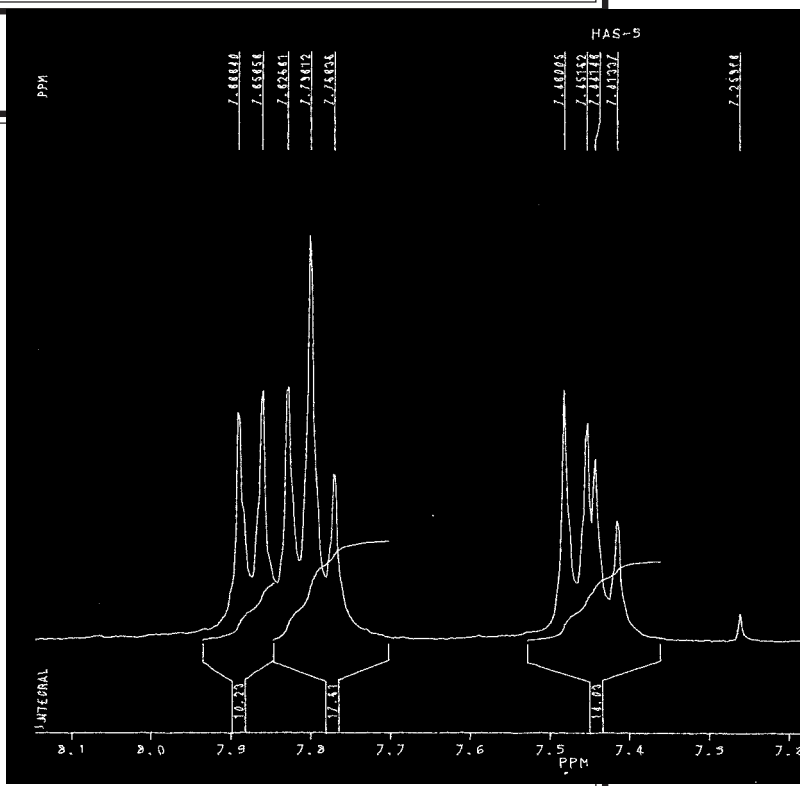
^{1}H NMR spectral data of 5-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)



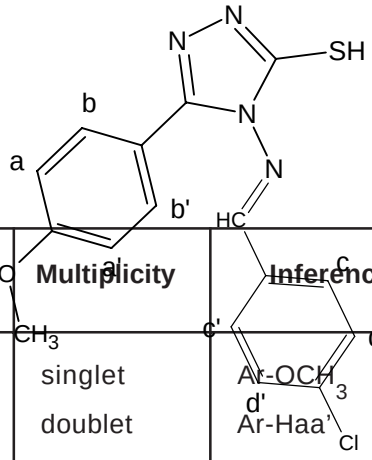
Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.84	3H	singlet	Ar-$OCH_{3(M)}$	-
2.	3.91	3H	singlet	Ar-OCH_3	-
3.	6.93-6.98	3H	quartaret	Ar-Haa'+He	-
4.	7.25-7.30	1H	d.doublet	Ar-Hd	-
5.	7.45-7.46	1H	doublet	Ar-Hc	-
6.	7.85-7.92	2H	doublet	Ar-Hbb'	9
7.	9.57	1H	singlet	-N=CH-	-

Table 17: ^{1}H NMR spectral study of 4-[(4-chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol (HAS-5)



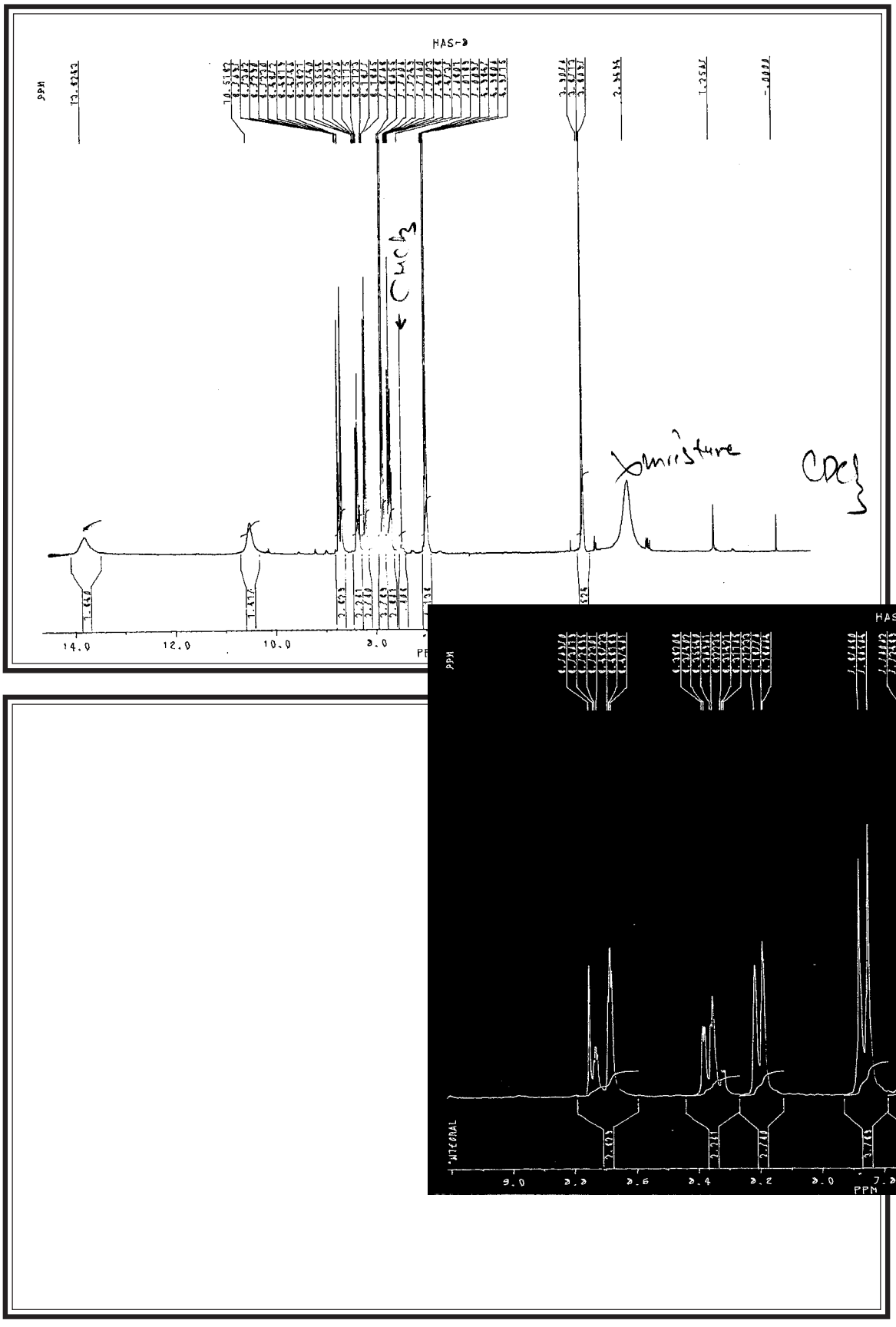


^{1}H NMR spectral data of 4-[(4-chlorobenzylidene) amino]-5-(4- methoxy phenyl)-4*H*-1, 2, 4-triazol (HAS-5)

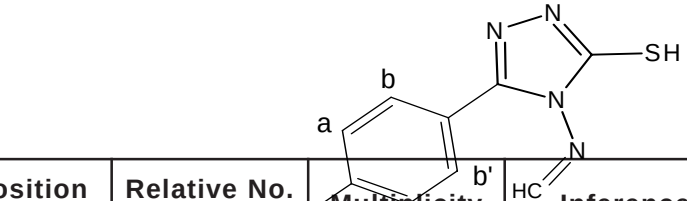


Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.86	3H	singlet	Ar-OCH_3	-
2.	6.97-7.00	2H	doublet	Ar-Haa’	8.7
3.	7.41-7.48	2H	quartet	Ar-Hcc’	-
4.	7.76-7.82	2H	triplet	Ar-Hdd’	-
5.	7.85-7.88	2H	doublet	Ar-Hbb’	9.0

Table 18: 1H NMR spectral study of 5-(4-methoxyphenyl)-4-[(3- nitrobenzy lidene) amino] - 4*H*-1, 2, 4-triazole-3-thiol (HAS-7)



^{1}H NMR spectral data of 5-(4-methoxyphenyl)-4-[(3- nitrobenzylidene) amino] -4*H*-1, 2, 4-triazole-3-thiol (HAS-7)



Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	J In Hz
1.	3.84	3H	singlet	-
2.	6.97-7.00	2H	doublet	8.7
3.	7.67-7.74	1H	multiplet	-
4.	7.84-7.87	2H	doublet	8.7
5.	8.18-8.21	1H	doublet	8.4
6.	8.31-8.38	1H	d.doublet	-
7.	8.67-8.74	1H	d.doublet	-
8.	10.51	1H	singlet	-
9.	13.82	1H	singlet	-

MASS SPECTRA

Mass spectrometry has been described as the smallest scale in the world, not because of its size but because of the size of the things it weighs. Mass spectrometry, also called mass spectroscopy, is an instrumental approach that allows for the mass measurement of molecules. The five basic parts of any mass spectrometer are: a vacuum system; a sample introduction device; an ionization source; a mass analyzer; and an ion detector. Combining these parts a mass spectrometer determines the molecular weight of chemical compounds by ionizing, separating, and measuring molecular ions according to their mass-to-charge ratio (m/z). The ions are generated in the ionization source by inducing either the loss or the gain of a charge (e.g. electron ejection, protonation, or deprotonation). Once the ions are formed in the gas phase they can be electrostatically directed into a mass analyzer, separated according to mass and finally detected. The result of ionization, ion separation, and detection is a mass spectrum that can provide molecular weight or even structural information.

Mass spectrometers have become important for a wide range of applications in the analysis of inorganic, organic, and bio-organic chemicals. Examples include dating of geologic samples, drug testing and drug discovery, process monitoring in the petroleum, chemical, and pharmaceutical industries, surface analysis and the structural identification of unknowns. Further, mass spectrometry is being continually improved and has recently had significant advances in its application to molecular biology, where it is now possible to analyze proteins, DNA, and even viruses.

Mass instrument : GCMS - SHIMADZU-QP2010

Table 19: Mass spectra of 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (HAS-E)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: Admin
Analyzed	: 3/7/2005 3:10:47 PM
Sample Name	: DG-A
Sample ID	: DG-A
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Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Report File	:
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

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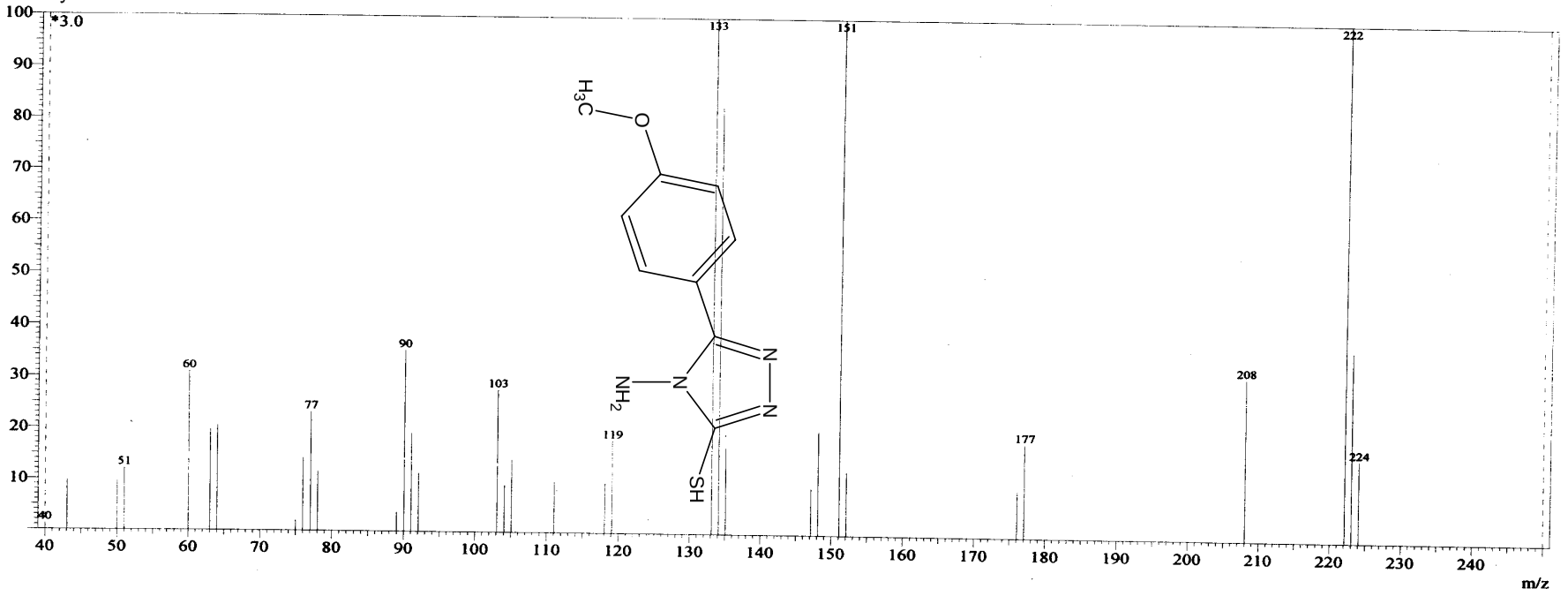
MassPeaks:34 BasePeak:222(35125)
RawMode:Averaged 6.0-6.2(681-710)
BG Mode:Averaged 9.7-10.9(1129-1267)



Scheme-1: 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (HAS-E)

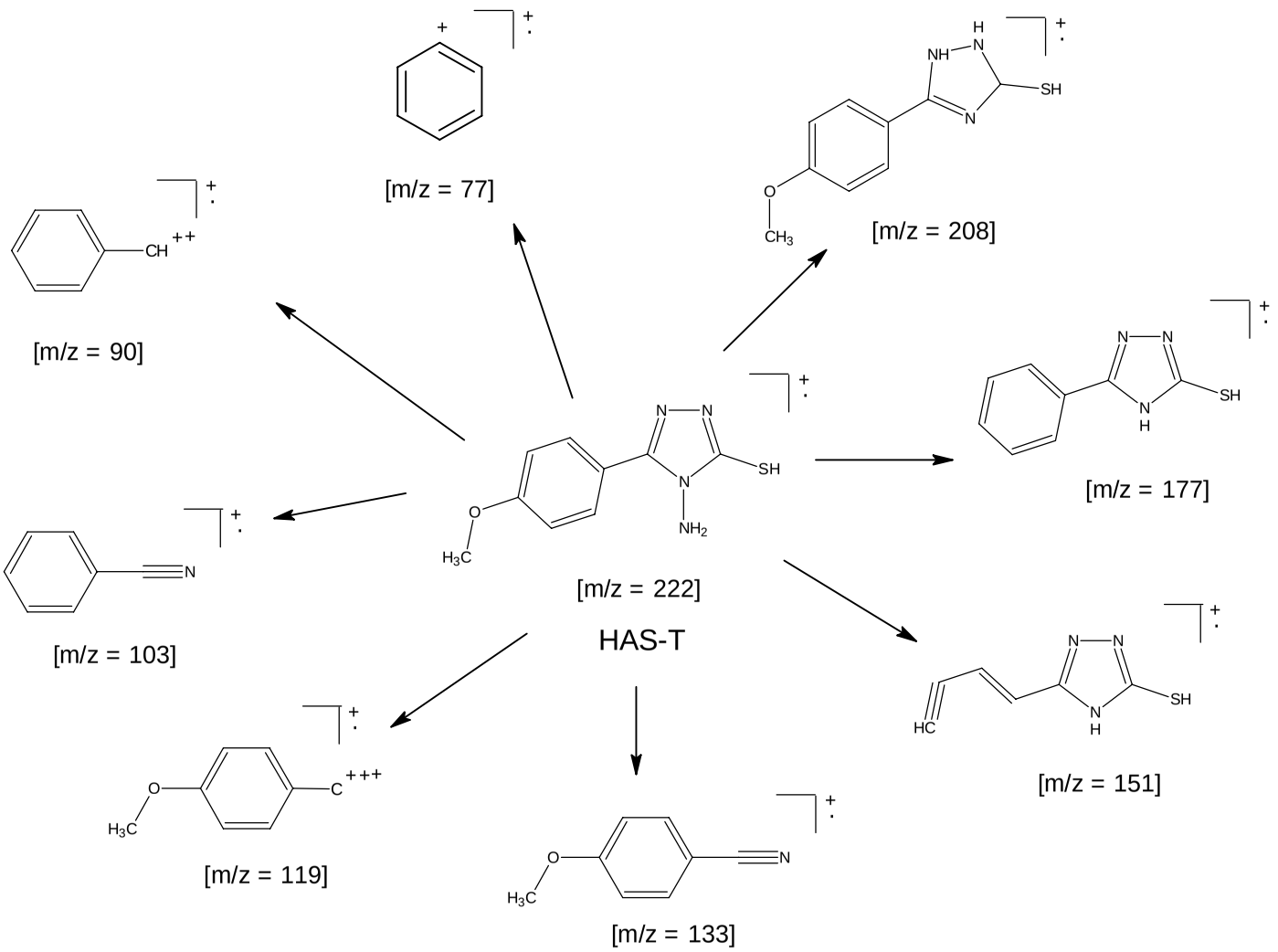


Table 19: Mass spectra of 4-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl (HAS-1)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by : PANKAJ KACHHADIA
Anaiyzed : 4/6/2005 10:33:52 AM
Sample Name : HAS-1
Sample ID : HAS-1
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Method File : C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File : C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:12.1(Scan#:1418)
MassPeaks:53 BasePeak:207(121792)
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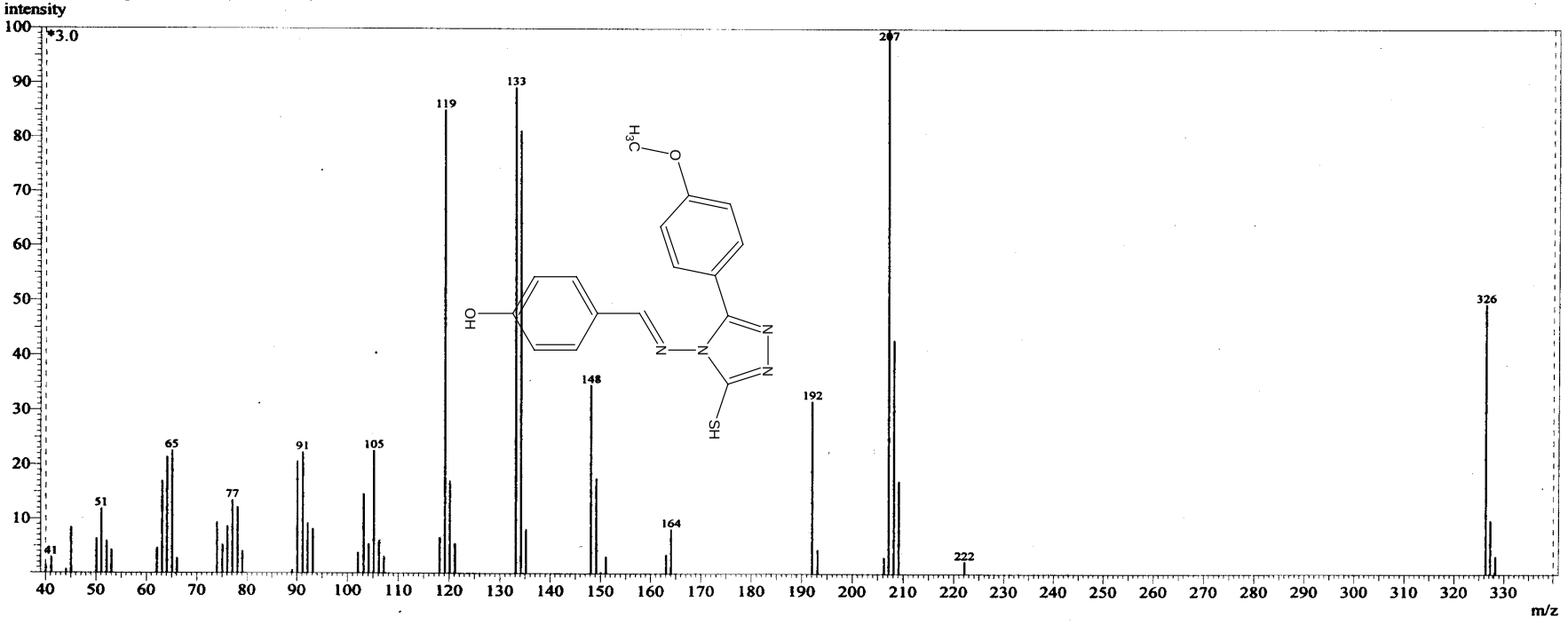
BG Mode:Averaged 14.1-14.3(1657-1684)
intensity



Scheme-2: 4-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl (HAS-1)

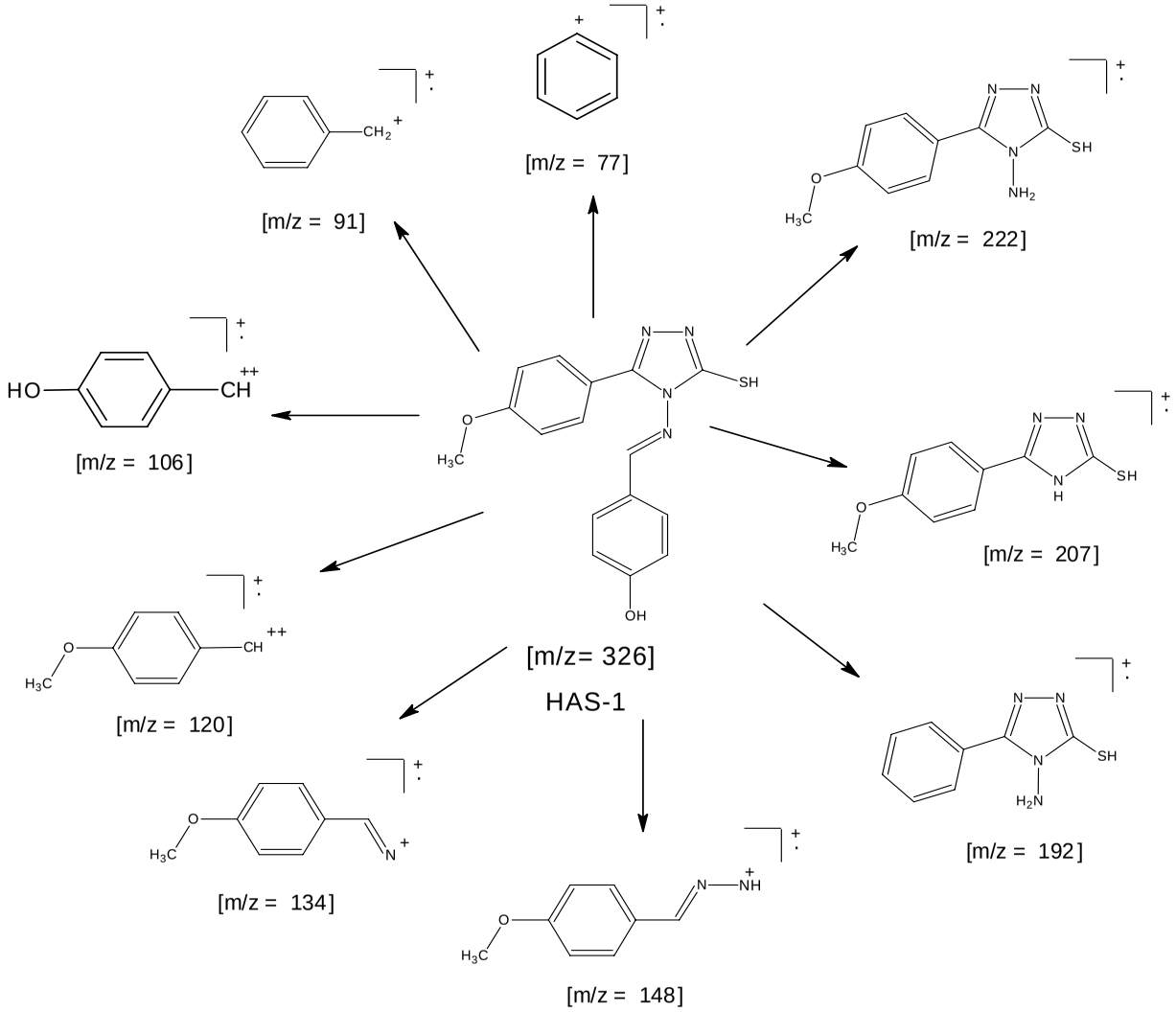


Table 21: Mass spectra of 4-[{4-methoxy benzylidene} amino]-5-(4-methoxy phenyl)-4H-1, 2, 4- triazole-3-thiol (HAS-2)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: Admin
Analyzed	: 2/26/2005 5:53:51 PM
Sample Name	: DG-C
Sample ID	: DG-C
Data File	: C:\GCMSsolution\Data\Project1\DG-C.QGD
Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Report File	:
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

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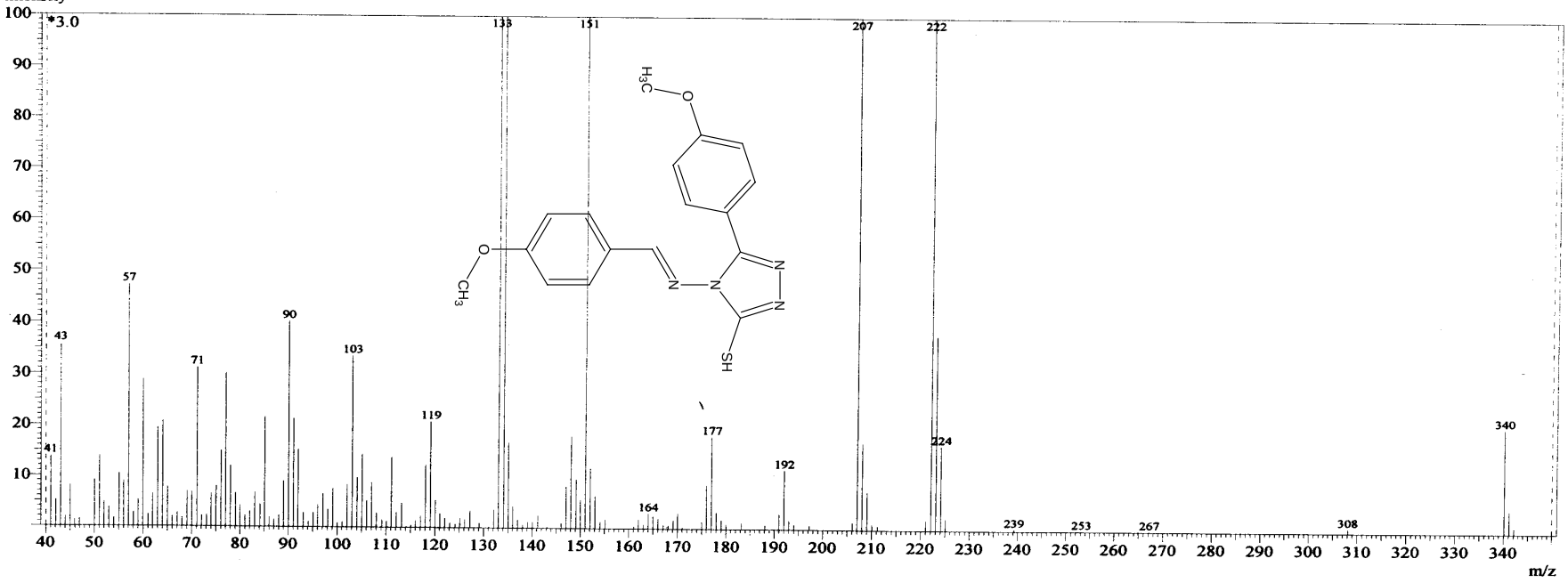
RawMode:Averaged 8.1-8.3(935-962)
BG Mode:Averaged 2.3-3.3(245-356)



Scheme-3: 4-[{4-methoxy benzylidene} amino]-5-(4-methoxy phenyl)-4H-1, 2, 4- triazole-3-thiol (HAS-2)

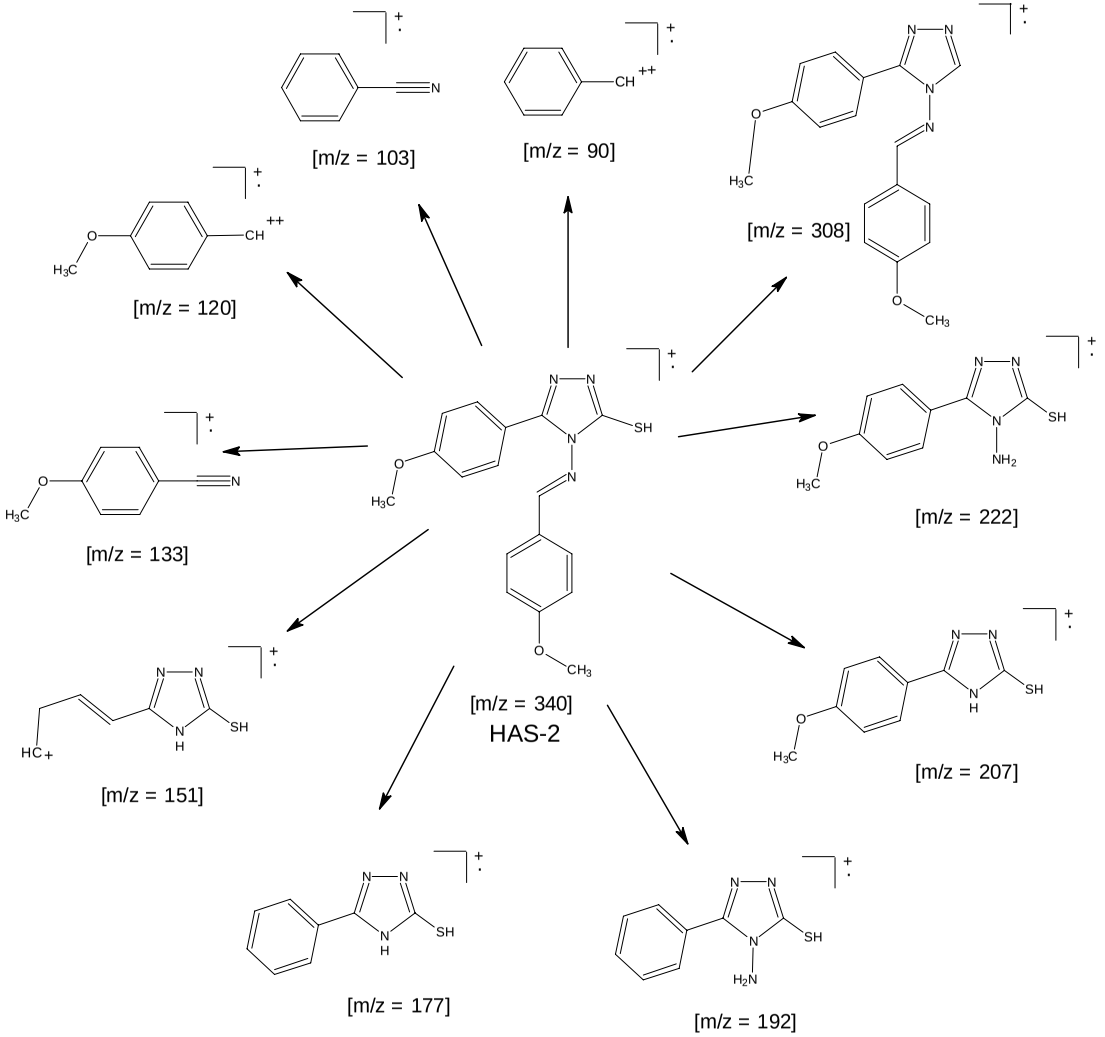


Table 22: Mass spectra of 4-[(4-fluorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1,2,4-triazole-3-thiol (HAS-3)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: Admin
Analyzed	: 3/7/2005 4:11:35 PM
Sample Name	: DG-E
Sample ID	: DG-E
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Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Report File	:
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

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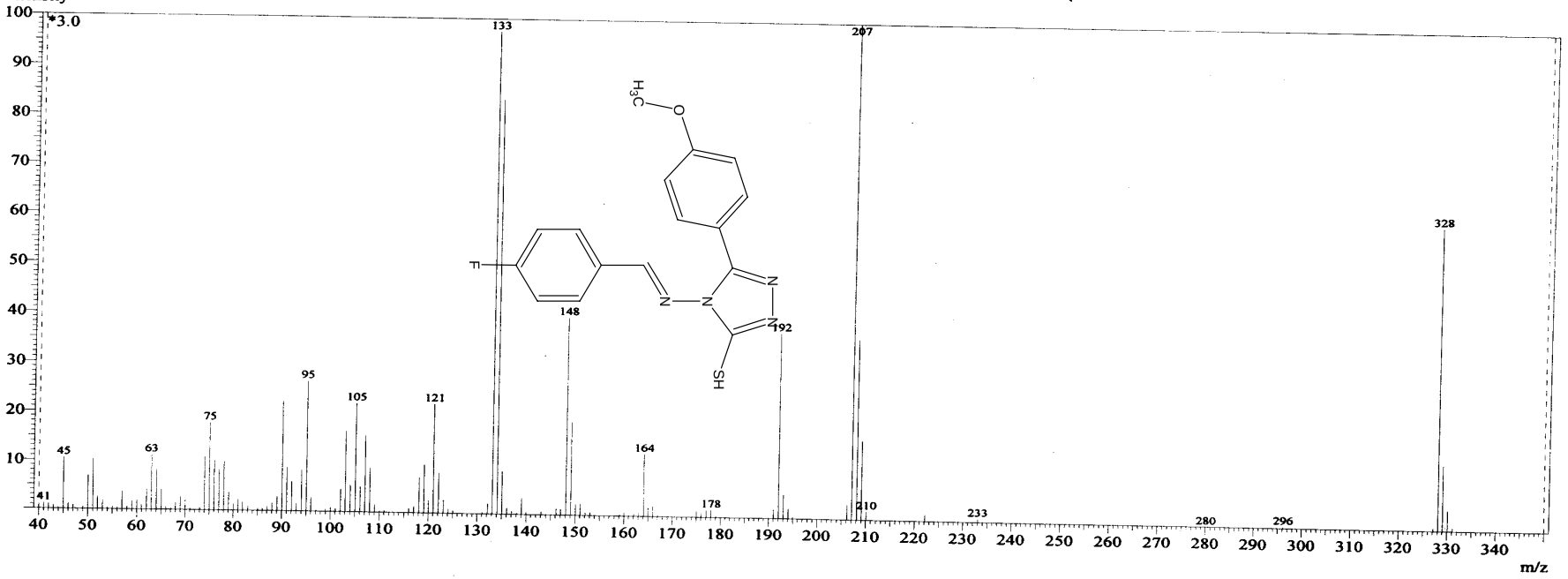
BG Mode:Averaged 11.2-12.3(1310-1442)
intensity



Scheme-4: 4-[(4-fluorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1,2,4-triazole-3-thiol (HAS-3)

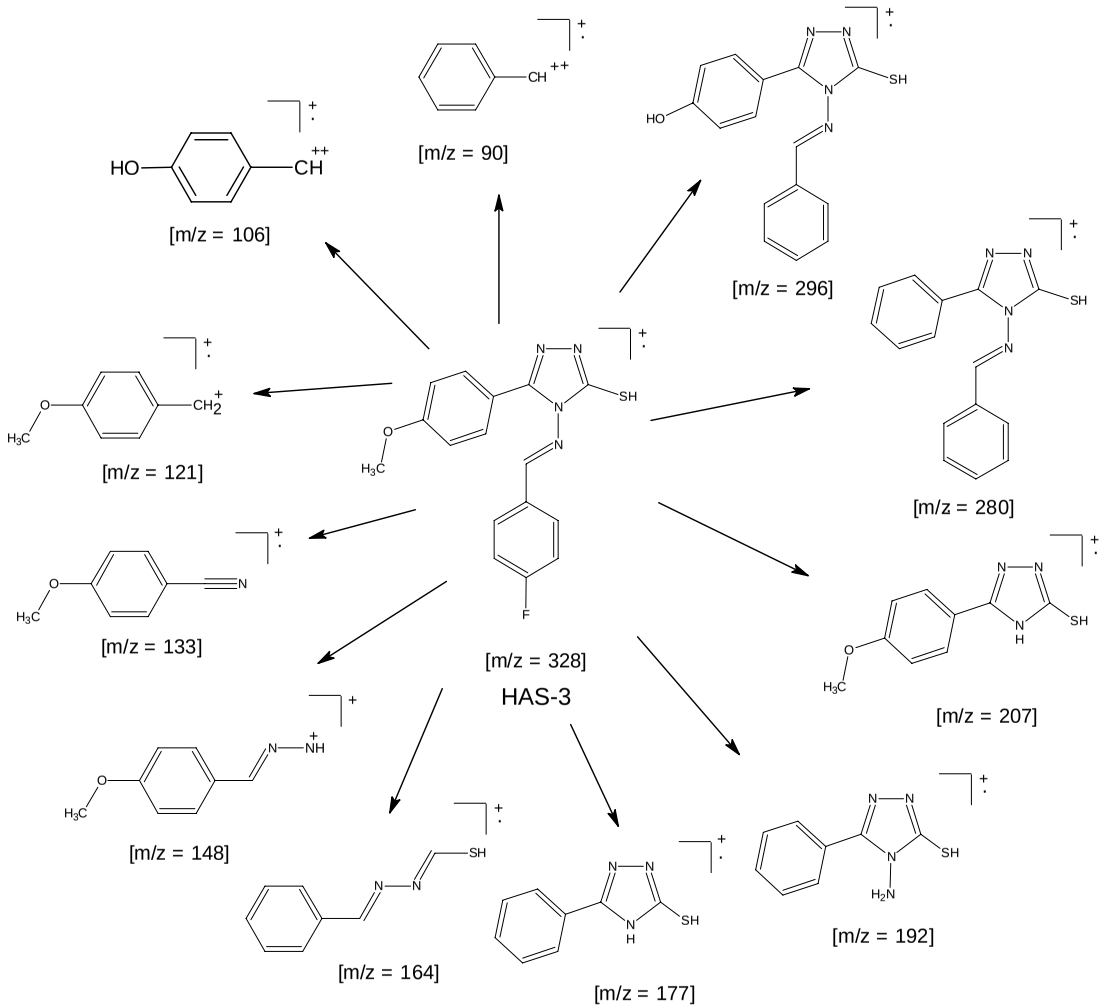


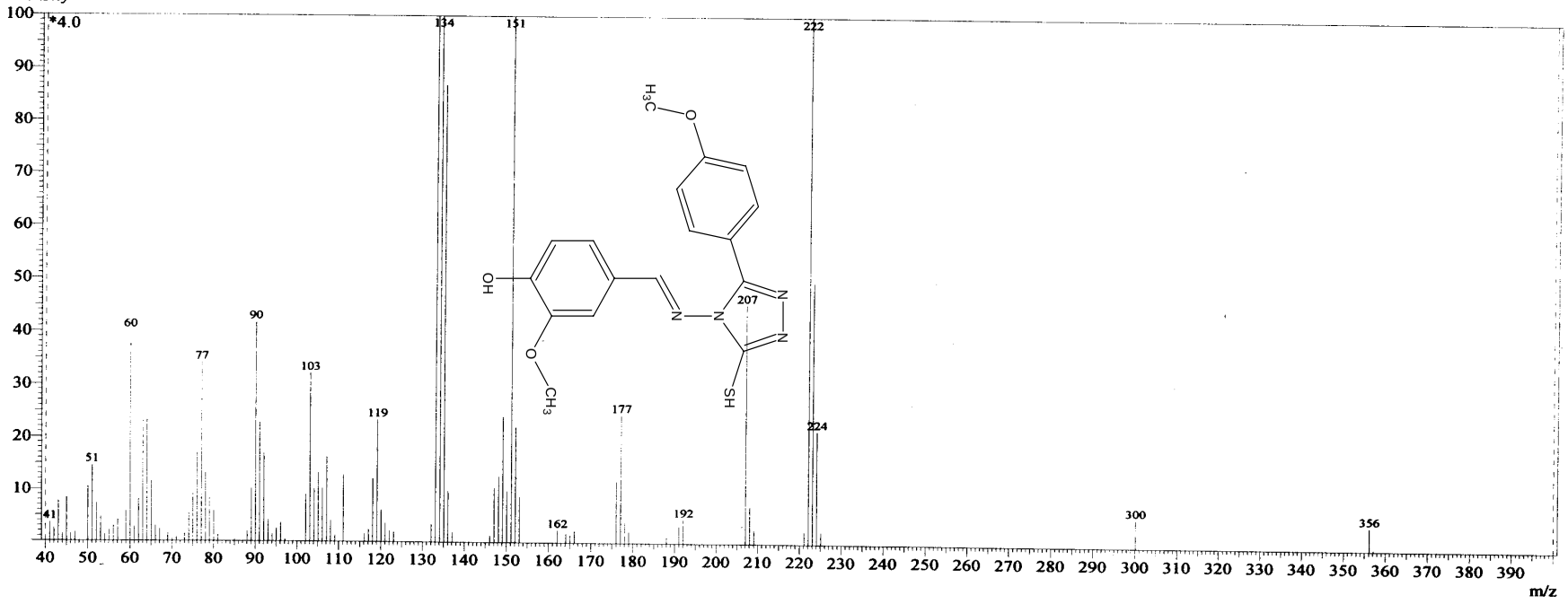
Table 23: Mass spectra of 5-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: Admin
Analyzed	: 3/10/2005 2:53:52 PM
Sample Name	: HAS-4
Sample ID	: HAS-4
Data File	: C:\GCMSsolution\Data\S.H.BALUJA\HAS-4.QGD
Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Report File	:
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:8.9(Scan#:1029)
MassPeaks:109 BasePeak:222(338261)
RawMode:Averaged 8.6-9.2(999-1074)
BG Mode:Averaged 16.9-17.4(1996-2048)
intensity



Scheme-5: 5-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol-4-yl] imino} methyl)-2-methoxyphenol (HAS-4)

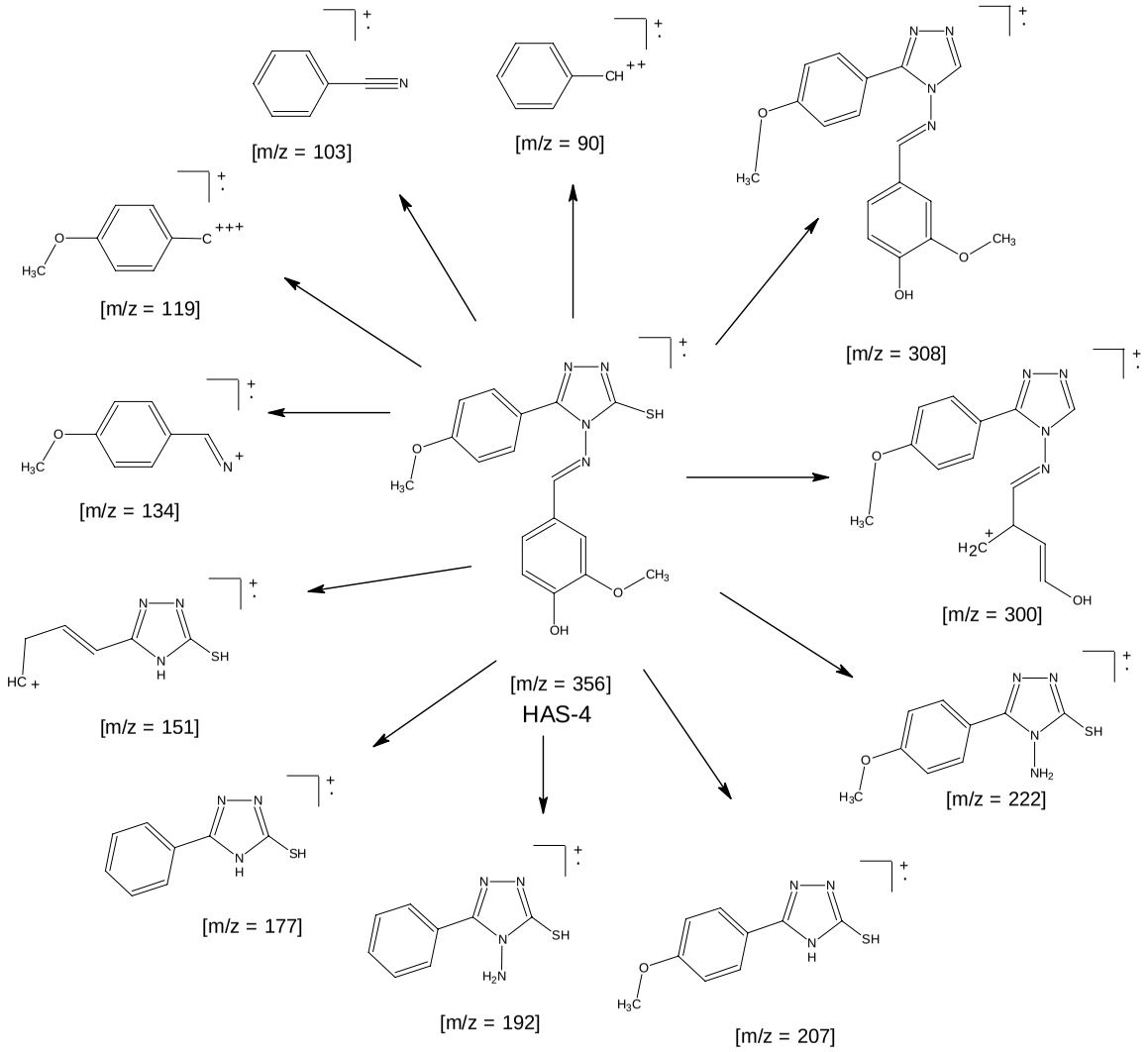


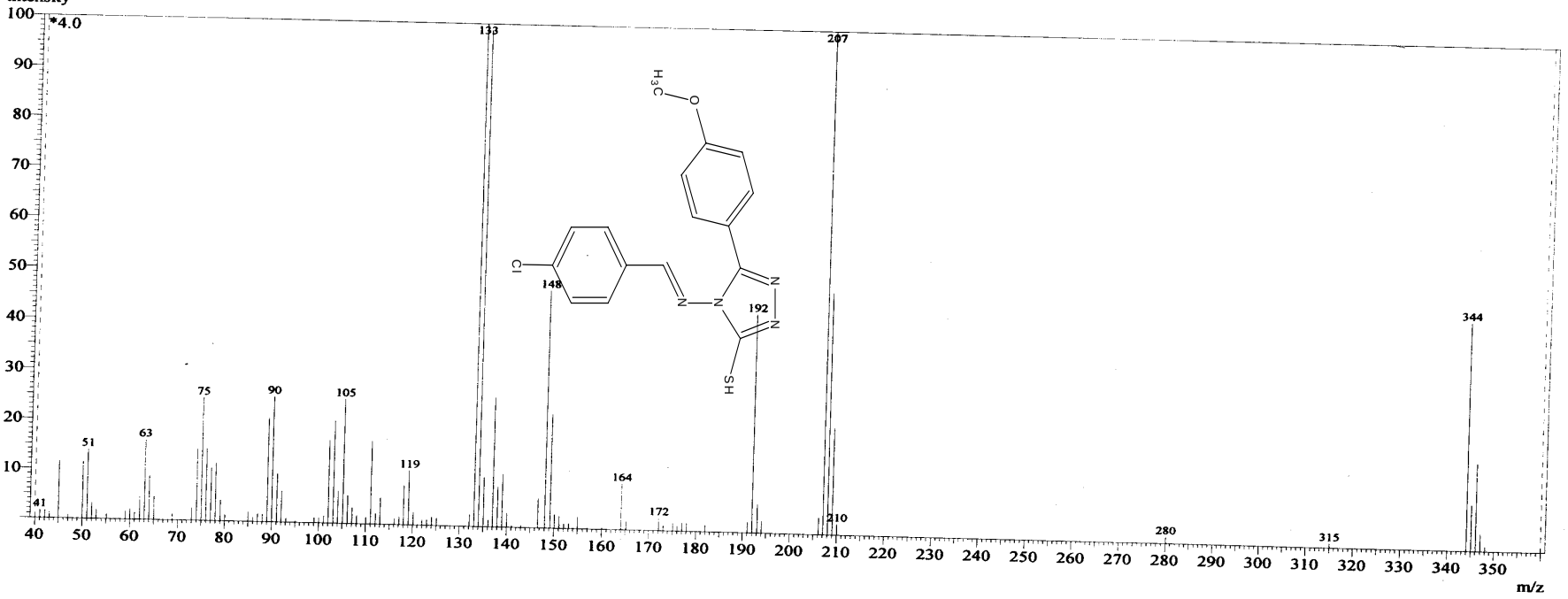
Table 24: Mass spectra of 4-[(4-chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol (HAS-5)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: Admin
Analyzed	: 3/7/2005 3:39:08 PM
Sample Name	: DG-D
Sample ID	: DG-D
Data File	: C:\GCMSsolution\Data\S.H.BALUJA\DG-D.QGD
Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Report File	:
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:8.8(Scan#:1022)
MassPeaks:113 BasePeak:207(439109)
RawMode:Averaged 8.6-9.1(1000-1058)
BG Mode:Averaged 12.5-13.3(1470-1564)



Scheme-6: 4-[(4-chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazol (HAS-5)

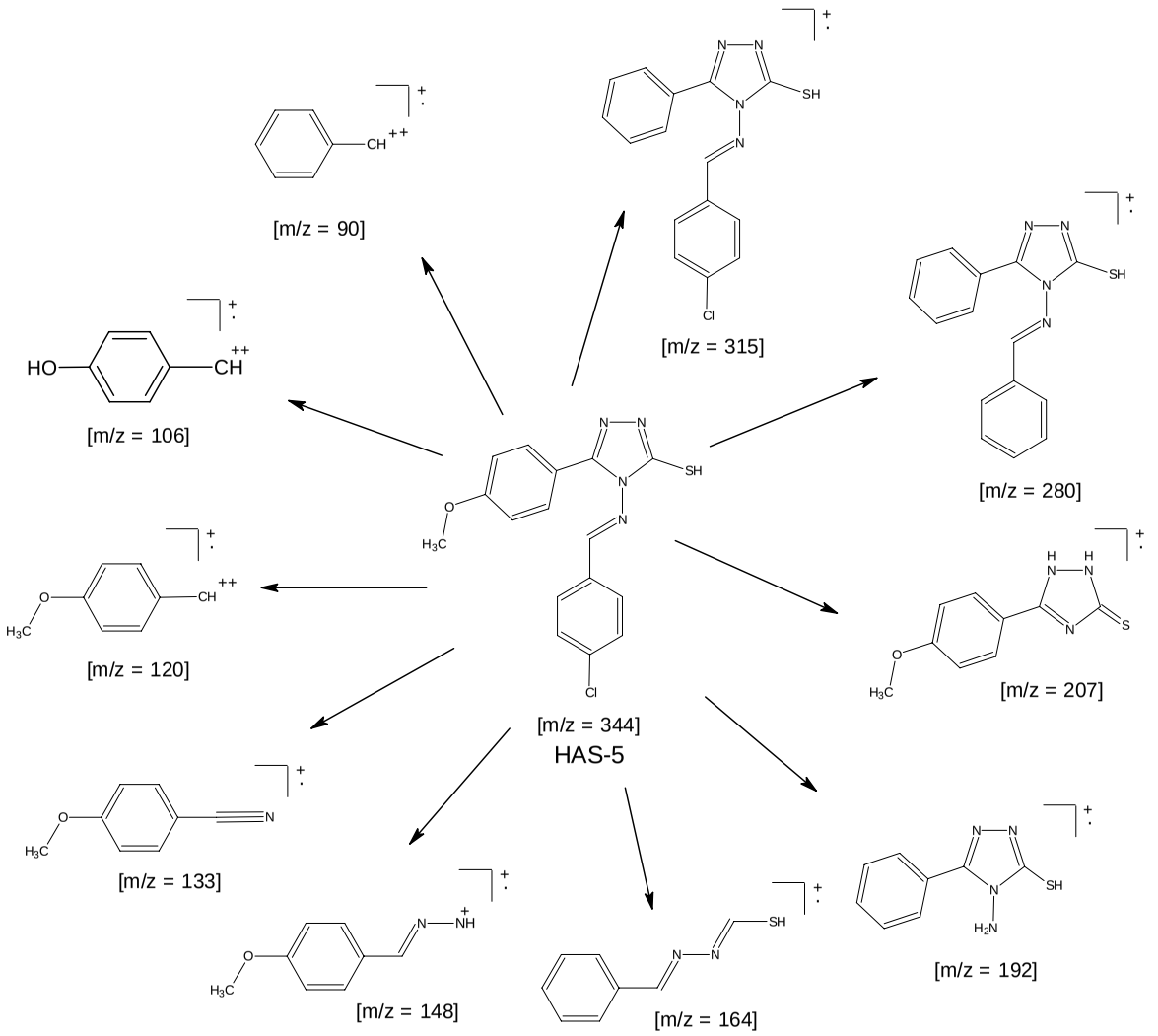


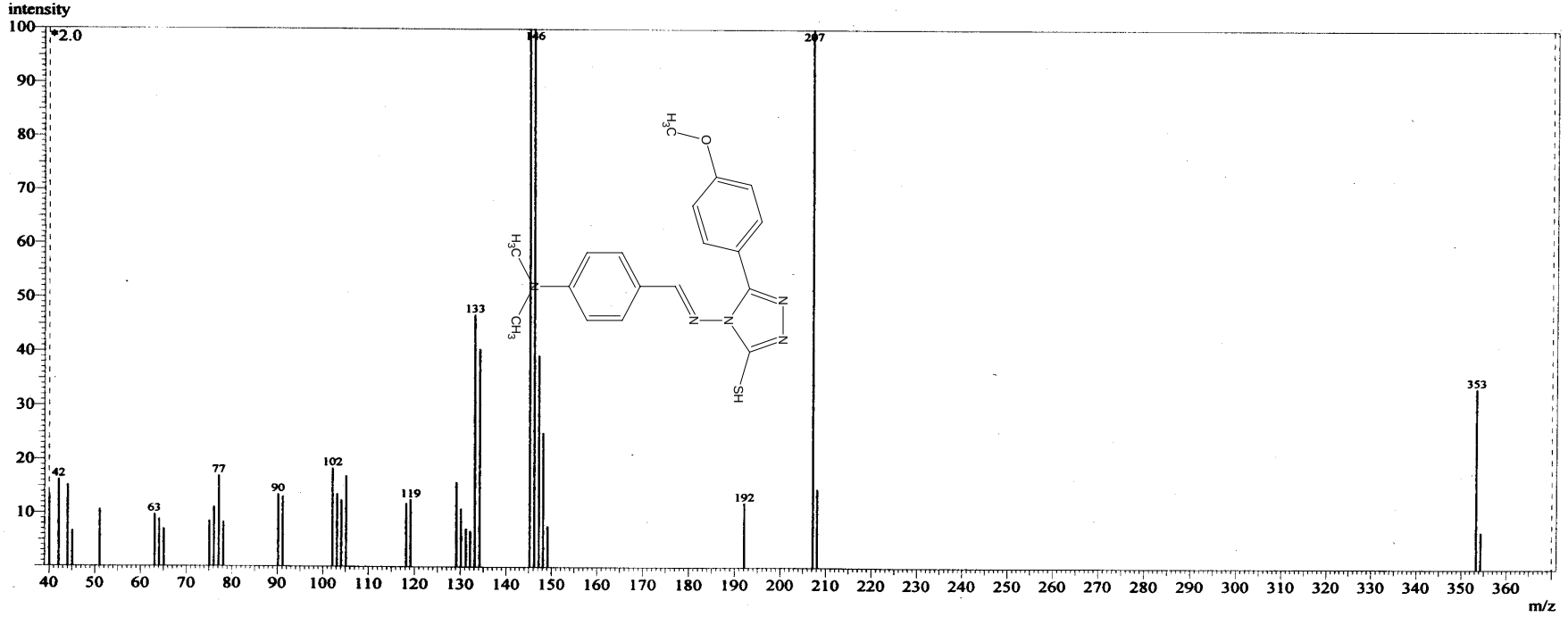
Table 25: Mass spectra of 4-{[4-(dimethylamino) benzylidene] amino}-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-6)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by : PANKAJ KACHHADIA
Anaiyzed : 4/6/2005 11:13:46 AM
Sample Name : HAS-6
Sample ID : HAS-6
Data File : C:\GCMSsolution\Data\S.H.BALUJA\HAS-6.QGD
Method File : C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File : C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:9.5(Scan#:1110)
MassPeaks:36 BasePeak:146(30422)
RawMode:Single 9.5(1110)
BG Mode:None
intensity



Scheme-7: 4-{[4-(dimethylamino) benzylidene] amino}-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-6)

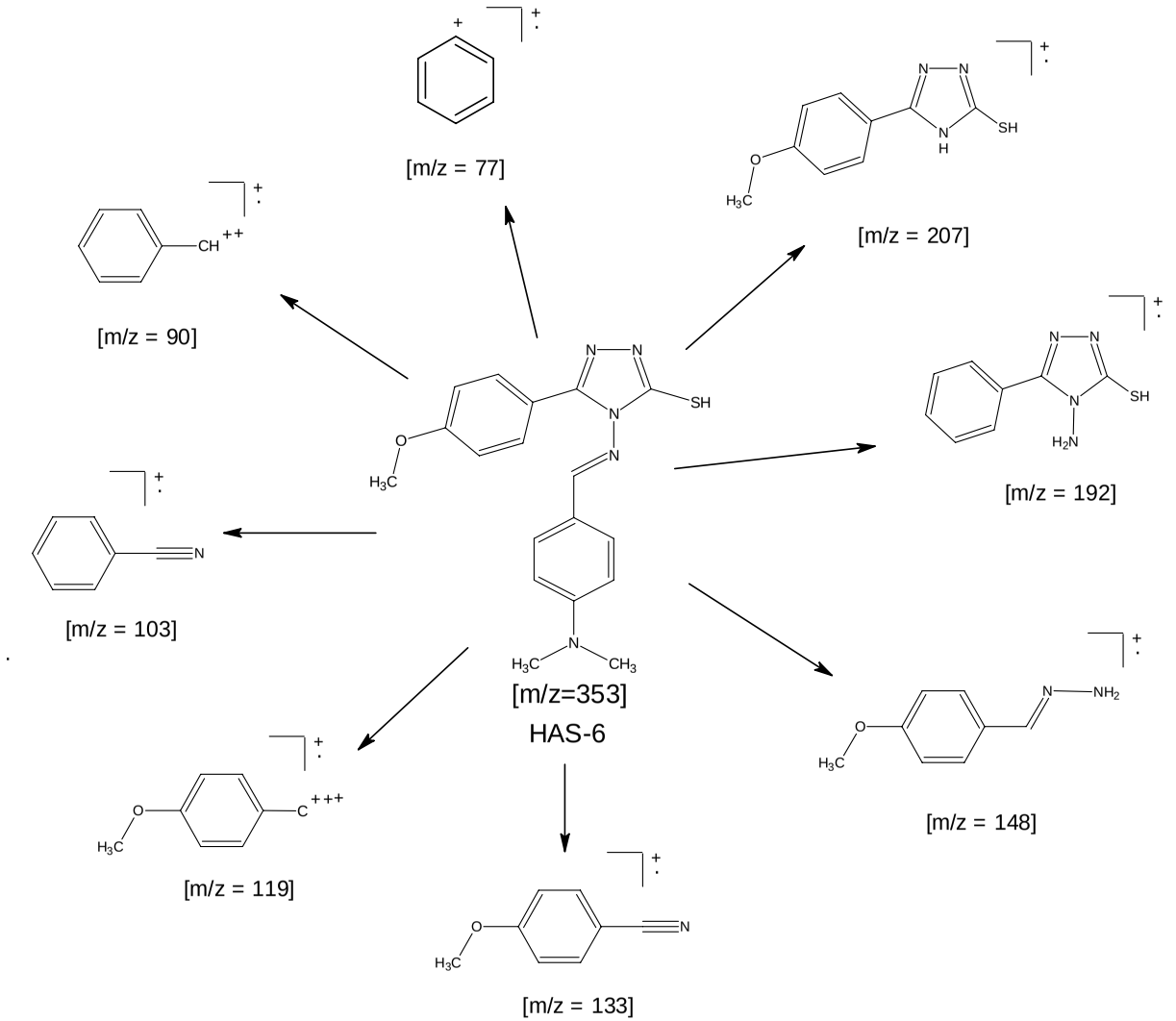


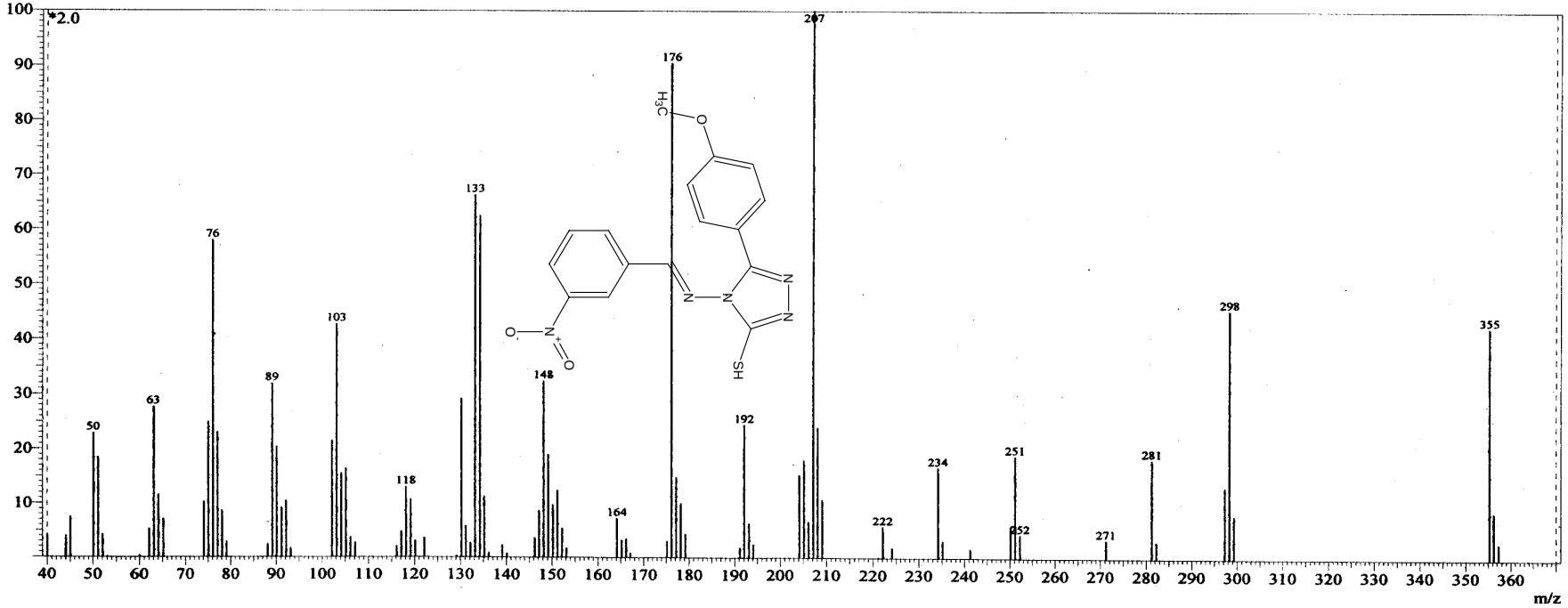
Table 26: Mass spectra of 5-(4-methoxyphenyl)-4-[(3-nitrobenzylidene) amino]-4*H*-1, 2, 4-triazole-3-thiol (HAS-7)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by : PANKAJ KACHHADIA
Anaiyzed : 4/6/2005 11:41:12 AM
Sample Name : HAS-7
Sample ID : HAS-7
Data File : C:\GCMSsolution\Data\S.H.BALUJA\HAS-7.QGD
Method File : C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File : C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:10.0(Scan#:1162)
MassPeaks:91 BasePeak:207(115729)
RawMode:Averaged 9.9-10.1(1151-1176)
BG Mode:None
intensity



Scheme-8: 5-(4-methoxyphenyl)-4-[(3-nitrobenzylidene) amino]-4*H*-1, 2, 4-triazole-3-thiol (HAS-7)

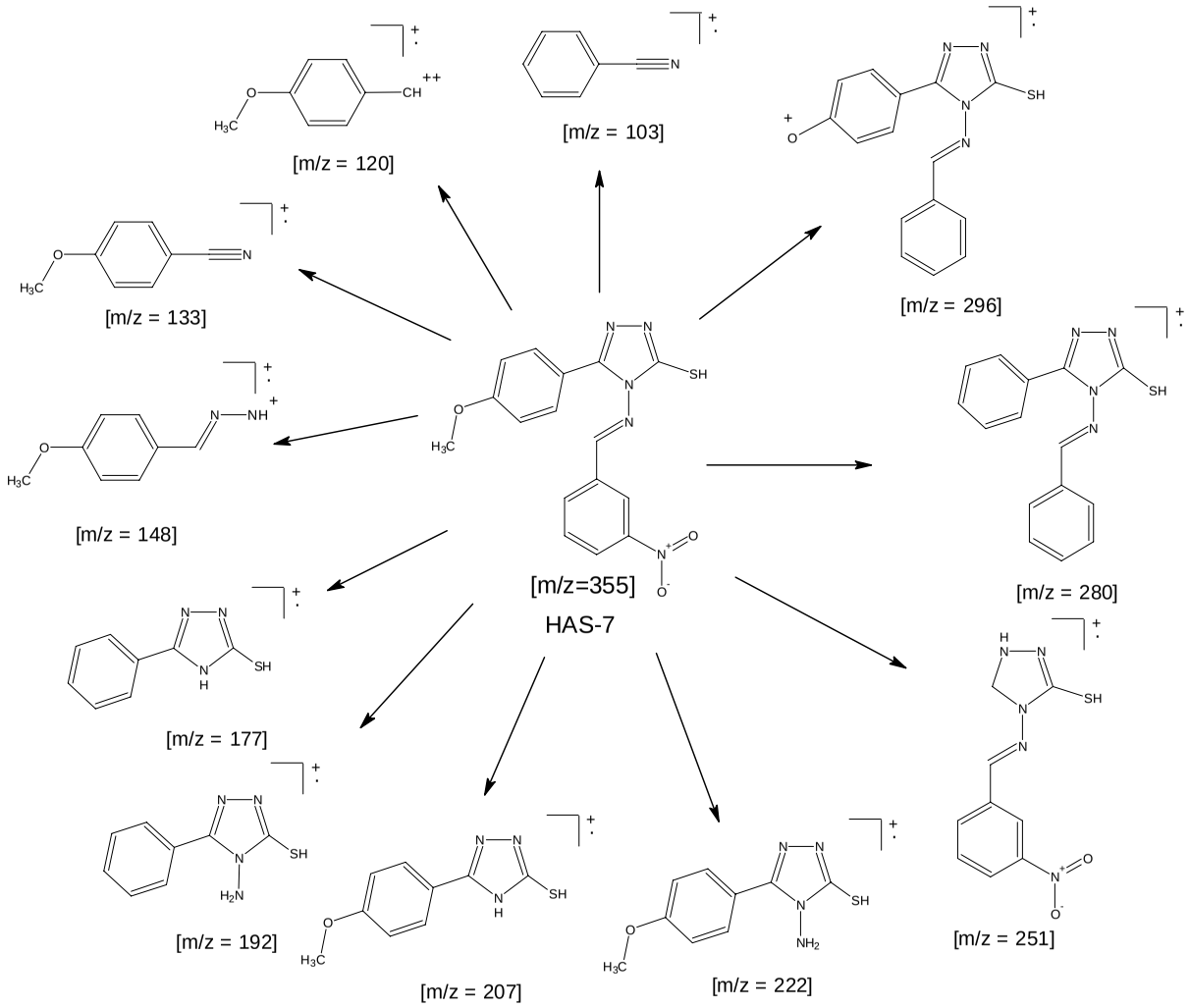


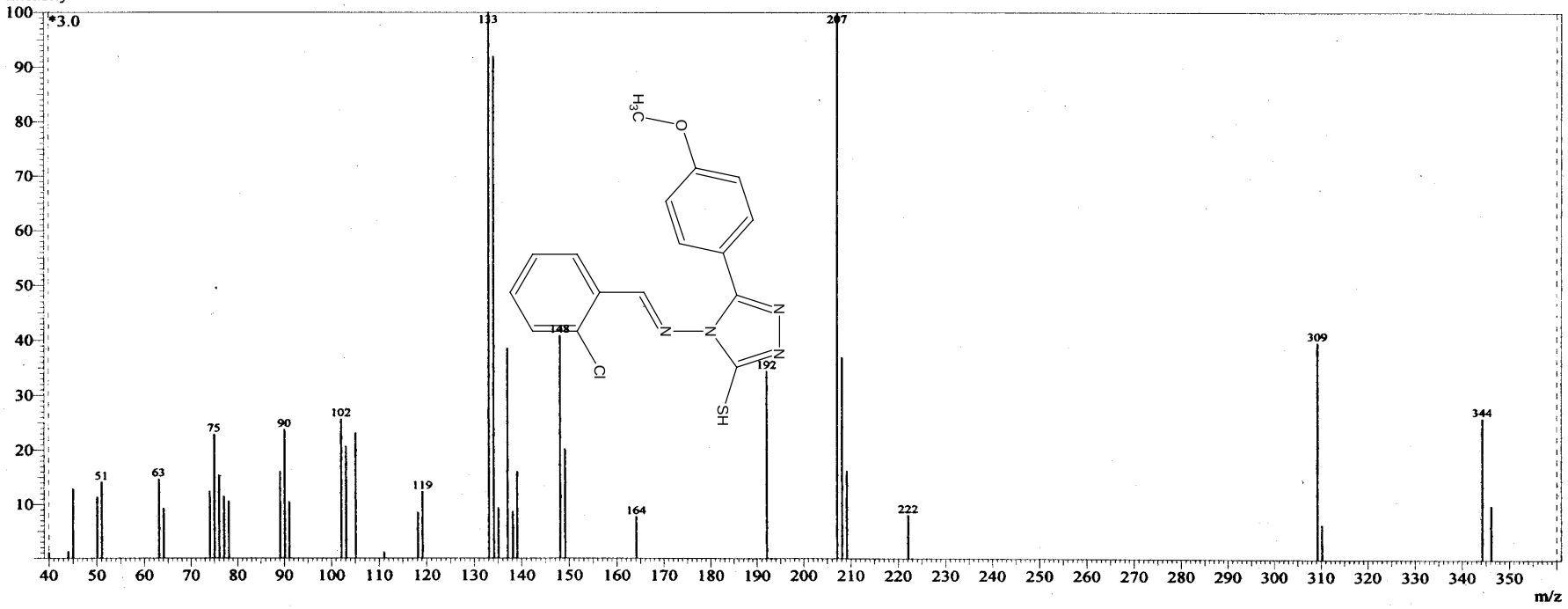
Table 27: Mass spectra of 4-[(2-chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-8)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by : PANKAJ KACHHADIA
Anaiyzed : 4/6/2005 12:12:33 PM
Sample Name : HAS-8
Sample ID : HAS-8
Data File : C:\GCMSsolution\Data\S.H.BALUJA\HAS-8.QGD
Method File : C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File : C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:8.4(Scan#:971)
MassPeaks:39 BasePeak:207(39489)
RawMode:Averaged 8.3-8.5(965-985)
BG Mode:Averaged 10.9-11.0(1268-1285)
intensity



Scheme-9: 4-[(2-chlorobenzylidene) amino]-5-(4-methoxyphenyl)-4*H*-1, 2, 4-triazole-3-thiol (HAS-8)

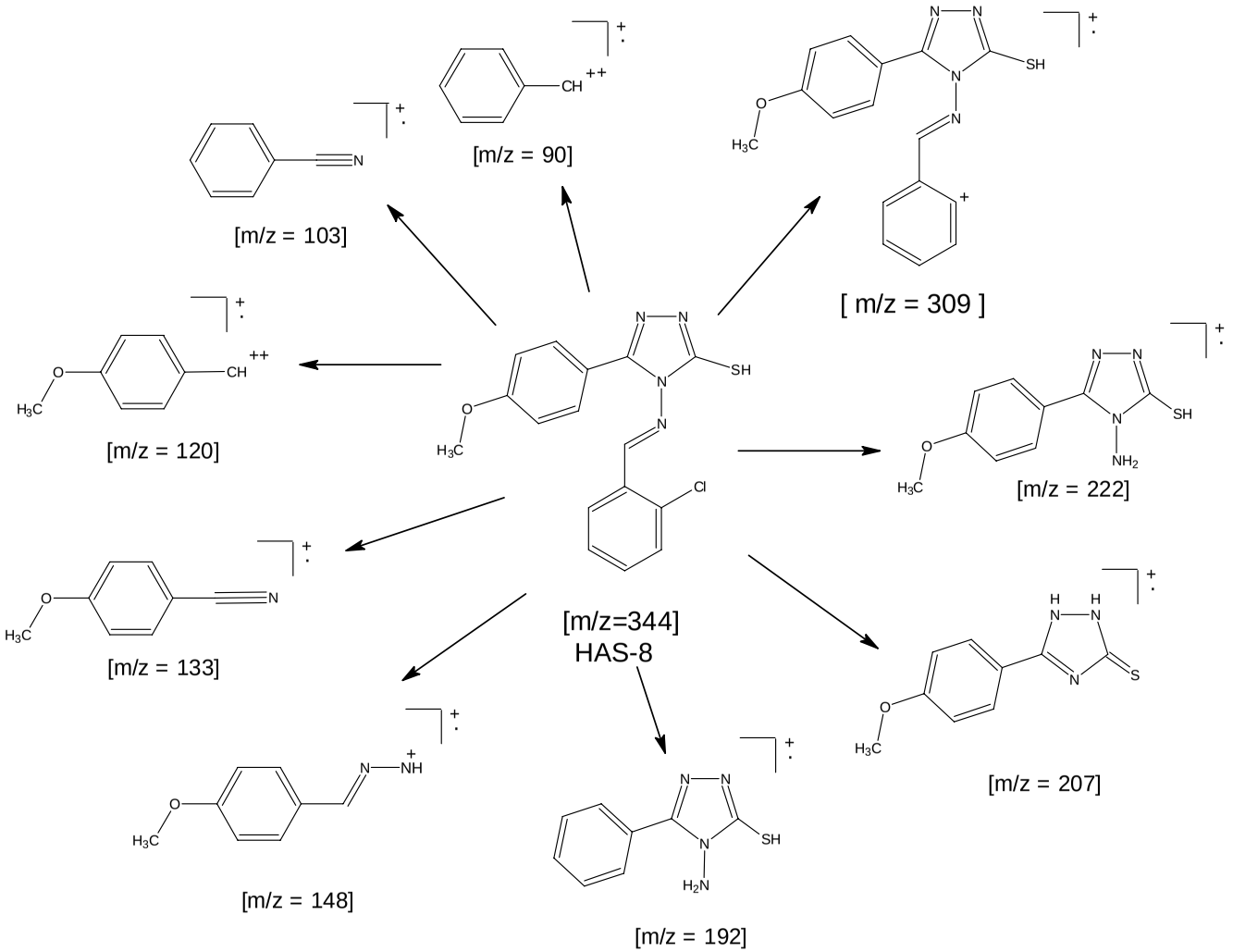


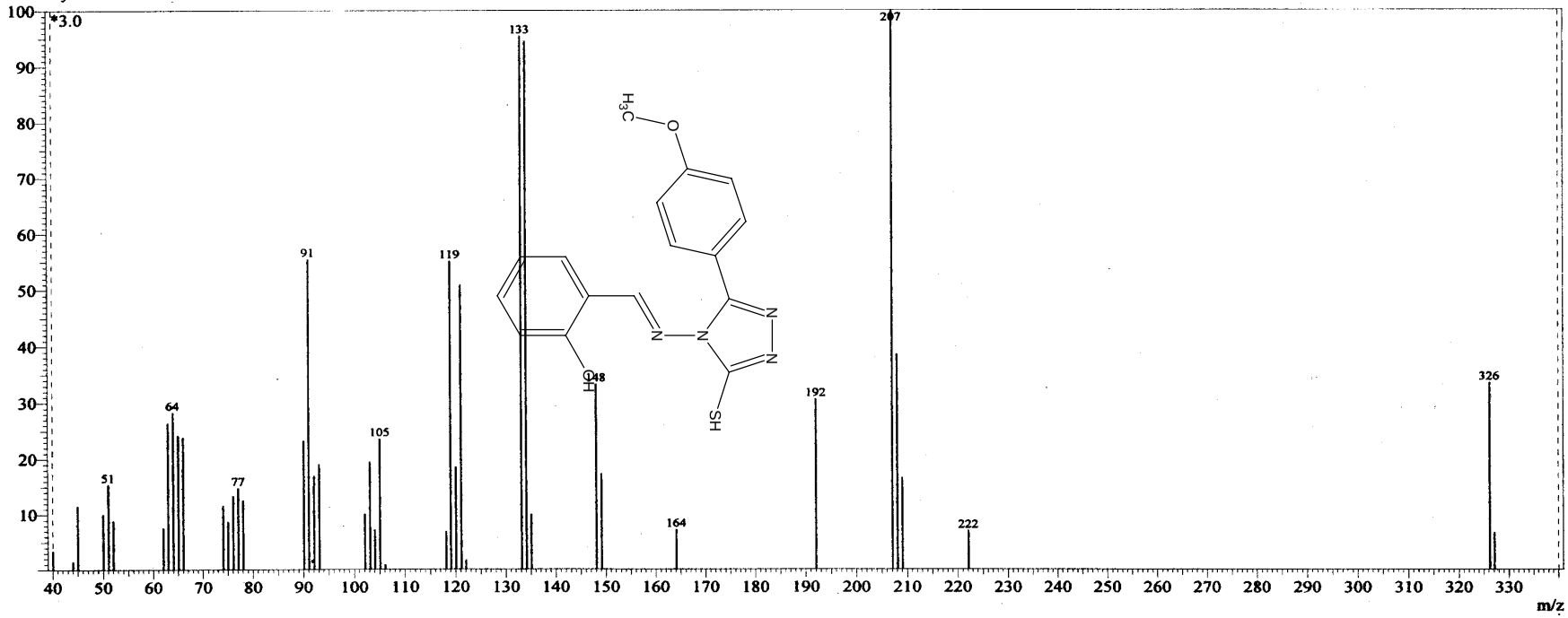
Table 28: Mass spectra of 2-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1,2,4-triazol yl]imino}methyl)phenol (HAS-9)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: PANKAJ KACHHADIA
Analyzed	: 4/7/2005 2:26:51 PM
Sample Name	: HAS-9
Sample ID	: HAS-9
Data File	: C:\GCMSsolution\Data\S.H.BALUJA\HAS-9.QGD
Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:8.0(Scan#:930)
MassPeaks:43 BasePeak:207(51872)
RawMode:Averaged 8.0-8.3(920-957)
BG Mode:Averaged 10.6-10.7(1233-1251)



Scheme-10: 2-({[3-mercapto-5-(4-methoxyphenyl)-4*H*-1,2,4-triazol yl]imino}methyl)phenol (HAS-9)

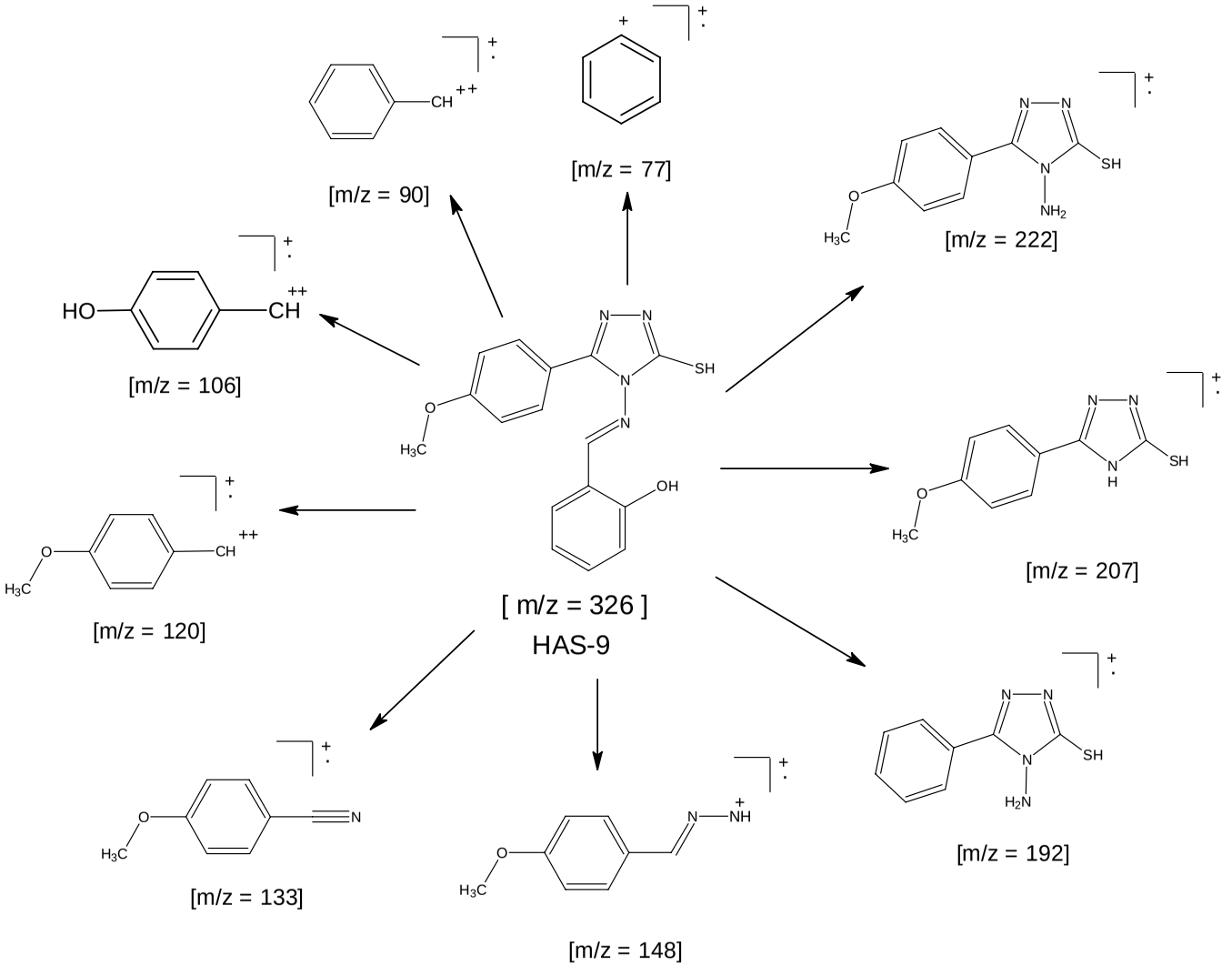


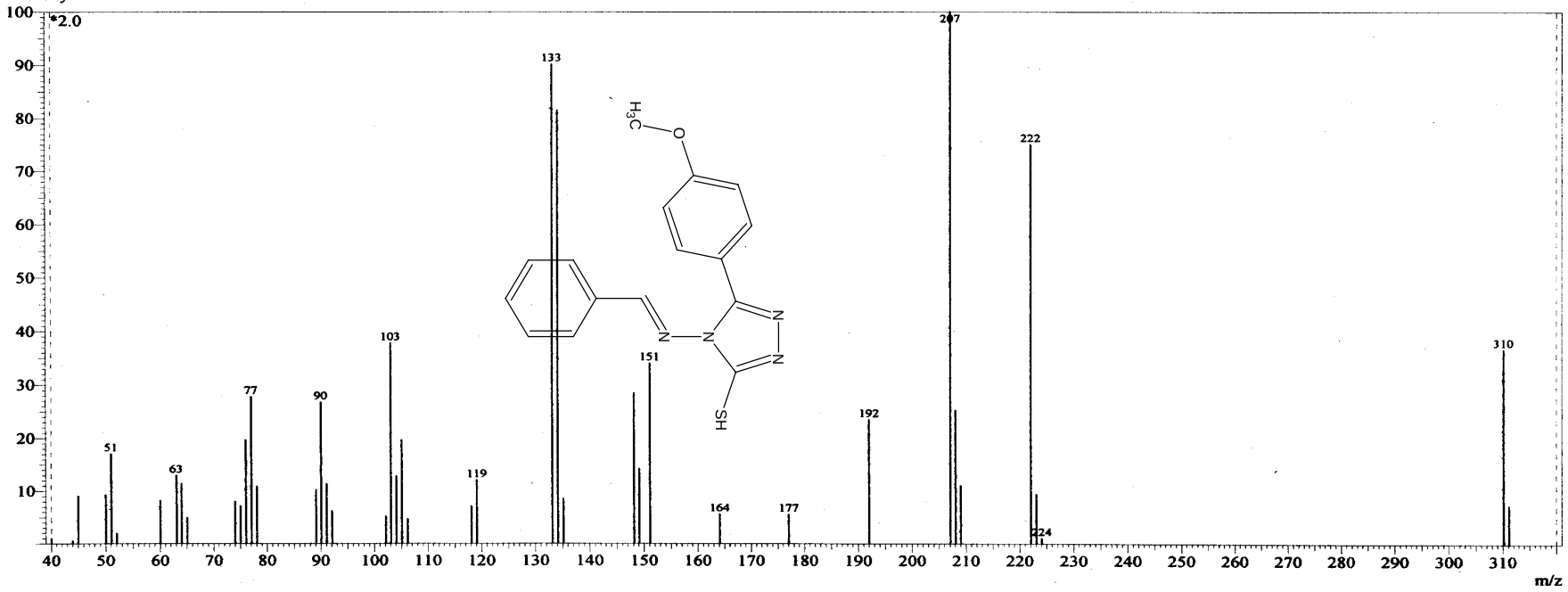
Table 29: Mass spectra of 5-(4-methoxyphenyl)-4-{[(1*E*)-phenylmethylene] amino}-4*H*-1, 2, 4-triazole-3-thiol (HAS-10)

SAURASHTRA UNIVERSITY - RAJKOT
DEPT. OF CHEMISTRY

Sample Information

Analyzed by	: PANKAJ KACHHADIA
Analyzed	: 4/7/2005 2:50:41 PM
Sample Name	: HAS-10
Sample ID	: HAS-10
Data File	: C:\GCMSsolution\Data\S.H.BALUJA\HAS-10.QGD
Method File	: C:\GCMSsolution\Data\Project1\DI.qgm
Tuning File	: C:\GCMSsolution\System\Tune1\tune3.qgt

Line#:1 R.Time:7.9(Scan#:908)
MassPeaks:43 BasePeak:207(46433)
RawMode:Averaged 7.6-8.0(882-922)
BG Mode:Averaged 10.8-11.0(1266-1289)



Scheme-11: 5-(4-methoxyphenyl)-4-{[(1*E*)-phenylmethylene] amino}-4*H*-1, 2, 4-triazole-3- thiol (HAS-10)

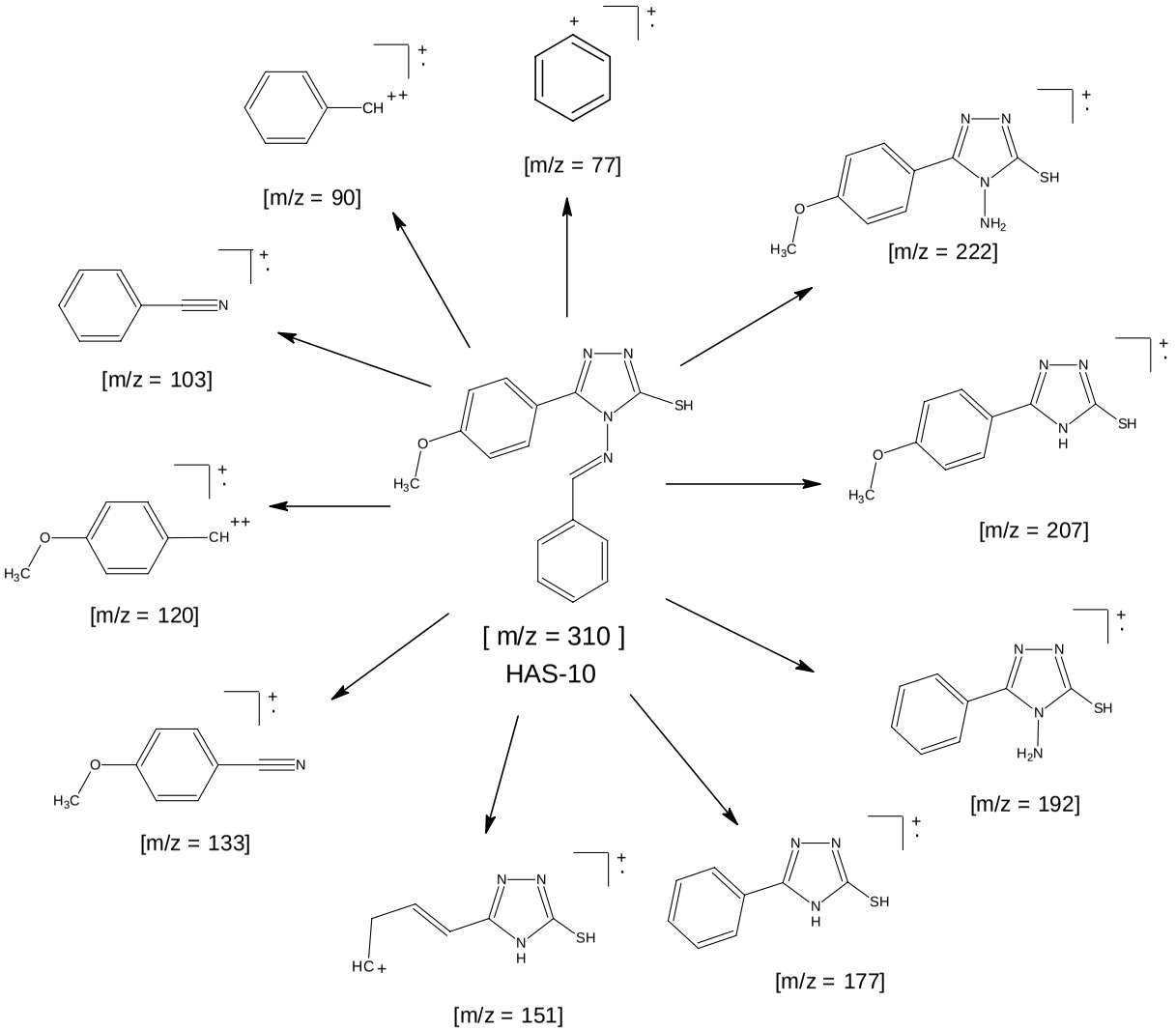


Table 30: Physical constants of Schiff bases

Sr. No.	R	Code.	M.Wt.(g)	M.F.	Rf* Value	M.P. ºC	Yield %
1.	4-OH-C_6H_4-	HAS-1	326	$C_{16}H_{14}O_2N_4S$	0.60	227	72
2.	4-OCH_3-C_6H_4-	HAS-2	340	$C_{17}H_{16}O_2N_4S$	0.83	215	82
3.	4-F-C_6H_4-	HAS-3	328	$C_{16}H_{13}ON_4SF$	0.81	222	79
4.	4-OCH_3-3-OH-C_6H_3-	HAS-4	356	$C_{17}H_{16}O_3N_4S$	0.77	232	69
5.	4-Cl-C_6H_5-	HAS-5	344	$C_{16}H_{13}ON_4SCl$	0.86	207	72
6.	4-$N(CH_3)_2$-C_6H_4-	HAS-6	353	$C_{18}H_{19}ON_5S$	0.74	244	74
7.	3-NO_2-C_6H_4-	HAS-7	355	$C_{16}H_{13}N_5O_3S$	0.88	230	68
8.	2-Cl-C_6H_4-	HAS-8	344	$C_{16}H_{13}ON_4SCl$	0.84	238	79
9.	2-OH-C_6H_4-	HAS-9	326	$C_{16}H_{14}O_2N_4S$	0.88	223	81
10.	C_6H_5-	HAS-10	310	$C_{16}H_{14}ON_4S$	0.75	241	76

*TLC solvent system: Acetone: Benzene: 1.5: 8.5

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INTRODUCTION

1,2,4-Triazole and their derivatives consist an important class of organic compounds. Amongst the five membered nitrogen containing heterocycles, the position of nitrogen atom at 1,2 and 4 activates the ring. The scientists all over the world have focused their attention to evalute 4-aryltriazole ring system.

The synthesis of these heterocycles has received considerable attention in recent years. Several methods have been reported in the literatures for the preparation of 4-aryl triazoles[1-6].

4-aryl triazole and its derivatives possessing a wide spectrum of activities[7-10]. Many workers have reported the different activities of 4-aryl triazoles. Chambers et.al [11] have investigated 4-aryl triazoles to be useful in the treatment of neurogenerative disease. Pier et.al.[12] reported as irreversible antagonist at the A_3, A_2A adenosine receptor[13]. Further, many workers have reported 4-aryl triazoles as aromatic –steroid sulfatage inhibitors [14], GSKK-3 inhibitors [15], anticancer [16], fungicidal [17], antibacterial [18], anti-inflammatory [19], PKB (protein kinas B) inhibitors [20]. The triazole derivatives have also been reported as better therapeutic agents[21].

The scientific literature also stated that the antiviral [22] and antibacterial [23,24] activities of thiourea derivatives are due to the presence of the –NH-C(S)-NH- function in the molecule and the changes in this activity depend on the nature of its substituents. With an aim to synthesise better therapeutic agents, we have investigated some new 4-aryl triazole derivatives which have been described as under.

EXPERIMENTAL

(1) Synthesis of potassium 4-methoxy benzoic acid hydrazide dithiocarbamate (HAS-D)

Part 1, Section I

(2) Synthesis of 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol

A mixture of potassium salt (HAS-D) and p-toludine was heated up to evolution of H_2S gas. DMF was added to this mixture and contents were poured into ice. The crude product was filtered and crystallized from ethyl alcohol.

Similarly other 4-aryl triazoles were synthesized. The reaction scheme is as given below:

REACTION SCHEME

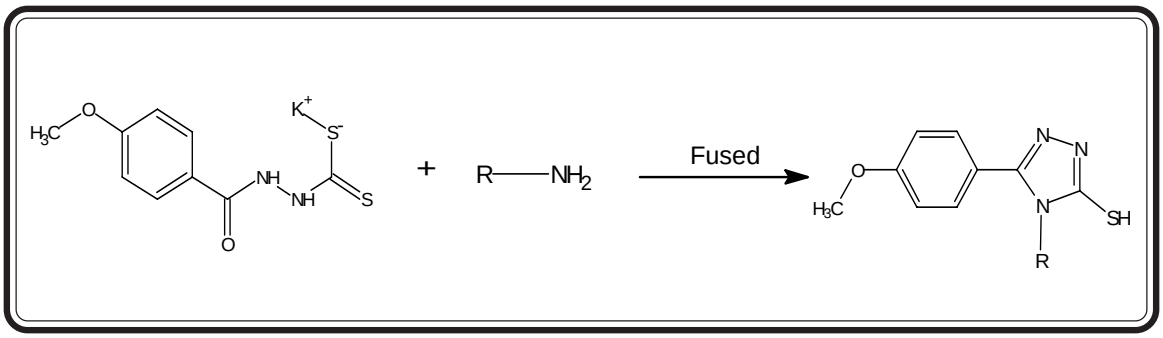
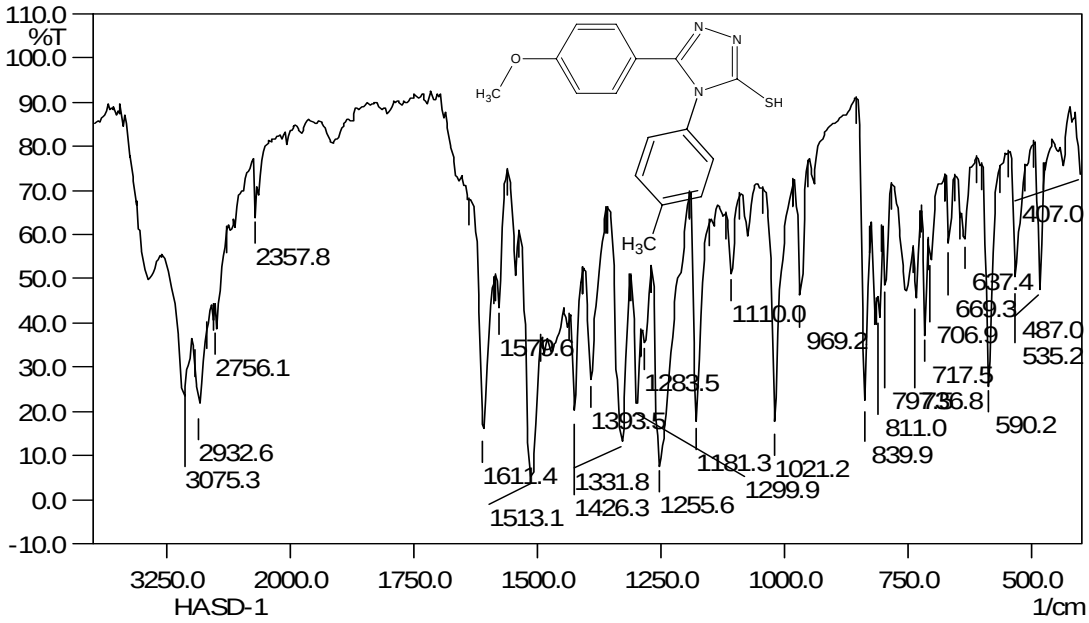
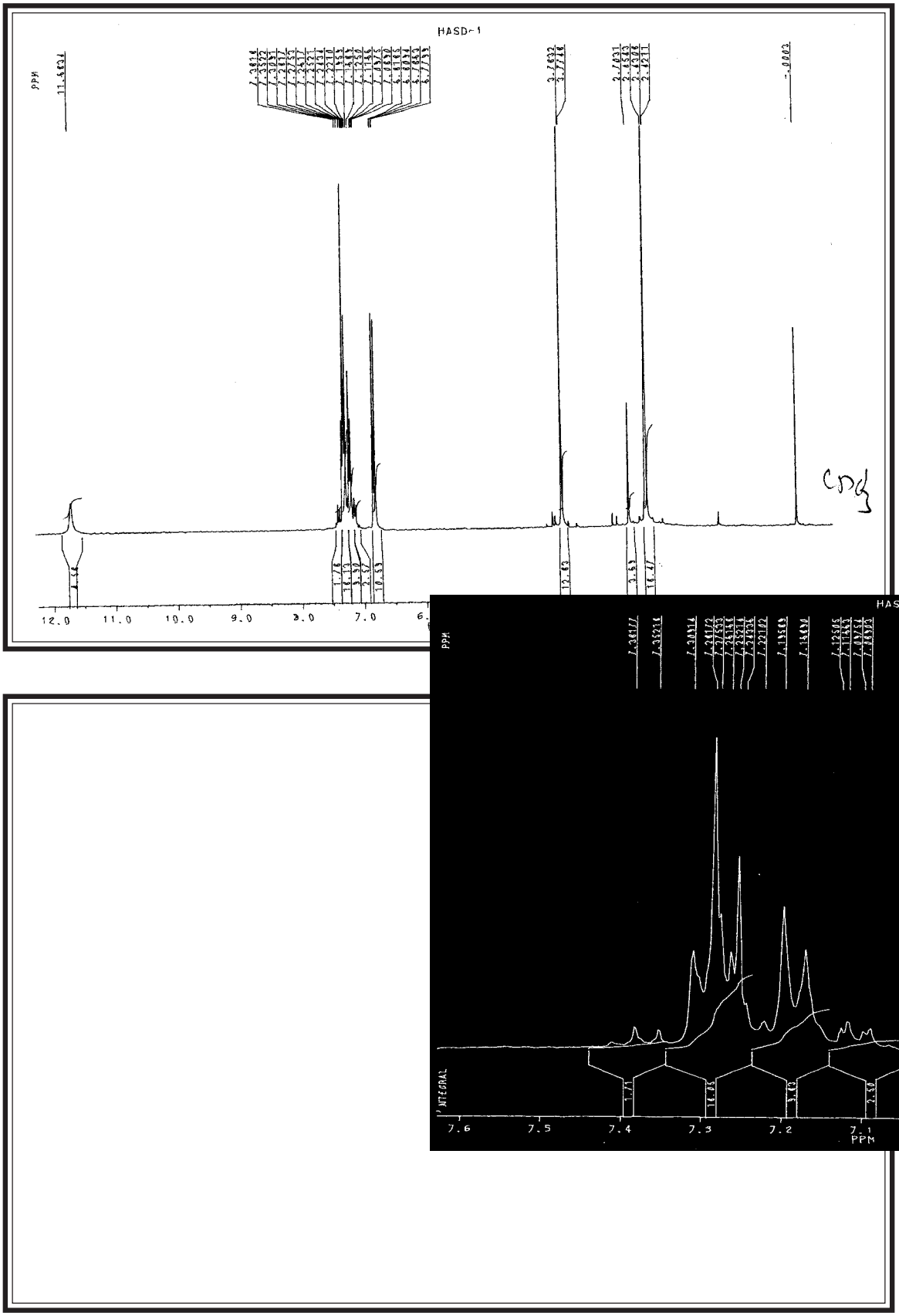


Table 1: IR Spectra of 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol. (HASD-1)

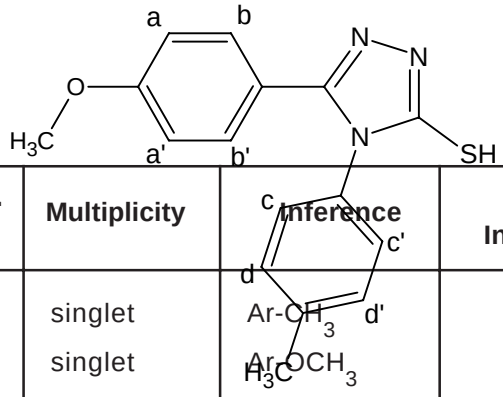


Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2932	2975 - 2950
	C-H def.(asym.)	1426	1470 - 1435
	C-H def.(sym.)	1331	1385 - 1350
Aromatic	C-H str.	3075	3100 - 3030
	C=C	1513	1585 - 1480
	C-H i.p. def.	1110	1125 - 1090
		1021	1070-1000
	C-H o.o.p. def.	839	835 - 810
Triazole	C=N str.	1611	1650 - 1580
	C-N str.	1255	1350 - 1200
	C-O-C str.(sym.)	1021	1075-1010
	C-S str.	669	700-600

Table 2: ^{1}H NMR Spectra of 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol (HASD-1).

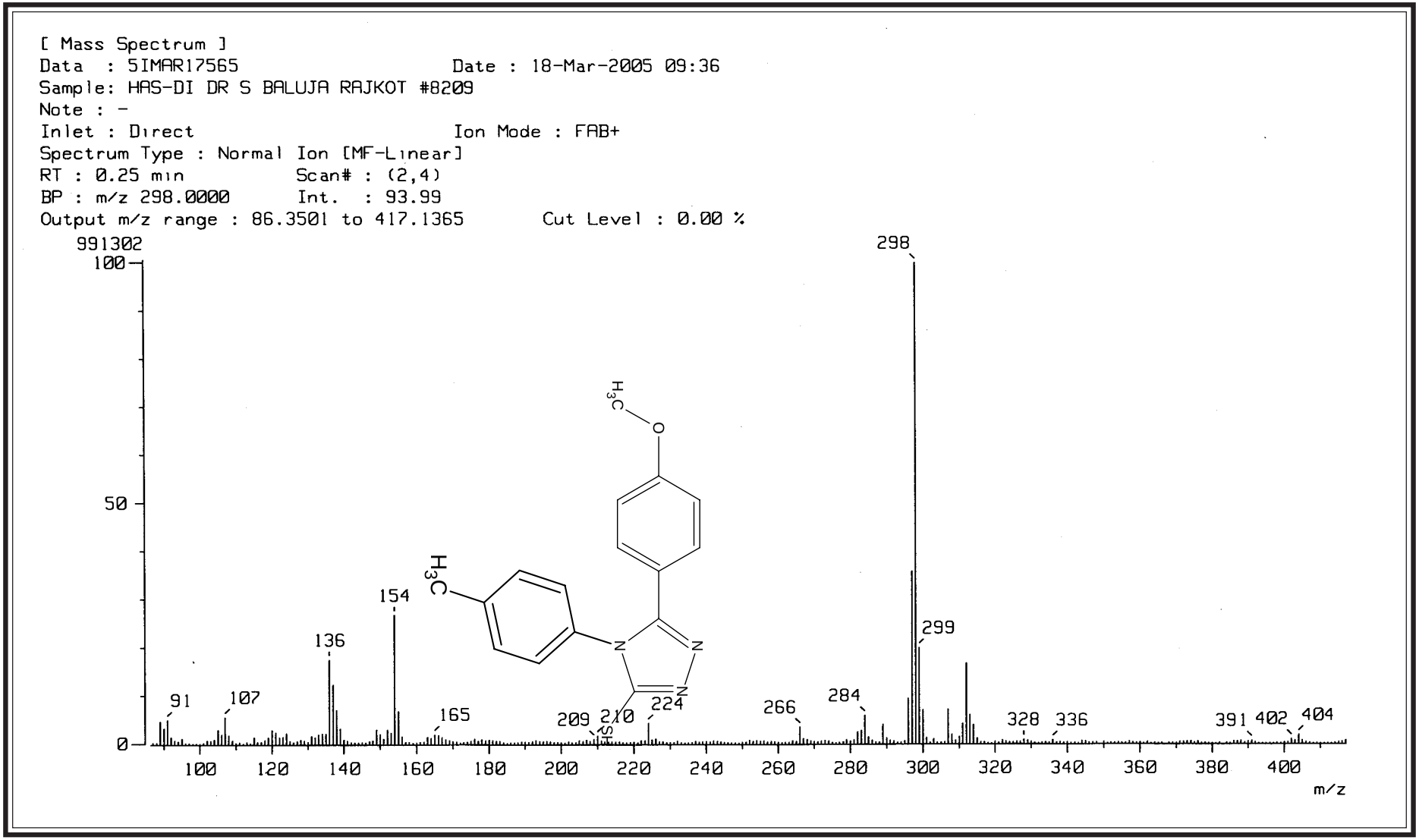


^{1}H NMR Spectral data of 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol (HASD-1).



Signal No.	Signal Position (ä ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	2.43	3H	singlet	Ar-CH_3	-
2.	3.78	3H	singlet	Ar-OCH_3	-
3.	6.77-6.80	2H	doublet	Ar-Haa’	9.0
4.	7.16-7.19	2H	doublet	Ar-Hdd’	8.1
5.	7.22-7.28	4H	d.doublet	Ar-Hbb'+Hcc’	-
6.	11.6	1H	singlet	-SH	-

Table 3: Mass spectra of 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol (HASD-1)



Scheme 1: 5-(4-methoxyphenyl)-4-(4-methylphenyl)-4*H*-1,2,4-triazole-3-thiol (HASD-1)

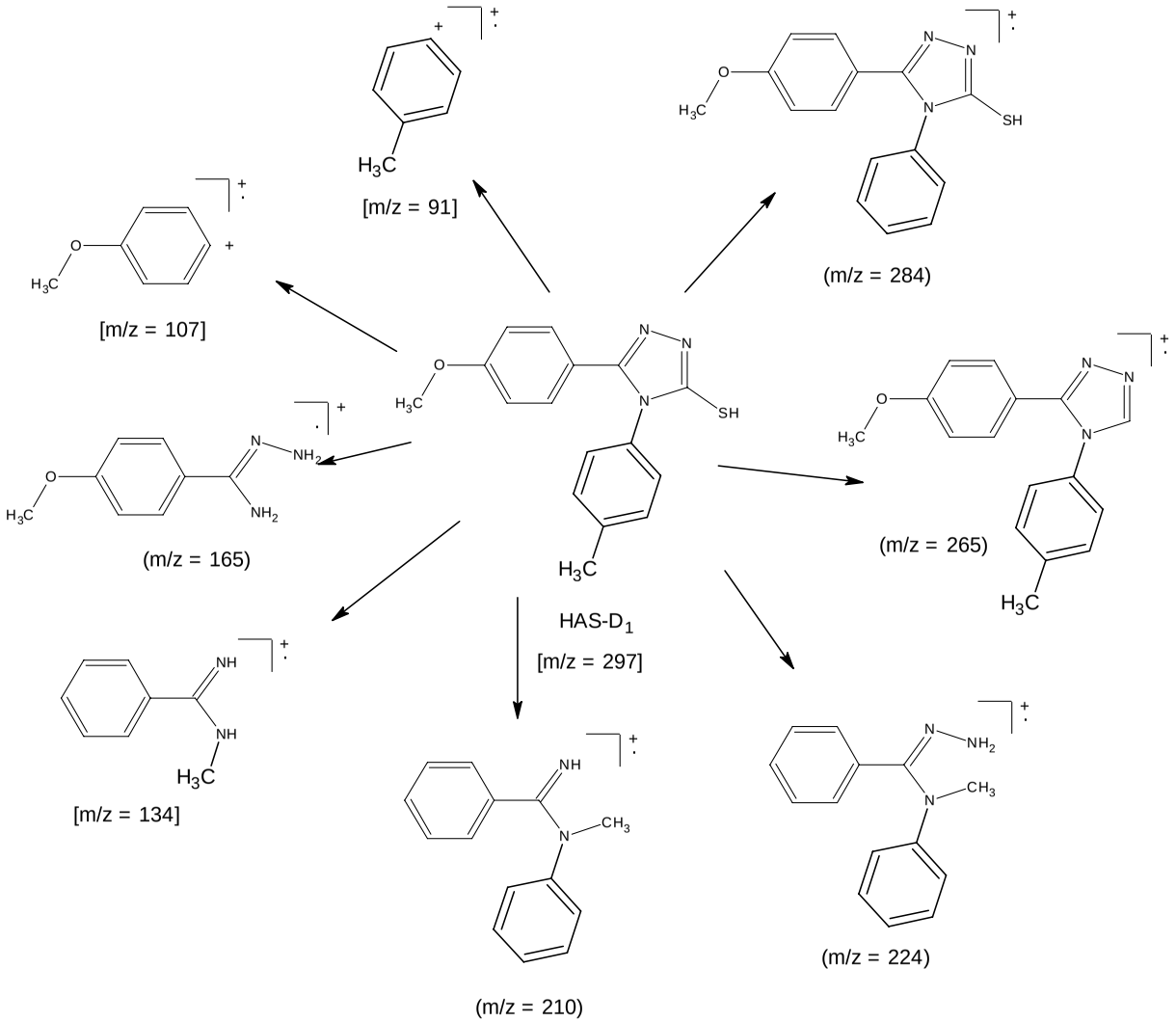


Table 4: Physical constants of 4-aryl triazoles

Sr. No.	R	Code.	M.Wt.(g)	M.F.	Rf* Value	M.P. ºC	Yield %
1.	4-CH_3-C_6H_4-	HASD-1	297	$C_{16}H_{15}ON_3S$	0.63	190	66
2.	4-OCH_3- C_6H_4-	HASD-2	313	$C_{16}H_{15}O_2N_3S$	0.59	196	79
3.	4-Cl- C_6H_4-	HASD-3	317	$C_{16}H_{12}OClN_3S$	0.78	160	81
4.	2-NO_2-C_6H_4-	HASD-4	328	$C_{15}H_{12}O_2N_4S$	0.65	240	59
5.	3-NO_2-C_6H_4-	HASD-5	328	$C_{15}H_{12}O_3N_4S$	0.45	260	77
6.	2,4-CH_3-C_6H_3-	HASD-6	311	$C_{17}H_{17}ON_3S$	0.51	162	74
7.	2,3- Cl-C_6H_3-	HASD-7	352	$C_{15}H_{11}OCL_2N_3S$	0.70	169	83
8.	2-CH_3-C_6H_4-	HASD-8	297	$C_{16}H_{15}ON_3S$	0.66	166	78
9.	3-Cl-4-F-C_6H_3-	HASD-9	335	$C_{15}H_{11}OClFN_3S$	0.61	135	64
10.	2-OCH_3-C_6H_4-	HASD-10	313	$C_{16}H_{15}O_2N_3S$	0.55	110	68

*TLC solvent system: Acetone: Benzene: 1:9

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INTRODUCTION

Thiadiazoles are the compounds containing three carbon atoms, one sulphur atom, and one nitrogen atom in five member ring. It is parent material for numerous of chemical compounds including sulfur drugs, biocides, fungicides, dyes, chemical reaction accelerators. Thiadiazoles and its derivatives are important in the industry of dyes, photographic chemicals, sulfa drugs, preservative and rubber. Thiadiazoles dyes contain the color radicals of =C=N- and -S-C= which decide colors to a compound. Some thiazole derivatives belong to a class of cyclic sulfur organo products containing sulfur atom (S) and often oxygen (O), nitrogen (N), hydrogen (H), as well as other elements. Such compounds find application for making biological activitive agents. Thiazole and its derivatives are also used as thiol flavouring substances.

In 1882, 1,3,4-thiadiazoles was first described by Fischer and further developed by Busch and co-workers. Literature survey reveals that several workers described the synthesis of Thiadiazoles[1-4]. Bano and co-workers have synthesized 6-phenyl amino 1,3,4-thiadiazoles[5]. 1,3,4-thiadiazoles have prepared through the intramolecular Mannich reaction by ian-Xian et al[6].Rune and co-workers have prepared some new 1,3,4-thiadiazoles derivatives[7]. 1,3,4-thiadiazole derivatives as non-mutagenic megazol analogues were synthesized by Samir and co-workers[8]. Investigation on the aromaticity of 1,3,4-thiadiazoles was studied by Safiye Sag and co-workers[9]. Andanappa and workers have synthesised these derivatives as anti tubercular agent[10].

Extensive research has been carried out to enhance the activity and reduce toxicity of thiadiazole drugs. Various derivatives have resulted in many drugs and exhibit different biological activities[11-14]. Thiadiazoles and its derivatives are used for biological activities such as antiviral[15], antibacterial[16], antifungal[17] and antituberculous[18].Gabriela and co-workers have prepared I,3,4-thiadiazole compounds as carbonic anhydrase inhibitors[19]. These compounds are also reported as anti-cancer agent by Nalan and co-workers[20]. Anti-inflammatory activity was reported for thiadiazole by Erhan and workers[21].

EXPERIMENTAL

(1) Synthesis of 3-(4-methoxyphenyl)-6-(4-methylphenyl) [1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASG-1)

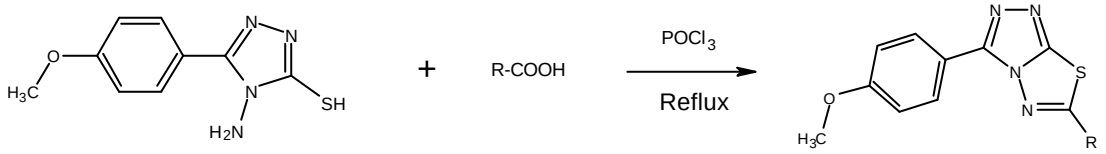
A mixture of P-toluic acid (1.36gm., 0.01mole) and 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (2.22gm., 0.01mole) in $POCl_3$ (25ml) was refluxed for 10 hours. The reaction mixture was poured onto crushed ice and thus solid separated out was filtered, washed with water and crystallised from ethanol. Similarly other aromatic acids have been condensed.

(2) Synthesis of 3,6-bis(4-methoxyphenyl)-5,6-dihydro[1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazole (HASH-1)

A mixture of 4-amino-5-(4-methoxyphenyl)-4*H*-1, 2, 4- triazole-3-thiol (2.22gm., 0.01mole), p-anisaldehyde (1.36gm, 0.01mole) and p-toluene sulphonic acid (P-TsOH)(50mg. in DMF, 50ml) was refluxed for 10 hours. The reaction was poured onto crushed ice and thus solid obtained was filtered, washed with water and crystallized from ethanol. Similarly other aromaticaldehydes have been condedensed.

REACTION SCHEME

HASG



HASH

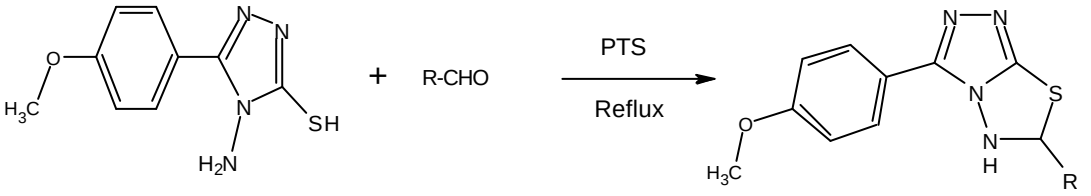
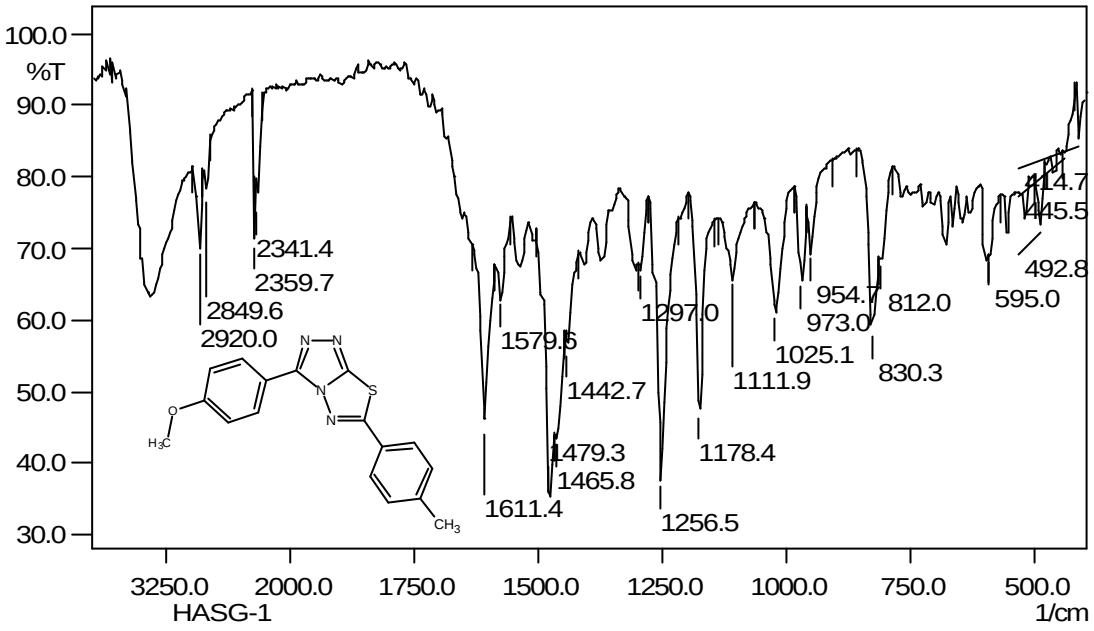
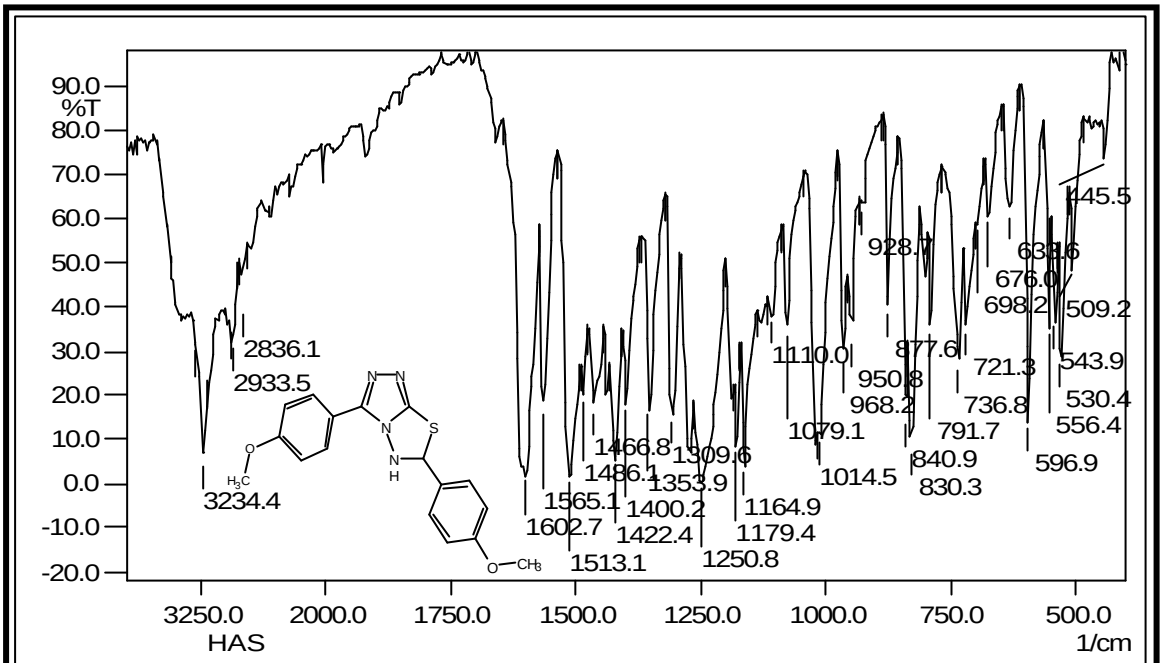


Table 1: IR spectral data of 3-(4-methoxyphenyl)-6-(4-methylphenyl) [1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASG-1).



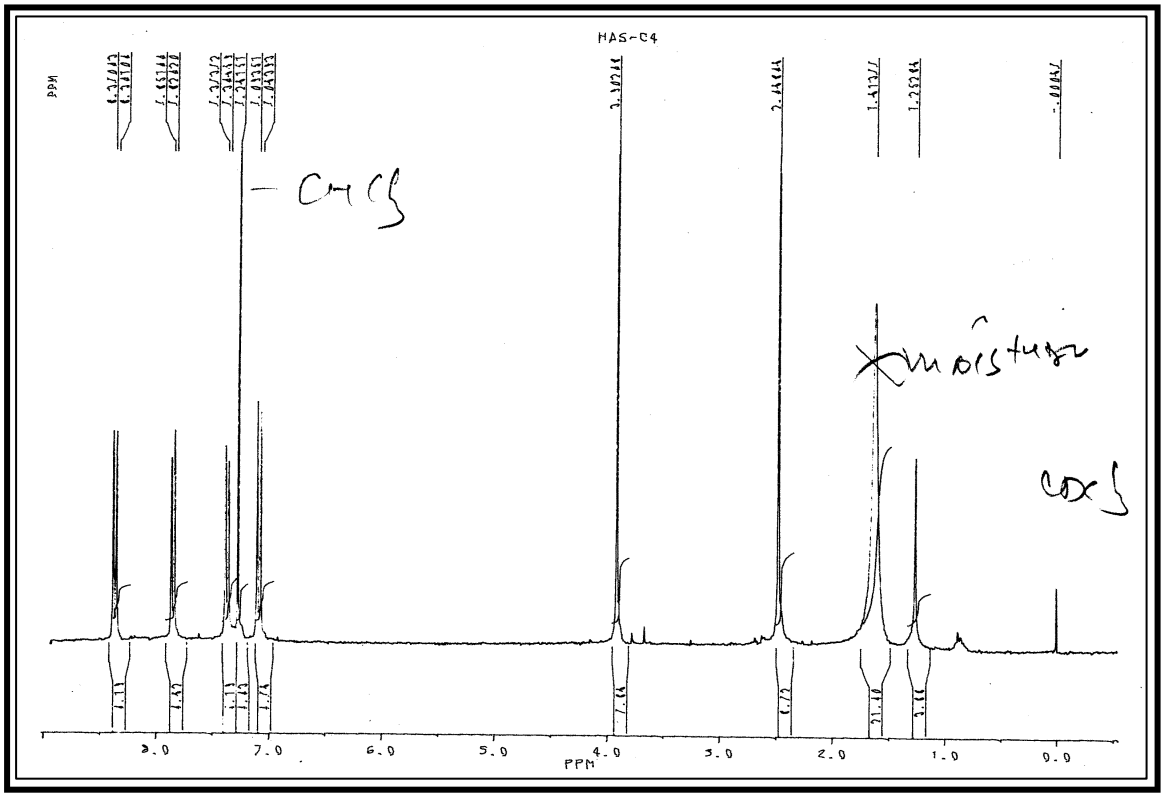
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2920	2975 - 2950
	C-H str.(sym.)	2849	2880 - 2860
	C-H def.(asym.)	1442	1470 - 1435
Aromatic	C=C	1579	1585 - 1480
	C-H i.p. def.	1112	1125 - 1090
		1025	1070-1000
	C-H o.o.p. def.	830	835 - 810
Triazole	C=N str.	1611	1650 - 1580
	C-N str.	1256	1350 - 1200
	C-O-C str.(sym.)	1025	1075-1010
	C-S str.	671	700-600

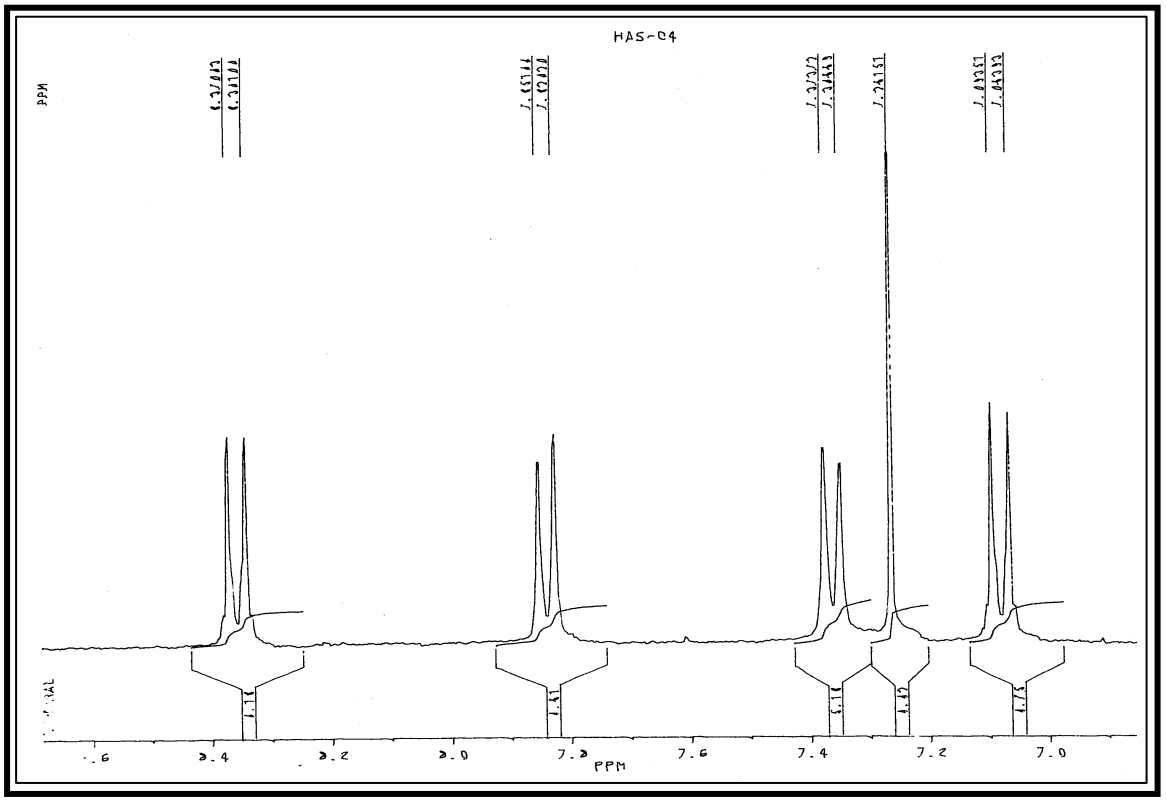
Table 2: IR spectra data of 3,6-bis (4-methoxyphenyl)-5,6-dihydro [1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASH-1).



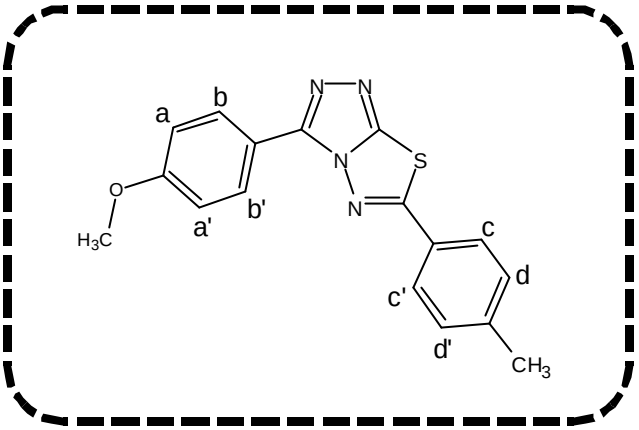
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane (Methyl)	C-H str.(asym.)	2933	2975 - 2950
	C-H str.(sym.)	2836	2880 - 2860
	C-H def.(asym.)	1466	1470 - 1435
	C-H def.(sym.)	1353	1385 - 1350
Aromatic	C=C	1513	1585 - 1480
	C-H i.p. def.	1179	1125 - 1090
		1079	1070-1000
	C-H o.o.p. def.	830	835 - 810
Triazole	C=N str.	1602	1650 - 1580
	C-N str.	1250	1350 - 1200
	C-O-C str.(sym.)	1014	1075-1010
	C-S str.	676	700-600

Table 3: ^{1}HNMR spectra 3-(4-methoxyphenyl)-6-(4-methylphenyl)[1,2,4]triazolo [3,4- *b*] [1,3,4] thiadiazole (HASG-1).



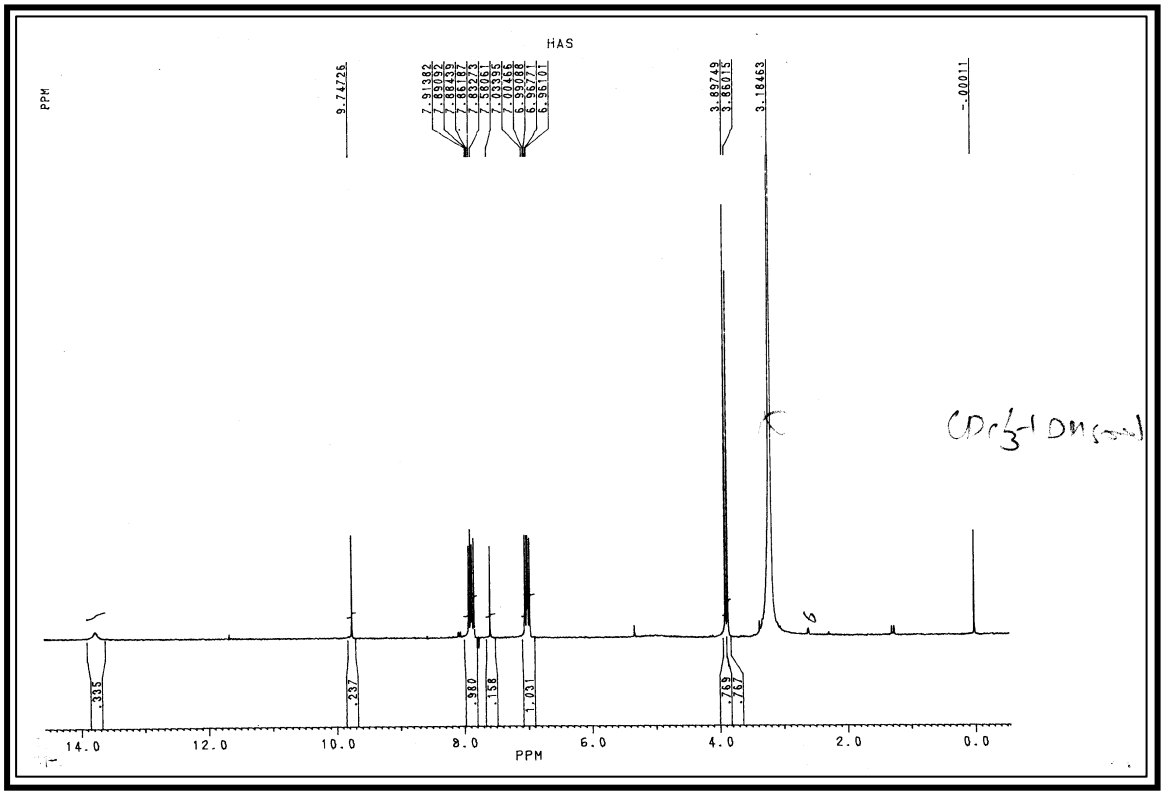


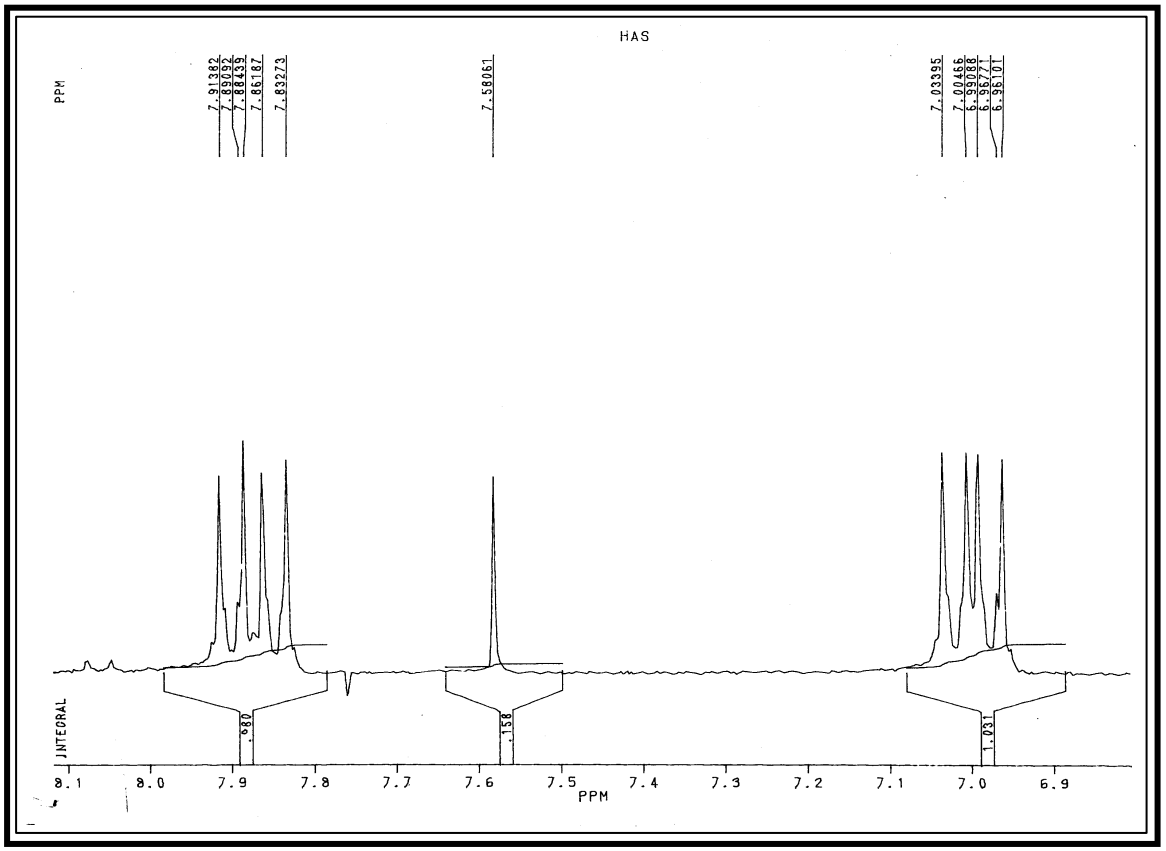
^{1}HNMR spectral data 3-(4-methoxyphenyl)-6-(4-methylphenyl)[1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASG-1).



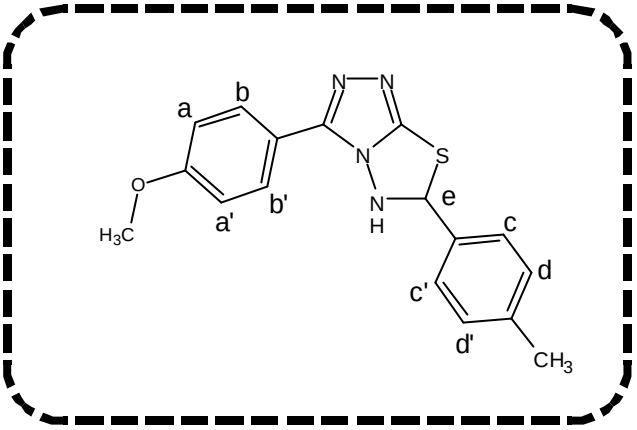
Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	2.46	3H	singlet	Ar-CH_3	-
2.	3.90	3H	singlet	Ar-OCH_3	-
3.	7.06-7.09	2H	doublet	Ar-Haa'	9.1
4.	7.34-7.37	2H	doublet	Ar-Hcc'	8.1
5.	7.82-7.85	2H	doublet	Ar-Hdd'	8.1
6.	8.34-8.37	2H	doublet	Ar-Hbb'	8.7

Table 4: ^{1}H NMR spectra of 3,6-bis(4-methoxyphenyl)-5,6-dihydro[1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASH-1).



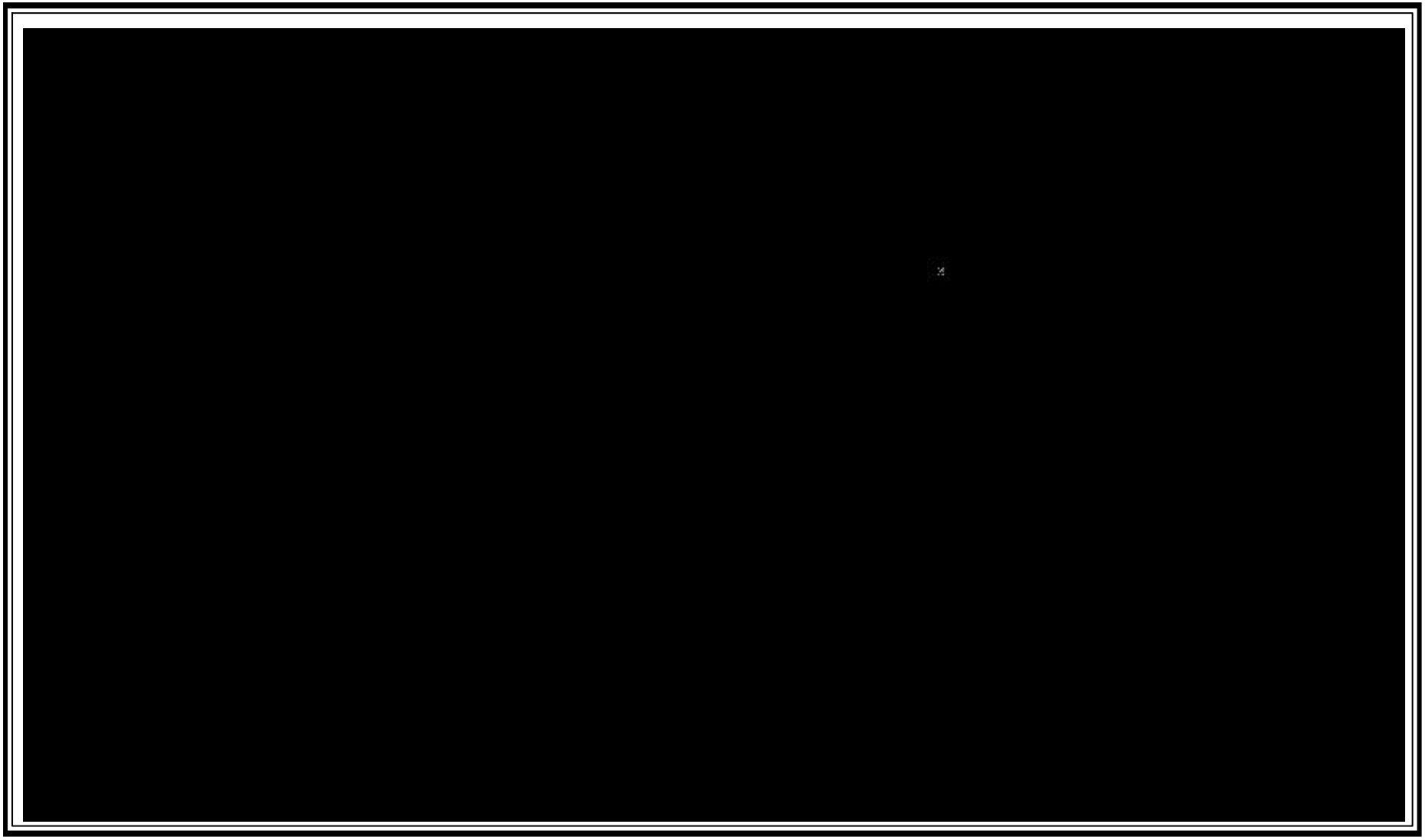


^{1}H NMR spectral data of 3,6-bis(4-methoxyphenyl)-5,6-dihydro [1,2,4]triazolo [3,4-*b*] [1,3,4] thiadiazole (HASH-1).



Signal No.	Signal Position (đ ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.86	3H	singlet	Ar-$OCH_{3(M)}$	-
2.	3.89	3H	singlet	Ar-OCH_3	-
3.	6.96-6.99	2H	doublet	Ar-Haa'	8.7
4.	7.00-7.03	2H	doublet	Ar-Hdd'	8.7
5.	7.58	1H	singlet	-NH	-
6.	7.83-7.86	2H	doublet	Ar-Hbb'	8.7
7.	7.88-7.91	2H	doublet	Ar-Hcc'	8.7
8.	9.74	1H	singlet	-CHe	-

Table 5: Mass spectra of 3-(4-methoxyphenyl)-6-(4-methylphenyl)[1,2,4]triazolo[3,4-*b*] [1,3,4] thiadiazole (HASG-1)



Scheme 1: 3-(4-methoxyphenyl)-6-(4-methylphenyl)[1,2,4]triazolo[3,4-*b*] [1,3,4] thiadiazole (HASG-1)

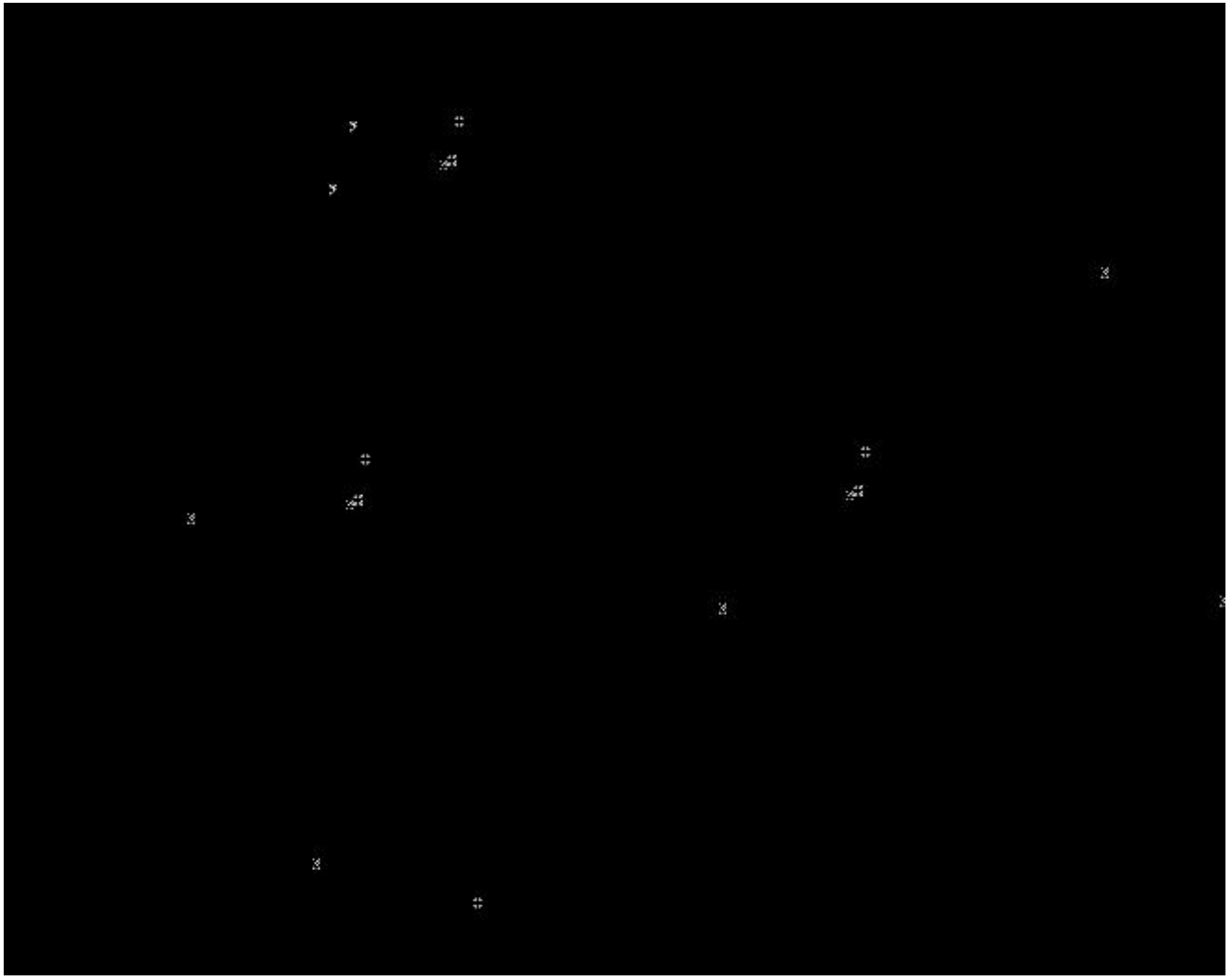
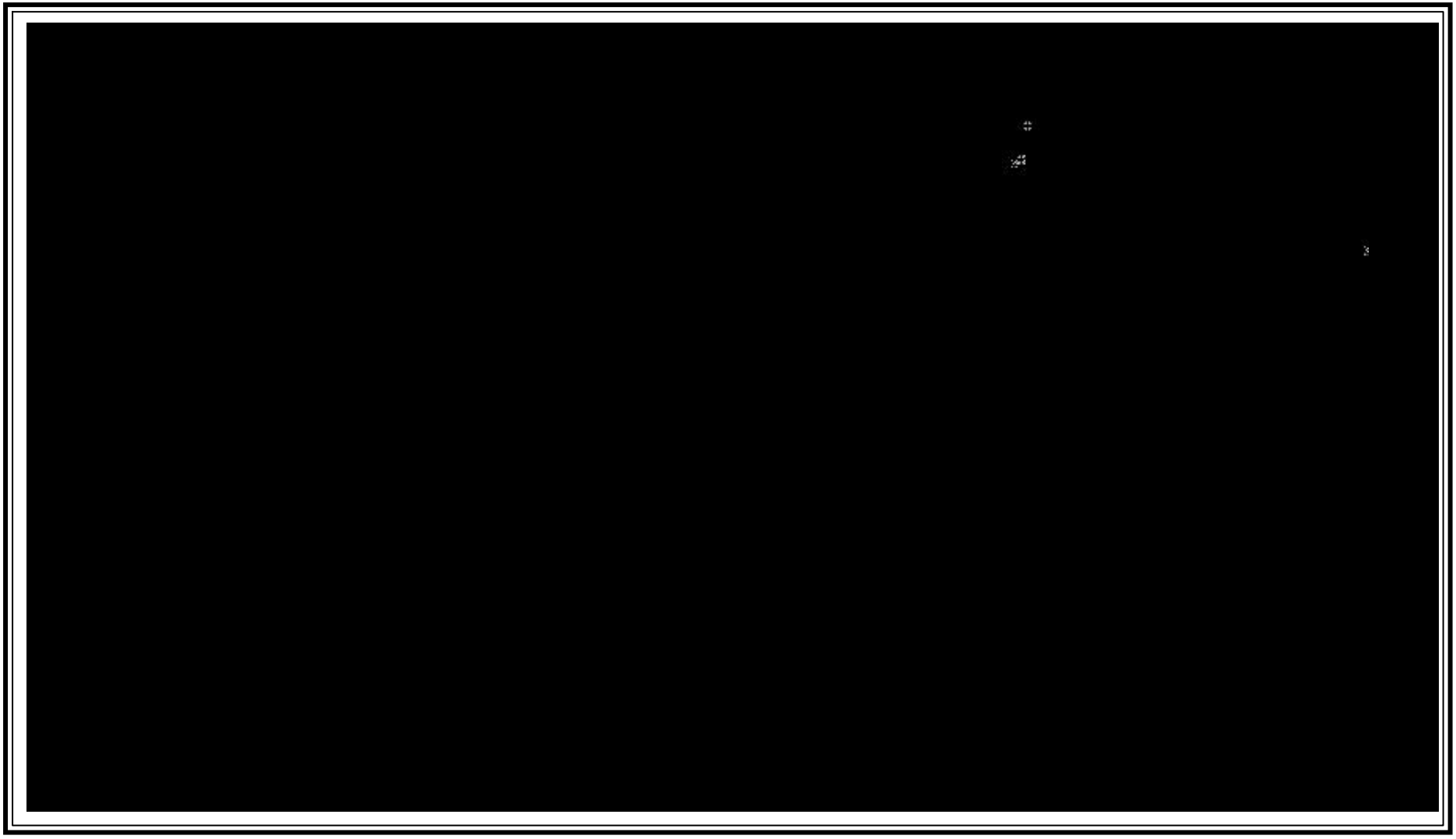


Table 6: Mass spectra of 3,6-bis(4-methoxyphenyl)-5,6-dihydro[1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazole (HASH-1)



Scheme 2: 3,6-bis(4-methoxyphenyl)-5,6-hydro[1,2,4]triazolo[3,4-*b*][1,3,4]thiadiazole (HASH-1)

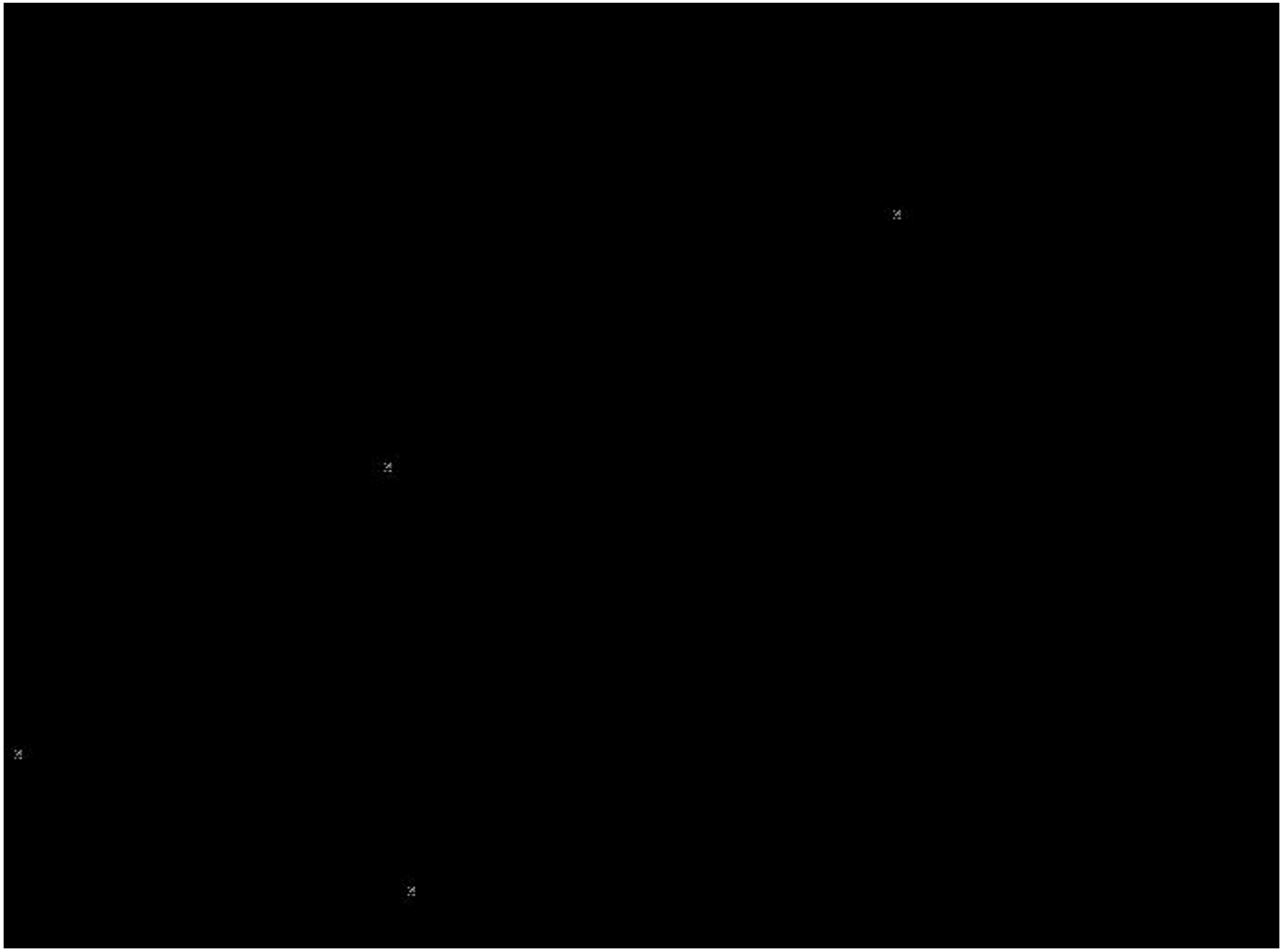
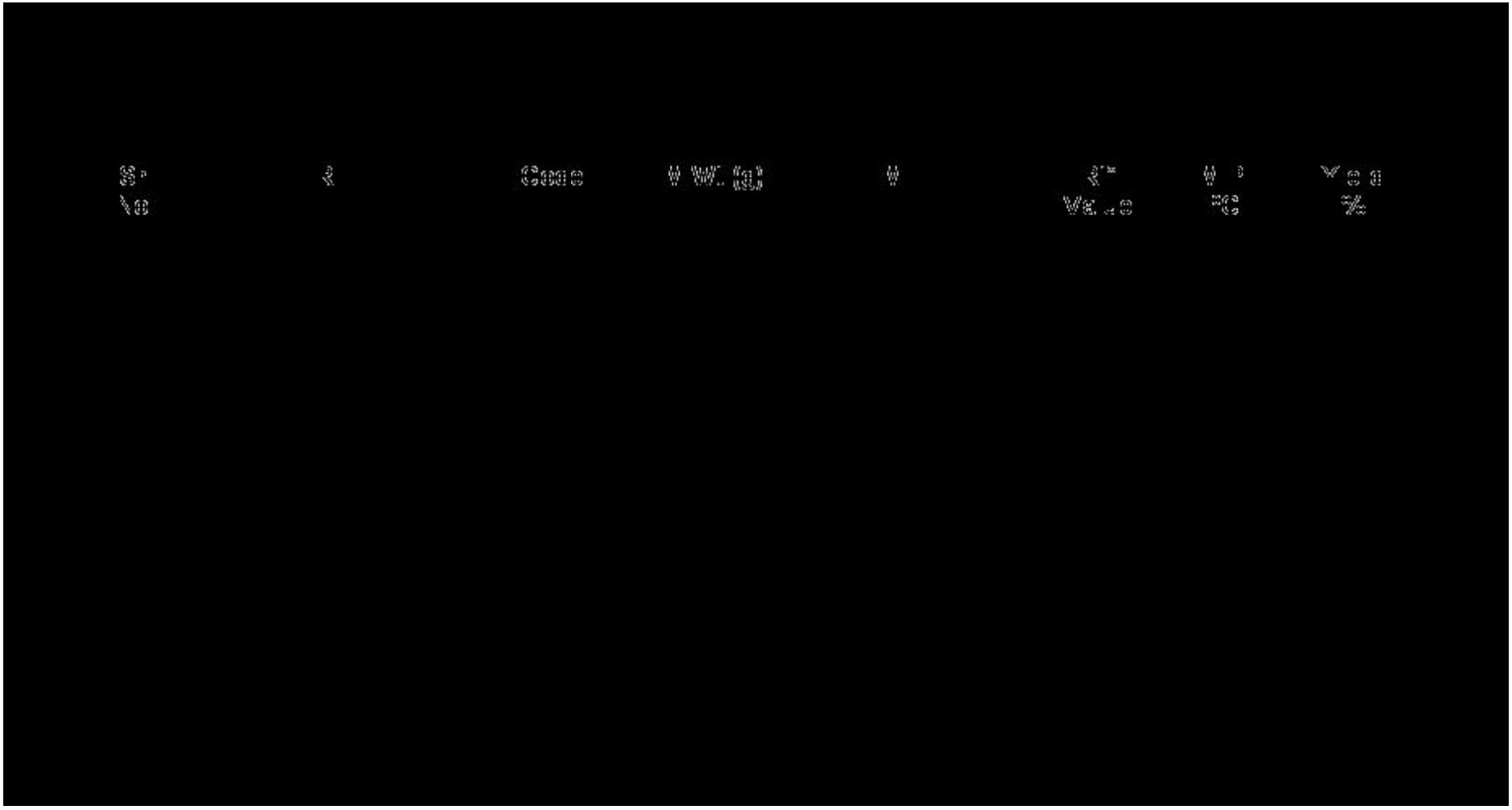


Table 7: Physical constants of 1, 3, 4-thiadiazoles

*TLC solvent system: Acetone: Benzene : 1:9



*TLC solvent system: Acetone: Benzene: 2 : 8

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INTRODUCTION

Heterocyclic compounds are predominant among the types of compounds used as pharmaceutical, agrochemical and veterinary products. One of the most useful class in this category is pyrazole. The pyrazole ring consists of a doubly unsaturated five membered ring containing two adjacent nitrogen atoms. In 1883, Knorr [1,2] first synthesized a compound by the reaction of ethyl acetoacetate with phenyl hydrazine, which yields 1-phenyl-3-methyl-5-pyrazoline. The name pyrazole was given to such compounds because the nucleus was derived from pyrrole by replacement of carbon by nitrogen[3]. Much research has been carried out with the aim to find the therapeutic values of pyrazole moiety, since their discovery[4-6]. Various pyrazole and its derivatives have been used in many drugs[7-9].

Different methods of preparation of pyrazoles are available in literature. Palmey synthesized two structurally isomeric pyrazoles by the reaction of the substituted hydrazines with 1,3-dicarbonyl compounds[10]. By the reaction of ethylacetoacetate with aryl hydrazine hydrate also, Esribano et al synthesized some pyrazoles[11]. Jacobs reported the synthesis by the reaction of acetylene with diazomethane[12] whereas Singh and Ojha synthesized pyrazoles by the reaction of ethylacetoacetate with aryl hydrazines[13]. Some workers reported synthesis by the reaction of acetonitrile derivatives with (DMF-DMA)[14] whereas others synthesized by the cyclocondensation of monosubstituted hydrazines with enaminones afforded pyrazoles[15].

Pyrazole derivatives were prepared and tested for a variety of biological activities such as antitumor[16,17], anticancer[18], antiviral[19], anti-inflammatory[20], antiepileptic[21], anti HIV[18] etc. Many pyrazoles are known to be used as antiproliferature agent [22], protein kinase inhibitors [23], herbicidal [24], CNS depressant [25], antiulcer [26],neurotonsin receptor [27], immino suppressants [28] etc. Freddy et al. reported the biological activity of 4-5-dihydro-3-phenyl-1H-pyrazole[29]. Shimzo and co-workers have also synthesized some pyrazole derivatives and reported their herbicidal activity[30]. Feid-Allah-Hassan reported antidiabetic and antibacterial activity of some other pyrazoles[31]. El-Emery et al. synthesized 1, 3, -diphenyl pyrazole derivatives and reported their variety of

biological activity(III)[32]. Edgardo et al. reported the glycine transport-2-inhibitors activity of some pyrazoles[33]. Some pyrazole derivatives have synthesized as a neuropeptide T_5 receptor antagonists by Nagaaki Sato et al[34]. Recently, Wilst et al. discovered pyrazole as potential glucocorticoid receptor ligand[35] whereas Prasanna and co-workers also reported pyrazoles as COX-2 inhibitors[36]

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INTRODUCTION

The chemistry of chalcones has generated intensive scientific studies throughout the world. Specially interest has been focused on the synthesis and biodynamic activities of chalcones. The name " Chalcones" was given by Kostanecki and tambor[1]. These compounds are also known as benzalacetophenones or benzylidene acetophenones. In chalcones, two aromatic rings are linked by an aliphatic three carbon chain. The presence of α,β-unsaturated carbonyl group gives good biological activity. Chalcone bears a very good synthon so that variety of novel heterocycles with good pharmacological profile can be designed.

Different methods are available for the preparation of chalcones[2-4]. The most convenient methods is the Claisen-Schimdt condensation of equimolar quantities of a aryl methyl ketones with aryl aldehyde in the presence of alcoholic alkali[5]. Chalcones are used to synthesise several derivatives like cyanopyridines, pyrazolines, isoxazoles, pyrimidines, having different heterocyclic ring systems[6-9].

With a variety of biological activity, chalcones are useful in pharmaceuticals. They are associated with different biological activities like insecticidal[10], anticancer[11], anti-inflammatory[12], bactericidal[13], fungicidal[14], antiviral[15], antitumor[16], antimalarial[17] and antiulcer[18]. Literature shows that lieochalcone and oxygenated chalcone has strong antileishmanial activity[19,20]. It is reported that chalcones exhibited potent activity against human malarial parasite[21]. Many workers have reported the different pharmacological activities of chalcones and its derivatives[22-25]. The antibacterial activities of some substituted chalcones have been studied by Modi et al.[26]. De Vincenzo et al. reported antiflammatory activity of som e chalcone derivatives[27]. Aldose reductase inhibitor activity of chalcone derivatives has also been reported by Okuyama et al.[28].Toru et al.[29] reported anticancer activities of chalchones. Seo et al. reports the chalcones as a-glucosidase inhibitors[30]. Antiplasmodial activity of ferrocenyl chalcones was reported Xiang et al.[31]. Bhat and co-workers reported cytotoxic properties of chalcones and their derived pyrazoles[32].

a

EXPERIMENTAL

Synthesis of 1-aryl-3-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl)-2-propene-1-ones

[A] Synthesis of N-aminophenyl-a-methyl-p-nitrophenyl azomethine

A mixture of phenylhydrazine (1.08 g, 0.01M) and p-nitrophenyl aceto phenone (1.65 g, 0.01M) in absolute ethanol was refluxed in water bath for 2 hrs. in presence of 1 ml glacial acetic acid. The crude product was isolated and crystallised from absolute alcohol.

[B] Synthesis of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole

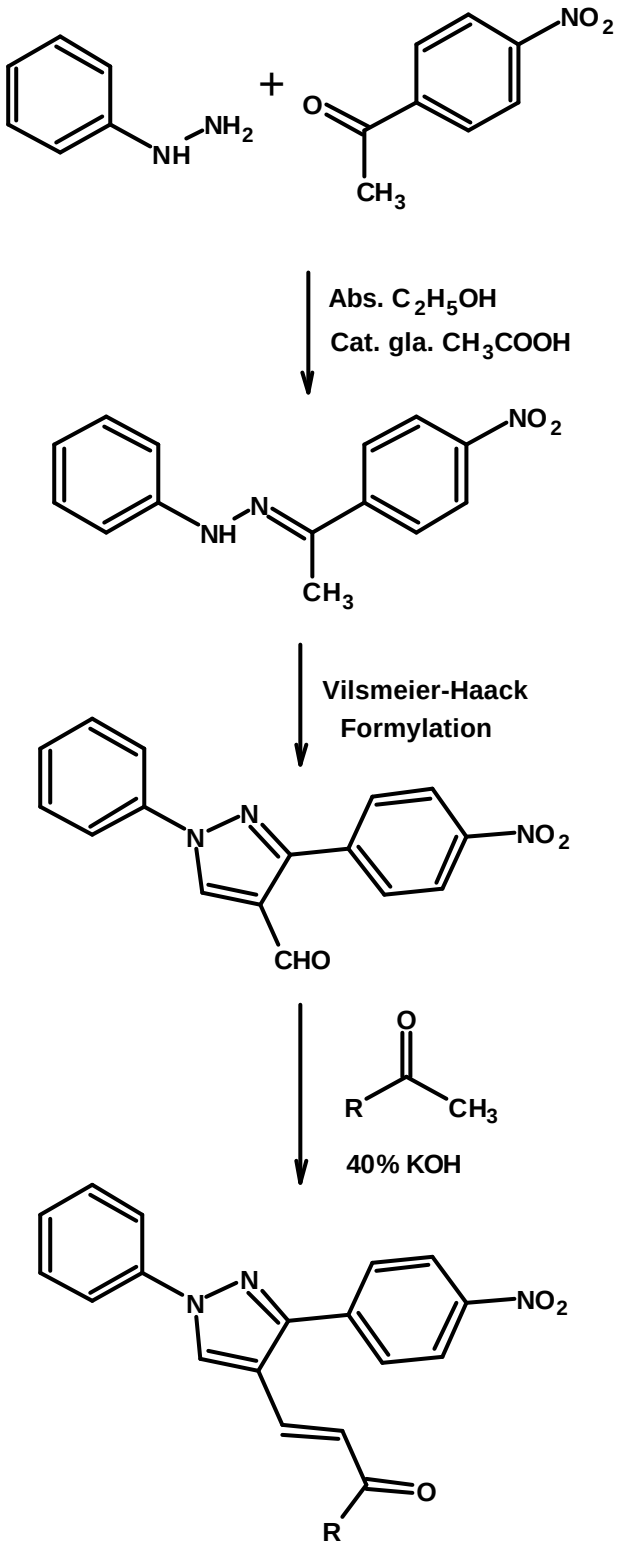
N-Aminophenyl-a-methyl-p-nitrophenyl azomethine (2.53g, 0.01M) was added in mixture of Vilsmeir-Haack reagent (prepared by dropwise addition of 3 ml $POCl_3$ in ice cooled 25 ml DMF). and refluxed for 5 hrs. The reaction mixture was poured into ice followed by neutralization using sodium bicarbonate. Crude product was isolated and crystallised from ethanol.

[C] Synthesis of 1-(p-Anisyl)-3-(1'-N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl)-2-propene-1-one (AS-1a)

To a well stirred solution of 1,N-phenyl-3-p-nitrophenyl-4-formyl-pyrazole (2.93gm, 0.01M) and p-methoxy-acetophenone (1.5 g, 0.01M) in ethanol (25 ml), 40% KOH added till the solution become basic. The reaction mixture was stirred for 24 hrs. The contents were poured into ice, acidified, filtered and crystallised from ethanol.

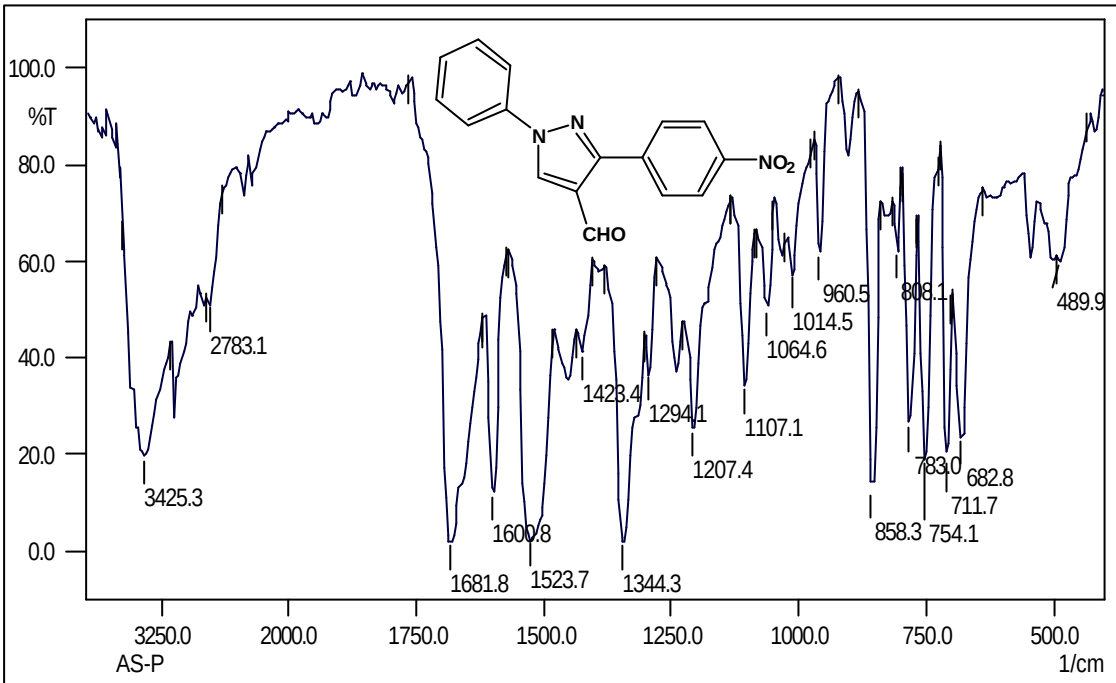
Similarly, other substituted chalcones have prepared. The physical data are recorded in Table 6.

REACTION SCHEME



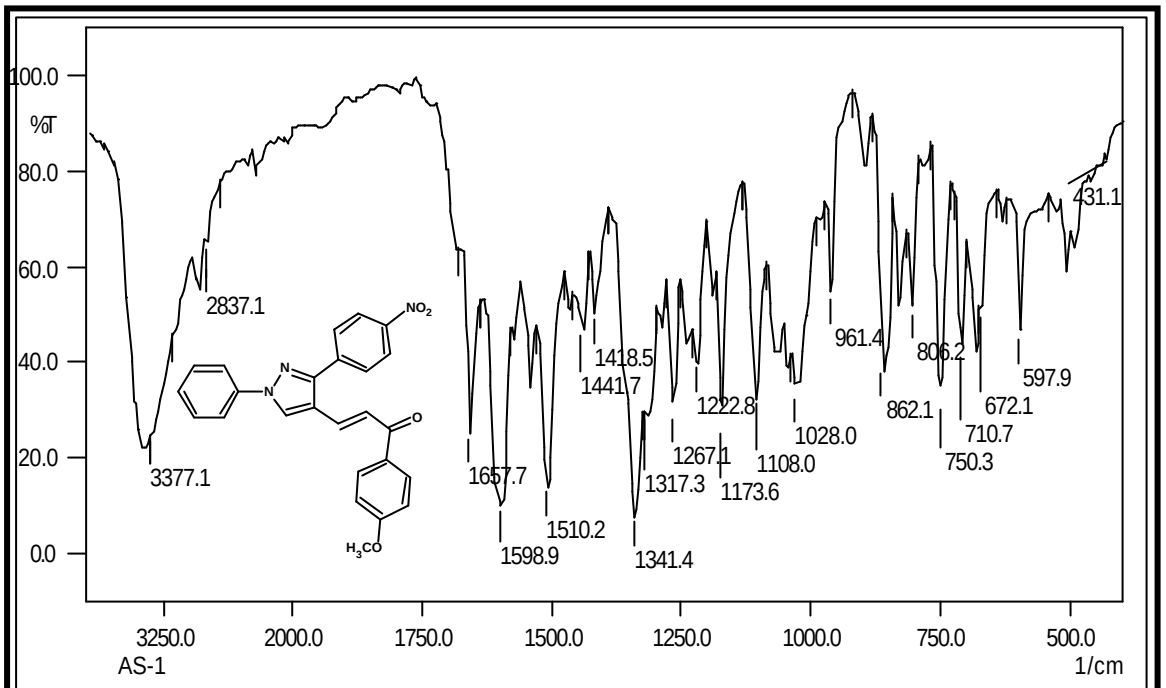
R= Aryl

Table 1: IR Spectral study of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole



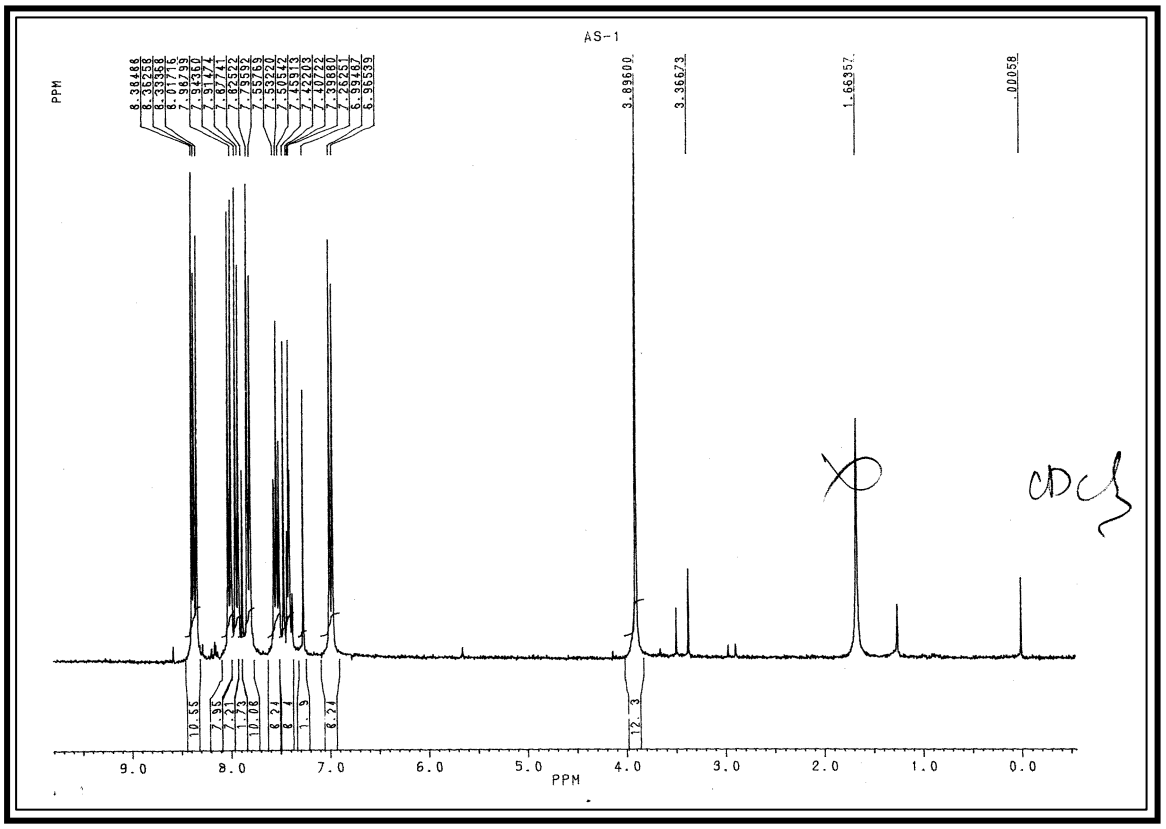
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2937	2975 - 2950
(Methyl)	C-H def.(asym.)	1423	1470 - 1435
	C-H def.(sym.)	1344	1385 - 1350
Aromatic	C=C	1524	1585 - 1480
	C-H i.p. def.	1107	1125 - 1090
	C-H o.o.p. def.	858	860 - 810
Pyrazole	C=N str.	1601	1650 - 1580
moiety	C-N str.	1294	1350 - 1200
Pyrazole	C=O str.	1682	1750 - 1650
aldehyde	C-H str.	2783	2800-2750

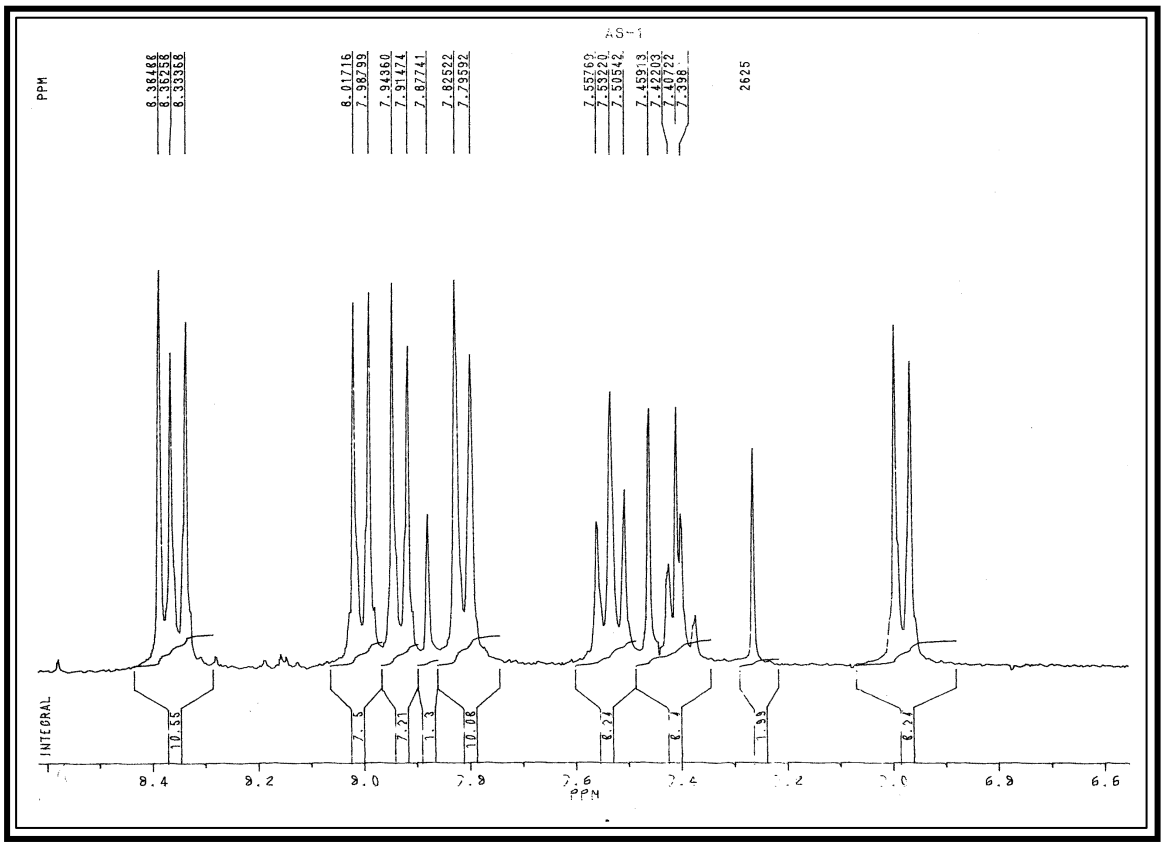
Table 2: IR Spectral study of 1-anisyl-3-[1', N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-2-propene-1-one (AS-1a)



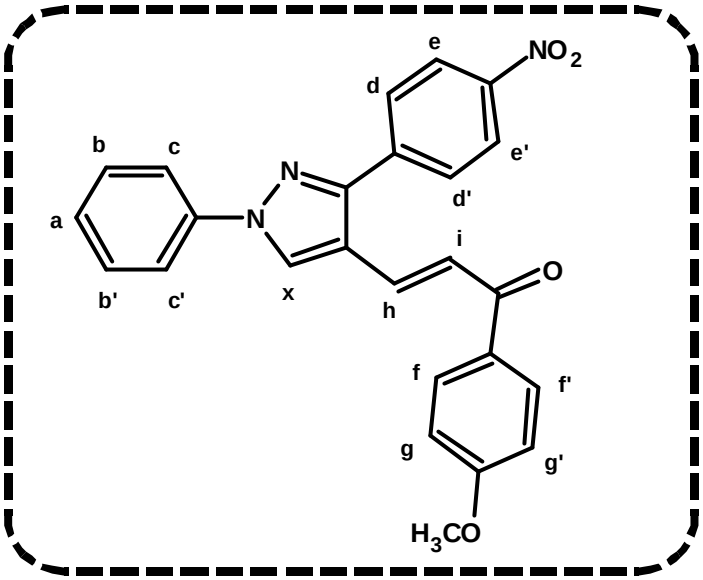
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(sym.)	2837	2880 - 2860
(Methyl)	C-H def.(asym.)	1441	1470 - 1435
	C-H def.(sym.)	1341	1385 - 1350
Aromatic	C=C	1510	1585 - 1480
	C-H i.p. def.	1108	1125 - 1090
	C-H o.o.p. def.	862	860 - 810
Pyrazole	C=N str.	1600	1650 - 1580
moiety	C-N str.	1317	1350 - 1200
Ether	C-O-Cstr.(asym).	1267	1275-1200
	C-O-C(sym.)	1028	1075- 1020
Chalcone	C=O str.	1658	1750-1650

Table 3: ^{1}H NMR spectra of 1-anisyl-3-[1', N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-2-propene-1-one (AS-1a)



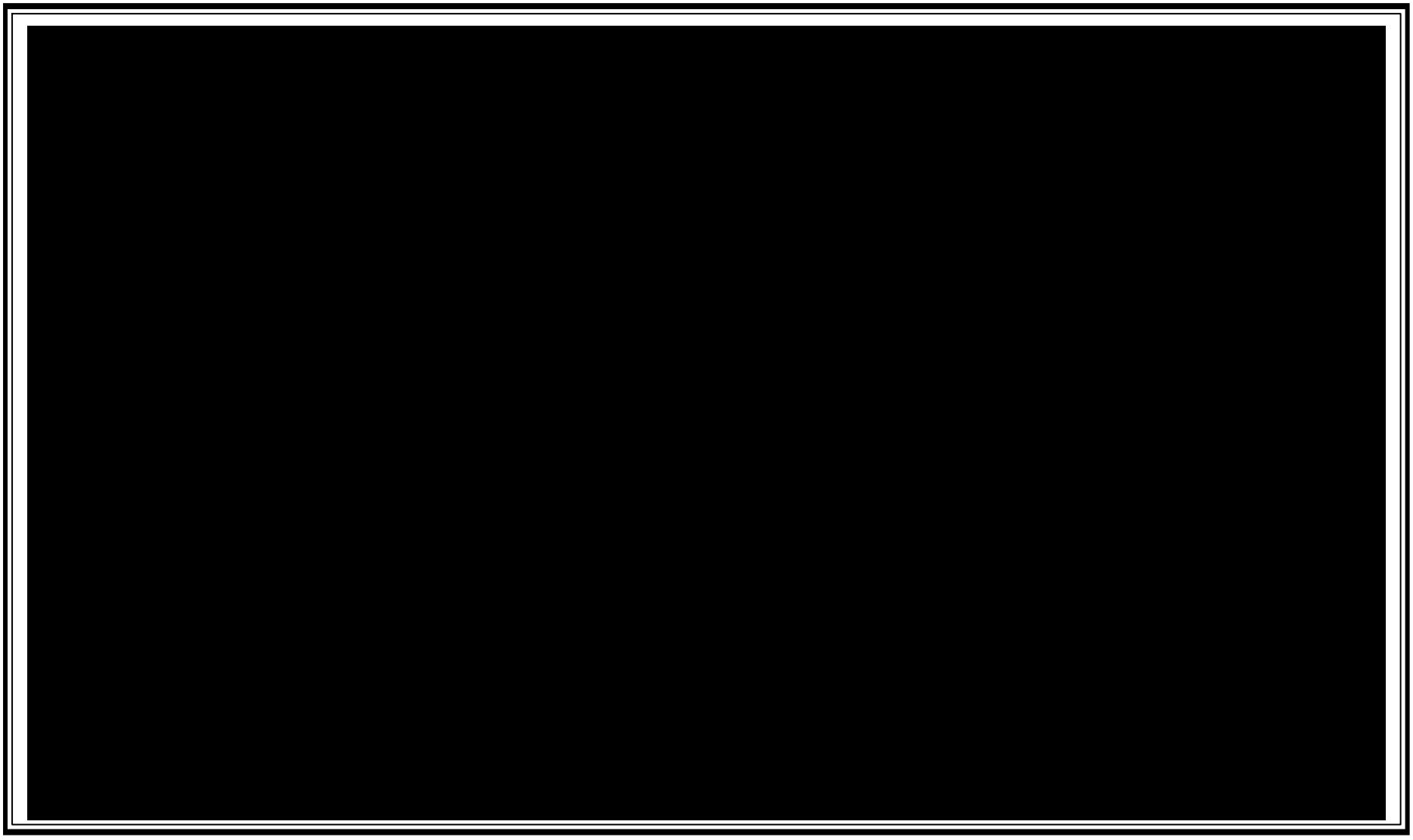


^{1}H NMR spectral data of 1-anisyl-3-[1', N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-2-propene-1-one (AS-1a)



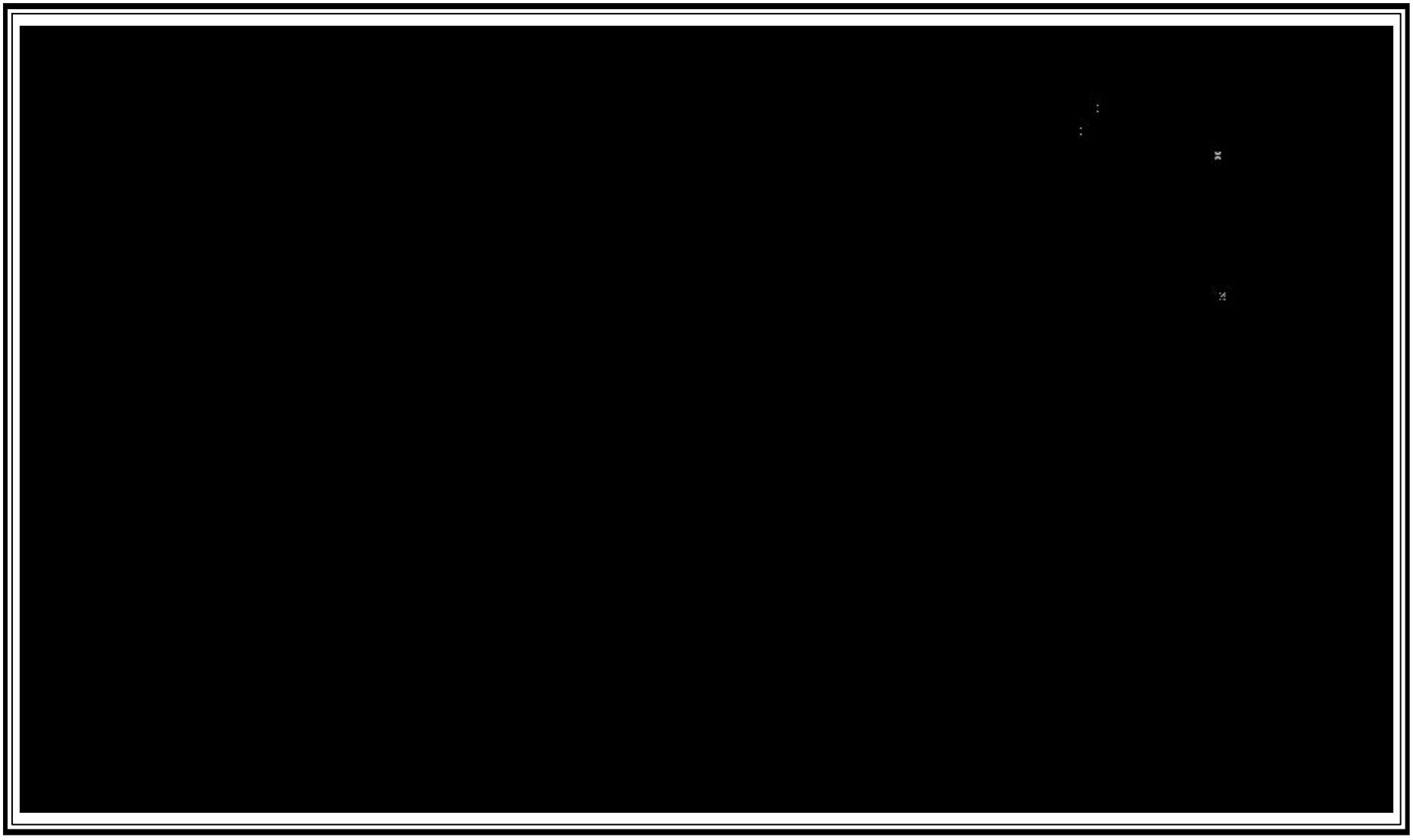
Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.89	3H	singlet	Ar-OCH_3	-
2.	6.96-6.99	2H	doublet	Ar-Hgg'	8.7
3.	7.39-7.42	2H	multiplet	Hh&Hi	-
4.	7.50-7.55	2H	triplet	Ar-Hbb'	- -
5.	7.79-7.82	3H	doublet	Ar-Hdd'+Ha	9.0
6.	7.91-7.94	2H	doublet	Ar-Hee'	8.7
7.	7.98-8.01	2H	doublet	Ar-Hcc'	9.0
8.	8.33-8.36	2H	doublet	Ar-Hff'	8.6
9.	8.38	1H	singlet	Hx	-

Table 4: Mass spectra of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole



Scheme 1: Mass spectra of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole

Table 5: Mass spectra of 1-anisyl-3-[1', N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-2-propene-1-one (AS-1a)



Scheme 2: 1-anisyl-3-[1', N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-2-propene-1-one (AS-1a)

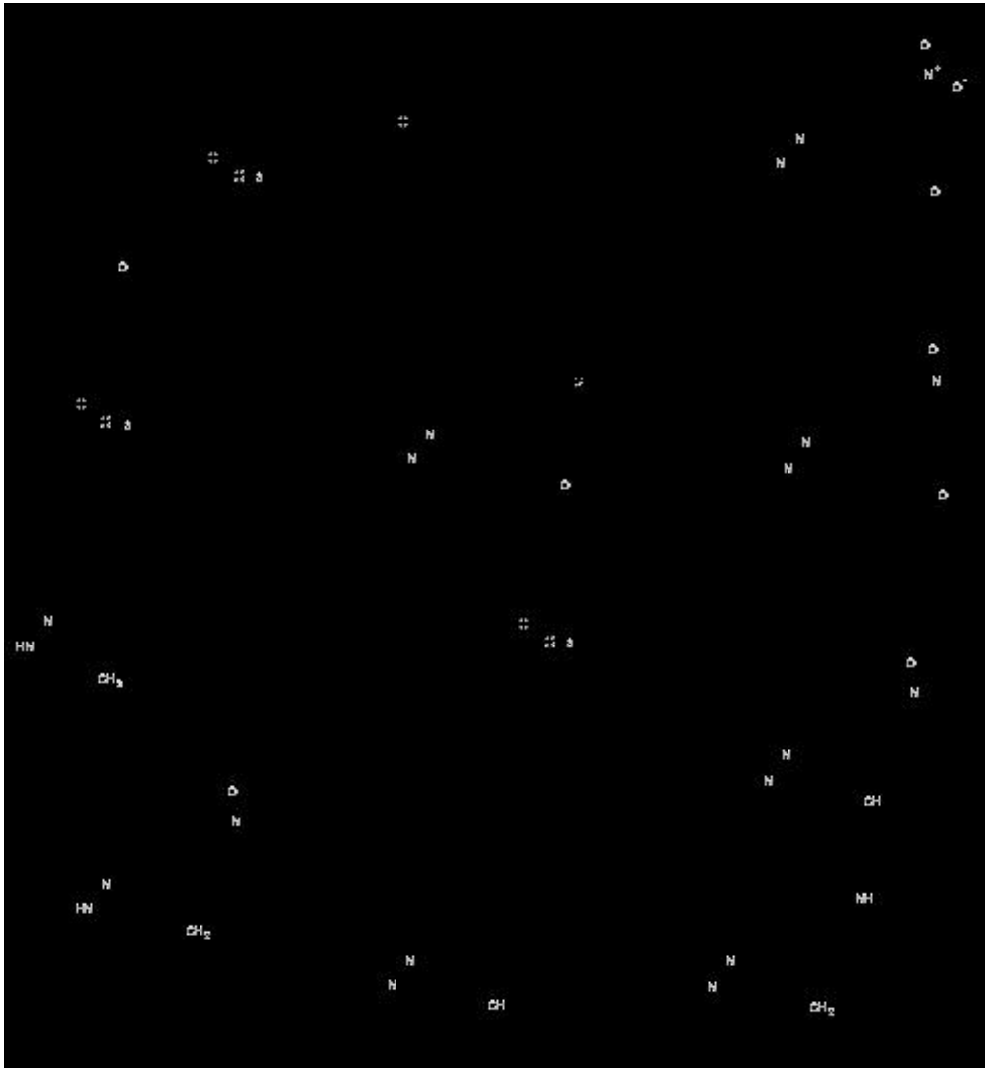


Table 6: Physical constants of Chalcones

*TLC solvent system: Acetone: Benzene : 1.5:8.5

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INTRODUCTION

Pyrazolines are well known for their varied applications in the field of medicine. Amongst nitrogen containing five membered heterocycles, pyrazolines have proved to be the most useful framework. In 1967, Jarobe[1,2] reviewed the chemistry of pyrazolines and studied their biological and industrial applications.

The preparation of pyrazoline derivatives have been reported in the literature[3-7]. Epoxidation of chalcones have epoxy ketones which reacts with hydrazine and phenyl hydrazine to give pyrazolines[8]. It can be constructed by the cyclo condensation of chalcones with hydrazine hydrate[9]. Desaea and coworkers[10] reported the synthesis of some new pyrazoline derivatives. Padya et al. reported that 2-pyrazoline can be prepared by the condensation of chalcone dibromide with hydrazines[11]. Some 3,5-diphenyl-2-pyrazolines were also synthesised by Palaska et al.[12]. Kucukguzel and Rollas reported the preparation of 4-arylhydrozono-2-pyrazoline-5-ones[13]. Recently, Ji and Shi have also synthesised some novel benzothiazoyl pyrazolines[14].

2-pyrazolines are also reported to be associated with different biological activities like antibacterial[15], antifungal[16], antidepresent[17], insecticidal[18], anti-inflmmatory[19], herbicidal[20], tranquilizing[21], anticonvulsant[22], antidiabetic[23], antiandeogenic[24], antiamoebic[25] etc. Garg and Singh[26] reported the antidiabetic activity of these compounds. Hans et al. reported the tranquilizing property of some pyrazolines[27]. Diuretic and hypoglycemic properties of some pyrazolines have also been reported[28,29]. Richard et al.[30] studied the anti-inflammatory and antiarthritic activity of some derivatives of pyrazolines.The antimicrobial activity of 3-(2-acetoxy-4-methoxyphenyl)-5-(substituted phenyl)-pyrazolines was reported by Sonare et al. [31]. Shivnanda et al.[32] also reported antibacterial activity whereas Palska et al. reported the antidepressant activity of some pyrazolines[33]. Carrion et al. have reported the iNOS/nNOS inhibitory activities of new benzopyrazolines derivatives[34]. Ucar et al. reported pyrazolines as cholinstearase and selective monoamine oxidase B inhibitiors for the treatment of Parkinson's and Alzheimer's diseases[35].

EXPERIMENTAL

Synthesis of 3-aryl-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl)-pyrazolines

[A] Synthesisof N-aminophenyl-a-methyl-2-p-nitrophenyl-azomethine

Section-I (A).

[B] Synthesis of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole

Section-I (B).

[C] Synthesis of 1-(p-Anisyl)-3-(1'-N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl)-2-propene-1-one

Section-I (C).

[D] Synthesis of 3-(p-Anisyl)-5-(1'-N-phenyl-3'-p-nitrophenylpyrazol-4'-yl)-pyrazoline

A mixture of 1-(p-anisyl)-3-(1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl)-2-propene-1-one (4.20g, 0.01M) in 25 ml of absolute alcohol, add hydrazine hydrate (0.5g, 0.01M) was refluxed in water bath at temp. 80-90^{O}C for 8 hrs. The reaction mixture was poured into ice. The product was isolated and crystallised from ethanol.

Similarly other substituted pyrazolines have been prepared. The physical data are recorded in Table 4.

REACTION SCHEME

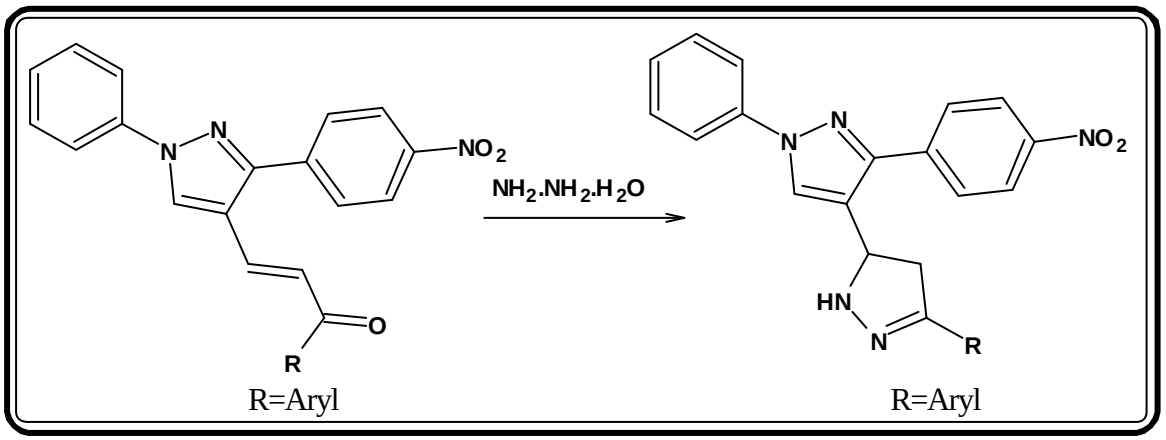
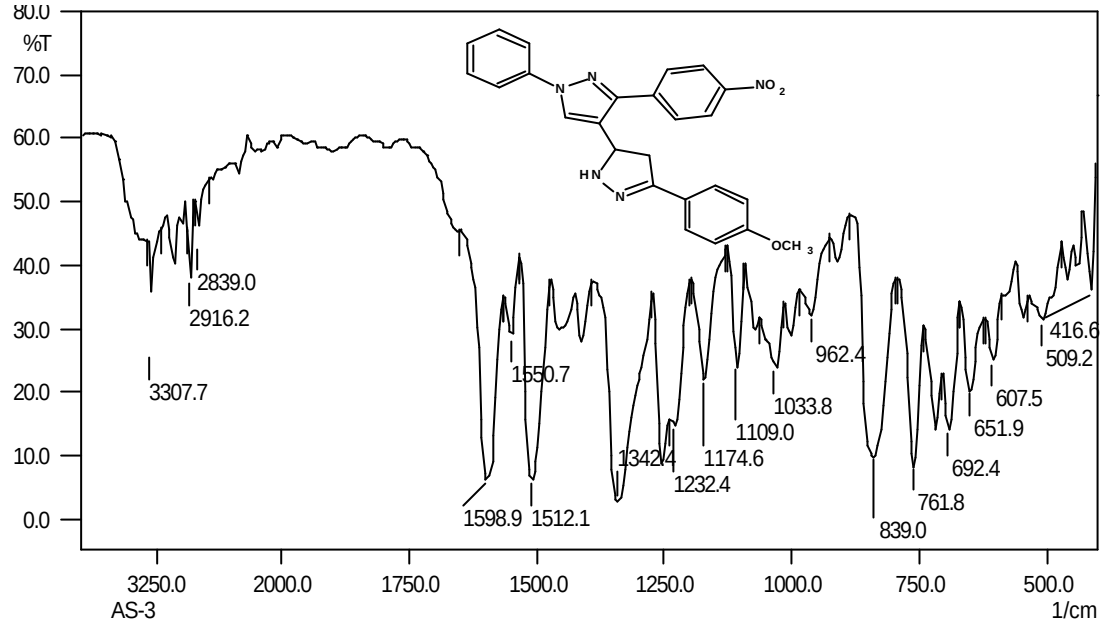


Table 1: IR spectral study of 3-anisyl-5-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-pyrazoline(AS-3a)



Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
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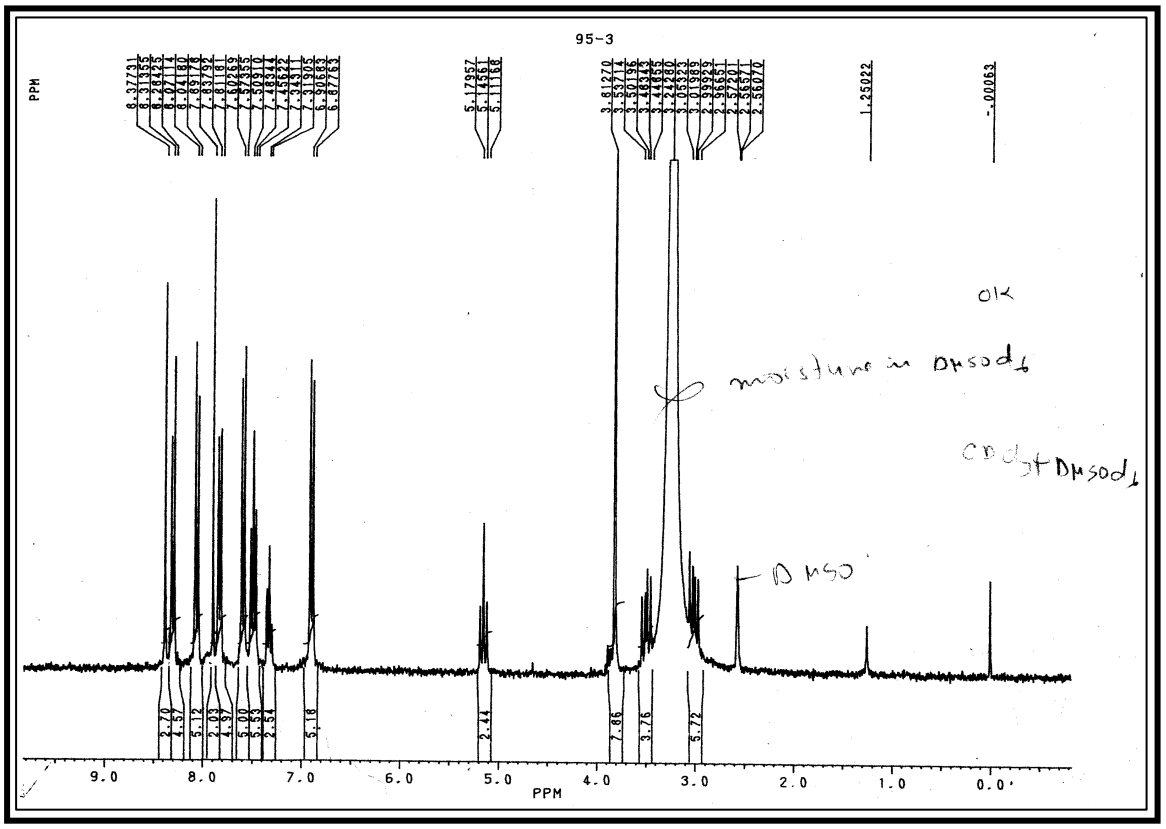
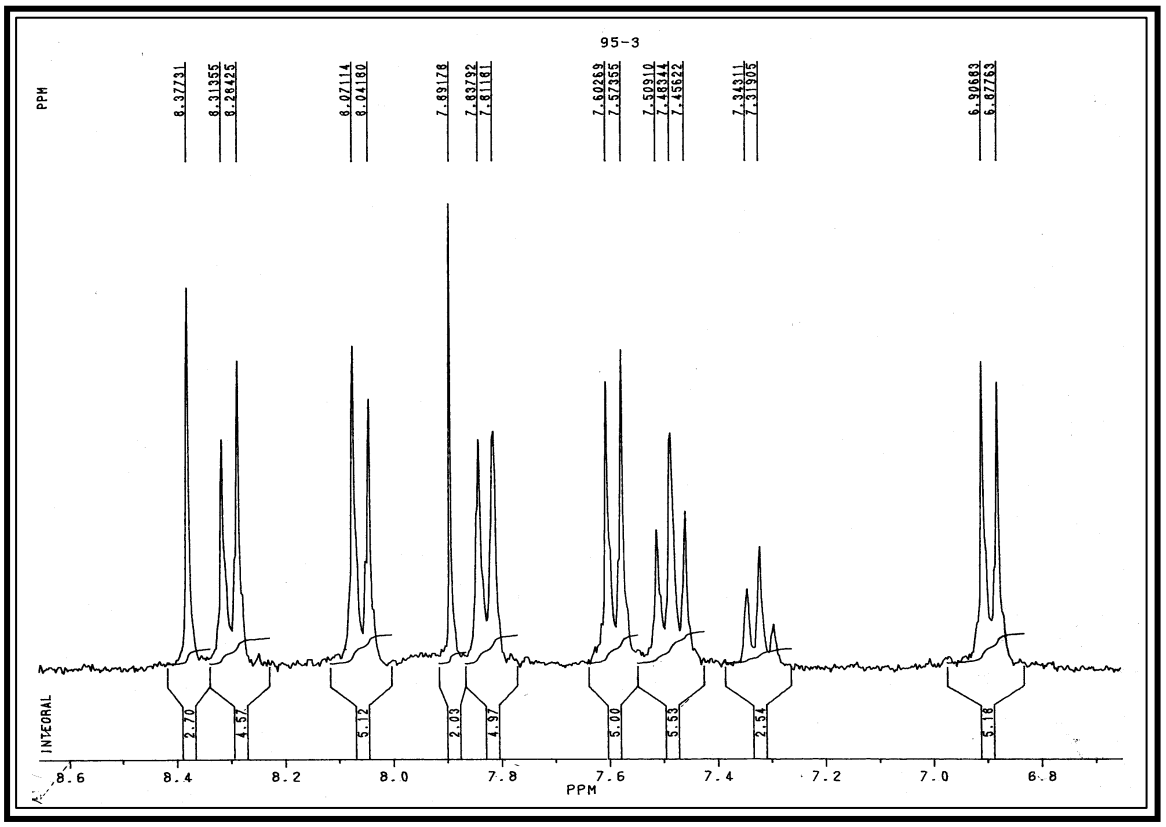
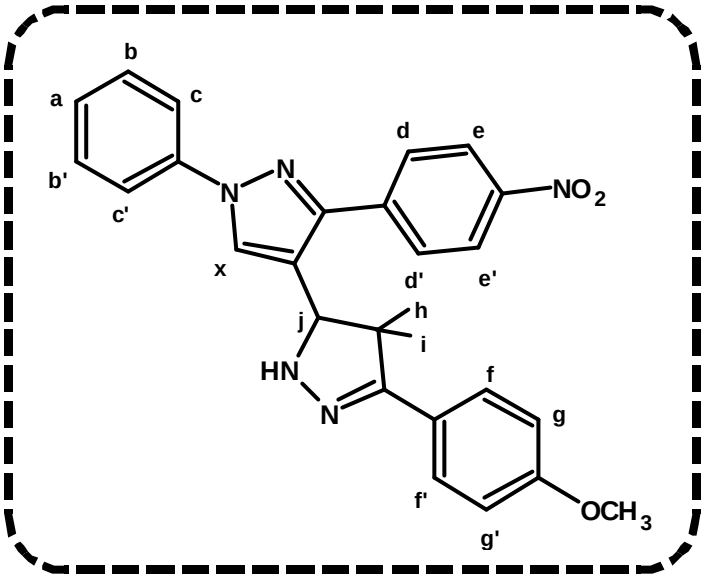
(Methyl)	C-H str.(sym.)	2839	2880 - 2860
	C-H def.(sym.)	1342	1385 - 1350
Aromatic	C=C	1109	1585 - 1480
	C-H i.p. def.	839	1125 - 1090
	C-H o.o.p. def.		860 - 810
Pyrazole	C=N str.	1599	1650 - 1580
moiety	C-N str.	1342	1350 - 1200
Ether	C-O-Cstr.(asym).	1232	1275-1200
	C-O-C(sym.)	1034	1075- 1020
Pyrazoline	C=N str.	1551	1627-1550
	N-H str.	3308	3450-3250

Table 2: ^{1}H NMR spectra of 3-anisyl-5-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-pyrazoline (AS-3a)





^{1}H NMR spectral data of 3-anisyl-5-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-pyrazoline (AS-3a)



Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	2.57	1H	d.doublet	h	-
2.	3.44-3.53	1H	d.doublet	i	-
3.	3.81	3H	singlet	Ar-OCH_3	-
4.	5.11-5.17	1H	d.doublet	j	-
5.	6.87-6.90	2H	doublet	Ar-Hgg'	8.7
6.	7.31-7.34	1H	triplet	Ar-Ha	-
7.	7.45-7.50	2H	triplet	Ar-Hbb'	-
8.	7.57-7.60	2H	doublet	Ar-Hdd'	8.77
9.	7.81-7.83	2H	doublet	Ar-Hee'	7.8
10.	7.89	1H	singlet	-NH	-
11.	8.04-8.07	2H	doublet	Ar-Hcc'	9
12.	8.28-8.31	2H	doublet	Ar-Hff'	8.7
13.	8.37	1H	singlet	Hx	-

Table 3: Mass spectra of 3-anisyl-5-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-pyrazoline (AS-3a)

Scheme 1: 3-anisyl-5-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-pyrazoline (AS-3a)

Table 4: Physical constants of Pyrazolines

*TLC solvent system: Acetone: Benzene : 1:9

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INTRODUCTION

Pyridine also belongs to an important class of heterocyclic compounds, which are useful in various fields such as medicine, agriculture and industrial chemistry. Some pyridine derivatives are active in the metabolism of body and are also used as a denaturant for antifreeze mixtures, as a dyeing assitant in textiles[1] and fungicides[2]. Some of them are also used as synthetic intermediates whereas some occurs as a component of structure of coenzymes[3-6].

Cyanopyridines, the derivatives of pyridine can be prepared by the different reported methods[7-11]. Samour[12] and co-workers have prepared substituted cyanopyridines by the condensation of chalcones with malanonitrile in presence of ammonium acetate.Sakurai and Midorikwa[13,14] have reported that malanonitrile when reacts with α,β-unsaturated ketones, it gives 2-amino-3-cyano-4-6-disubstituted pyridines. M. Kanded reported some other derivatives of pyridine[15].

Due to varied therapeutic activity, cyanopyridine derivatives have been used extensively in medicines[16-18]. It possess different activities like analgesic[19], antihypertensive[20], antibacterial[21], anticonvulsant[22] etc. Latif and coworkers[23] have reported the antibacterial and antifungal activity of 2-amino-3-cyano-4,6-disubstituted pyridines. Teu and coworkers have also shown cyanopyridines as agrochemical fungicides[24]. Gadaginamath and co-workers[25] have synthesized various cyanopyridyl derivatives and documentated their variety of biological activities.The anti infammatory activity of 3-cyanopyridines has also been reported[26]. The pharmacological activity of these cyanopyridine have been reported by Galil and Amr[27]. Hammana Abou and co-workers have studied the anticancer and anti-HIV activity of 3-cyanopyridines[28].

EXPERIMENTAL

Synthesis 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl pyrazole-4'-yl]-6-aryl pyridines

[A] Synthesis of N-aminophenyl-a-methyl-p-nitrophenyl-azomethine

Section-I (A).

[B] Synthesis of 1,N-phenyl-3-p-nitrorophenyl-4-formyl pyrazole

Section-I (B).

[C] Synthesis of 1-phenyl-3-(1'-N-phenyl-3'-p-fluorophenyl-pyrazol-4'-yl)-2-propene-1-one

Section-I (C).

[D] Synthesis of 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine

A mixture of 1-anisyl-3-(1',N-phenyl)-3'-p-nitrophenyl pyrazol-4'-yl)-2-porpene-1-one (4.20 g, 0.01M), malononitrile (0.66 g, 0.01 M) and sodium methoxide (10 ml) (6.61g, 0.08M) dissolved in absoulte alcohol was refluxed for 10 hrs. in water bath at temp 70^{O}C. The reaction product was poured into ice, crude product was isolated, crystallized from ethanol.

Similarly other cyanopyridines have been obtained. The physical data are recorded in Table 4.

REACTION SCHEME

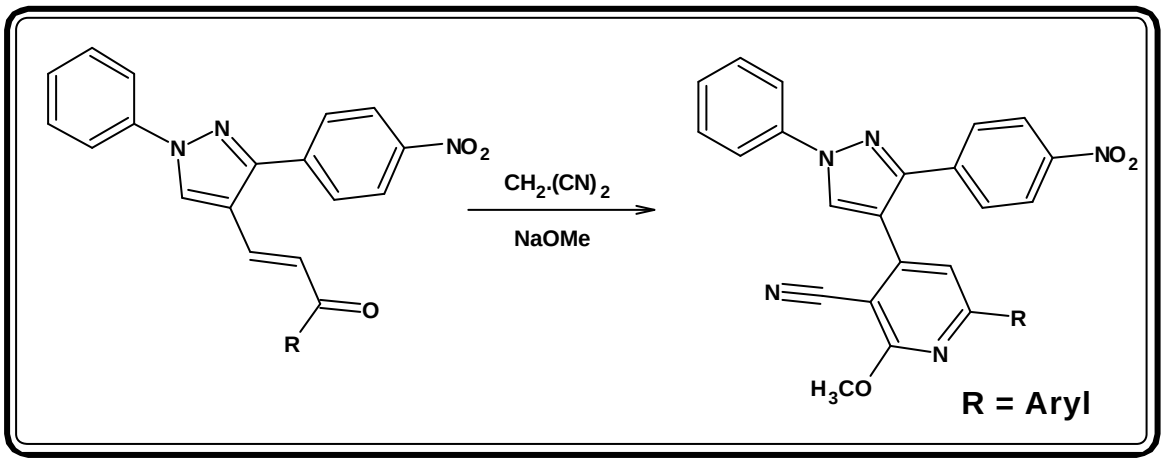
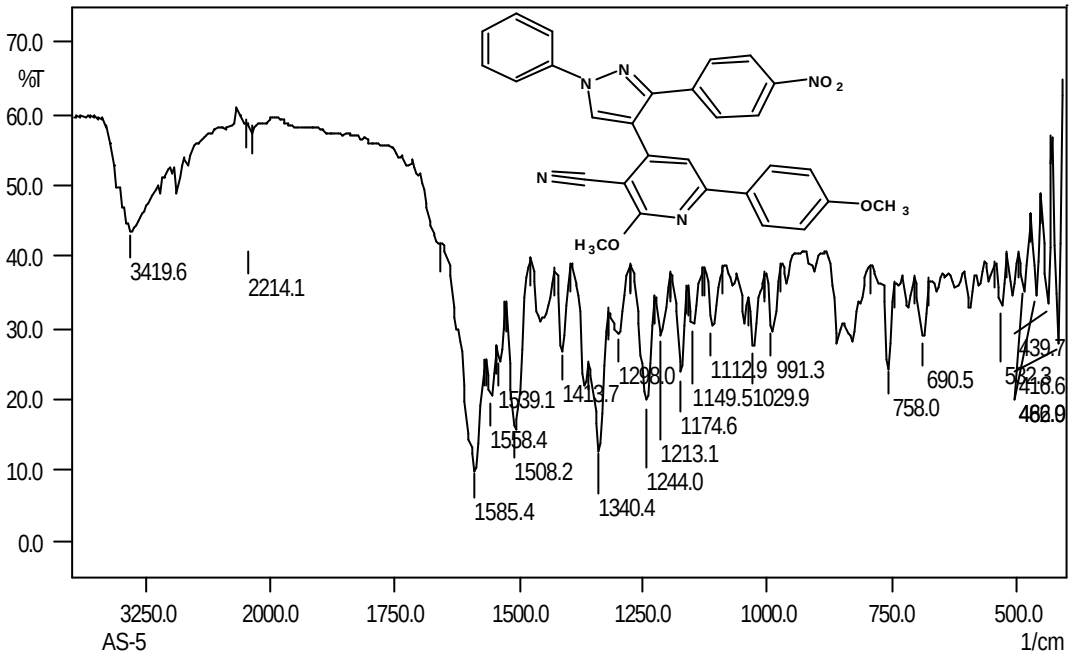
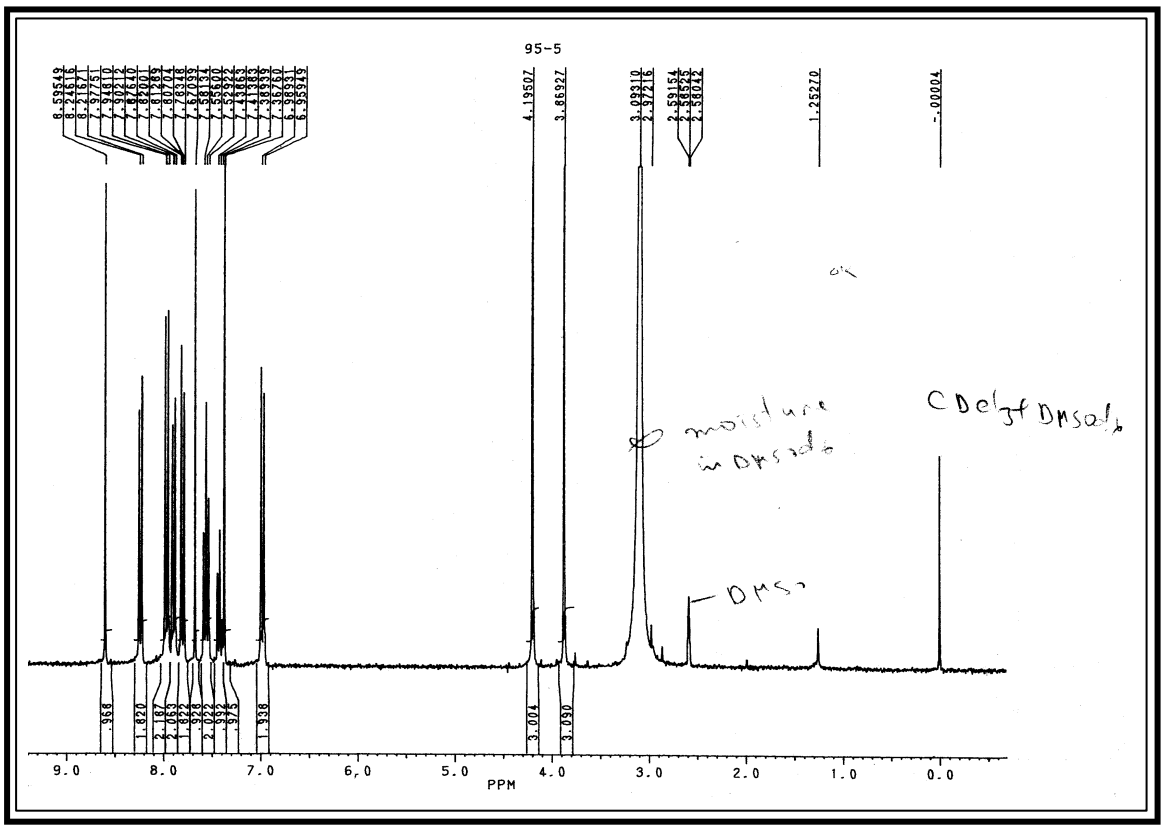


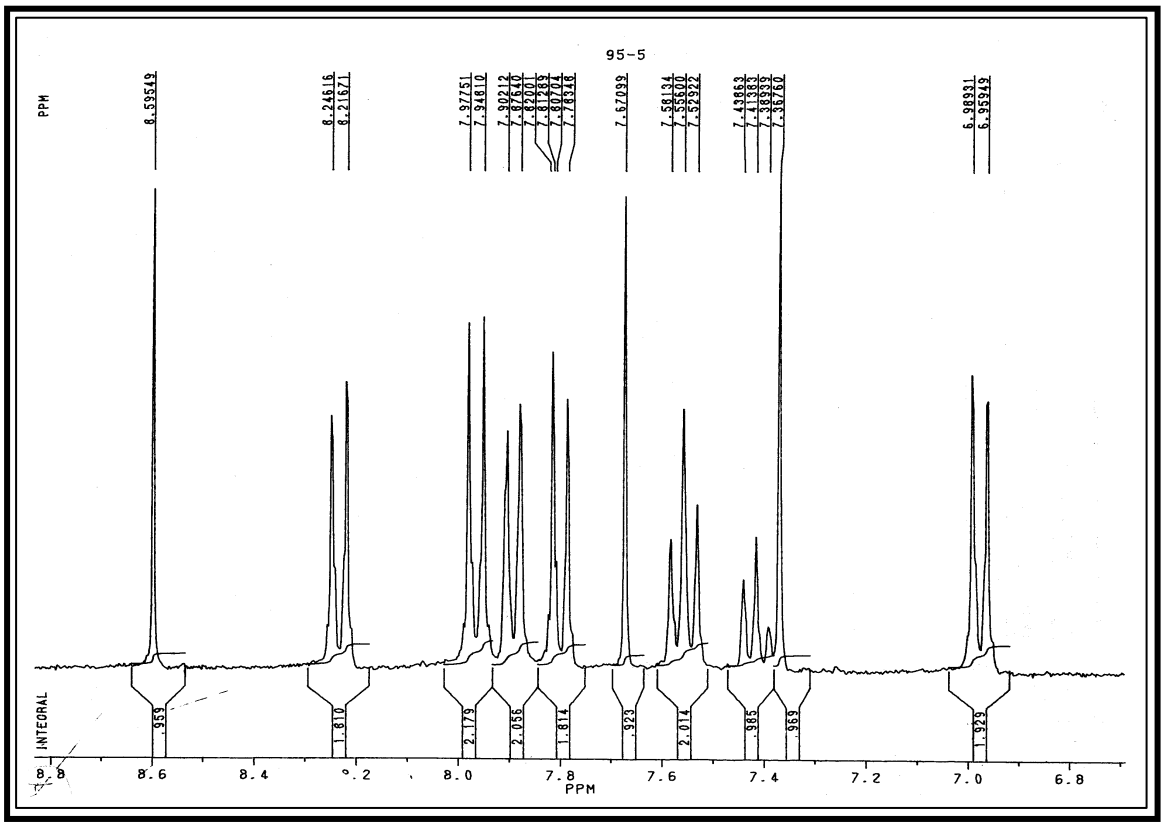
Table 1: IR spectral study of 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine (AS-5a)



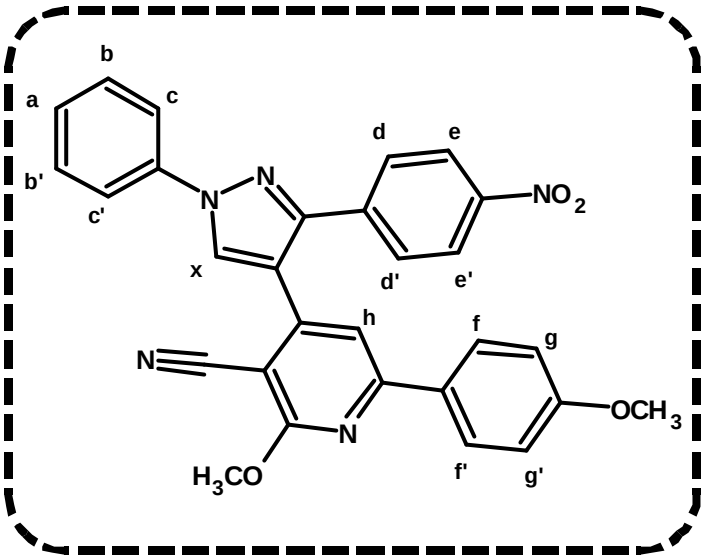
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2916	2975 - 2950
(Methyl)	C-H str.(sym.)	2839	2880 - 2860
	C-H def.(asym.)	1413	1470 - 1435
	C-H def.(sym.)	1340	1385 - 1350
Aromatic	C=C	1539	1585 - 1480
	C-H i.p. def.	1029	1125 - 1000
	C-H o.o.p. def.	839	835 - 810
Pyrazole	C=N str.	1585	1650 - 1580
moiety	C-N str.	1244	1350 - 1200
Ether	C-O-Cstr.(asym).	1213	1275-1200
Pyridine ring	C-N str.	2214	2240-2120
	C=N str.	1558	1650-1550
	C=C str.	1508	1585-1480

Table 2: ^{1}H NMR spectra of 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine (AS-5a)





^{1}H NMR spectral data of 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine (AS-5a)



Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.86	3H	singlet	Ar-OCH_3	-
2.	4.19	3H	singlet	Pyridinering Ar-OCH_3	-
3.	6.95-6.98	2H	doublet	Ar-Hgg'	9.9
4.	7.36	1H	singlet	Ar-Hh	-
5.	7.38-7.43	1H	triplet	Ar-Ha	-
6.	7.52-7.58	2H	triplet	Ar-Hbb'	-
7.	7.78-7.81	2H	doublet	Ar-Hdd'	7.2
8.	7.87-7.90	2H	doublet	Ar-Hee'	7.8
9.	7.94-7.97	2H	doublet	Ar-Hcc'	8.7
10.	8.21-8.24	2H	doublet	Ar-Hff'	9
11.	8.59	2H	singlet	Ar-Hx	-

Table 3: Mass spectra of 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine (AS-5a)

Scheme 1: 2-methoxy-3-cyano-4-[1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl]-6-anisyl-pyridine (AS-5a)

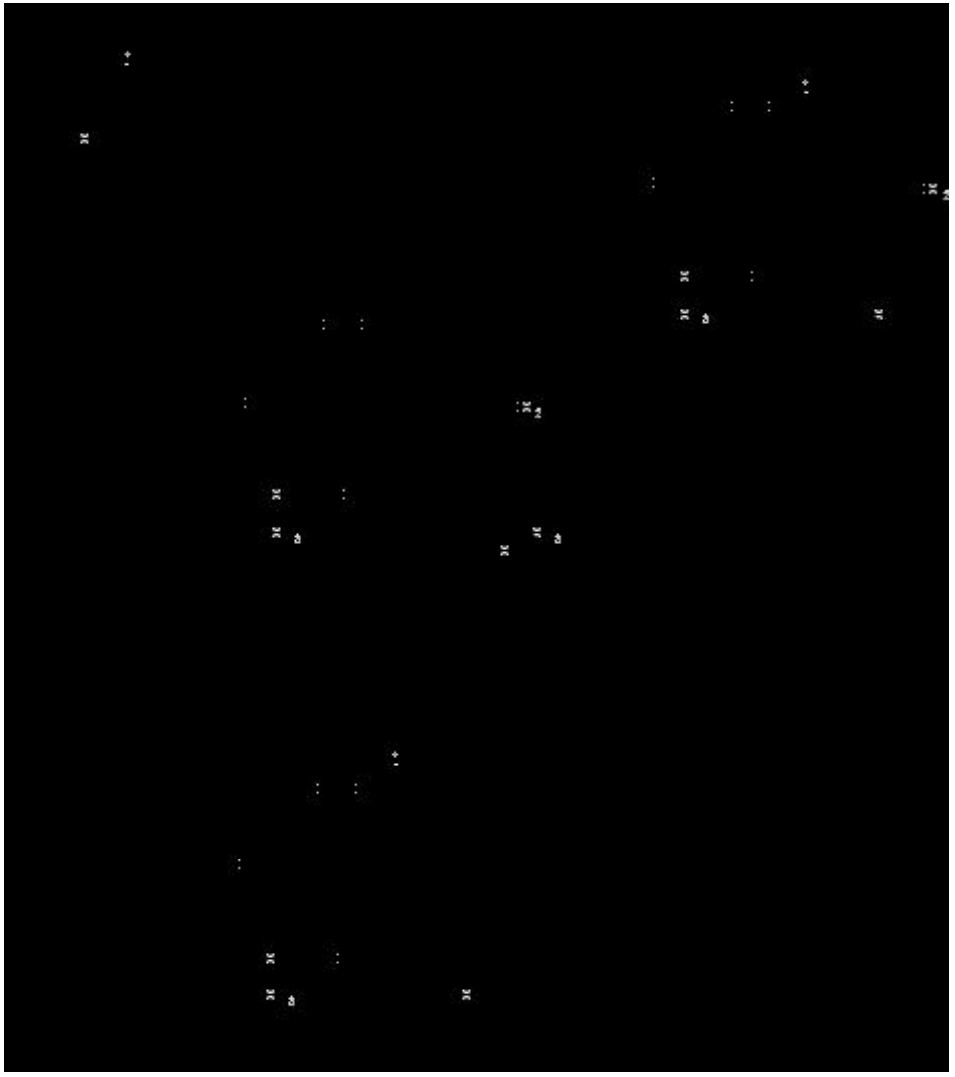


Table 4: Physical constants of Cyanopyridines

*TLC solvent system: Acetone: Benzene : 2:8

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INTRODUCTION

Thiazolidinones are derivatives of thiazolidines with carbonyl group at position 2, 4 or 5. These heterocyclic compounds have been extensively explored for their applications in the field of medicine. Some of these are an integral part of medicinally important compounds like penicillin's and some antiradiation drugs.

Preparations of 4-thiazolidones are narrated in literature[1-9]. Shah and Trivedi[10] synthesized thiazolidinone from 4-aryl thiosemicarbazones by condensing them with chloroacetic acid, α-bromopropioinic acid and α-bromo phenyl acetic acids. Nath et al have prepared 4-thiazolidinone by cyclization of N-aryl-N'-(2'-pyridyl)thio carbamide with chloroacetic acid[10]'. Some new thiazolidinone derivatives have been synthesized by Saeda et al.[11]. Hassan et al[12] also synthesized some thiazolidinones. Recently, some new thiazolidinone derivatives have also been reported[13-17].

Many Thiazolidinones are known to possess different activities like antitumor[18], antitubercular[19,20], anti-HIV and anticancer[21], antiprolifature[22], antiviral[23] antifungal[24,25], anti-inflammatory[26] etc. Some thiazolidinones are known to have antithelmintic[27], cardiovascular[28], and analgesic[29], hypnotic[30,31] properties. Monforte et al.[32] studied the antitumor activity of some thiazolidinones. El-Shafi and Hassan[33] reported that some thiazolidinone derivatives can act as local anaesthetic. The antitubercular studies of some other thiazolidinones were also done[34,35]. Rao reported the antifundal activities of some thiazolidinones[36]. Pawar and co-workers[37] have studied *invitro* anti bacterial activity of some 4-thiazolidinone derivatives. Antioxidant activity of thiazolidinones have been studied by Mei-Hsiu Shih[38].

Thus, the important role displayed by thiazolidinone and its derivatives for various therapeutic and pharmaceutical activities prompted to synthesize some arylidene derivatives.

EXPERIMENTAL

Synthesis of 2-arylimino-3,N-aryl-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinones

[A] Preparation of N^1, N^3-Bis-p-tolyl thiourea

In a round bottom flask, a mixture of p. toludine (0.2M), carbon disulphide (7ml, 0.01M) and absolute alcohol for 5-6 hrs. at temp 40^{o}C. On completion of reaction, the excess of carbon disulphide and alcohol was removed by distillation. The product was treated with hydrochloric acid to remove excess of amine present and crude product was isolated and crystallised from ethanol.

[B] Preparation of 2-Tolylimino-3-tolyl-5H-4-thiazolidinones

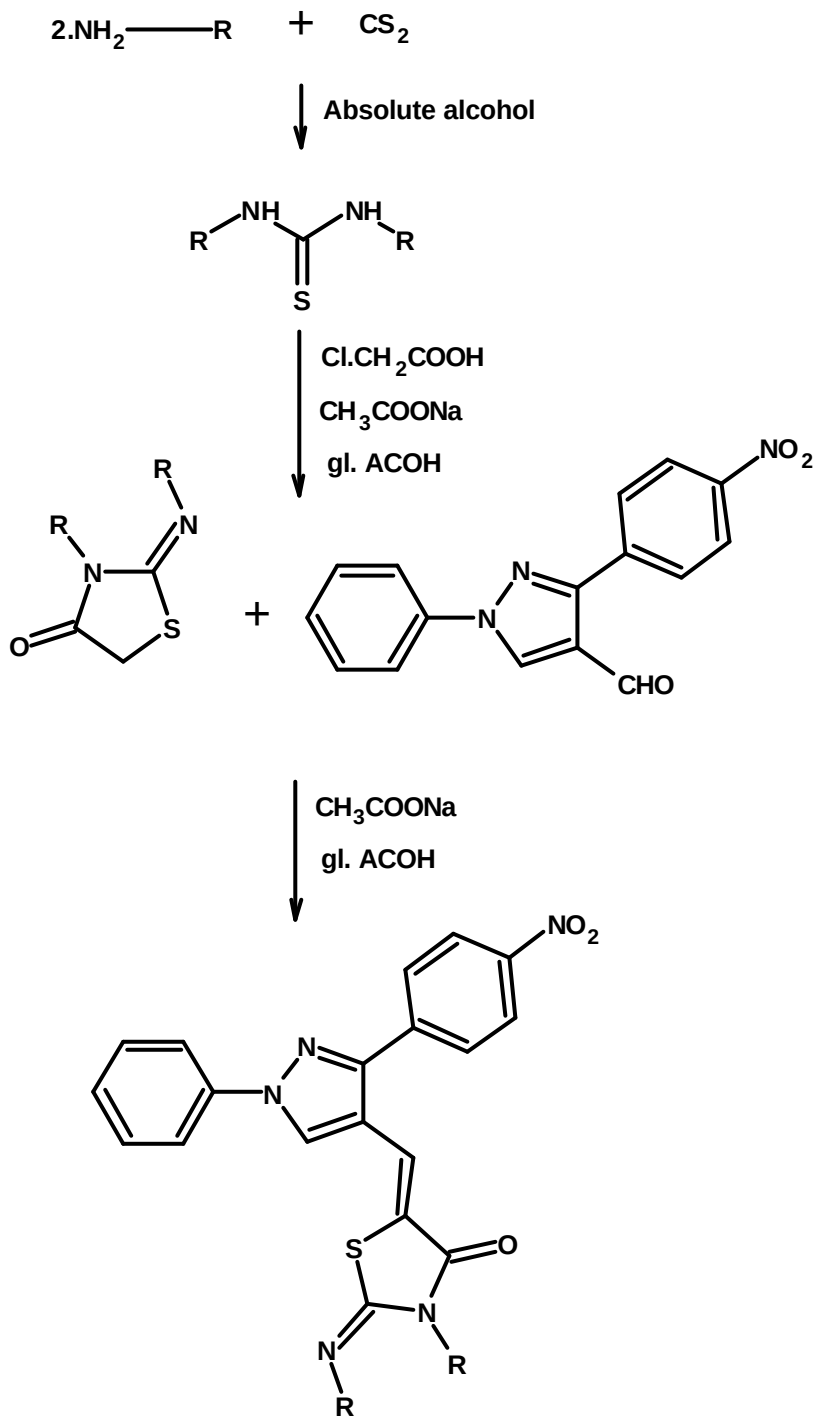
A solution of N^1, N^3-bis-p-tolyl thiourea (0.01M) and chloroacetic acid (0.94g, 0.01M) in glacial acetic acid (15 ml) was refluxed with fused sodium acetate (1.25g, 0.015M) for 5 hrs. The reaction product was poured in water, kept overnight, crude product was isolated and crystallised from ethanol.

[C] Preparation of 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone

A mixture of 2-(p-tolylimino)-3-(p-tolyl)-5H-4-thiazolidinone (2.69g, 0.01M) 1,N-phenyl-3-p-fluorophenyl-4-formyl pyrazole (2.93g, 0.01M) and fused sodium acetate (1.25g, 0.015M) was refluxed in glacial acetic acid (15 ml) for 4-5hrs. at temp 120^{o}C. cooled, poured into water and treated with ammonia to remove excess of glacial acetic acid. The product was isolated and crystallised from ethanol.

Similarly other substituted thiazolidinones have been prepared. The physical data are recorded in Table 4.

REACTION SCHEME



R= Aryl

REACTION SCHEME

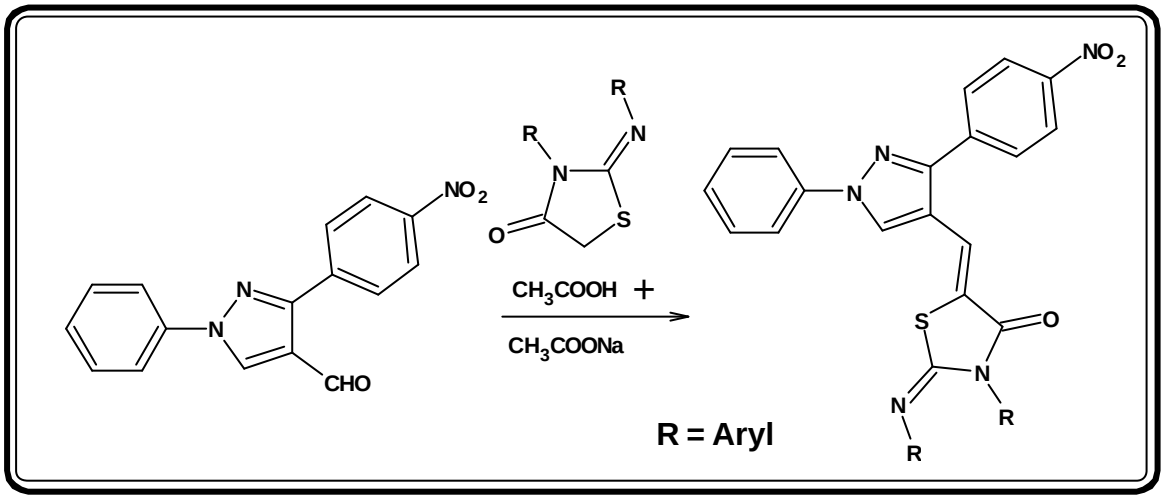
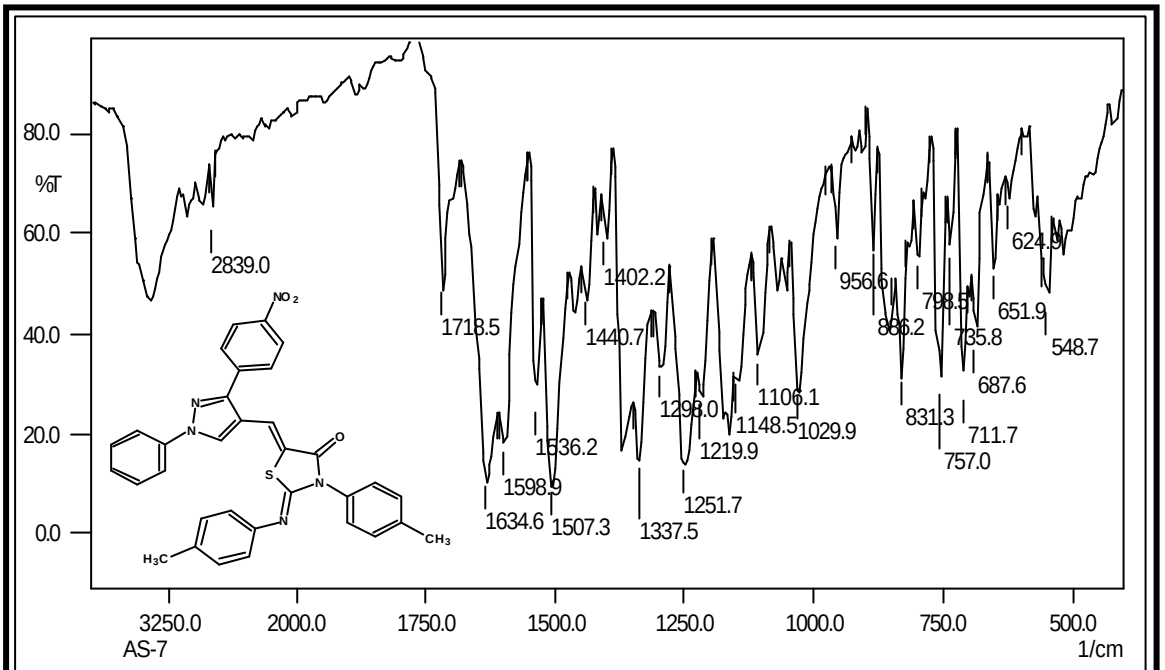
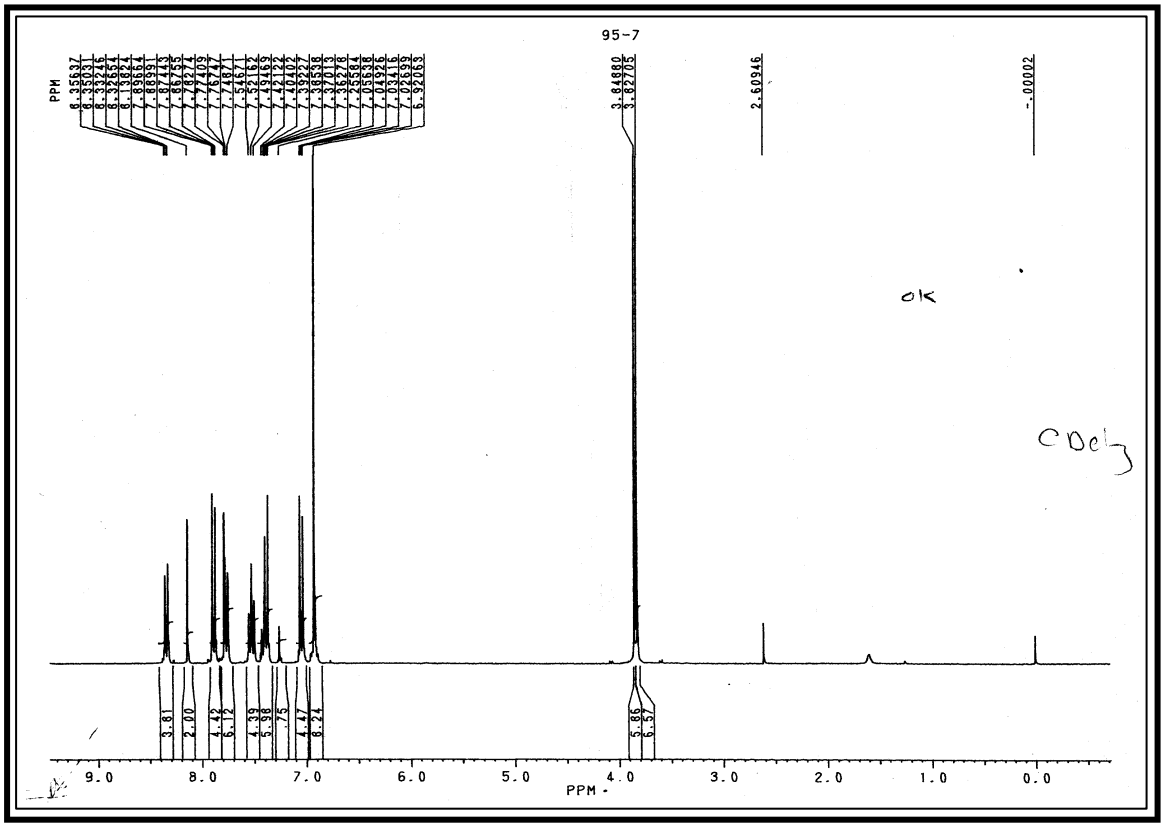


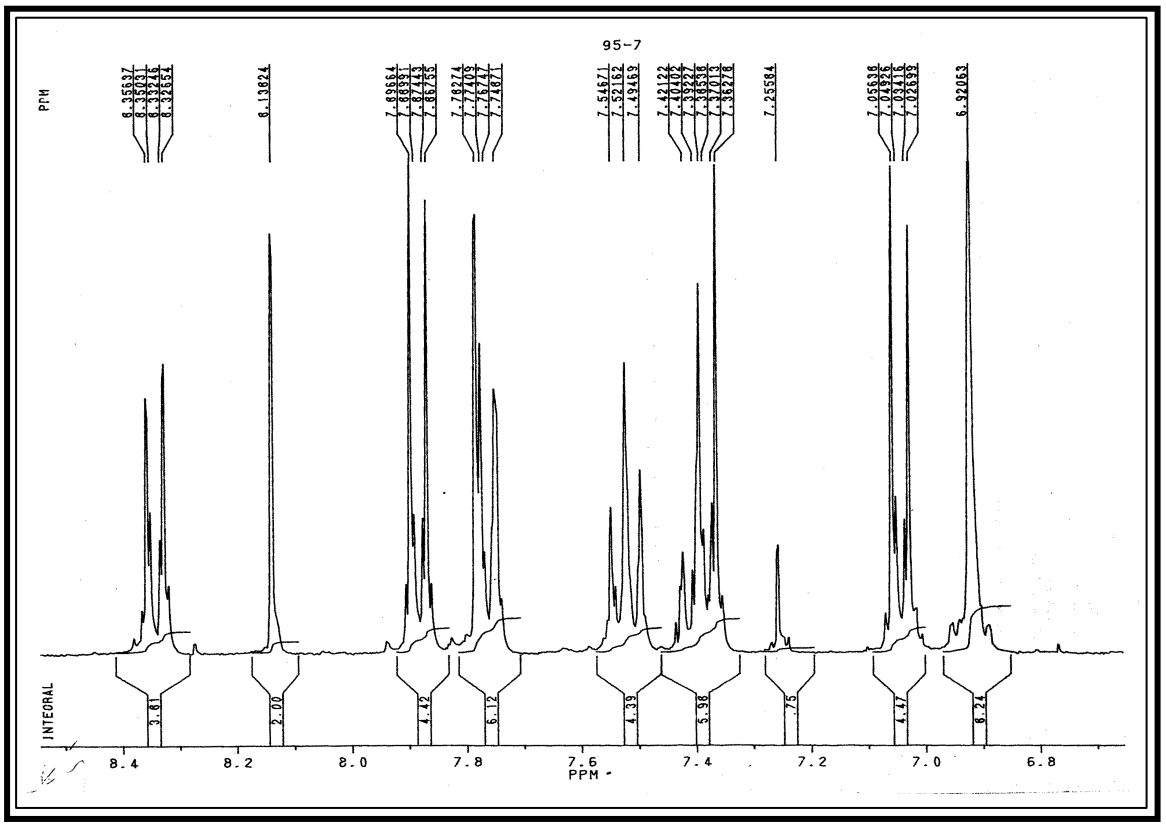
Table 1: IR spectral study of 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone (AS-7a)



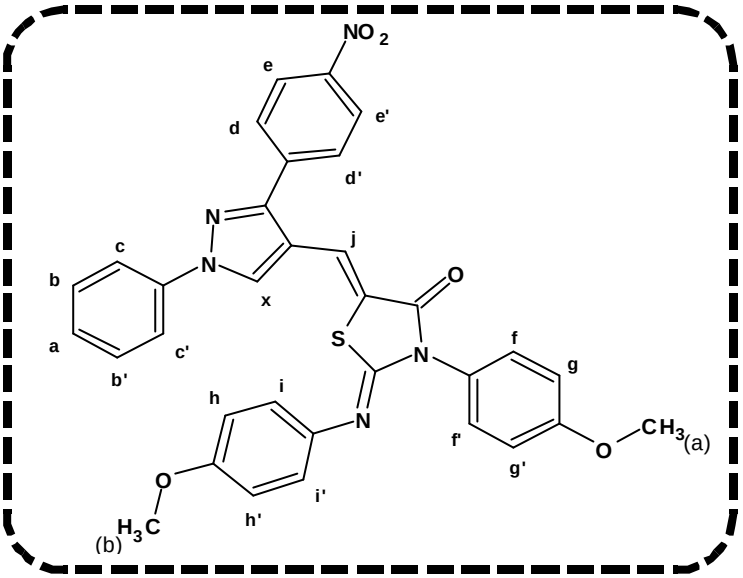
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2916	2975 - 2950
(Methyl)	C-H str.(sym.)	2839	2880 - 2860
	C-H def.(asym.)	1440	1470 - 1435
	C-H def.(sym.)	1337	1385 - 1350
Aromatic	C=C	1536	1585 - 1480
	C-H i.p. def.	1106	1125 - 1090
		1029	1070-1000
	C-H o.o.p. def.	831	860 - 810
Pyrazole	C=N str.	1634	1650 - 1580
ring	C-N str.	1251	1350 - 1200
Thiazolidinone	C=Ostr.(asym).	1718	1760-1655
ring	C=N str.	1598	1650-1590
	C-S-C str.	687	700-600

Table 2: ^{1}H NMR spectra of 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone (AS-7a)





^{1}H NMR spectral data of 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone (AS-7a)



Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.82	3H	singlet	Ar-$OCH_{3(a)}$	-
2.	3.84	3H	singlet	Ar-$OCH_{3(b)}$	-
3.	6.92	4H	singlet	Ar-Hgg'+Hhh'	-
4.	7.02-7.05	2H	doublet	Ar-Hdd'	9.0
5.	7.36-7.42	3H	multiplet	Ar-Hee'+Ha	-
6.	7.49-7.54	2H	triplet	Ar-Hbb'	-
7.	7.74-7.78	3H	triplet	Ar-Hj+Hcc'	-
8.	7.86-7.89	2H	doublet	Ar-Hff'	8.7
9.	8.13	1H	singlet	Hx	-
10.	8.32-8.35	2H	doublet	Ar-Hii'	9.0

Table 3: Mass spectra of 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone (AS-7a)

Scheme 1: 2-(p-Tolylimino)-3-(p-tolyl)-5-(1',N-phenyl-3'-p-nitrophenyl-4'-pyrazolylmethino)-4-thiazolidinone (AS-7a)

Table 4: Physical constants of Thiazolidinones

*TLC solvent system: Acetone: Benzene: 1:9

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INTRODUCTION

Heterocyclic compounds have a broad array of biological activity but their synthesis can be sometimes very challenging for industrial applications (low yields and very low reaction temperatures). Therefore it may be interesting to find new procedures in order to achieve better yields and better reaction conditions.

The research on the chemistry of pyrazoles has been a focus of attention for chemists for several years; due to their wide spread diversified biological activities. Considering the increasing importance of pyrazole nucleus, the synthesis of some pyrazolines have been done.

Pyrazolines have been reported to show a broad spectrum of biological activities including antibacterial[1], antifungal[2], anti-inflammatory[3] and antidepressant activities.[4] Pyrazole motifs are found in a variety of kinase inhibitors[5].This characteristic suggeste that a pyrazole would make a good template for a lead generation library. This prompted us to synthesize various substituted pyrazoline derivatives using the Microwave-assisted (MW) method,Ultrasound irradiation (US) and Conventional thermal (Con.) method.

The microwave region of the electromagnetic spectum lies between 1 cm and 1 m, most domestic and commercial microwave instruments operate at 2.45 GHz. When a molecule is irradiated with microwaves it rotates to align itself with the applied field. The frequency of molecular rotation is similar to the frequency of microwave radiation and consequently the molecule continually attempts to realign itself with the changing field and energy is absorbed. It is particularly convenient that qualitatively, the larger the dielectric constant the great the coupling with microwaves. Thus solvents such as water, methanol, DMF, ethyl acetate, acetone, chloroform, acetic acid and dichloromethane are all heated when irradiated with microwaves.

In the last few years Microwave-induced Organic Reaction Enhancement (MORE) chemistry has gained popularity as a non-conventional technique for rapid organic synthesis[6]. Microwave-assisted synthesis has a large impact on synthetic organic chemistry, in particular the medicinal/combinatorial chemistry communities.

Many researchers have reported the synthetic utility of MORE chemistry in routine organic synthesis[7-9]. Compared to traditional processing of organic synthesis, microwave-enhanced chemistry saves significant time and very often improves conversions, clean product formation.

It can be termed as 'e-chemistry' because it is easy, effective, economical and eco-friendly and is believed to be a step towards green chemistry. Further, it offers low cost with simplicity in processing and handling[10]. By this method, one can also develop new reaction conditions.

In 1986, Gedye and co-workers first reported the utilization and advantages of microwave irradiation for organic synthesis[11,12] and studied different types of reactions[11]. Later on, this technique has been used to promote a variety of chemical reactions such as additions, cycloadditions, substitutions, eliminations, fragmentations etc[12-19].

On the other side, ultrasound waves are known for their wide applications in various fields like life sciences, medical, cleaning, sonar, electronics, agriculture, oceanography, material science etc[20-24]. Further, these waves prove to be important in synthetic organic chemistry[25-27] by lowering the reaction temperature and reaction time[28]. By using these waves, yield can be increased[29] and one can avoid the use of phase transfer catalysts in chemical reactions[30].

Ultrasounds have been used in chemistry for the past thirty years. These waves have proven to enhance reactions yields along with more convenient reactions conditions, especially in hetergeneous systems. Literature survey shows that few workers synthesized some compounds using ultrasonic techniques[31-34].

Therefore, our research deals with sonochemistry and its application to the synthesis of heterocycles. For instance, some widely used biologically active compounds have a heterocyclic skeleton and are currently prepared at very low temperatures with a moderate yield.

In the present chapter, some pyrazolines have been synthesized by concentional method, microwave technique and by using ultrasound waves.

EXPERIMENTAL

Synthesis of 1,N-acetyl-3-aryl-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl)-pyrazolines

[A] Synthesis of N-aminophenyl-α-methyl-p-nitrophenyl azomethine

Section-I (A).

[B] Synthesis of 1,N-phenyl-3-p-nitrophenyl-4-formyl pyrazole

Section-I (B).

[C] Synthesis of 1-(anisyl)-3-(1'-N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl)-2 propene-1-one

Section-I (C).

[D] Synthesis of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline

To a mixture of 1-(p-anisyl)-3-(1',N-phenyl-3'-p-nitrophenyl-pyrazole-4'-yl)-2-propene-1-one (4.20g, 0.01M) in 25 ml of absolute alcohol, hydrazine hydrate (0.5g, 0.01M) and glacial acetic acid (10 ml) was added, the contents were refluxed for 10 hrs. at temp 120^{O}C. The reaction mixture was then poured into ice. The product was isolated and crystallised from ethanol.

Similarly, other substituted pyrazolines have also been prepared. The physical data are recorded in Table 1.

[E] Synthesis of 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline

To a mixture of 1-(p-anisyl)-3-(1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl)-2-propene-1-one (4.20gm, 0.01M) in 25 ml of absolute alcohol add phenyl hydrazine (1.08g, 0.01M) was added in presence of basic catalyst like piperidine

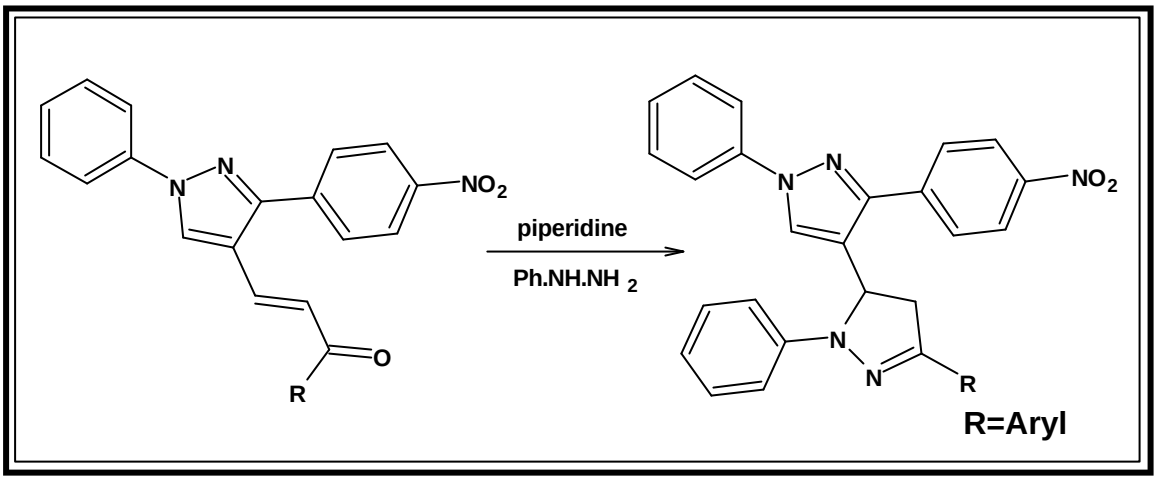
and refluxed for 12 hrs. at temp 70^{o}C. The reaction product was poured into ice. The product was isolated and crystallised from ethanol

[F] Synthesis of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazolines using microwave induced synthesis

A mix of 1-anisyl-3-(1',N-phenyl-3'-p-nitrophenyl-pyrazol-4'-yl)-2-propene-1-one (3.98g, 0.01M), hydrazine hydrate (0.5g, 0.01M) and glacial acetic acid (15 ml) was irradiated in a Q-Pro-M Microwave oven (220 VAC, 60Hz) [Questron Technologies Corporation-CANADA] at 120^{O}C for 9 min. under power level of 40% taking care not to heat the contents longer than 2 min at a time to avoid boiling off the reaction mixture. The contents were cooled and poured into ice cold. water. Product was isolated and crystallised from ethanol.

REACTION SCHEME

1,N-phenyl-3-(aryl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline



1,N-acetyl-3-(aryl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline

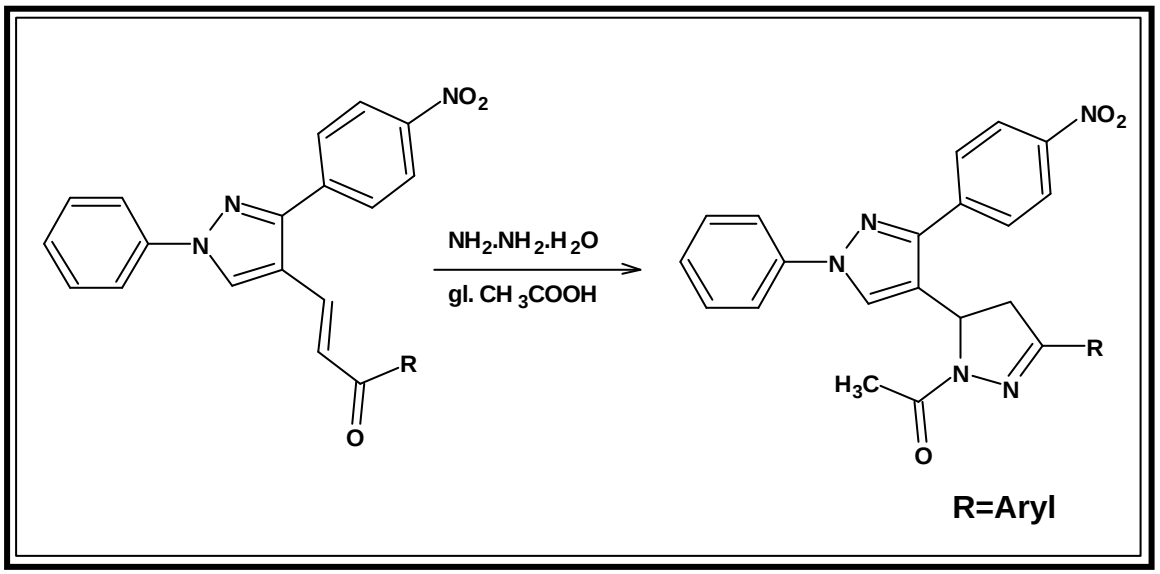
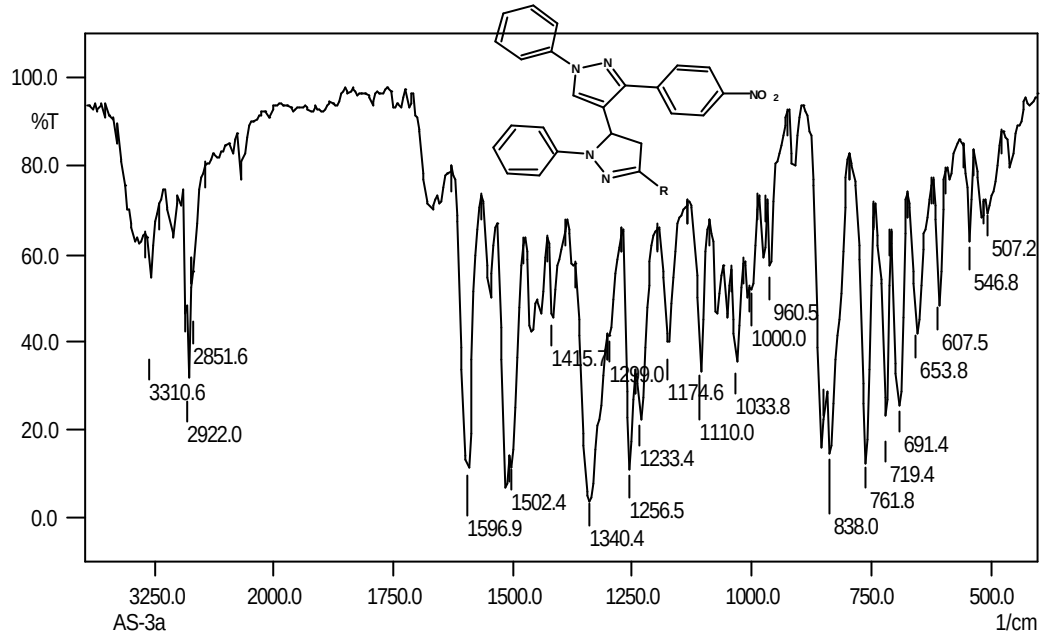
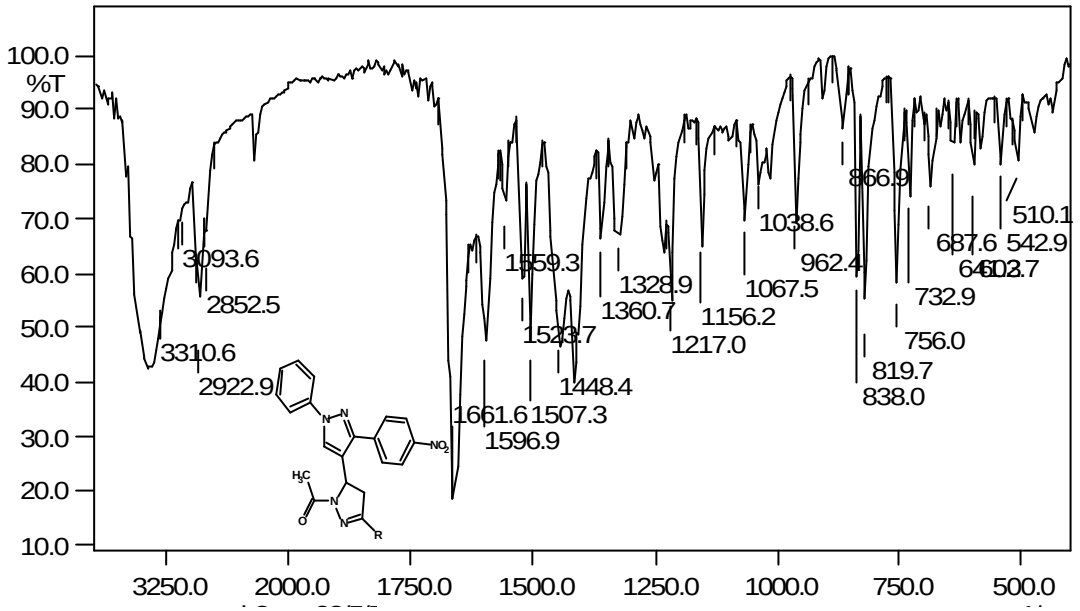


Table 1: IR spectral study of 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline (AS-2a)



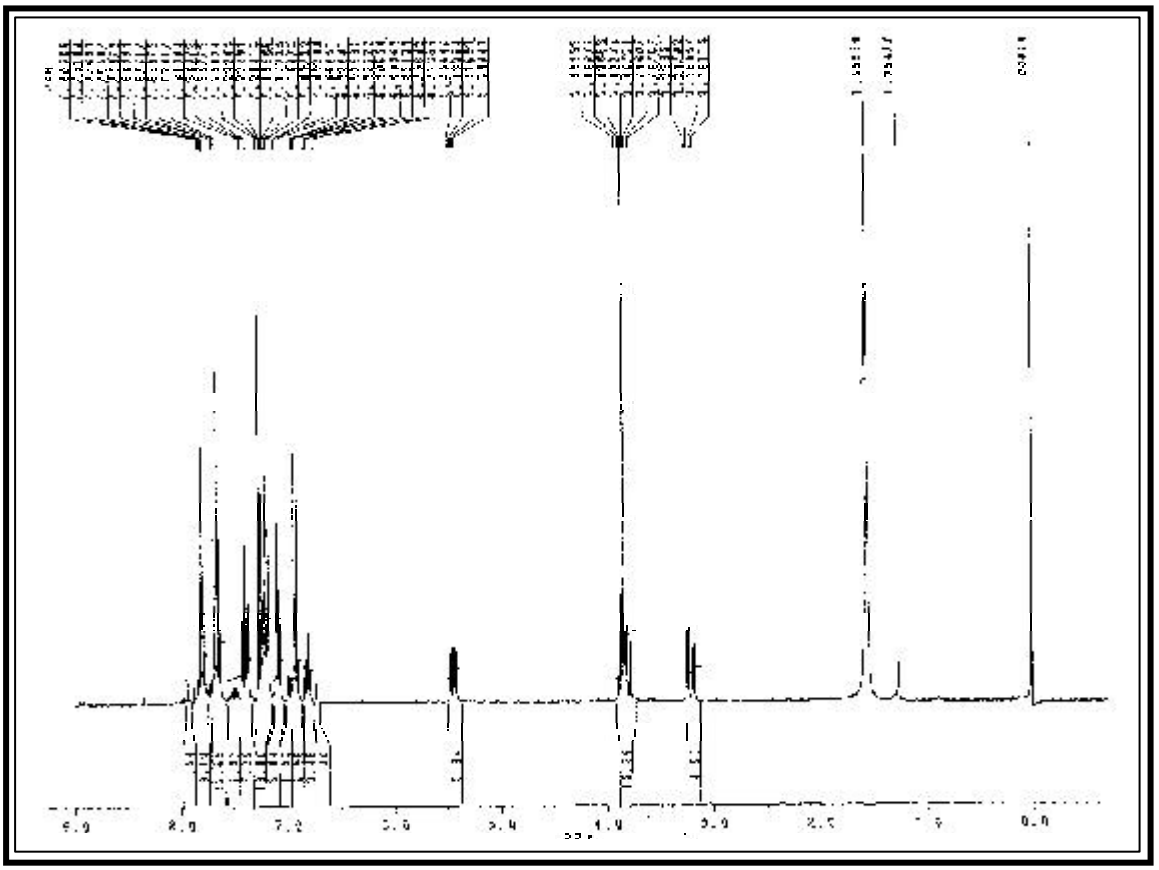
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2922	2975 - 2920
(Methyl)	C-H str.(sym.)	2851	2880 - 2850
	C-H def.(asym.)	1415	1470 - 1435
	C-H def.(sym.)	1340	1385 - 1350
Aromatic	C=C	1502	1585 - 1480
	C-H i.p. def.	1110	1125 - 1090
		1000	1070-1000
	C-H o.o.p. def.	838	845 - 810
Pyrazole	C=N str.	1596	1650 - 1590
moiety	C-N str.	1299	1350 - 1200
Ether	C-O-Cstr.(asym).	1257	1275-1200
	C-O-C(sym.)	1033	1075- 1020
Pyrazoline	C=N str.	1596	1650-1590
	C=C	1502	1585-1480
	C-H def.	691	698-680

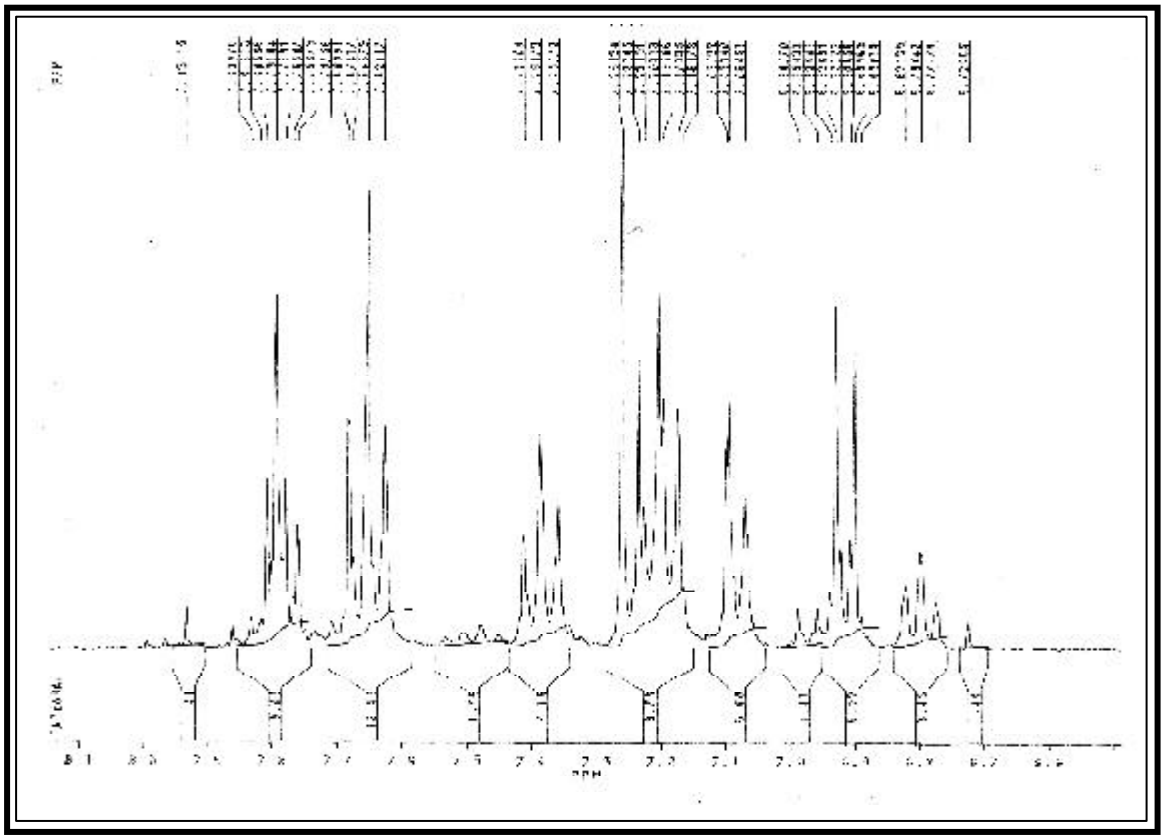
Table 2: IR spectral study of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline (AS-4a)



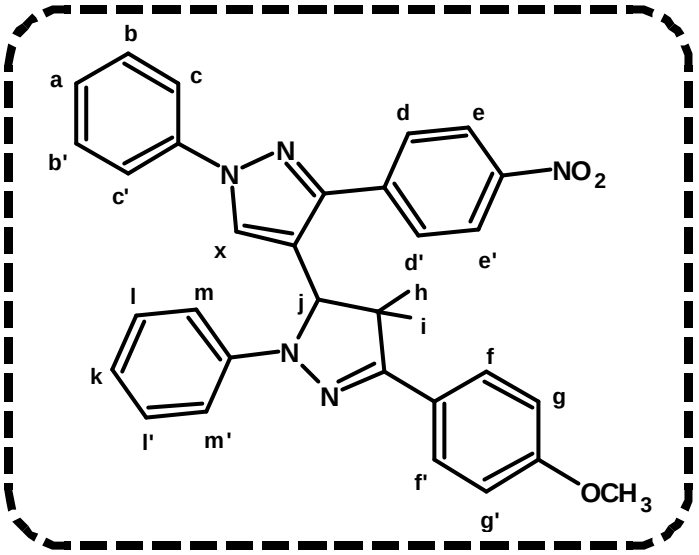
Type	Vibration mode	Frequency in cm^{-1}	
		Observed	Reported
Alkane	C-H str.(asym.)	2922	2975 - 2950
(Methyl)	C-H str.(sym.)	2852	2880 - 2860
	C-H def.(asym.)	1448	1470 - 1435
	C-H def.(sym.)	1360	1385 - 1350
Aromatic	C-H str.	3093	3130 - 3030
	C=C	1559	1585 - 1480
	C-H i.p. def.	1067	1125 - 1090
	C-H o.o.p. def.	838	845 - 810
Pyrazole	C=N str.	1596	1650 - 1590
moiety	C-N str.	1328	1350 - 1200
Ether	C-O-C str.(asym).	1217	1275-1200
	C-O-C (sym.)	1038	1075- 1020
Pyrazoline	C=N str.	1596	1650-1590
	C-H def.	691	698-680
	C=C	1502	1585-1480

Table 3: ^{1}H NMR spectra of 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline (AS-2a)



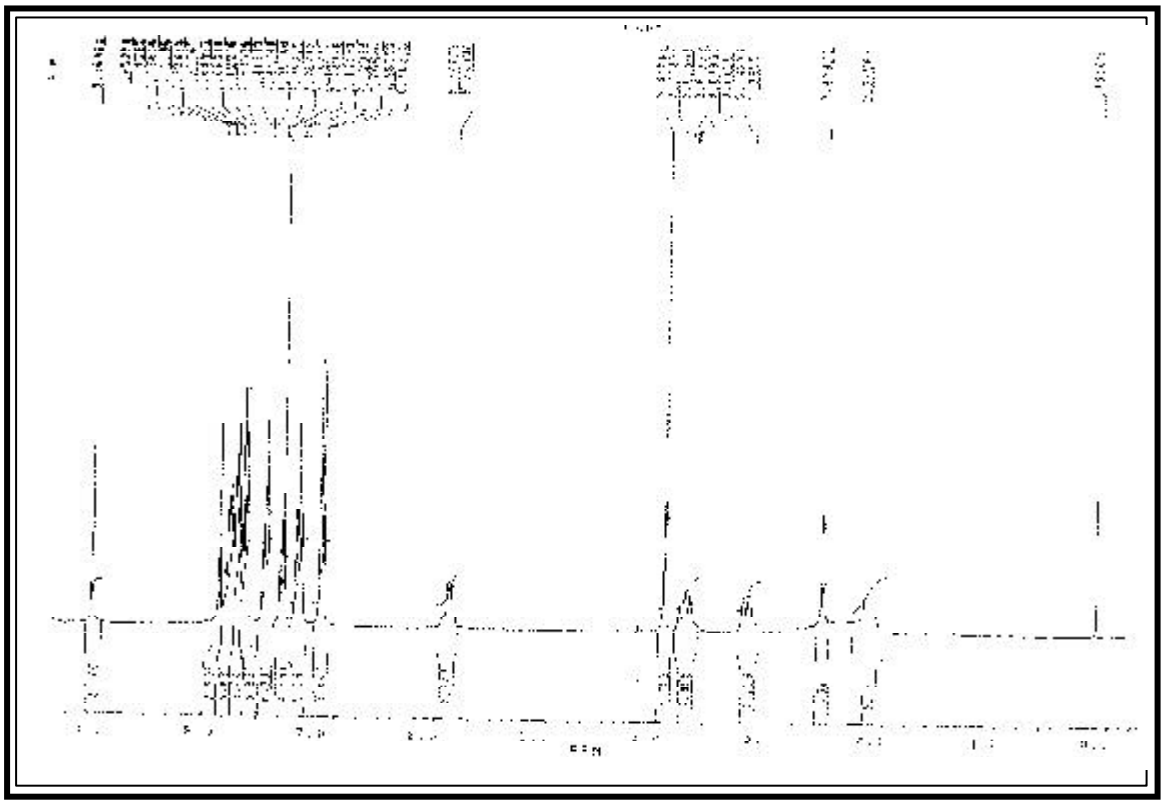


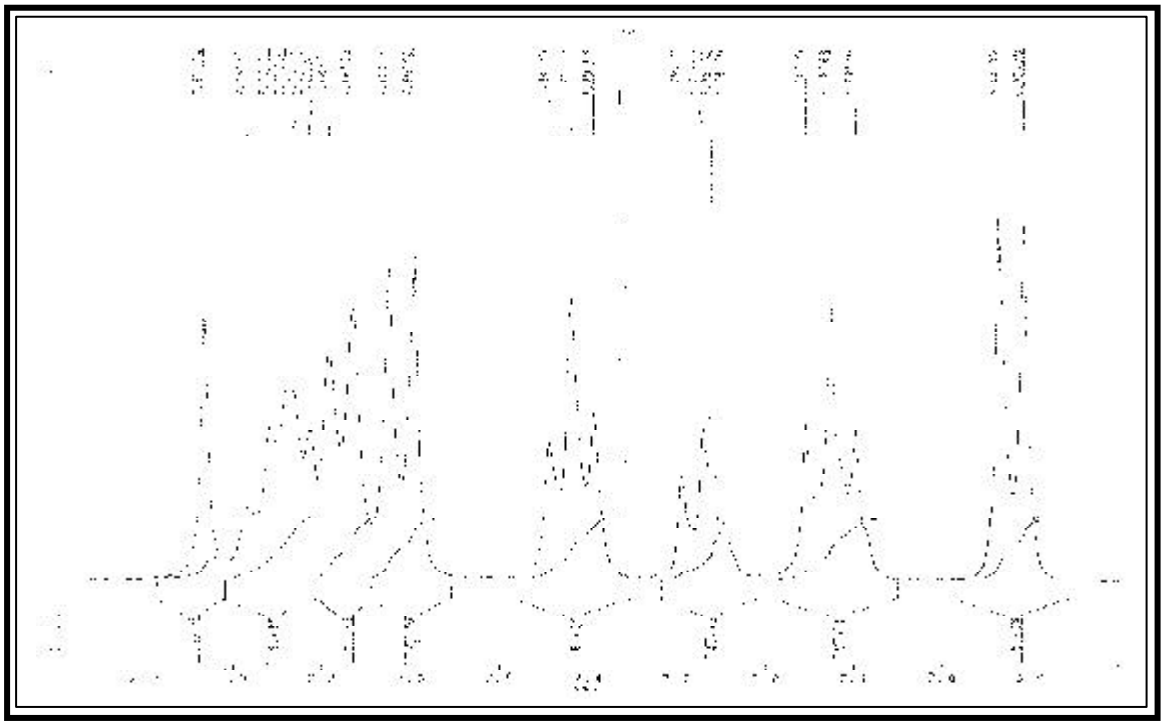
1H NMR spectral data of 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline (AS-2a)



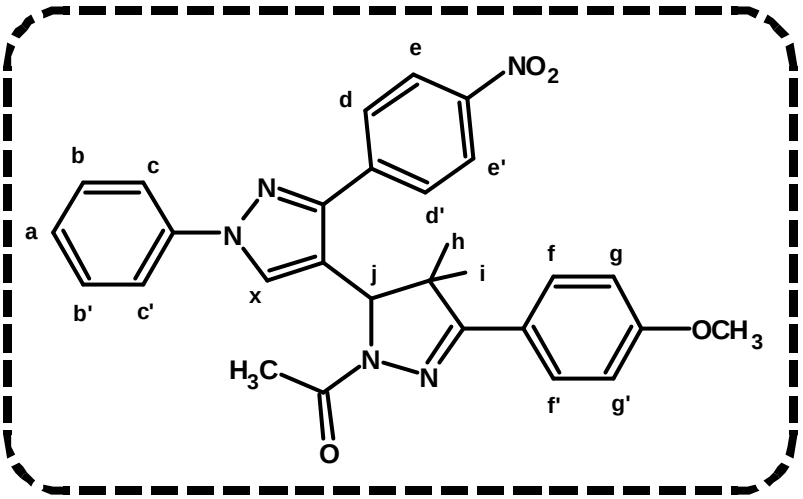
Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	3.16-3.23	1H	d. doublet	CHh	-
2.	3.76-3.82	1H	d. doublet	CHi	-
3.	3.83	3H	singlet	Ar-OCH_3	-
4.	5.39-5.45	1H	d. doublet	CHj	-
5.	6.77-6.82	1H	triplet	Ar-Ha	-
6.	6.89-6.92	2H	doublet	Ar-Hgg'	6.96
7.	7.06-7.09	2H	doublet	Ar-Hdd'	8.7
8.	7.16-7.23	5H	multiplet	Ar-Hbb'+Hii'+Hk	-
9.	7.35-7.41	2H	triplet	Ar-Hee'	-
10.	7.62-7.70	4H	triplet	Ar-Hmm'+Hcc'	-
11.	7.75-7.83	3H	quartet	Ar-Hff'+CHx	-

Table 4: ^{1}HNMR spectra of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline (AS-4a)





^{1}H NMR spectral data of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline (AS-4a)



Signal No.	Signal Position (d ppm)	Relative No. of Protons	Multiplicity	Inference	J In Hz
1.	2.07	3H	singlet	$COCH_3$	-
2.	3.09-3.14	1H	d. doublet	CHh	-
3.	3.61-3.71	1H	d. doublet	CHi	-
4.	3.84	3H	singlet	Ar-OCH_3	-
5.	5.74-5.77	1H	d. doublet	CHj	-
6.	6.90-6.93	2H	doublet	Ar-Hgg'	Jgf = 8.7
7.	7.09-7.15	2H	triplet	Ar-Hdd'	-
8.	7.39-7.44	2H	triplet	Ar-Hbb'	-
9.	7.59-7.62	2H	doublet	Ar-Hee'	Jef = 8.7
10.	7.68-7.71	2H	doublet	Ar-Hff'	Jfg = 7.9
11.	7.73-7.78	3H	multiplet	Ar-Hcc' + Ha	-
12.	7.83	1H	singlet	CHx	-

Table 5: Mass spectra of 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline (AS-2a)

SCHEME 1: 1,N-phenyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitorphenyl pyrazol-4'-yl)-pyrazoline (AS-2a)

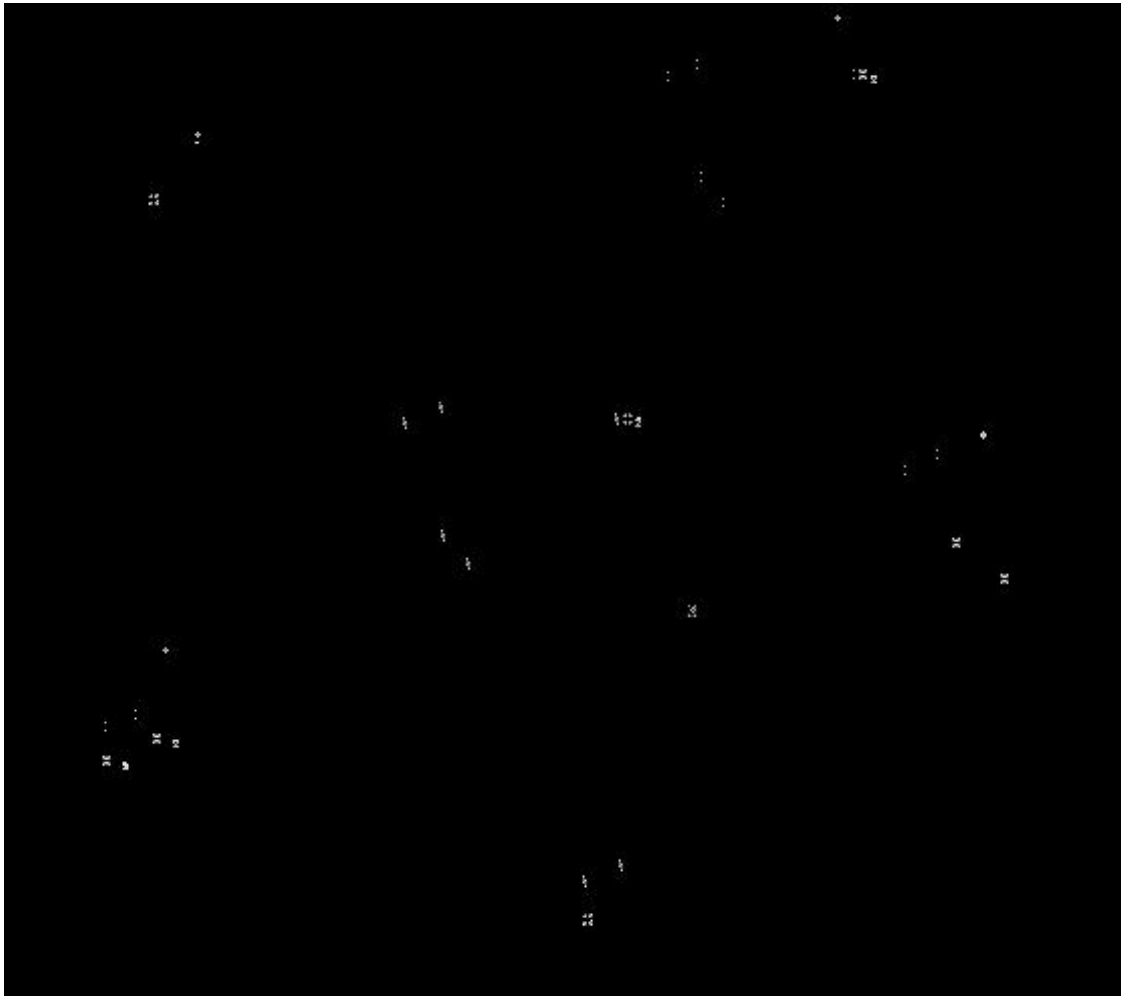


Table 6: Mass spectra of 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline (AS-4a)

Scheme 2: 1,N-acetyl-3-(p-anisyl)-5-(1',N-phenyl-3'-p-nitrophenyl pyrazol-4'-yl) pyrazoline (AS-4a)

Table 7: Physical constants of Phenyl pyrazolines

*TLC solvent system: Acetone: Benzene: 1.5:8.5

Table 8: Physical constants of Acetyl pyrazolines

*TLC solvent system: Acetone: Benzene: 2:8

RESULTS AND DISCUSSION

The physical constants of all the synthesized compounds by different techniques are given in Table 7 and 8. The reaction time and yield of different synthesized compounds by using microwave, ultrasonic waves and conventional techniques are reported in Table 9. It is observed that using microwave and ultrasonic waves, the reaction time is reduced considerably whereas % yield increased markedly.

Further, the amount of catalyst required in these techniques is very less in comparision to conventional method.

Thus, microwave and ultrasonics proved to be better technique than conventional method.

Table 9: Comparision of % Yield and Reaction time of compounds synthesised by MW, US and Con. methods

Code	Yield %			Reaction Time		
	MW	US	Con.	MW min	US hrs	Con. hrs
AS-2a	77	66	61	6	1.45	10
AS-2b	79	63	59	8	1.45	10
AS-2c	75	66	65	7	1.45	10
AS-2d	78	66	63	6	1.45	10
AS-2e	86	67	67	6	1.30	10
AS-2f	86	61	61	7	2.00	9
AS-2g	84	63	62	8	2.00	9
AS-2h	74	69	61	8	2.00	10
AS-2i	72	68	61	6	2.00	10
AS-2j	79	71	60	7	1.45	9
AS-4a	68	69	59	6	1.45	10
AS-4b	67	60	54	6	1.45	10
AS-4c	73	54	59	6	1.45	10
AS-4d	73	64	63	6	1.45	10
AS-4e	73	62	54	7	2.00	10
AS-4f	78	68	63	7	1.45	10
AS-4g	79	61	60	6	1.30	10
AS-4h	81	63	54	6	1.45	10
AS-4i	67	69	66	6	1.45	10
AS-4j	67	60	63	6	1.45	10

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GENERAL INTRODUCTION

Much advancement have been made in the field of science and technology which helped people in leading a sophisticated yet luxurious life.

Several physico chemical parameters are available in the list and few of them are of much interest. It was well understood by the literature that physico chemical properties such as acoustical properties, conductivity, density, refractive index etc. have contributed advancement in the physical sciences and also in daily human life. Drug macro-molecular interactions are an important phenomenon in physiological media, such as blood, membranes and intra and extra cellular fluids. Thermodynamic properties like partial molar volume and partial molar compressibility are the few sensitive indicators for understanding molecular interactions.

Refractive index is a very useful method to determine the structure and identity of unknown compounds. Thermal analysis is one the important tool for the study of thermal transformation of materials.

The study of physicochemical properties of compounds in solutions give complete understanding of the behavior of compounds in different solvents. Literature survey shows that very little work has been reported for the study of physico chemical studies such as thermal properties, refractive index, conductance and ultrasonic of the Schiff bases.

Thus, in this part of the thesis we have tried to add something in this field of science. Physicochemical properties of some Schiff bases derived from 1, 2, 4-triazole have been reported. Various physicochemical properties such as refractive index, heat of solution, conductance, thermal properties and acoustical properties for Schiff bases were determined in different solvents.

INTRODUCTION

Ultrasonics is the study of high frequency sound waves, usually in excess of 20 KHz (20,000 Cycles per sec). Around 1880[1-3], Curies discovered the Piezoelectric effect, which established the basis of ultrasound for the present day generation. Most modern ultrasonic devices rely on transducers (energy converters), which are composed of piezoelectrical material. Ultrasonic technology is now a days employed in a wide range of applications in medicine, biology, industry, material science, agriculture, oceanography, sonochemistry research etc. due to its non-destructive nature[4-8]. Further, it is one of the most rapid and realiable technique for the characterization of materials.

In medicine, it is used mostly for diagnosis of cancer cells[9]. Applications in materials science include the determination of some properties of solids such as compressibility, specific heat ratios, elasticity[10] etc. Ultrasound has also proved to be very useful for both soldering and welding. It is reported to improve the quality of homogenized milk. With the tracking of submarines, oceanographic applications include mapping the counters of the sea bottom, discovering sunken ships and searching for schools of fish.

More recently, a lots of interest has been generated on the use of ultrasound radiation in synthetic organic chemistry, which includes decrease of reaction time, increase of yield, lower reaction temperature, avoidance of phase transfer catalysis etc [11-16].

Further, cleaning is the most common type of applications of ultrasonic, which includes the removal of grease, dirt, rust and paint from metal, ceramic glass and crystal surfaces. Another area where ultrasonic is now-a-days being used, is to obtain the information about microstructures[17,18]. It is reported that these ultrasonic waves provide valuable information about the structure of solids[19,20]. By ultrasonic velocity measurements, the molecular interactions in pure liquids [21-24], aqueous solutions [25] and liquid mixtures[26, 27] can also be studied. It provides a powerful, effective and reliable

tool to investigate properties of polymers[28-35], carbohydrates[36-38], amino acids[39-42], solution of simple salts[43,44]etc.. However, very little work has been done for solid organic compounds [45-49]. In our laboratory, ultrasonic measurements for some Schiff bases in different solvents have been done[50-53].

Thus, in the present chapter, sound velocity studies of some triazole derivatives in dimethylformamide (DMF) and tetrahydrofuran(THF) solution were done at 308.15 K with a view to understand the molecular interactions in these solutions.

EXPERIMENTAL

Choice of Solvents:

Tetrahydrofuran (THF) and dimethylformamide (DMF) have been chosen as solvents in the present work. These two solvents are of industrial interest because of their wide use as solvents and solubilizing agents. THF is widely used in pharmaceutical and cosmetic industries.

The densities, viscosities and ultrasonic velocities of solvents and solutions of different concentration were measured at 308.15 K by using pyknometer, an Ubbelohde suspended level viscometer and single frequency ultrasonic interferometer operating at 2 MHz, with the uncertainties of 0.0001 g/cm^3, $\pm$ 0.06 % and 0.01% respectively.

Density measurements:

The weight of distilled water, pure solvents and solutions of Schiff bases were measured by using pyknometer. The densities were evaluated by using following equation:

$$\rho\ (g/cm^3) = [(\text{wt. of solvent or solution}) / (\text{wt. of water})] \times [\text{density of water}] \quad \ldots\ldots\ldots\ (1.1)$$

Viscosity Measurements:

To determine the viscosity of solution, Ubbelohde viscometer[54] was used, which obeys Stoke's low[55]. The measured quantity of the distilled water / solvent / solution was placed in the viscometer, which was suspended in a thermostat at 308.15 K. The digital stopwatch, with an accuracy of $\pm$ 0.01 sec was used to determine flow time of solutions. Using the flow times (t) and known viscosity of standard water sample, the viscosity of solvent and solutions were determined according to equation:

$$\eta_1 / \eta_2 = t_1\rho_1 / t_2\rho_2 \quad \ldots\ldots(1.2)$$

Sound velocity measurement:

Ultrasonic interferometer (Model No. F-81), Mittal Enterprise, New Delhi, working at frequency (F) of 2 MHz was used to determine sound velocity.

The solvent / solution were filled in the measuring cell with quartz crystal and then micrometer was fixed. The circulation of water from the thermostat at 308.15 K was started and test solvent / solution in the cell is allowed to thermally equilibrate. The micrometer was rotated very slowly so as to obtain a maximum or minimum of anode current (n). A number of maximum reading of anode current were counted. The total distance (d) travel by the micrometer for n=10, was read. The wave length (λ) was determined according to the equation (1.3).

$$\lambda = 2d / n \qquad \ldots\ldots\ldots (1.3)$$

The sound velocity (U) of solvent and solutions were calculated from the wavelength and frequency (F) according to equation (1.4).

$$U = \lambda F \qquad \ldots\ldots\ldots (1.4)$$

RESULTS AND DISCUSSION

The density (ρ), viscosity (η) and sound velocity (U) of pure solvents and different Schiff bases solutions in tetrahydrofuran (THF) and dimethylformamide (DMF) were calculated at 308.15 K and are given in Table 1.1.

From these measurements, various acoustical parameters like specific acoustical impendence (Z), isentropic compressibility (κ_s), intermolecular free length (L_f), Rao's molar sound function (R_m), molar compressibility (W), Vander Waals constant (b), relaxation strength (r), internal pressure (π), solvation number (S_n) etc., were evaluated using the following equations:

1. Specific acoustical impedance:

Specific acoustical impedance (Z) can be calculated as:

$$Z = U\rho \qquad \ldots\ldots\ldots (1.5)$$

2. Isentropic compressibility:

Isentropic compressibility (κ_s) can be evaluated according to the following the equation [56]:

$$\kappa_s = 1/U^2\rho \qquad \ldots\ldots\ldots (1.6)$$

3. Intermolecular free path length:

Jacobson [57] proposed an equation to calculate the intermolecular free path length (L_f), which is given below:

$$L_f = K_J \kappa_s^{1/2} \qquad \ldots\ldots\ldots (1.7)$$

where K_J is Jacobson constant (=6.0816 x 10^4)

4. Molar compressibility:

Molar compressibility (W) can be calculated by the following equation [58]:

$$W = (M/\rho)\, \kappa_s^{-1/7} \qquad \ldots\ldots\ldots (1.8)$$

The apparent molecular weight (M) of the solution can be calculated according to equation (1.10):

$$M = M_1W_1 + M_2W_2 \qquad \ldots\ldots\ldots (1.10)$$

where W_1 and W_2 are weight fractions of solvent and solute, respectively. M_1 and M_2 are the molecular weights of the solvent and compounds respectively.

5. Rao's molar sound function:

Rao's molar sound function (R_m) can be evaluated by an equation given by Bagchi et al [59]:

$$R_m = (M/\rho)\, U^{1/3} \qquad \ldots\ldots\ldots (1.9)$$

6. Van der Waals Constant:

Van der Waals constant (b) can be calculated as follows [60]:

$$b = M/\rho \{1- (RT/MU^2) \sqrt{} [1 +(MU^2/ 3RT) – 1]\} \ldots\ldots (1.11)$$

where R is the gas constant (=8.3143 JK^{-1} mol^{-1}) and T is the absolute temperature.

7. Relaxation Strength:

The relaxation strength (r) can be calculated as follows [61]:

$$r = 1- [U/U_\infty]^2 \qquad \ldots\ldots\ldots (1.12)$$

where $U_\infty = 1.6 \times 10^5$ cm/sec.

8. Relative Association (R_A):

$$R_A = \rho/\rho_0\, (U_0/U)^{1/3} \qquad \ldots\ldots\ldots (1.13)$$

where U, U0 and ρ, ρ_0 are ultrasonic velocities and densities of solution and solvent respectively.

9. Internal Pressure:

Suryanarayana and Kuppuswamy[62] gave the following equation for evaluating internal pressure:

$$\pi = bRT\, [K\eta/U]^{1/2}\, \rho^{2/3}/M^{7/6} \qquad \ldots\ldots\ldots (1.14)$$

where b is the packing factor (= 2). K is a constant (=4.28 X 10^9). The internal pressure (π) depends on temperature, density, ultrasonic velocity and specific heat at constant pressure.

10. Free Volume:

Free volume [63] can be calculated according to equation (1.15):

$$V_f = [MU/K\eta]^{3/2} \qquad \ldots\ldots\ldots (1.15)$$

Figure 1.1 and 1.2 shows the variation of ultrasound velocity (U) with concentrations for all the Schiff bases in both the solvents, DMF and THF. The variations of Intermolecular free length (L_f) with concentration of these bases are also shown in Figure 1.3 and 1.4 for both the solvents. Comparision of these figures shows that ultrasonic velocity (U) and intermolecular free length (L_f) are inversely related. Increase in the L_f causes velocity to decrease or vice versa.

The isentropic compressibility (κ_s) of the solutions in both the solvents is also found to decrease with increase of concentration. This phenomenon can be explained

by assuming that the solvated molecules are fully compressed by the electrical forces of the ions[19]. The compressibility of the solution is mainly due to the free solvent molecules. Due to solute-solvent interaction in the system, compressibility of the solution decreases with the increase in solute concentration. This is further confirmed by decrease of relaxation strength (r) and increase in specific impedance (Z) values. The increase in viscosity in both solvents also confirms the same. The association between solute and solvent molecules is further confirmed by relative association (R_A) values, which are found to increase continuously with concentration for all the compounds in both the solvents.

In both DMF and THF solutions, the Rao's molar sound function (R_m), Vander Waal's constant (b) and molar compressibility (W) for all the solutions are observed to increase linearly, which suggest that no complex or aggregate formation takes place in these solutions. Figure 1.5, 1.6 and 1.7 shows the linear variation of R_m, b and W with concentration in both DMF and THF solutions for HAS-1 to HAS-5 Schiff bases. This is further supported by the values of correlation coefficient (γ) which are given in Table 1.4 along with the correlation equations for some acoustical parameters.

The internal pressure (π) is the resultant of forces of attraction and repulsion between the molecules in a solution. Table 1.2 shows that in both THF and DMF solutions, internal pressure decreases with concentration. The decrease in internal pressure indicates the decrease in cohesive forces. Although decrease in compressibility, internal molecular free length, relaxation strength and increase of velocity, viscosity suggest predominance of solute-solvent interaction, the decrease in internal pressure indicates the existence of other interactions also (solute-solute interactions) in these solutions. This is further supported by free volume. The free volume (V_f) of a solute molecule at a particular temperature and pressure depends on the internal pressure of a liquid in which it is dissolved. The decrease in molecular association causes an increase in free volume. Thus, free volume is an inverse function of internal pressure. Hence, increase in free volume causes internal pressure to decrease or vice versa. However, Table 1.2 shows that although internal pressure decreasing linearly, free volume varies irregularly for different Schiff bases in both DMF and THF. This again confirms the existence of both solute-solute and solute-solvent interaction in these systems.

The apparent molar compressibility (F_K) of the solutions was calculated by the following equation:

$$F_K = (?_0\kappa_s - ?\kappa_{s0})\ 1000/c?_0 + \kappa_{s0}M_2/?_0 \quad \ldots\ldots\ldots (1.18)$$

where κ_{s0} is isentropic compressibility of pure solvent. These F_K values were fitted with Gucker's relation[64]:

$$F_K = F_K^o + S_K \sqrt{C} \quad \ldots\ldots\ldots (1.19)$$

It is found that the relation is applicable above 0.04M concentrations. From the plots of F_K verses $\sqrt{C}$, values of intercept (F_K^o) and slope (S_K) were calculated.

Further, apparent molar volumes F_V of the solutions were calculated by the following equation:

$$F_v = M/?-[1000(?-?_0)/?c] \quad \ldots\ldots\ldots (1.20)$$

and were fitted in the relation:

$$F_V = F_V^o + S_v \sqrt{C} \quad \ldots\ldots\ldots (1.21)$$

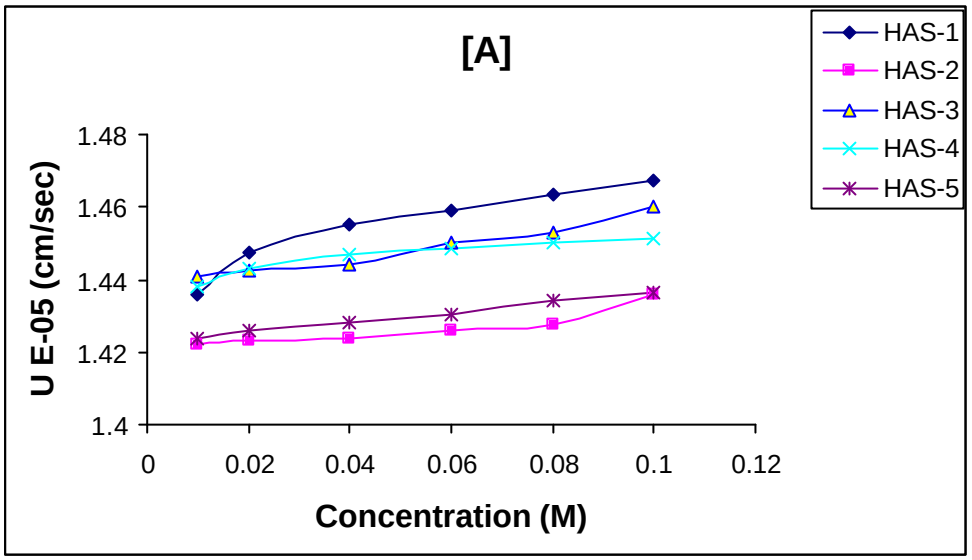
From the plot of F_V verses $\sqrt{C}$, F_V^o and S_v values were calculated from the intercept and slope respectively. S_v is the measure of solute-solvent interaction. These values of F_V^o and S_v, along with the Gucker's constants F_K^o and S_k are reported in Table-1.3.

Table 1.3 shows that in DMF solutions, for all other Schiff bases solutions (except HAS-1), f^o_k values are positive but less whereas S_k values are both positive and negative. However, in THF solutions, for all Schiff bases, f^0_k values are negative whereas S_K values are positive. The negative or less positive f^0_k values and positive S_K values indicate the existence of solute-solvent interactions or vice versa. Thus, in DMF solutions, although solute-solvent interactions predominates, solute-solute interactions also exist. Whereas, in THF solutions, solute-solvent interaction exists. The predominance of any of these interactions is further confirmed by f^o_V and S_V values. The negative f^o_V and higher S_V values indicate the predominance of solute-solvent interactions in the system. Thus, in both DMF and THF solutions, solute-solvent interactions exist. It is reported by Nikam and Hiray that the negative f^o_V and positive S_V suggest electrostrictive solvation of ions[65,66].

Thus, both solute-solute and solute-solvent interactions exist in both DMF and THF solutions. However, in THF, most of the parameters indicate the predominance of

solute-solvent interactions, internal pressure and free volume indicate some solute-solute interactions also. In DMF, the two lone pair of electrons may interact differently with different solute molecules. Thus, the dipole –dipole interactions between solute and solvent molecules play an important role in DMF solutions due to which predominance of type of interaction is much affected.

Figure 1.1: Variation of ultrasonic velocity (U) with concentration in [A] DMF and [B] THF at 308.15 K.



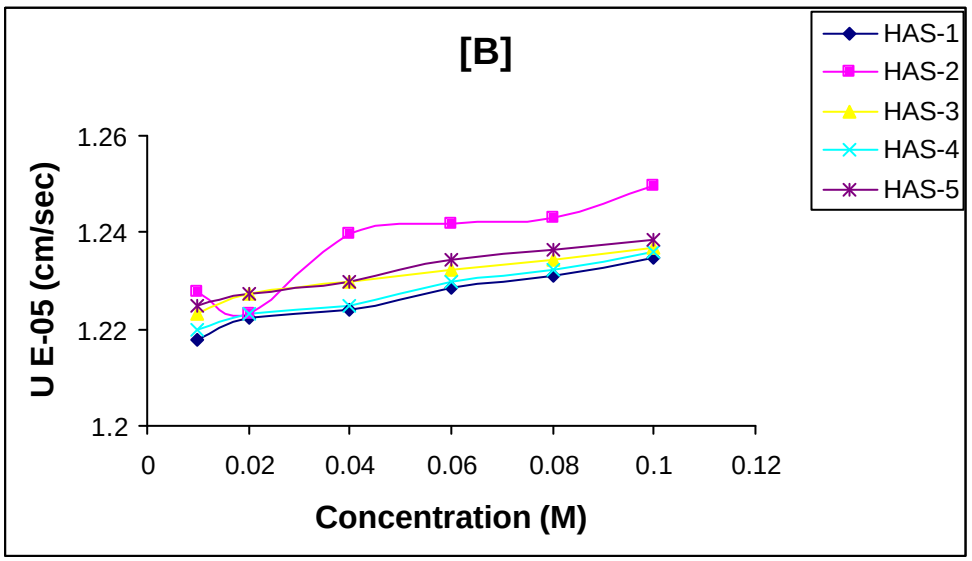
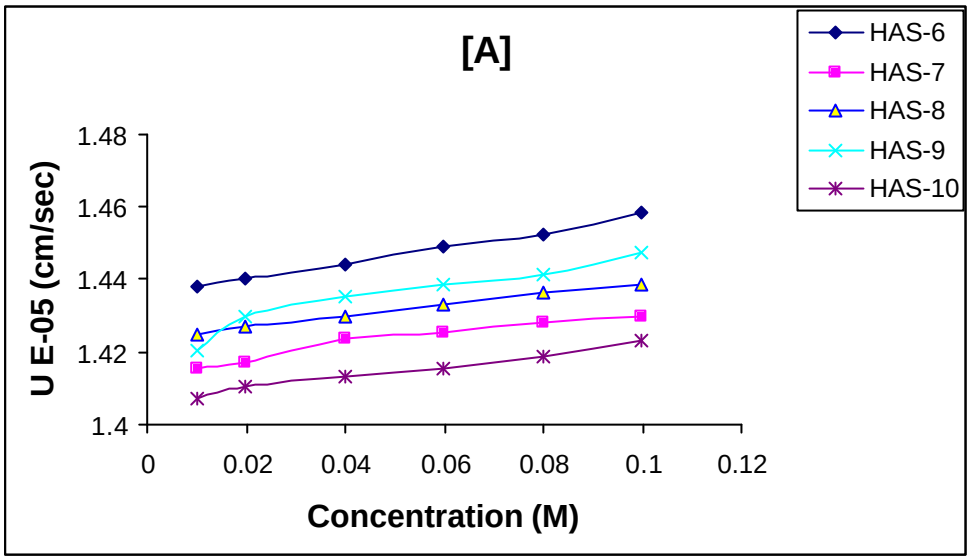


Figure 1.2: Variation of ultrasonic velocity (U) with concentration in [A] DMF and [B] THF at 308.15 K.



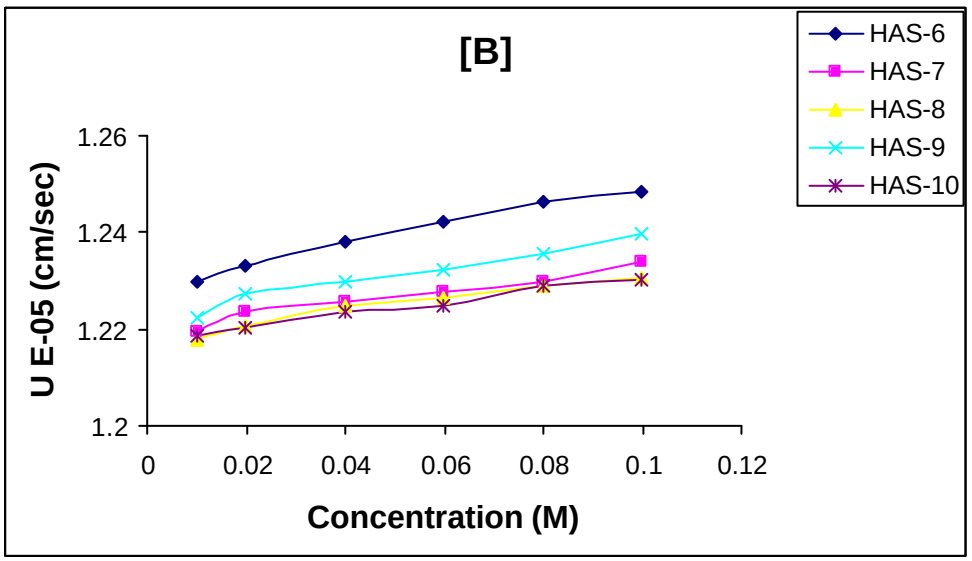
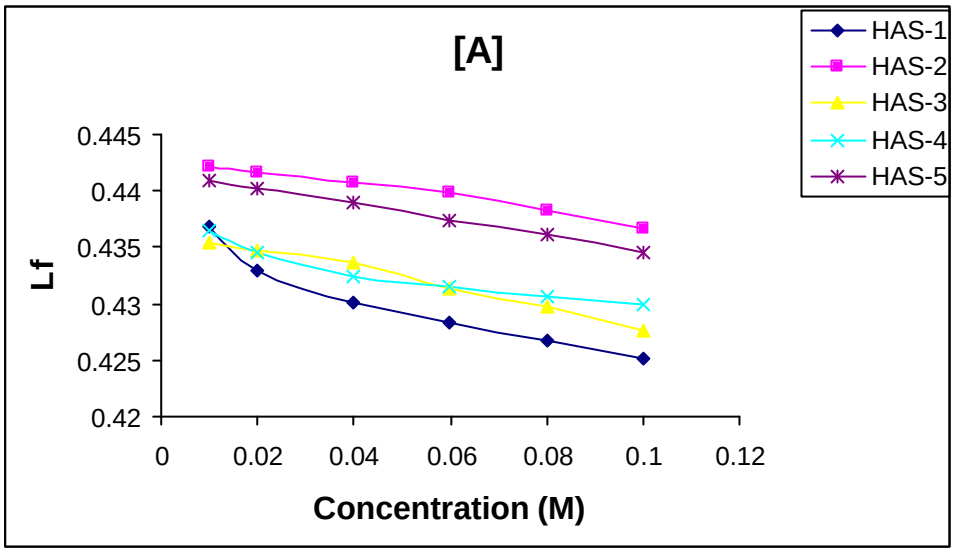


Figure 1.3: Variation of intermolecular free path length (L_f) with concentration in [A] DMF and [B] THF at 308.15 K.



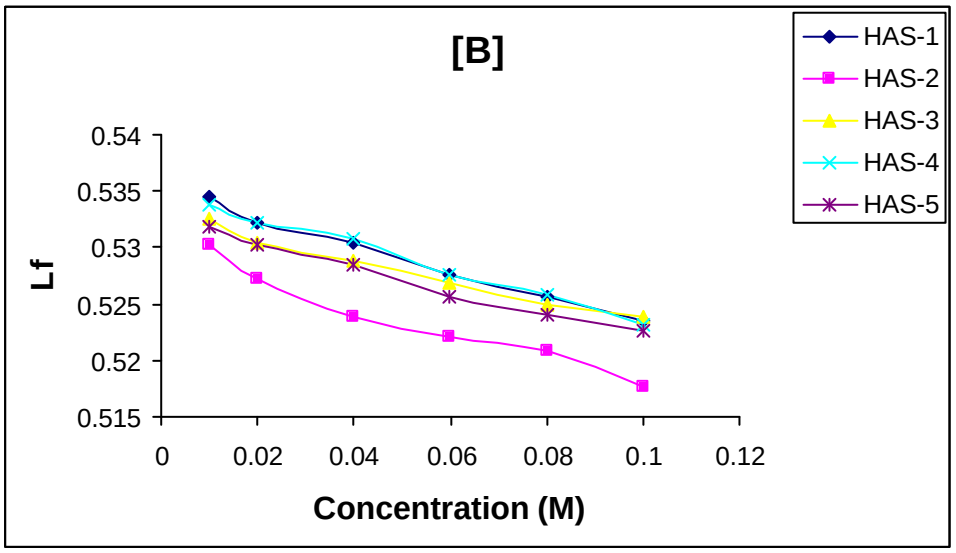
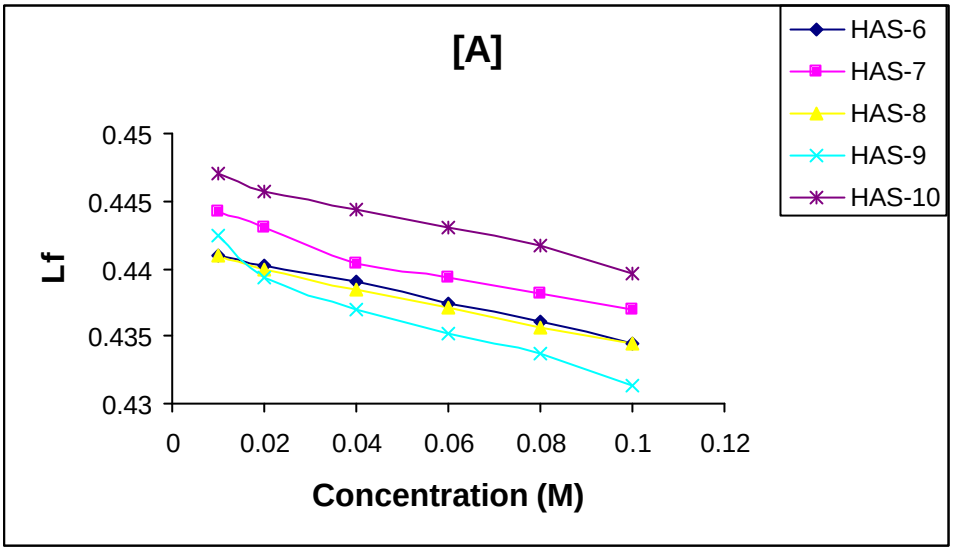


Figure 1.4: Variation of intermolecular free path length (L_f) with concentration in [A] DMF and [B] THF at 308.15 K.



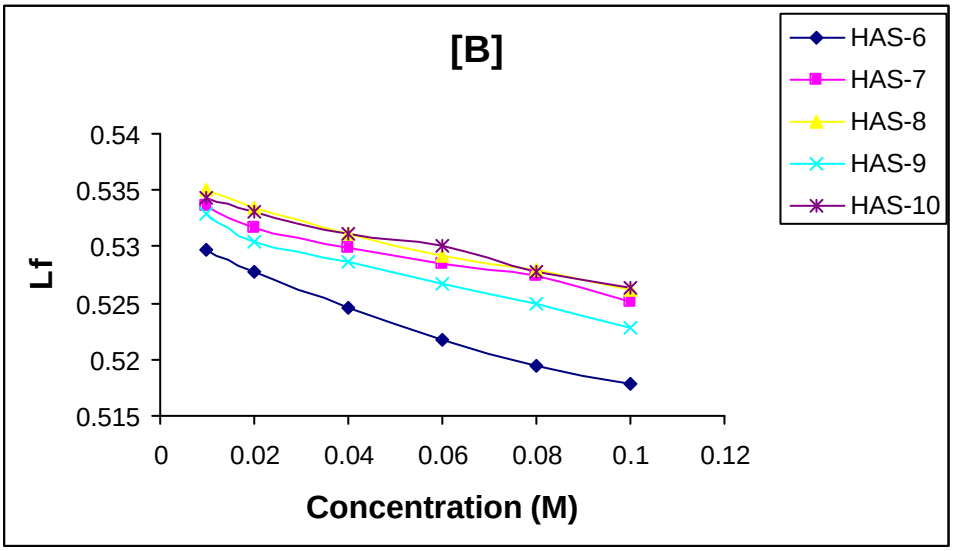
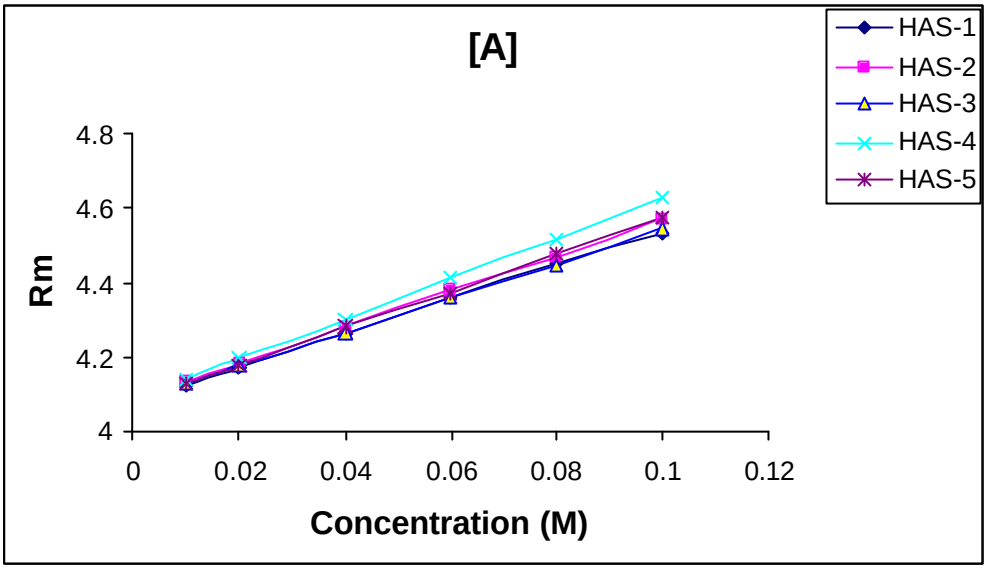


Figure 1.5: Variation of Rao's molar constant (R_m) with concentration in [A] DMF and [B] THF at 308.15 K.



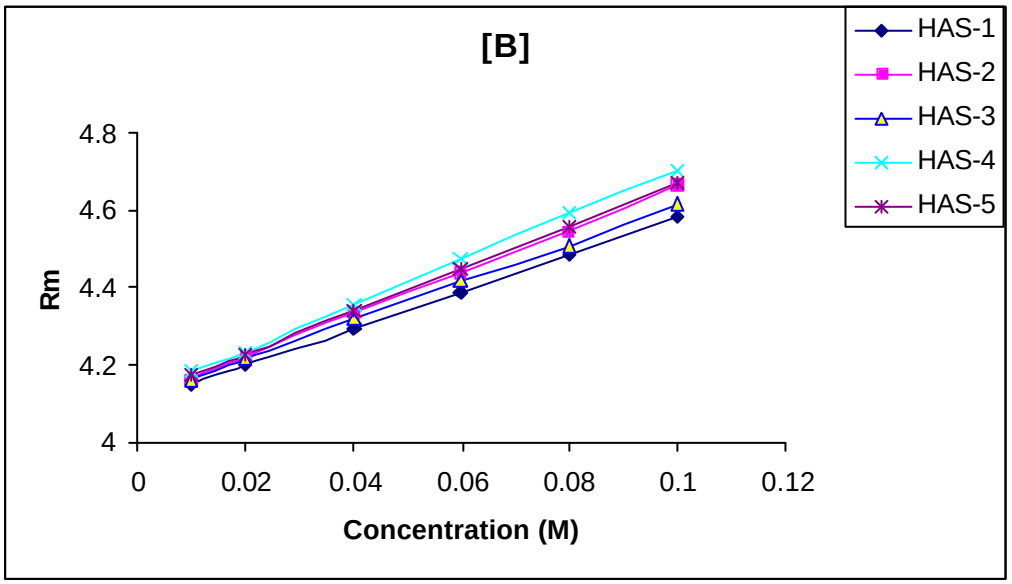
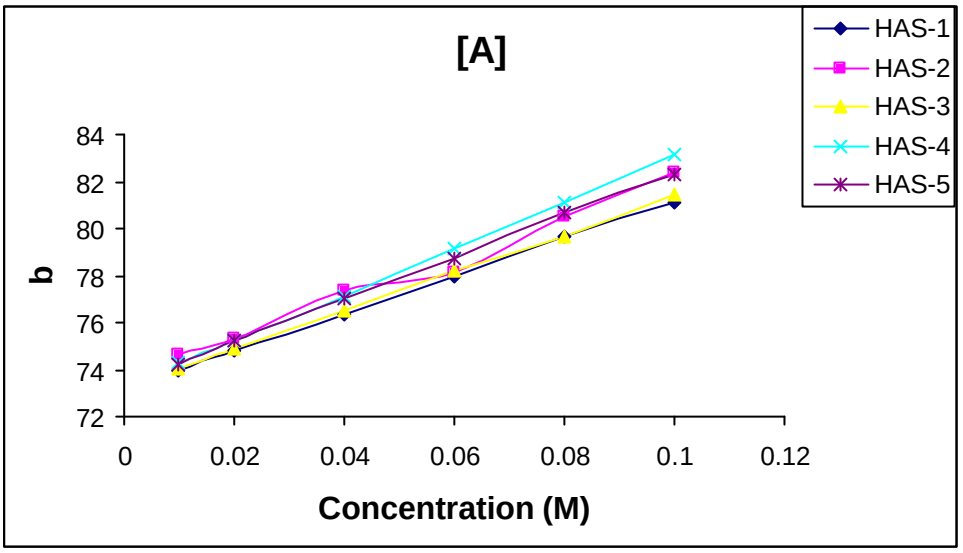


Figure 1.6: Variation of Vander Walls constant (b) with concentration in [A] DMF and [B] THF at 308.15 K.



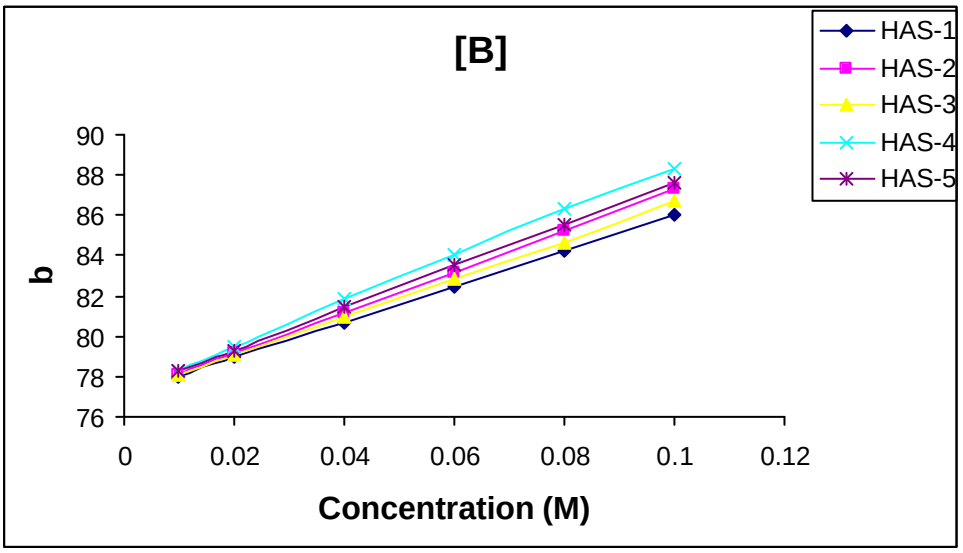
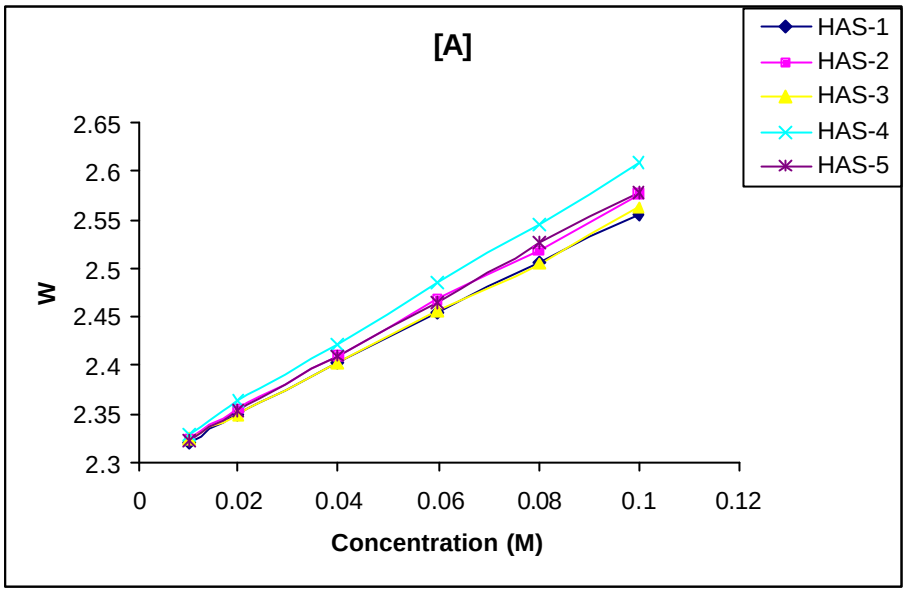


Figure 1.7: Variation of Molar compressibility (W) with concentration in [A] DMF and [B] THF at 308.15 K.



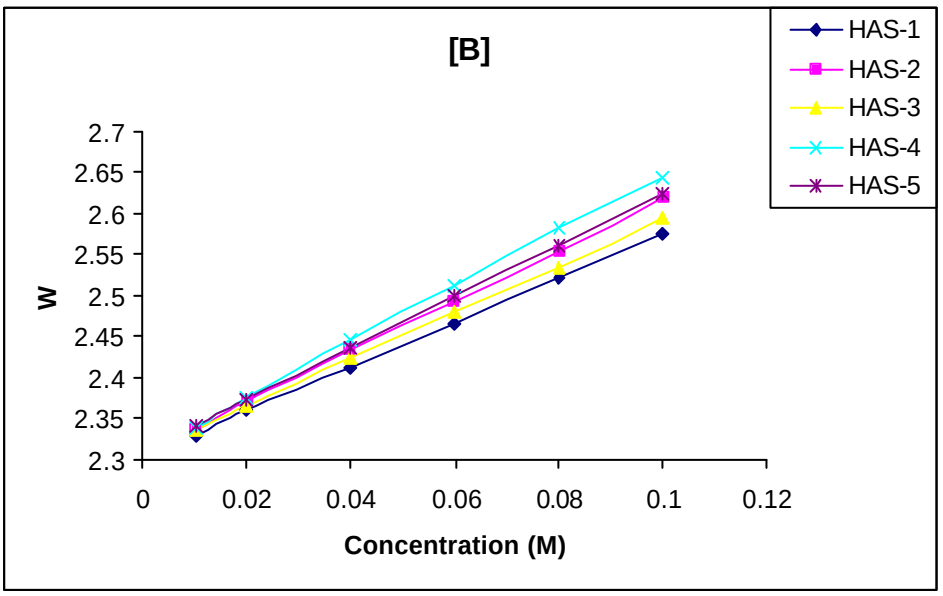
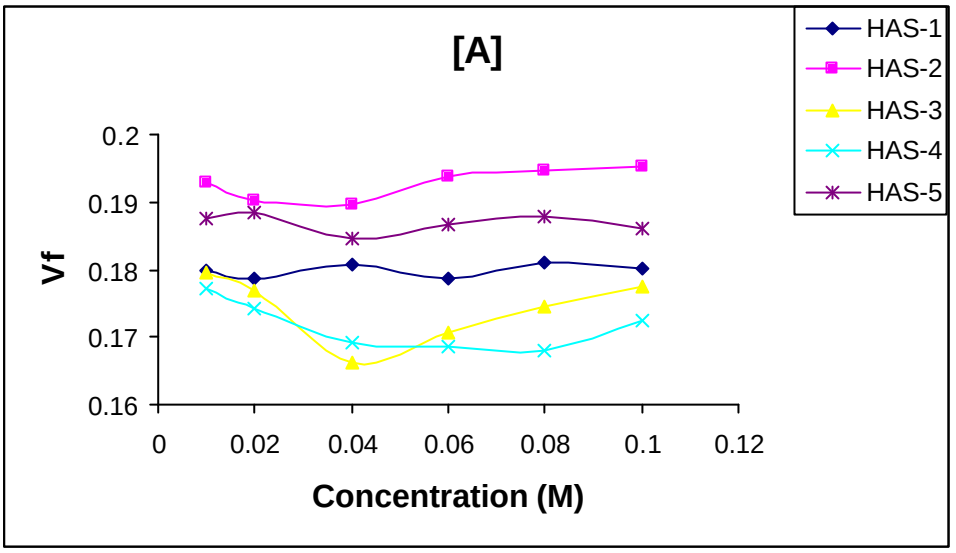


Figure 1.8: Variation of Free volume (V_f) with concentration in [A] DMF and [B] THF at 308.15 K.



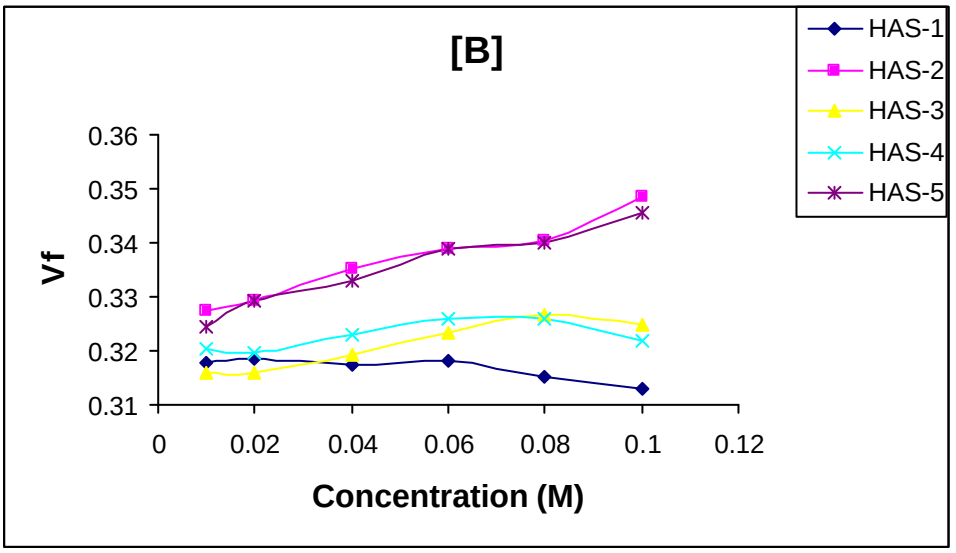
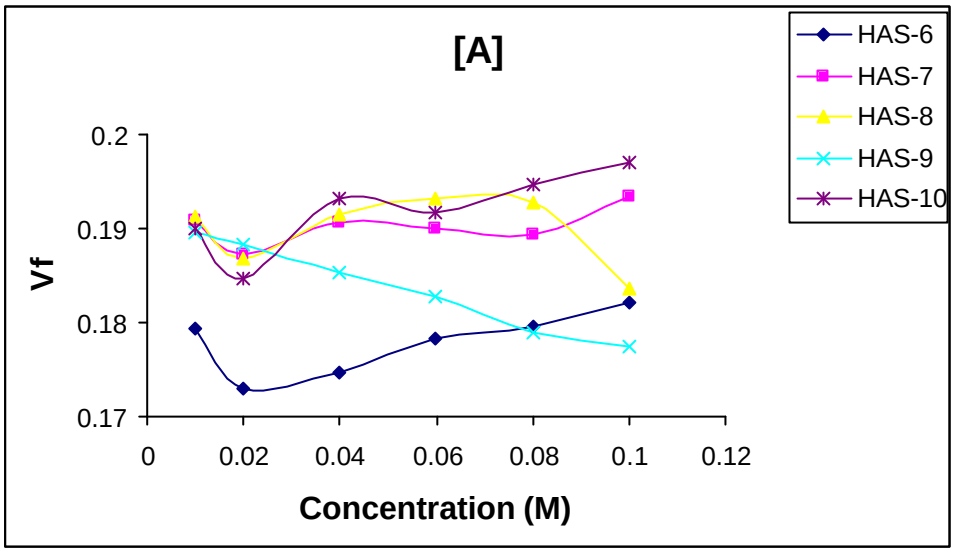
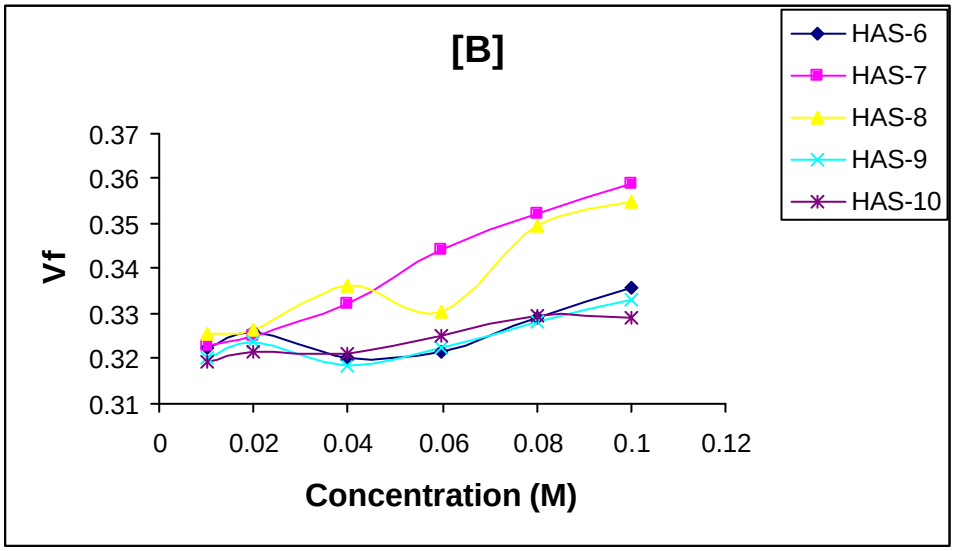


Figure 1.9: Variation of Free volume (V_f) with concentration in [A] DMF and [B] THF at 308.15 K.





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Conc. (M)	Density (g cm^{-3})	Velocity (m s^{-1})	Viscosity (mPa s)	Density (g cm^{-3})	Velocity (m s^{-1})	Viscosity (mPa s)
		DW				
		AS 4			AS 4	
		AS 5			AS 5	
		AS 6			AS 6	

Conc. (M)	Density (g cm^{-3})	Velocity $u \times 10^{-5}$ (cm/s)	Viscosity $\eta \times 10^{3}$ (m sec)	Density (g cm^{-3})	Velocity $u \times 10^{-5}$ (cm/s)	Viscosity $\eta \times 10^{3}$ (m sec)
		AS 7			AS 7	
		AS 8			AS 8	
		AS 9			AS 9	

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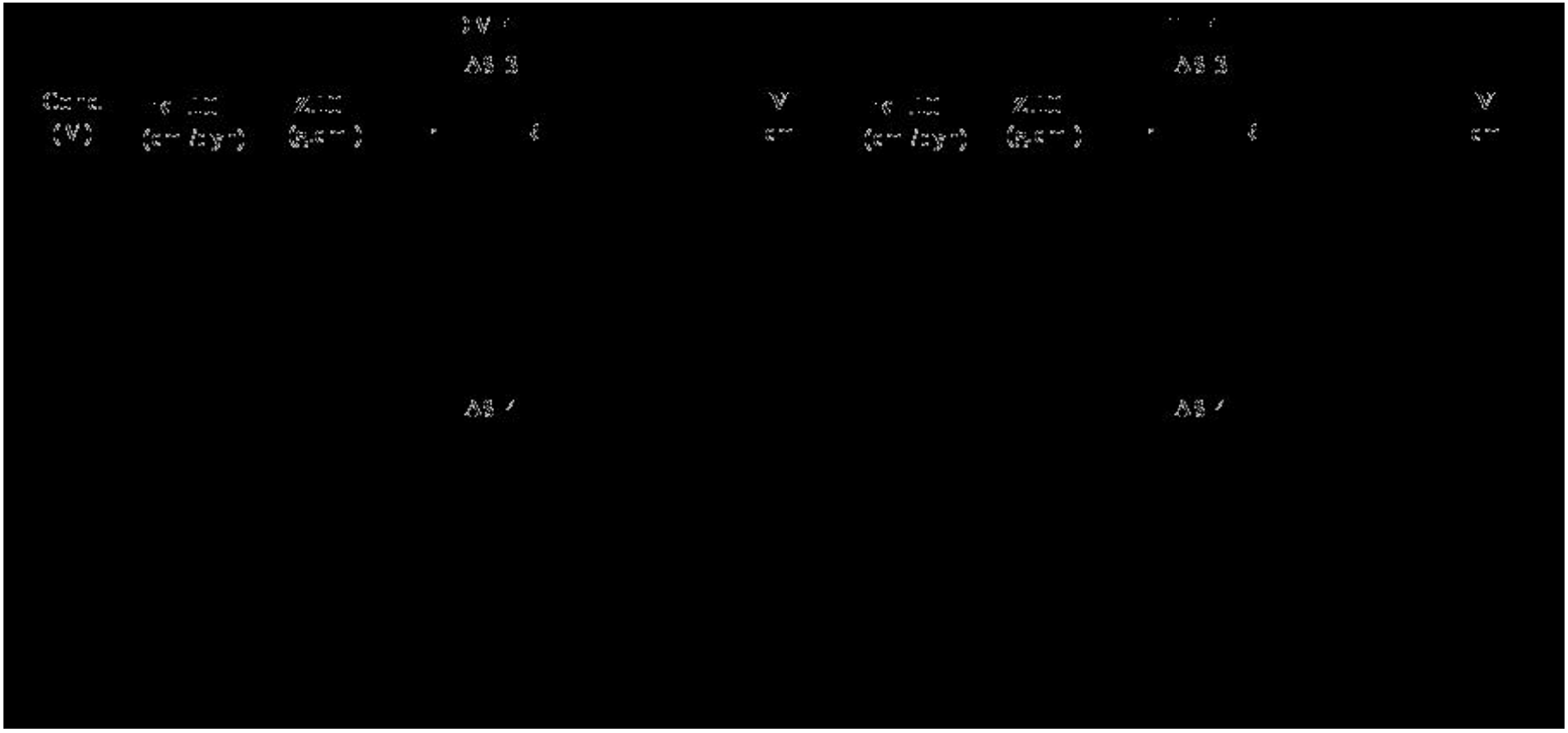

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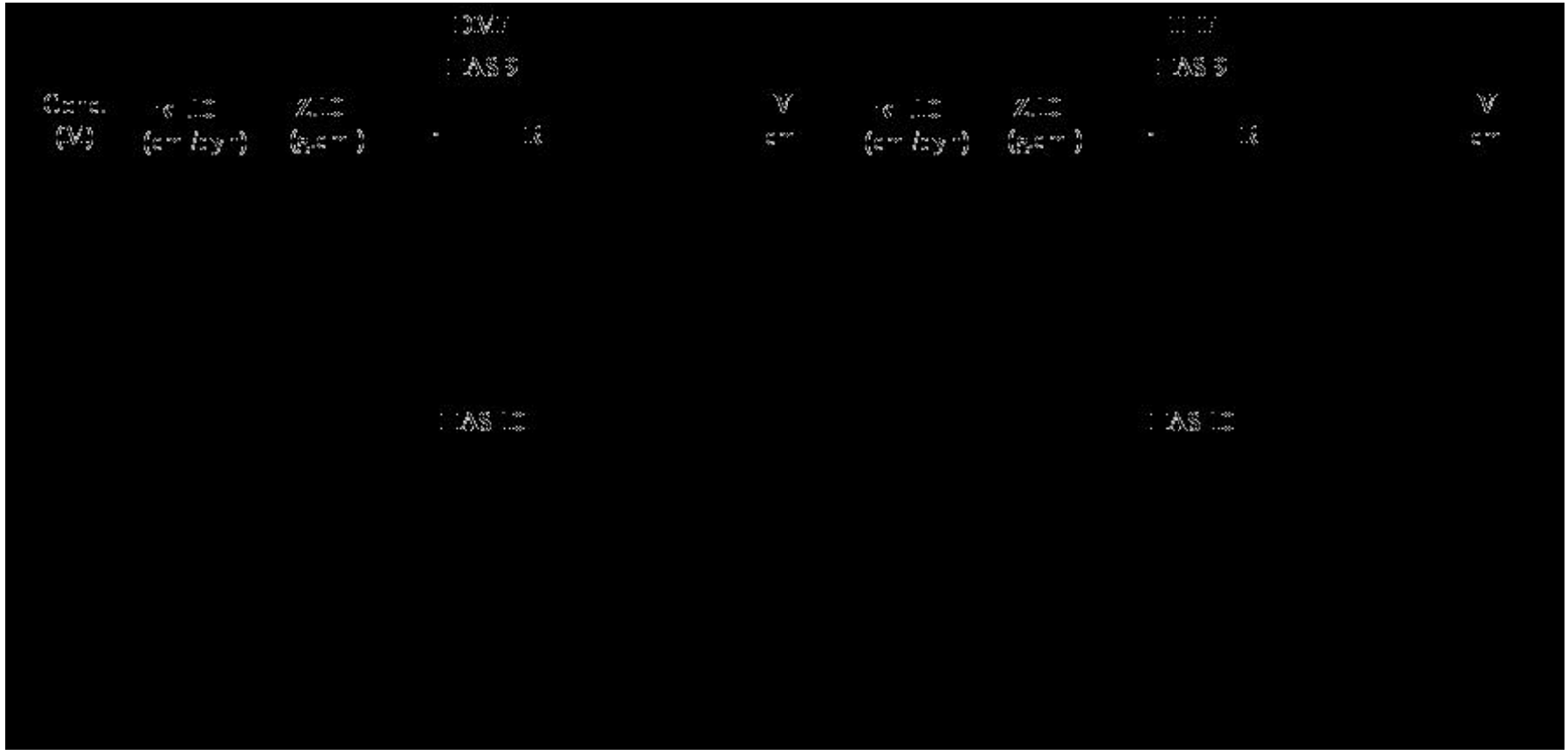

Table 1.3 Various constants of Bachem's and Gucker's equation

		DMF		
	$F^{o}_{K} \times 10^{8}$	$S_K \times 10^{8}$	F^{o}_{V}	S_V
HAS-1.	-1.02	0.85	-462.53	1133.1
HAS-2.	9.8	-40.00	-111.95	158.8
HAS-3.	5.8	-19.59	-365.14	862.0
HAS-4.	9.1	-10.00	-481.99	1207.8
HAS-5.	10.6	32.13	-244.74	463.7
HAS-6	7.00	26.67	-285.00	1764.7
HAS-7	9.00	18.57	-177.00	1184.2
HAS-8	7.00	17.15	-190.00	1425.0
HAS-9	5.00	10.71	85.00	3250.0
HAS-10	13.00	32.50	-45.00	117.6
		THF		
HAS-1.	-3.7	5.48	-171.33	574.6
HAS-2.	-19.8	30.00	-153.24	1122.5
HAS-3.	-5.8	12.96	-20.00	722.2
HAS-4.	-4.95	11.75	-21.77	812.6
HAS-5.	-8.55	14.62	-60.42	307.7
HAS-6	-11.3	25.19	-132.00	300.0
HAS-7	-9.5	30.30	-158.00	1125.0
HAS-8	-1.7	3.24	3.01	600.1
HAS-9	-9.0	22.50	-76.00	312.5
HAS-10	-3.3	7.37	-146.11	1400.0

Table 1.4: The correlation coefficients (g) and correlation equations between some acoustical parameters and concentrations (C) of Schiff base in DMF and THF at 308.15 K.

Parameters	g	Correlation equation
	DMF	
	HAS-1	
? (poise)	0.9912	?-10.741C=7.7255
k_s **(cm^2.dyn^{-1})**	0.9218	κ_s+2.7661C=5.1434
L_f (A^O)	0.9237	L_f+0.1191C=0.4300
Z (gm.cm^{-2}s^{-1})	0.9448	Z- 0.4624C=1.3511
W (cm^{-1}.dyn^{-1})	0.9997	W- 2.6112C=2.2905
b (cm^3.mol^{-1})	0.9999	b-79.854C=73.182
R_m (cm$^{-8/3}$.sec$^{-1/3}$)	0.9996	R_m- 4.6058C=4.0793
r	0.9022	r+ 0.3553C=0.1916
R_A	0.8953	R_A- 0.0501C=1.0103
	HAS-2	
? (poise)	0.9801	?-8.7671C=7.3407
k_s **(cm^2.dyn^{-1})**	0.9780	κ_s+1.4010C=5.3039
L_f (A^O)	0.9777	L_f+0.0595C=0.4429
Z (gm.cm^{-2}s^{-1})	0.9819	Z- 0.2647C=1.3271
W (cm^{-1}.dyn^{-1})	0.9997	W- 2.7807C=2.2992
b (cm^3.mol^{-1})	0.9876	b-84.8630C=73.676
R_m (cm$^{-8/3}$.sec$^{-1/3}$)	0.9996	R_m- 4.8714C=4.0848
r	0.9333	r+ 0.1129C=0.2117
R_A	0.9661	R_A- 0.1046C=1.0091

Continue.....

.....Continue

Parameters	g	Correlation equation
	DMF	
	HAS-3	
? (poise)	0.8627	?-11.013C = 7.8608
k_s ($cm^2.dyn^{-1}$)	0.9917	k_s+ 2.050C = 5.1553
L_f (A^O)	0.9915	L_f+ 0.0876C = 0.4366
Z ($gm.cm^{-2}s^{-1}$)	0.9963	Z- 0.357C = 1.3489
W ($cm^{-1}.dyn^{-1}$)	0.9996	W- 2.6197C = 2.298
b ($cm^3.mol^{-1}$)	0.9997	b- 81.567C = 73.25
R_m ($cm^{-8/3}.sec^{-1/3}$)	0.9994	R_m- 4.6102C = 4.0824
r	0.9688	r+ 0.2392C = 0.1926
R_A	0.8705	R_A- 0.0677C = 1.0095
	HAS-4	
? (poise)	0.9574	?-14.257C = 7.8698
k_s ($cm^2.dyn^{-1}$)	0.9194	κ_s+ 1.6067C = 5.1432
L_f (A^O)	0.9210	L_f+ 0.0691C = 0.4362
Z ($gm.cm^{-2}s^{-1}$)	0.9420	Z- 0.3063C = 1.3506
W ($cm^{-1}.dyn^{-1}$)	0.9999	W- 3.0988C = 2.2991
b ($cm^3.mol^{-1}$)	0.9998	b- 98.082C = 73.262
R_m($cm^{-8/3}.sec^{-1/3}$)	0.9998	R_m- 5.4368C = 4.0847
r	0.8663	r+ 0.1501C = 0.1906
R_A	0.9675	R_A- 0.1036C = 1.0091

.....Continue

Parameters	g	Correlation equation
	DMF	
	HAS-5	
?(poise)	0.9913	?-11.033C = 7.4204
k_s **($cm^2.dyn^{-1}$)**	0.9985	κ_s + 1.6931C = 5.2756
L_f(A^O)	0.9986	L_f + 0.0714C = 0.4417
Z($gm.cm^{-2}s^{-1}$)	0.9953	Z- .3141C = 1.332
W($cm^{-1}.dyn^{-1}$)	0.9996	W- 2.837C = 2.2961
b($cm^3.mol^{-1}$)	0.9995	b- 89.753C = 73.399
R_m($cm^{-8/3}.sec^{-1/3}$)	0.9994	R_m - 4.970C = 4.0782
r	0.9933	r+ 0.1507C = 0.2092
R_A	0.9533	R_A - 0.1091C = 1.0108
	HAS-6	
?(poise)	0.9537	?-10.296C = 7.8577
k_s **($cm^2.dyn^{-1}$)**	0.9957	κ_s + 2.186C = 5.1661
L_f(A^O)	0.9986	L_f + 0.0714C = 0.4417
Z($gm.cm^{-2}s^{-1}$)	0.9952	Z- 0.3838C = 1.348
W($cm^{-1}.dyn^{-1}$)	0.9999	W- 3.0864C = 2.2958
b($cm^3.mol^{-1}$)	0.9999	b- 96.508C = 73.198
R_m($cm^{-8/3}.sec^{-1/3}$)	0.9999	R_m - 5.4298C = 4.0777
r	0.9936	r+ 0.250C = 0.195
R_A	0.9481	R_A - 0.0773C = 1.0109

.....Continue

Parameters	g	Correlation equation
	DMF	
	HAS-7	
? (poise)	0.9820	?-10.6600C = 7.347
k_s **(cm².dyn⁻¹)**	0.9682	κ_s + 1.8965C = 5.3408
L_f **(A^O)**	0.9665	L_f + 0.08C = 0.4445
Z (gm.cm⁻²s⁻¹)	0.9824	Z- 0.3325C = 1.3230
W (cm⁻¹.dyn⁻¹)	0.9997	W- 3.0931C = 2.2948
b (cm³.mol⁻¹)	0.9998	b- 97.927C = 73.457
R_m **(cm$^{-8/3}$.sec$^{-1/3}$)**	0.9996	R_m - 5.4294C = 4.0756
r	0.9292	r+ 0.1795C = 0.2179
R_A	0.9708	R_A - 0.0968C = 1.0115
	HAS-8	
? (poise)	0.9395	?-11.737C = 7.3167
k_s **(cm².dyn⁻¹)**	0.9967	κ_s + 1.6981C = 5.2701
L_f **(A^O)**	0.9957	L_f + 0.0712C = 0.4415
Z (gm.cm⁻²s⁻¹)	0.9979	Z- 0.2959C = 1.3326
W (cm⁻¹.dyn⁻¹)	1.0000	W- 2.9182C = 2.2967
b (cm³.mol⁻¹)	1.0000	b- 92.38C = 73.399
R_m **(cm$^{-8/3}$.sec$^{-1/3}$)**	1.0000	R_m - 5.1327C = 4.0796
r	0.9950	r+ 0.1722C = 0.2081
R_A	0.9935	R_A - 0.9935C = 1.0103

.....Continue

Parameters	g	Correlation equation
	DMF	
	HAS-9	
? (poise)	0.9994	?-14.603C = 7.3079
k_s **(cm².dyn^{-1})**	0.9565	κ_s + 2.6341C = 5.2885
L_f (A^O)	0.9578	L_f + 0.1116C = 0.4423
Z (gm.cm^{-2}s^{-1})	0.9778	Z- 0.4445C = 1.3294
W (cm^{-1}.dyn^{-1})	0.9995	W- 2.5381C = 2.2982
b (cm³.mol^{-1})	0.9998	b- 78.143C = 73.484
R_m (cm$^{-8/3}$.sec$^{-1/3}$)	0.9993	R_m - 4.4523C = 4.0827
r	0.9211	r+ 0.2936C = 0.2102
R_A	0.9296	R_A - 0.0868C = 1.0096
	HAS-10	
? (poise)	0.9687	?-6.6302C = 7.3046
k_s **(cm².dyn^{-1})**	0.9912	κ_s + 1.8832C = 5.4174
L_f (A^O)	0.9903	L_f + 0.779C = 0.4476
Z (gm.cm^{-2}s^{-1})	0.9917	Z- 0.3138C = 1.3126
W (cm^{-1}.dyn^{-1})	0.9998	W- 2.2617C = 2.2936
b (cm³.mol^{-1})	0.9997	b- 70.912C = 73.543
R_m (cm$^{-8/3}$.sec$^{-1/3}$)	0.9998	R_m - 3.966C = 4.0731
r	0.9869	r+ 0.1844C = 0.2277
R_A	0.9815	R_A - 0.0814C = 1.0018

.....Continue

Parameters	g	Correlation equation
	THF	
	HAS-1	
? (poise)	0.9981	?-6.9717C=4.3878
k_s **(cm².dyn⁻¹)**	0.9893	κ_s+3.3819C=7.7402
L_f **(A°)**	0.9901	L_f+0.1180C=0.5351
Z (gm.cm⁻²s⁻¹)	0.9932	Z- 0.3289C=1.0609
W (cm⁻¹.dyn⁻¹)	0.9999	W- 2.7245C=2.3038
b (cm³.mol⁻¹)	0.9999	b-89.118C=77.124
R_m **(cm$^{-8/3}$.sec$^{-1/3}$)**	0.9999	R_m- 4.7766C=4.1035
r	0.9790	r+0.1674C=0.4211
R_A	0.9816	R_A-0.1161C=0.9996
	HAS-2	
? (poise)	0.8597	U-0.2665C=1.2237
k_s **(cm².dyn⁻¹)**	0.9960	?-4.9224C=4.3795
L_f **(A°)**	0.9607	κ_s+3.5898C=7.6005
Z (gm.cm⁻²s⁻¹)	0.9601	L_f+0.1270C=0.5302
W (cm⁻¹.dyn⁻¹)	0.9769	Z- 0.3385C=1.0711
b (cm³.mol⁻¹)	0.9997	W- 3.1108C=2.3077
R_m **(cm$^{-8/3}$.sec$^{-1/3}$)**	0.9999	b-101.7300C=77.0920
r	0.9996	R_m- 5.4879C=4.1116
R_A	0.9319	r+0.2074C=0.4109

.....Continue

Parameters	g	Correlation equation
	THF	
	HAS-3	
? (poise)	0.9834	?-4.3479C = 4.4839
k_s **($cm^2.dyn^{-1}$)**	0.9772	κ_s + 2.6349C = 7.6707
L_f (A^O)	0.9781	L_f + 0.093C = 0.5327
Z ($gm.cm^{-2}s^{-1}$)	0.9823	Z-0.2546C = 1.0655
W ($cm^{-1}.dyn^{-1}$)	0.9997	W- 2.8517C = 2.308
b ($cm^3.mol^{-1}$)	0.9997	b- 94.442C = 77.181
R_m ($cm^{-8/3}.sec^{-1/3}$)	0.9997	R_m- 5.0264C = 4.1122
r	0.9627	r+ 0.1337C = 0.4153
R_A	0.9492	R_A- 0.0848C = 0.9974
	HAS-4	
? (poise)	0.9927	?-7.2169C = 4.3898
k_s **($cm^2.dyn^{-1}$)**	0.9908	κ_s + 3.3276C = 7.7353
L_f (A^O)	0.9919	L_f + 0.1162C = 0.5349
Z ($gm.cm^{-2}s^{-1}$)	0.9903	Z- 0.3227C = 1.0604
W ($cm^{-1}.dyn^{-1}$)	0.9995	W- 3.390C = 2.3083
b ($cm^3.mol^{-1}$)	0.9994	b- 111.98C = 77.276
R_m ($cm^{-8/3}.sec^{-1/3}$)	0.9994	R_m- 5.8322C = 4.1227
r	0.9847	r+ 0.166C = 0.4197
R_A	0.9616	R_A- 0.1131C = 0.9976

.....Continue

Parameters	g	Correlation equation
	THF	
	HAS-5	
? (poise)	0.9962	?-4.8687C = 4.3766
k_s **(cm².dyn⁻¹)**	0.9882	κ_s + 2.9557C = 7.6673
L_f **(A°)**	0.9883	L_f + 0.1037C = 0.5325
Z (gm.cm⁻²s⁻¹)	0.9925	Z- 0.2909C = 1.0654
W (cm⁻¹.dyn⁻¹)	0.9999	W- 3.1484C = 2.3098
b (cm³.mol⁻¹)	1.0000	b- 104.12C = 77.241
R_m **(cm⁻⁸/³.sec⁻¹/³)**	0.9999	R_m - 5.5402C = 4.1159
r	0.9811	r+ 0.1468C = 0.4148
R_A	0.9976	R_A - 0.1047C = 0.9966
	HAS-6	
? (poise)	0.9681	?-7.1306C = 4.4351
k_s **(cm².dyn⁻¹)**	0.9977	κ_s + 4.6144C = 7.6286
L_f **(A°)**	0.9830	L_f + 0.134C = 0.5304
Z (gm.cm⁻²s⁻¹)	0.9859	Z- 0.3711C = 1.0696
W (cm⁻¹.dyn⁻¹)	1.0000	W- 3.6916C = 2.3128
b (cm³.mol⁻¹)	1.0000	b- 121.32C = 77.276
R_m **(cm⁻⁸/³.sec⁻¹/³)**	1.0000	R_m - 6.4991C = 4.1221
r	0.9787	r+ 0.2033C = 0.4102
R_A	0.9911	R_A - 0.1151C = 0.9953

.....Continue

Parameters	g	Correlation equation
	THF	
	HAS-7	
? (poise)	0.9849	?-3.424C = 4.4193
k_s **(cm².dyn⁻¹)**	0.9754	κ_s + 2.4817C = 7.7041
L_f **(A°)**	0.9767	L_f + 0.0865C = 05338
Z (gm.cm⁻²s⁻¹)	0.9813	Z- 0.2282C = 1.0643
W (cm⁻¹.dyn⁻¹)	0.9999	W- 3.5022C = 2.3016
b (cm³.mol⁻¹)	0.9999	b- 117.01C = 77.005
R_m **(cm⁻⁸/³.sec⁻¹/³)**	0.9998	R_m - 6.1975C = 4.0991
r	0.9592	r+ 0.1357C = 0.4191
R_A	0.8926	R_A - 0.0758C = 0.9991
	HAS-8	
? (poise)	0.9905	?-3.6799C = 4.3782
k_s **(cm².dyn⁻¹)**	0.9786	κ_s + 2.7452C = 7.7502
L_f **(A°)**	0.9802	L_f + 0.0959C = 0.5354
Z (gm.cm⁻²s⁻¹)	0.9825	Z- 0.2681C = 1.0592
W (cm⁻¹.dyn⁻¹)	0.9997	W- 2.8516C = 2.3071
b (cm³.mol⁻¹)	0.9996	b- 104.91C = 77.278
R_m **(cm⁻⁸/³.sec⁻¹/³)**	0.9995	R_m - 5.5524C = 4.1123
r	0.9620	r+ 0.1293C = 0.4206
R_A	0.9433	R_A - 0.1015C = 0.9975

.....Continue

Parameters	g	Correlation equation
	THF	
	HAS-9	
? (poise)	0.9709	?-5.0902C = 4.4277
k_s **(cm²·dyn⁻¹)**	0.9821	κ_s + 2.9736C = 7.6852
L_f **(A°)**	0.9838	L_f + 0.105C = 0.5332
Z (gm.cm⁻²s⁻¹)	0.9866	Z- 0.2747C = 1.0644
W (cm⁻¹.dyn⁻¹)	0.9999	W- 3.1568C = 2.308
b (cm³.mol⁻¹)	0.9999	b- 93.994C = 77.171
R_m **(cm⁻⁸/³.sec⁻¹/³)**	0.9998	R_m - 5.0368C = 4.1106
r	0.9727	r+ 0.1662C = 0.4165
R_A	0.9421	R_A - 0.0670C = 0.9977
	HAS-10	
? (poise)	0.9934	?-4.4341C = 4.4035
k_s **(cm²·dyn⁻¹)**	0.9881	κ_s + 2.499C = 7.7378
L_f **(A°)**	0.9887	L_f + 0.087C = 0.5349
Z (gm.cm⁻²s⁻¹)	0.9893	Z- 0.2395C = 1.0610
W (cm⁻¹.dyn⁻¹)	0.9999	W- 2.4877C = 2.3038
b (cm³.mol⁻¹)	0.9998	b- 82.236C = 77.12
R_m **(cm⁻⁸/³.sec⁻¹/³)**	0.9998	R_m - 4.3768C = 4.1037
r	0.9860	r+ 0.1238C = 0.4207
R_A	0.9742	R_A - 0.0817C = 0.9994

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INTRODUCTION

One of the common use of the refractive index is to compare the value obtained with the values listed in the literature. This comparison is used to confirm the identity of the compound and assess its substances[1]. The concentration of a solute in a solution is probably the most popular use of refractometry for example, determining the percentage of sugar in fruits, juices and syrups[2], the percentage of alcohol in beer or wine, the salinity of water, and concentration of antifreeze in radiator fluid. Further, refractive indexes along with density, molecular mass and specific volume are also useful in the evaluation of various thermodynamic properties of chemical materials. Van Nes and Van Westen gave the method for the analysis of petroleum fraction using refractometry[3]. Recently, refractive index measurements have been used to determine complex refractive index[4] and film thickness[5].

Much work has been done in liquid mixtures [6-18] but scanty work has been reported for the solutions [19-26], which includes solutions of organic, inorganic and polymeric materials. However, very little work has been reported on Schiff bases in solutions [27-30].

In this chapter, the density and refractive index of all triazole Schiff bases have determined in dimethylformamide (DMF) and tetrahydrofuran (THF) solutions at 308.15 K.

EXPERIMENTAL

The solvents DMF and THF were of LR grade and are fractionally distilled by the reported method[31]. All the Schiff bases were recrystalized from methanol. For each Schiff base, a series of solutions of different concentrations were prepared in both the solvents. The density and refractive index of solutions are measured by using Pyknometer and Abbe Refrectometer respectively at 308.15 K. The results are given in Tables 2.1 and 2.2.

RESULTS AND DISCUSSION

The density of solution ($?_{12}$) is related to densities of the solvent, solute and their weight fractions g_1 and g_2, according to the equation:

$$1/?_{12} = g_1/?_1 + g_2/?_2 \qquad \ldots\ldots\ldots (2.1)$$

where r_{12} is density of solution and r_1 and r_2 are the densities of the solvent and solute respectively. Tables 2.1 and 2.2 shows the experimental values of densities and refractive index for all the Schiff bases in different solutions of DMF and THF.

The density of these Schiff bases was determined from the slope of the plot of $1/ g_1?_{12}$ verses g_2/g_1. Figure 2.1 shows the plots of $1/?_{12}g_1$ verses g_2/g_1 for HAS-1 in DMF and THF respectively. The inverse of slope gives $?_2$ i.e., the density of solute. The density of all the Schiff bases calculated from such plots are given in Table 2.3.

Further, from the knowledge of structural aspects, the density of a compound can be determined by following equation [32].

$$? = KM / N_A\Sigma\Delta V_i \qquad \ldots\ldots\ldots (2.2)$$

where r is the density of the compound, K is packing fraction (0.599), M is the molecular weight of the compound, N_A is the Avogadro's number and ΔV_i is the volume increment of the atoms and atomic groups present in the compound. ΔV_i for some of the atoms and group of atoms are reported in Table 2.5. The densities calculated from equation (2.2) are given in Table 2.3.

It is evident from Table 2.3 that the evaluated values of densities for all the compounds from equation 2.2 differs from those calculated by refractive index measurements in DMF and THF. However, in some cases, deviation is less in one of the solvent, THF. This suggests that the presence of molecular interactions in different solvents affect the density of solute. Usually intermolecular interactions does not affect the density but due to the presence of different substituted groups in solutes, interactions differ in different solvents which may cause change in volume thereby affecting the density of solute in particular solvent. This is further confirmed by ultrasonic studies explained in chapter-1.

The molar refraction of pure liquid and solutions can be determined according to Lorentz and Lorentz [33] equations (2.3) and (2.4) respectively.

For pure liquid:

$$(MRD) = [(n^2 - 1) / (n^2 + 2)]. M/? \quad \ldots\ldots (2.3)$$

where n, M and r are refractive index, molecular weight and density of pure liquid respectively.

For solutions:

$$(MRD)_{12} = [(n^2_{12} - 1) / (n^2_{12} + 2)]. (X_1M_1 + X_2M_2) / ?_{12} \quad \ldots\ldots (2.4)$$

where n_{12} and r_{12} are refractive index and density of the solution respectively. X_1 and X_2 are the mole fractions and M_1 and M_2 are the molecular weights of the solvent and solute respectively.

The plots of $(MRD)_{12}$ verses concentration for all the Schiff bases in DMF and THF are given in Figures 2.2 and 2.3 respectively. It is evident from the figures that $(MRD)_{12}$ increases with increase in concentration. From the values of the molar refraction of solution and pure solvent, molar refraction of solid compounds were determined by the following equation:

$$(MRD)_{12} = X_1 (MRD)_1 + X_2 (MRD)_2 \quad \ldots\ldots\ldots (2.5)$$

From the density and molar refraction data, the refractive index of each Schiff bases was calculated from equation (2.3). The molar refraction and refractive index of all the Schiff bases are reported in Table 2.4.

It is evident from Table 2.4 that both $(MRD)_2$ and refractive index of compounds are different in each solvent. This again proves that in different solvents, intermolecular interactions are different, which affect these parameters. In some solvents, aggregation or hydrogen bonding takes place whereas in others, breakage of bonds takes place. As refractive index and molar refraction depends not only upon atomic refractions but also upon single, double or triple bonds[28], these parameters are affected by the type of interactions taking place in solution. However, it is reported that bond refraction is more effective than atomic refraction [34-36]. Further, bond polarity also causes change in molar refraction[37]. This again suggests the effect of solvent on refractive index and molar refraction of the solute.

Table 2.1: The density (r_{12}) and refractive index (n) of Schiff bases in dimethyl formamide at 308.15 K.

Conc. (M)	r_{12}	g_1	g_2	n
HAS-1				
0.00	-	-	-	1.411
0.01	0.9398	0.9966	0.0034	1.414
0.02	0.9416	0.9931	0.0069	1.415
0.04	0.9444	0.9863	0.0137	1.417
0.06	0.9464	0.9795	0.0205	1.418
0.08	0.9478	0.9727	0.0273	1.419
0.10	0.9507	0.9660	0.0340	1.422
HAS-2				
0.01	0.9359	0.9936	0.0024	1.412
0.02	0.9364	0.9931	0.0069	1.413
0.04	0.9387	0.9863	0.0137	1.415
0.06	0.9404	0.9795	0.0205	1.416
0.08	0.9445	0.9727	0.0273	1.417
0.10	0.9461	0.9643	0.0357	1.418
HAS-3				
0.01	0.9393	0.9997	0.0003	1.415
0.02	0.9402	0.9937	0.0063	1.416
0.04	0.9428	0.9862	0.0138	1.419
0.06	0.9448	0.9793	0.0209	1.420
0.08	0.9480	0.9725	0.0275	1.422
	0.9484	0.9657	0.0343	1.423
HAS-4				
0.01	0.9390	0.9962	0.0038	1.414
0.02	0.9402	0.9925	0.0075	1.415
0.04	0.9446	0.9850	0.0150	1.417
0.06	0.9462	0.9776	0.0224	1.418
0.08	0.9486	0.9702	0.0298	1.420
0.10	0.9500	0.9628	0.0372	1.421
HAS-5				
0.01	0.9378	0.9964	0.0036	1.412
0.02	0.9385	0.9927	0.0073	1.414
0.04	0.9411	0.9855	0.0145	1.415
0.06	0.9450	0.9783	0.0217	1.417
0.08	0.9456	0.9711	0.0289	1.418
0.10	0.9497	0.9641	0.0359	1.419

Continue.....

.....Continue

Conc. (M)	r_{12}	g_1	g_2	n
		HAS-6		
0.01	0.9397	0.9963	0.0037	1.413
0.02	0.9417	0.9926	0.0074	1.414
0.04	0.9436	0.9852	0.0148	1.416
0.06	0.9471	0.9778	0.0222	1.418
0.08	0.9489	0.9705	0.0295	1.419
0.10	0.9505	0.9632	0.0368	1.420
		HAS-7		
0.01	0.9359	0.9962	0.0037	1.411
0.02	0.9381	0.9925	0.0075	1.412
0.04	0.9404	0.9850	0.0150	1.413
0.06	0.9425	0.9776	0.0224	1.415
0.08	0.9446	0.9702	0.0298	1.417
0.10	0.9480	0.9628	0.0372	1.418
		HAS-8		
0.01	0.9368	0.9664	0.0036	1.413
0.02	0.9381	0.9927	0.0073	1.414
0.04	0.9405	0.9855	0.0145	1.415
0.06	0.9423	0.9783	0.0217	1.416
0.08	0.9443	0.9711	0.0289	1.419
0.10	0.9465	0.9639	0.0360	1.420
		HAS-9		
0.01	0.9364	0.9930	0.0070	1.412
0.02	0.9376	0.9931	0.0069	1.414
0.04	0.9400	0.9862	0.0138	1.416
0.06	0.9435	0.9794	0.0206	1.417
0.08	0.9463	0.9727	0.0273	1.418
0.10	0.9484	0.9659	0.0341	1.419
		HAS-10		
0.01	0.9345	0.9962	0.0038	1.412
0.02	0.9360	0.9925	0.0075	1.413
0.04	0.9377	0.9850	0.0150	1.414
0.06	0.9405	0.9776	0.0224	1.415
0.08	0.9418	0.9702	0.0298	1.417
0.10	0.9450	0.9628	0.0372	1.418

Table 2.2: The density (r_{12}) and refractive index (n) of Schiff bases in tetrahydrofuran at 308.15 K.

Conc. (M)	r_{12}	g_1	g_2	n
HAS-1				
0.00	-	-	-	1.385
0.01	0.8727	0.9963	0.0037	1.387
0.02	0.8740	0.9926	0.0074	1.388
0.04	0.8775	0.9853	0.0147	1.391
0.06	0.8807	0.9780	0.0220	1.393
0.08	0.8829	0.9707	0.0293	1.394
0.10	0.8823	0.9635	0.0365	1.396
HAS-2				
0.01	0.8732	0.9961	0.0039	1.391
0.02	0.8746	0.9923	0.0077	1.392
0.04	0.8769	0.9846	0.0154	1.393
0.06	0.8801	0.9770	0.0220	1.394
0.08	0.8823	0.9694	0.0306	1.395
0.10	0.8837	0.9618	0.0382	1.396
HAS-3				
0.01	0.8719	0.9963	0.0037	1.391
0.02	0.8731	0.9926	0.0075	1.392
0.04	0.8749	0.9851	0.0149	1.393
0.06	0.8776	0.9778	0.0222	1.394
0.08	0.8805	0.9705	0.0295	1.395
0.10	0.8809	0.9631	0.0369	1.396
HAS-4				
0.01	0.8721	0.9960	0.0040	1.386
0.02	0.8728	0.9919	0.0081	1.387
0.04	0.8750	0.9839	0.0161	1.390
0.06	0.8784	0.9759	0.0241	1.391
0.08	0.8804	0.9679	0.0321	1.392
0.10	0.8849	0.9601	0.0399	1.397
HAS-5				
0.01	0.8714	0.9961	0.0039	1.388
0.02	0.8733	0.9922	0.0078	1.389
0.04	0.8755	0.9844	0.0156	1.390
0.06	0.8782	0.9767	0.0233	1.392
0.08	0.8808	0.9690	0.0310	1.394
0.10	0.8830	0.9951	0.0049	1.396

Continue.....

.....Continue

Conc. (M)	r_{12}	g_1	g_2	n
		HAS-6		
0.01	0.8714	0.9960	0.0040	1.388
0.02	0.8734	0.9920	0.0080	1.389
0.04	0.8769	0.9840	0.0180	1.391
0.06	0.8803	0.9761	0.0239	1.392
0.08	0.8825	0.9683	0.0317	1.394
0.10	0.8850	0.9604	0.0396	1.395
		HAS-7		
0.01	0.8735	0.9960	0.0040	1.385
0.02	0.8738	0.9919	0.0081	1.386
0.04	0.8767	0.9839	0.0161	1.387
0.06	0.8767	0.9759	0.0241	1.389
0.08	0.8790	0.9679	0.0321	1.394
0.10	0.8810	0.9600	0.0400	1.395
		HAS-8		
0.01	0.8708	0.9961	0.0039	1.387
0.02	0.8721	0.9922	0.0078	1.388
0.04	0.8742	0.9844	0.0156	1.389
0.06	0.8765	0.9767	0.0233	1.390
0.08	0.8779	0.9689	0.0311	1.392
0.10	0.8817	0.9613	0.0387	1.393
		HAS-9		
0.01	0.8716	0.9963	0.0037	1.388
0.02	0.8727	0.9926	0.0074	1.390
0.04	0.8753	0.9852	0.0148	1.391
0.06	0.8777	0.9779	0.0221	1.392
0.08	0.8788	0.9706	0.0294	1.394
0.10	0.8805	0.9633	0.0367	1.395
		HAS-10		
0.01	0.8717	0.9965	0.0035	1.387
0.02	0.8740	0.9925	0.0075	1.388
0.04	0.8758	0.9860	0.0140	1.390
0.06	0.8773	0.9790	0.0210	1.392
0.08	0.8795	0.9720	0.0280	1.393
0.10	0.8816	0.9651	0.0349	1.394

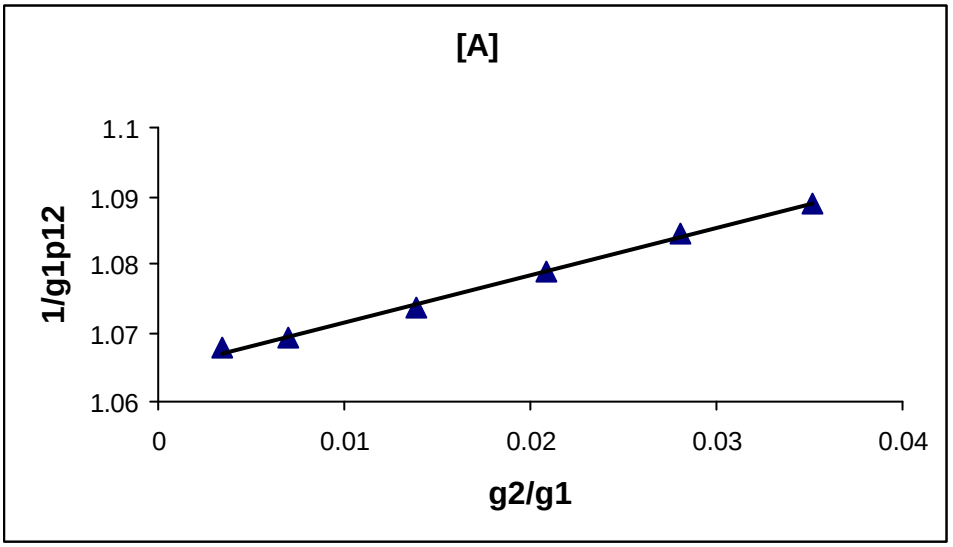
Table 2.3: Experimental and calculated densities of Schiff bases in DMF and THF solutions at 308.15 K.

Compounds	Density calculated from slope of Fig. 2.1 in two Solvents		Density gm/cm^2 Calculated from eq^n. 2
	DMF	THF	
HAS-1	1.4815	1.4999	1.2104
HAS-2	1.4166	1.3421	1.2571
HAS-3	1.1730	1.3399	1.3046
HAS-4	1.2500	1.2812	1.3367
HAS-5	1.3959	1.4318	1.3149
HAS-6	1.3793	1.3669	1.3000
HAS-7	1.4999	1.1429	1.3441
HAS-8	1.3704	1.3333	1.3149
HAS-9	1.5294	1.2324	1.2104
HAS-10	1.4783	1.2618	1.2801

Table 2.4: Calculated molar refraction and refractive index of Schiff bases in DMF and THF at 308.15 K.

Compounds	Solvents			
	DMF		THF	
	$(MRD)_2$	n	$(MRD)_2$	n
HAS-1	83.25	1.6810	124	1.9637
HAS-2	119.0	1.9875	140	2.1692
HAS-3	151.0	2.1265	253	2.5809
HAS-4	102.1	1.6360	187	2.6785
HAS-5	111.0	1.8597	119.5	1.9912
HAS-6	90.00	1.6209	166	3.9667
HAS-7	44.00	1.2981	80.5	1.4316
HAS-8	110.4	1.8318	120	1.8997
HAS-9	89.40	1.7796	140.5	2.0973
HAS-10	112.2	2.1100	129.5	2.0843

Figure 2.1: The variation of $1/g_1 r_{12}$ with g_2/g_1 for HAS-1 in [A] DMF and [B] THF at 308.15 K.



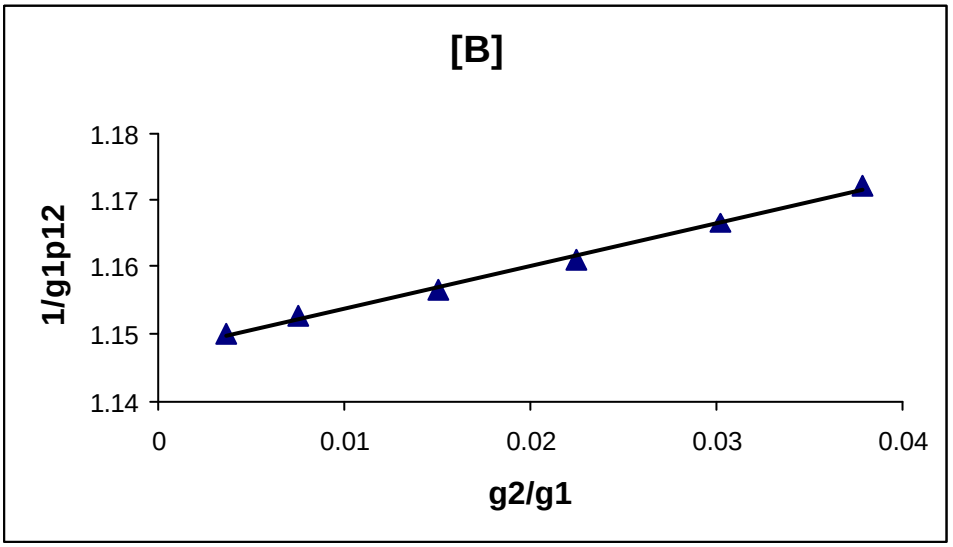
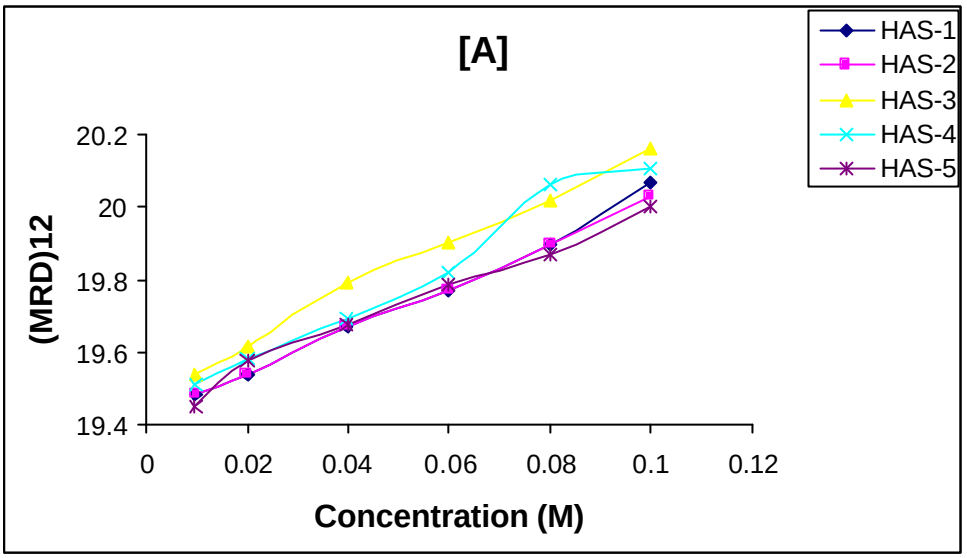


Figure 2.2 **The plots of molar refraction $(MRD)_{12}$ against concentration of Schiff bases in DMF solutions at 308.15 K.**



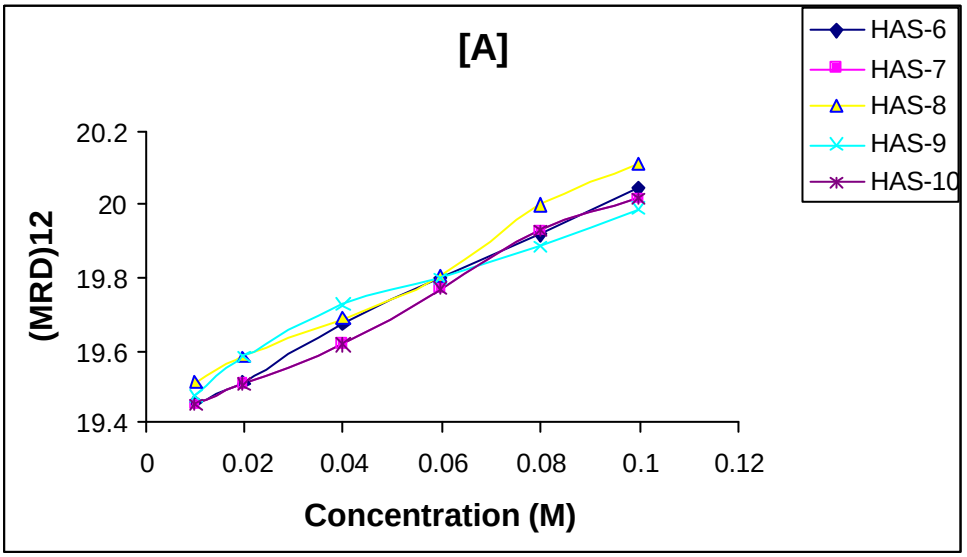
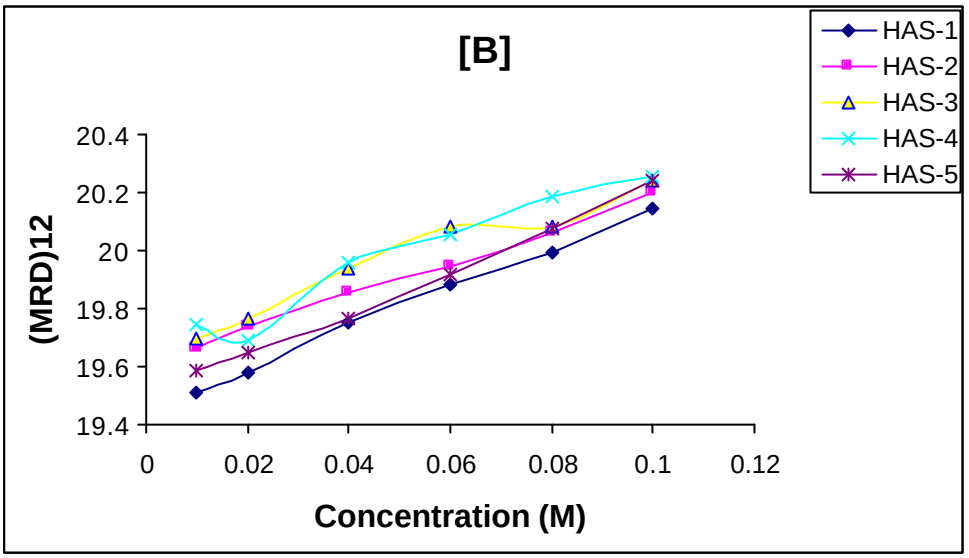


Figure 2.3 The plots of molar refraction $(MRD)_{12}$ against concentration of schiff bases in THF solutions at 308.15 K.



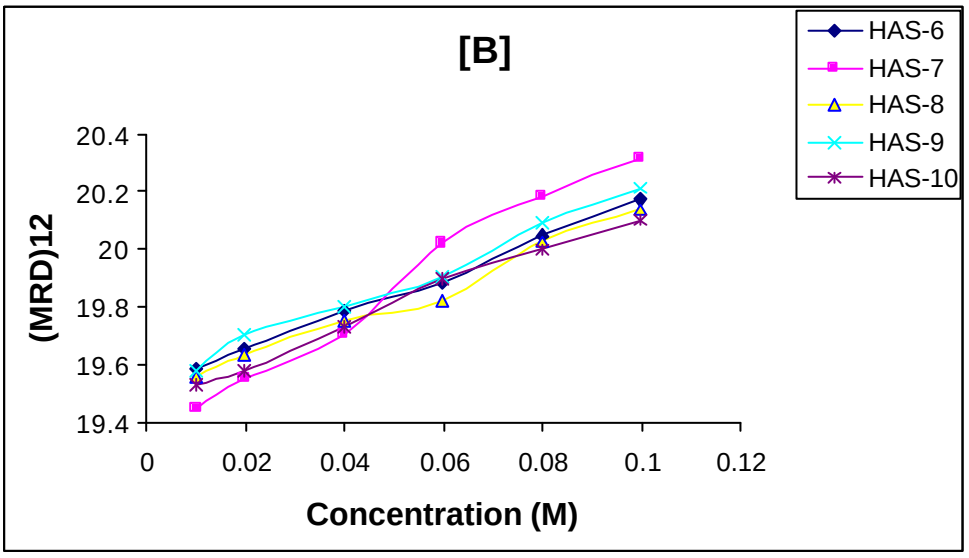
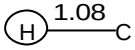
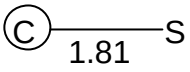
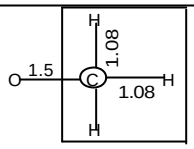
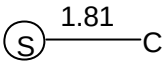
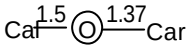
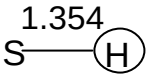
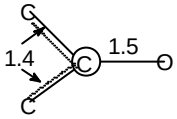
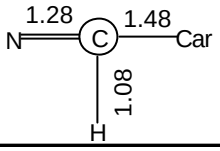
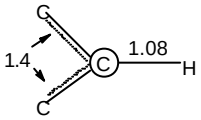
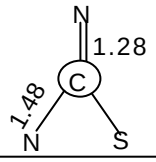
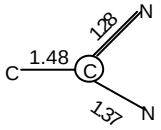
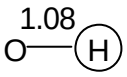
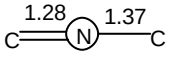
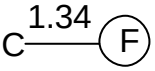
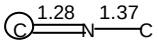
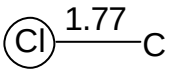
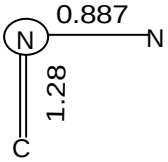
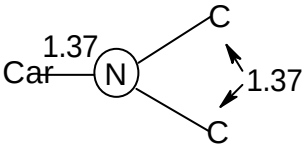


Table 2.5: **Volume increments of some atoms and groups of atoms**

Atom or Atomic group	Volume Increment $(A^o)^3$	Atom or Atomic group	Volume Increment $(A^o)^3$
	1.68		4.6
	26.3		3.92
	2.67		4.8
	10.2		3.61
	14.7		13.46
	8.90		4.7
	5.62		9.2
	7.32		19.35
	5.04		0.9

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INTRODUCTION

Electrical conduction is a property of ionic solutions. From a macroscopic point of view, ionic conduction of solutions is similar to electron or hole conduction through solid objects. In the latter cases electrones are moving without ion cores, while in the former, charges are moving as ions. Although water itself is a very poor conductor of electricity, the presence of ionic species in solution increases the conductance considerably. The conductance of such electrolytic solutions depends on the concentration of the ions and also on the nature of the ions present (through their charges and mobilities). This property is useful for physico-chemical analysis. By conductometry, one can determine the dissociation constants, solubilities and rate of reactions.

This method is also useful to check the purity of water, amount of nitrogen in biological materials etc[1]. An indirect conductometric screening method has been reported for the detection of antibiotic residues in bovine kidneys[2]. Sawai et al. [3] have used this technique to investigate the growth of fungi.

Literature survey shows that conductance of many inorganic and organic compounds have been measured in aqueous [4-16] and non-aqueous solvents[17-20]. However, scanty data is available for Schiff bases[21-30].

Recently, conductances of some Schiff bases in DMF and DMSO have been measured at different temperatures by Grzeszcuk and Bator[31]. Further, in our laboratory, some conductance measurements have been done for Schiff bases [32,33].

In the present work, conductance of Schiff bases are measured in dimethylformamide (DMF) and dimethylsulfoxide (DMSO) solutions at a definite temperature, 308.15 K over a wide range of concentration. The selection of these two solvents (DMF and DMSO) is due to their dipolar aprotic characteristics, which avoid any proton interference with the conductivity of complex systems[34]. The solubility restriction in solvents of different dielectric constants does not allow to study conductance over a wide range of varying dielectric constants. Thus, the measurements could not be done in tetrahydrofuran (THF) and 1,4-dioxan due to poor conductance in these solvents.

EXPERIMENTAL

All the solvents used were distilled prior to use. The solutions of different concentrations were prepared for each Schiff base in DMF and DMSO and the conductance of each solution was measured by using Systronics Conductivity Meter (Model No. 306) having cell constant 0.85 cm^{-1} at 308.15 K. The measured conductance was corrected by subtracting the conductance of pure solvent.

RESULTS AND DISCUSSION

The measured conductance of each solution after correction was used to determine the specific conductance K, which is then used for the calculation of equivalent conductance λ_C. The equations used for calculating specific conductance (K) and equivalent conductance (λ_C) are:

$$K = \kappa.\theta \qquad .....(3.1)$$

$$\lambda_C = 1000K/c \qquad .....(3.2)$$

where κ is the measured conductance, θ is the cell constant and c is the concentration (g.equi/lit) of the solution.

The equivalent conductance of all Schiff bases in DMF and DMSO at 308.15 K, are reported in Tables 3.1 and 3.2 along with measured conductance (C). In DMSO, the relatively low conductivities are due to greater electro relaxation effect owing to the higher permittivity of DMSO, which contributes interionic repulsions to a larger extent [35]. It is observed that for all the systems studied, conductance increases with concentration. The equivalent conductance (λc) is plotted against $\sqrt{c}$ for all Schiff bases and is shown in Figures 3.1 and 3.2 at 308.15 K. It is obvious from Figures that all Schiff bases behave as weak electrolytes. For HAS Schiff bases, the equivalent conductance increases in DMF and DMSO uninterruptedly with decreasing concentration.

Figures 3.1 and 3.2 shows the following order of λ_C in both DMF and DMSO solvents:

In DMF : HAS-1> HAS-2> HAS-3> HAS-5> HAS-10-
>HAS-4> HAS-6> HAS-9 >HAS-8> HAS-7

In DMSO: HAS-9> HAS-7> HAS-6> HAS-3>HAS-10-
> HAS-5> HAS-4> HAS-2>HAS-8> HAS-1

For weak electrolytes, the equivalent conductance at infinite dilution (λ_0) can not be calculated by extrapolation of λ_C verses $\sqrt{c}$ plots. However, we have tried to determine λ_0 values, by extrapolation of the plot of λ_C verses $\sqrt{c}$. These λ_0 values are given in Table 3.3. For weak electrolytes, an alternative procedure can be used to calculate λ_0 values.

In this procedure, λ_0 is related to conductivity by using the equation:

$$\kappa = \kappa_0 + \lambda_0 c + c\,\phi(c) \qquad \text{.....(3.3)}$$

where κ and κ_0 are the electrolytic conductivities of the solutions and solvent respectively. c is the equivalent concentration and the function $\phi(c)$ denotes the effect of interionic interactions. The limiting conductivity (λ_0) can be determined accurately from the slope, $d\kappa k/dc$ of the plot of κk verses c, provided other derivatives ($d\kappa k_0/dc$ and $d[c\phi(c)]/dc$) in the differential form of equation (3.3) are neglected as compared to λ_0, which can be determined from differential form of equation (3.3) is:

$$d\kappa/dc = d\kappa_0/dc + \lambda_0 + d/dc\,[c\phi(c)] \qquad \text{.....(3.4)}$$

However, from the Table 3.3, it is observed that the calculated values are much different than those observed from graphs. This suggests that equation (3.4) can not be used for studied compounds. Further, it is mentioned in chapter 1 and 3 that molecular interactions play an important role in solution properties. So, the derivatives $d[c\phi(c)]/dc$ which are neglected, should actually be considered.

Thus, for the studied compounds, the above used method is not applicable at all.

Table 3.1: The measured conductance (C) and equivalent conductance (l_c) of Schiff bases in DMF at 308.15 K.

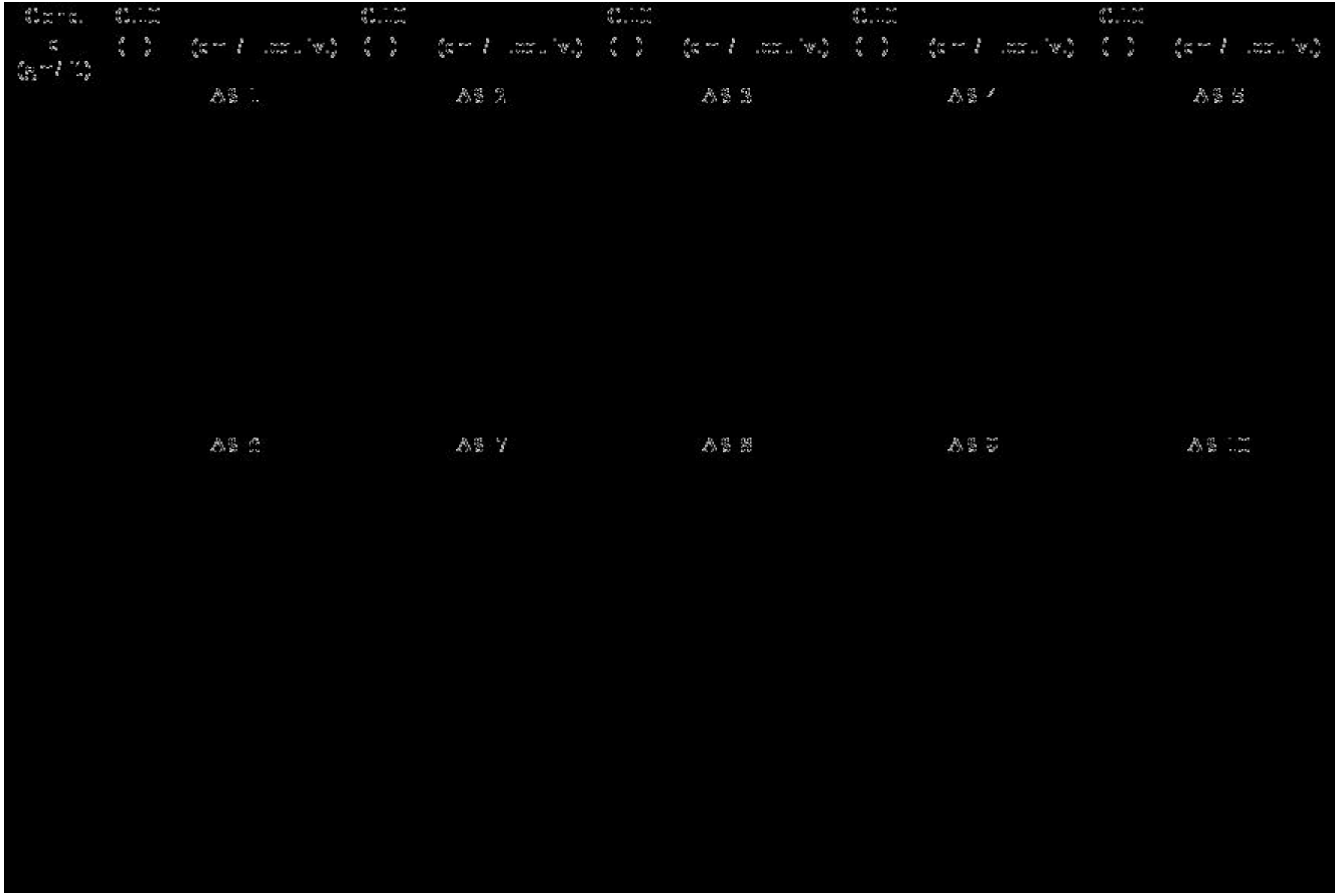
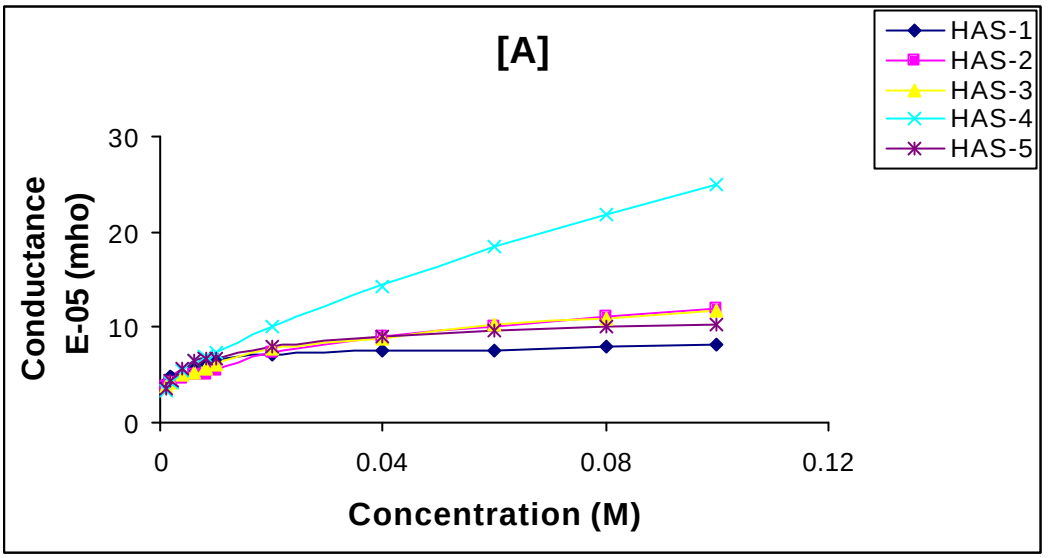


Figure 3.1: The variation of conductance (C) with concentration for Schiff bases in [A] DMF and [B] DMSO at 308.15 K.



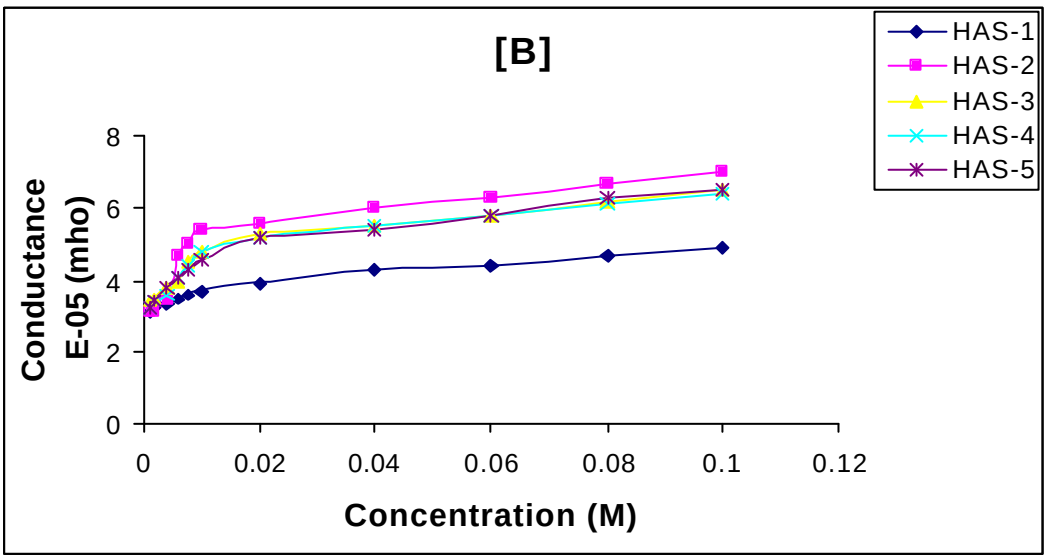
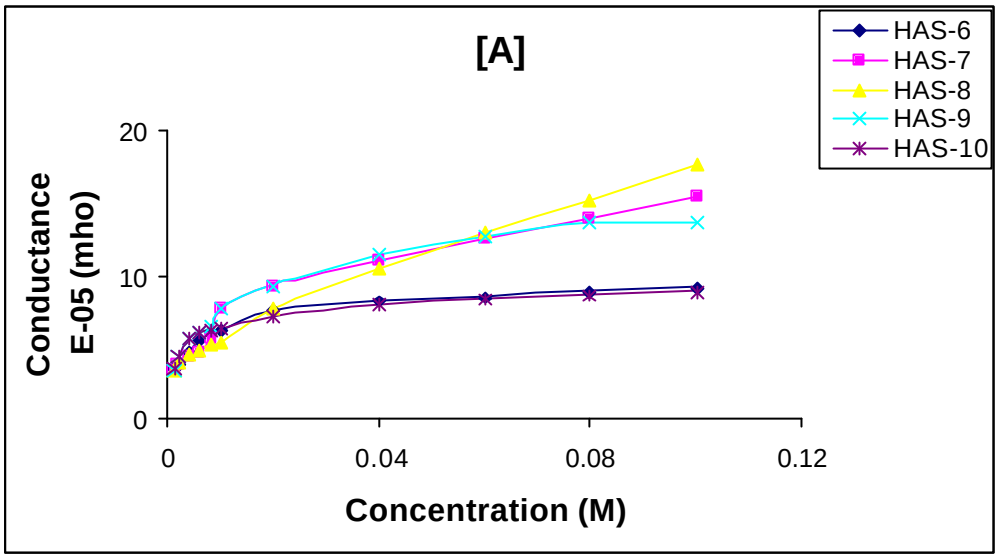


Figure 3.2: The variation of conductance (C) with concentration for Schiff bases in [A] DMF and [B] DMSO at 308.15 K.



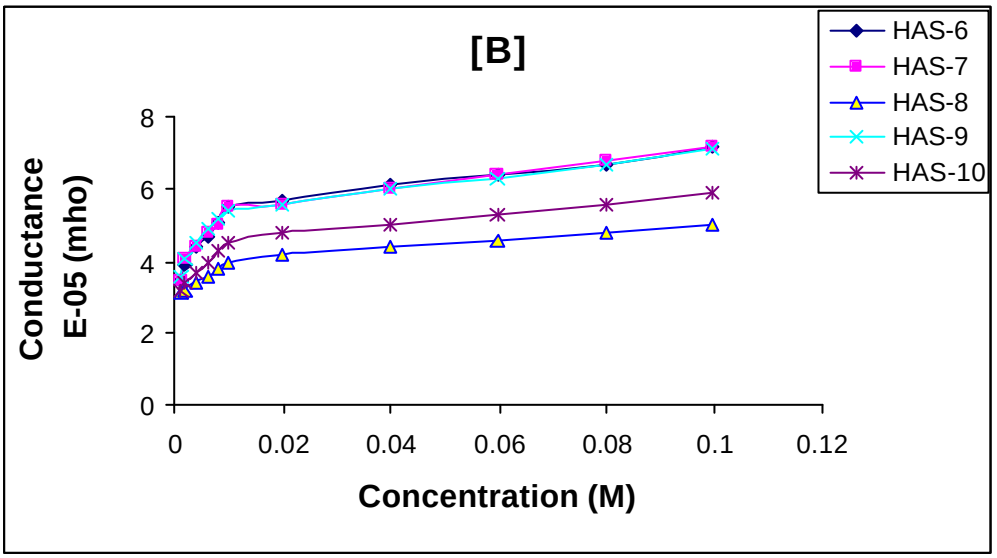
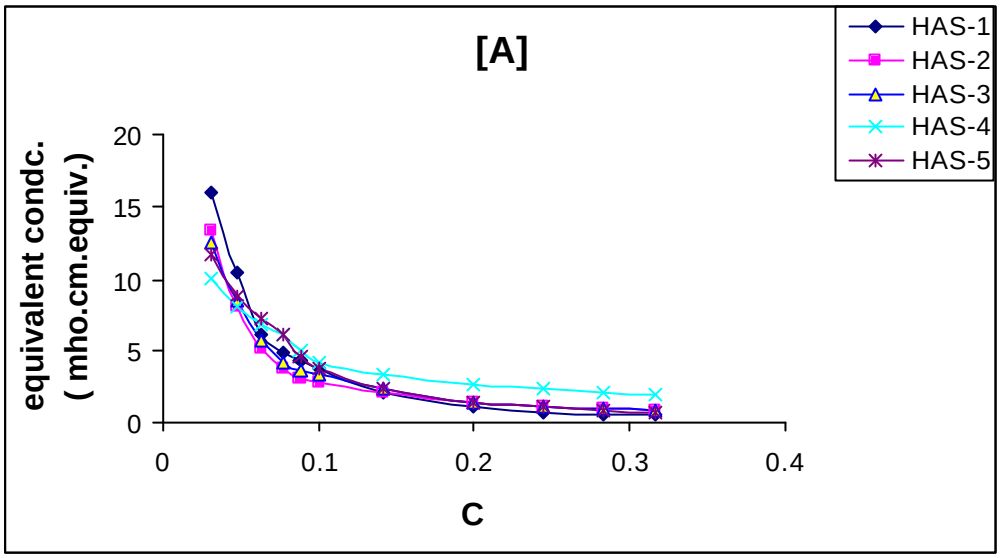


Figure 3.3: **The variation of equivalent conductance (λ_c) with √C for Schiff bases in [A] DMF and [B] DMSO at 308.15 K.**



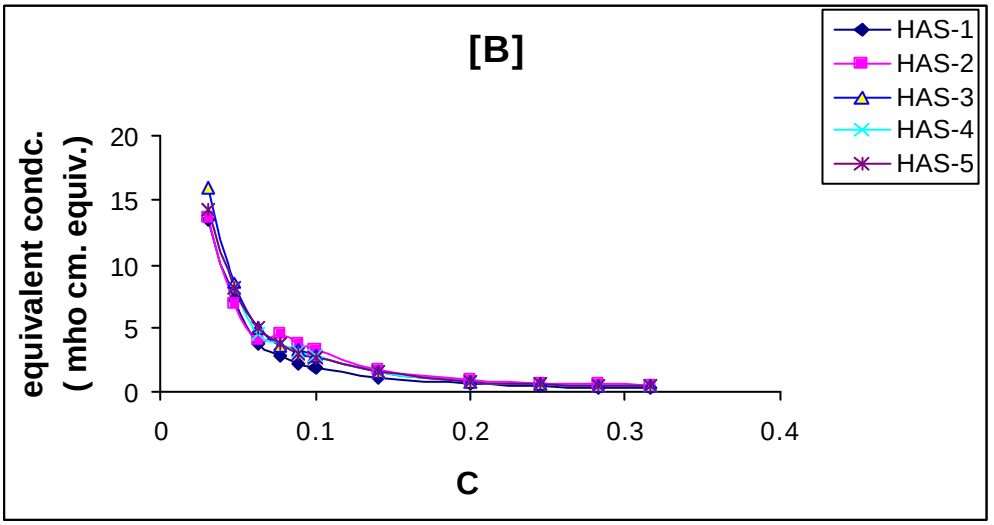
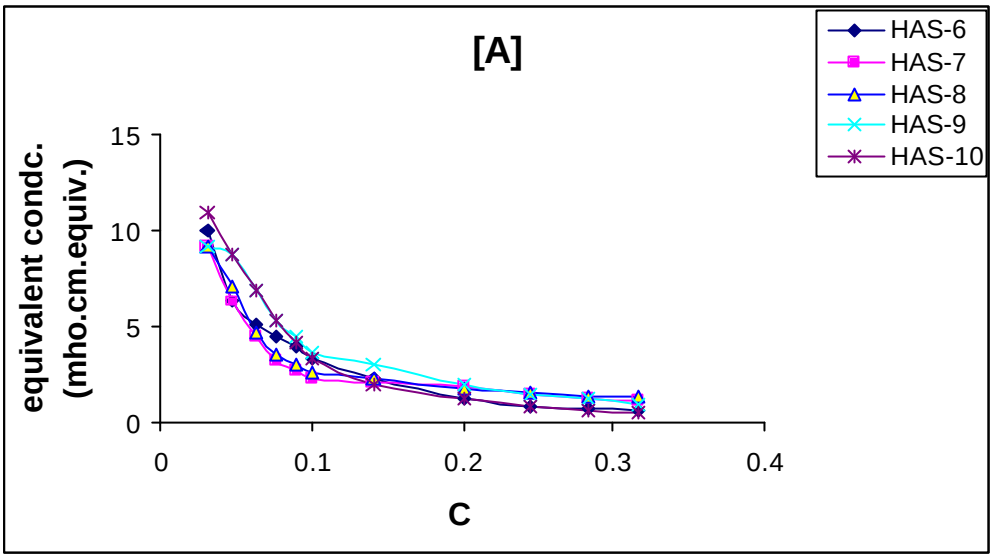


Figure 3.4: **The variation of equivalent conductance (λ_c) with √C for Schiff bases in [A] DMF and [B] DMSO at 308.15 K.**



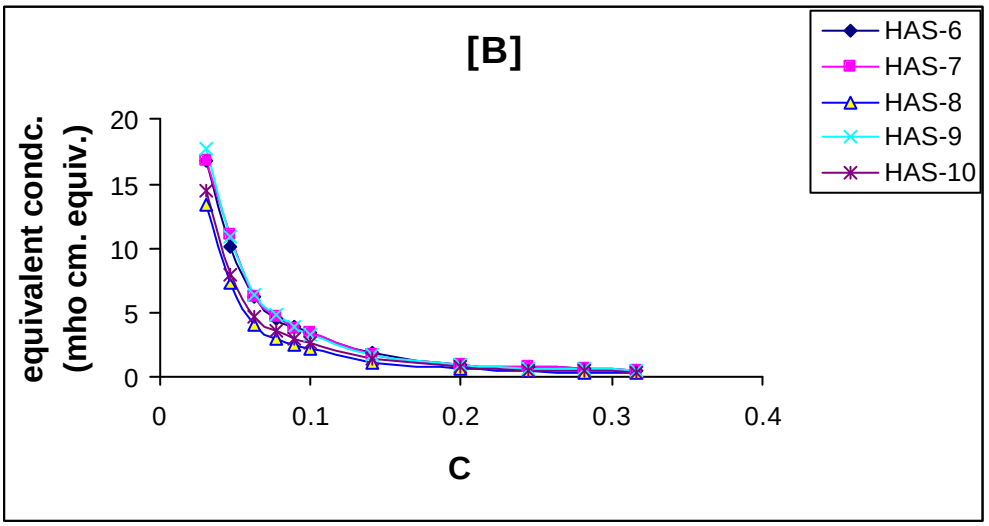


Table 3.3. The limiting equivalent conductance (λ_0) of all the Schiff bases in DMF and DMSO at 308.15 K.

Compound code	λ_0 $cm^2/\Omega.equiv.$ calc. by eq. (5.3)	λ_0 $cm^2/\Omega equiv.$	λ_0 $cm^2/\Omega.equiv.$ calc. by eq. (5.3)	λ_0 $cm^2/\Omega equiv.$
	DMF		DMSO	
HAS-1	0.2792	3.9	0.0584	3.5
HAS-2	0.1800	5.0	0.1434	5.0
HAS-3	0.2507	5.5	0.1599	5.5
HAS-4	0.4326	6.2	0.1799	7.0
HAS-1	0.3510	7.0	0.1545	6.0
HAS-2	0.3197	6.6	0.2105	6.3
HAS-3	0.3880	4.0	0.2023	3.4
HAS-4	0.2096	4.6	0.0968	3.9
HAS-9	0.4288	6.2	0.1933	5.5
HAS-10	0.2899	5.8	0.1455	6.1

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INTRODUCTION

Today, an impressive array of powerful, elegant ant automated tools is available with physical and material scientists for obtaining qualitative and quantitative information about the composition, structure and characteristics of materials. Among the several instruments and techniques, thermal analysis and calorimetry has grown rapidly in recent years. This increasing importance is due to the advancement of thermal analysis technology, relative cheapness of the equipment and time required to achieve the desired results. In general, it is assumed that X-ray analysis is the most important tool for evaluation of minerals, rocks; soils, clays etc., but at the same time, thermal analysis also provide very valuable and useful information.

Thermal analysis includes a group of techniques in which specific physical properties of a material are measured as a function of time or temperature. Requirement for a more precise characterization of substances have increased the demand for thermal analysis techniques. Thermal analysis have used to determine the physical and chemical properties of polymers, electronic circuit boards, geological materials and coals[1-3]. The well facilated instrument can measure transition temperatures, weight losses, energies of transition, dimensional changes, modulus changes and viscoelectric properties. Both quantitative and qualitative analysis can be carried out and one can identify and characterize the samples by qualitative investigations of their thermal behaviors. Current areas of applications include environmental measurements, composition analysis, product reliability, stability, chemical reactions and dynamic properties. Further, various reversible and non-reversible reactions[4,5], the decomposition of a compound at defined conditions, the decomposition of molecules adsorbed on a surface, phase transitions etc. can also be studied.

Literature survey shows that several investigations have been carried out on the application of thermal methods in pharmaceutical industry[6-15]. Wendlandt and Collins[16] used DTA and TG techniques for the characterization and identification of commercial non prescription analgesics. Vaddin et al[17] have studied thermal transition of muscle protein present in fish and shell fish meat by using DSC. Starterant[18] have

reported the biological application of DSC. A number of investigators have studied the physical and chemical properties of various inorganic, organic and polymeric materials[19-36] by using thermal methods. Kinetic study of thermal decomposition of various metal complexes have also been reported by several workers[37-46].

For the study of these thermal behaviour of materials, various techniques such as : Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA), Thermo gravimetric Analysis (TGA), Evolved Gas Detection (EGD), Evolved Gas Analysis (EGA) etc. have been used.

Differential Scanning Calorimetry (DSC):

Differential Scanning Calorimetry (DSC) has become the most widely used thermal analysis technique. The difference in temperature between the samples and a thermally inert reference material is measured as a function of temperature. Reaction kinetic, purity analysis and polymer cures are the typical applications of DSC. Further, DSC provides useful information about crystallinity, stability of crystallites, glass transition temperature, kinetics parameters etc.

Differential Thermal Analysis (DTA):

Differential Thermal Analysis (DTA) is one of the simplest and oldest thermal techniques employed to study the physical and chemical transformations in the materials, associated with the energy changes. The technique involves the measurement of temperature difference between the sample and thermally inert reference material when both are heated simultaneously at the predetermined constant heating rate in controlled atmosphere. Phase diagrams and thermal stability are the prime applications of DTA.

Thermo gravimetric Analysis (TGA):

In this technique, the mass change in a sample is recorded continuously as a function of temperature or time when it is subjected to a programmed temperature change in a specified atmosphere. A derivative of therogravimetric curve is useful in resolving the partially overlapping steps in the multisteps reactions involving the formation

of weakly stable intermediates. By TGA, thermal stability and compositional analysis can also be measured.

In this chapter, thermal properties of triazole Schiff bases have been studied using TGA, DTA and DSC techniques.

From TGA curves, various kinetic parameters can be evaluated by several methods. In all these methods, it is assumed that thermal and diffusion barriers are negligible because small quantity of material is used. The shape of any TGA curve depends on the nature of apparatus and the way in which it is used. Further, Arrhenius equation is valid in all these methods.

The kinetic treatments are generally based on the relationship of the type:

$$dC/dt = K f(C) \qquad \text{.....(4.1)}$$

where C is the degree of conversion, t is time and K is rate constant. f(C) is a temperature independent function of C.

The constant K is assumed to have the Arrhenius form:

$$K = A e^{-E/RT} \qquad \text{.....(4.2)}$$

C can also be defined as:

$$C = 1-(W/W_0) \qquad \text{.....(4.3)}$$

where W_0 and W are the initial weight at t=0 and weight at any time t of the material.

Equation (7.3) can be written as:

$$(W/W_0) = (1-C) \qquad \text{.....(4.4)}$$

W/W_0 is known as residual weight fraction.

Thus, the rate of conversion is,

$$dC/dt = - (1/W_0) (dW/dt) \qquad \text{.....(4.5)}$$

For homogeneous kinetics, the conversion is assumed to be of the form:

$$f(C) = (1-C)^n \qquad \text{.....(4.6)}$$

where n is the order of the reaction.

Substituting the values from equation (4.2) and (4.6) in equation (4.1) gives:

$$dC/dt = A\, e^{-E/RT} (1-C)^n$$

or $$dC/dt = (A/\beta)\, e^{-E/RT} (1-C)^n \quad \text{.....(4.7)}$$

where A is the frequency factor, β is the rate of heating and E is the energy of activation.

Various methods for single and multiple heating rates have been reported[13-17]. The methods of single heating rate are as follows:

1. Freeman-Carroll [47] and Anderson-Freeman Method [48]:

At a single heating rate, Freeman and Carroll gave the following relation to analysis TGA data :

$$\ln (dC/dt)/\ln (1-C) = n - E/R\, [(1/T/(\Delta \ln(1-C)] \quad \text{.....(4.8)}$$

A plot of left hand side against (1/T)/(Δln(1-C)) gives a straight line with a slope equal to -E/R and the intercept is equal to n.

Anderson and Freeman then derived the following equation by using equation (4.8):

$$(\Delta \ln[dC/dt]) = n\, (\Delta \ln(1-C)) - E/R\, \Delta(1/T) \quad \text{.....(4.9)}$$

The plot of (Δln[dC/dt]) against (Δln(1-C)) for equal intervals of Δ(1/T) gives a straight line with slope equal to n and intercept -E/RΔ(1/T).

2. Sharp-Wentworth method [49]:

To analyse the TGA data for first order kinetics (n=1), Sharp and Wentworth gave the relation:

$$\log [(dC/dt)/(1-C)] = \log (A/\beta) - (E/2.303R).(1/T) \quad \text{.....(4.10)}$$

The plot of log [(dC/dt)/(1-C)] against 1/T would be a straight line with slope equal to - (E/2.303R) and intercept equal to log (A/β).

3. Chatterjee Method[50]:

Based on the weight units, the following relation was developed by Chatterjee:

$$n = [\log(dW/dt)_1 - \log(dW/dt)_2] / (\log W_1 - \log W_2) \quad \text{.....(4.11)}$$

where W_1 and W_2 are the sample weights.

4. Horowitz and Metzger method[51] :

In this method, the value of energy of activation E can be determined from a single TG curve by the relation:

$$\ln [\ln(1-C)^{-1}] = (E/RTs^2)\theta \qquad .....(4.12)$$

where $\theta = T-T_s$. T_s is the temperature at which the rate of decomposition is maximum.The frequency factor A and entropy change ΔS can be determined by the following equations:

$$\ln E - \ln (RT_s^2) = \ln A - \ln\beta - E/RT_s \qquad .....(4.13)$$

$$A = (k_b T / h)\, e^{\Delta S/R} \qquad .....(4.14)$$

where k_b is Boltzmann constant and h is Planck's constant.

EXPERIMENTAL

The Differential Scanning Calorimetry (DSC), Differential thermal analysis (DTA) and Thermo gravimetric analysis (TGA) measurements were made on the instrument "Universal V2.6D TA Instruments at the heating rate of 10°C / min in nitrogen atmosphere for all the triazole Schiff bases.

RESULTS AND DISCUSSION

The TG / DTA and DSC thermograms of Schiff bases are given in Figures 4.1 and 4.10. Various thermal properties such as initial decomposition temperature (IDT), the decomposition temperature range and the maximum degradation along with the percentage weight loss and Exo / Endo transitions of Schiff bases are reported in Table 4.1.

It is observed from the Table 4.1 that the stability of Schiff bases decrease in order: HAS-8> HAS-1> HAS-7> HAS-10> HAS-3>HAS-4> HAS-9> HAS-5>HAS-2>HAS-6. So, HAS-8 is most stable whereas HAS-6 is least stable. All the studied bases have the same central moiety triazole with different side chains. Thus, the presence of different substituent affects thermal stability. It is observed that o-chloro benzaldehyde as side chain (in HAS-8) causes greater stability than N,N-dimethyl benzaldehyde as in HAS-6, which is least stable. In the present case, thermal stability can not be decided by weight loss because for all compounds, degradation is multi step process (Figures 4.1 to 4.10). Each step is of different order. The degradation in complete for HAS-3 whereas HAS-10 is least degradated. Further, the variation in the trend of thermal decomposition might be interpreted to be of account of some intermolecular interactions (structural as well as electronic) and also because of several experimental factors.

The melting temperature of all the triazole Schiff bases observed by DSC and DTA are also compared with those determined by open capillary method. Although there is good agreement between the values calculated by different methods, it was difficult to decide the stability by these values.

The kinetic parameters, such as order of the degradation (n), energy of activation (E), frequency factor (A) and entropy change (ΔS) for each step are reported in Tables 4.2 to 4.4. The Anderson-Freeman plots for HAS-1 for first and third steps are given in Figure 4.11.

It is evident from Tables 4.2 to 4.4 that order of reaction is quite different in different steps for different Schiff bases. For first step, order of reaction varies from 0.2 to 4.33. For second step also, values of n varies from 1.55 to 4.90. However, for the third step, all n values are in the range 1.61 to 1.93.

In first step, energy of activation (E) is maximum for HAS-6 and minimum for HAS-2. The frequency factor (A) also varies in the same order i.e., maximum for HAS-6 and minimum for HAS-2. In second step, energy of activation is not very high and maximum is observed for HAS-1 and minimum for HAS-5. The frequency factor A is also maximum for HAS-1 and minimum for HAS-5. In the third step, for HAS-9, both E and A are maximum and HAS-10, these values are minimum. Comparison of E and A values in Tables 4.2 to 4.4 shows that values of E and A are minimum for second steps of all the Schiff bases.

Further, change in entropy (ΔS^0) for all these reactions were also calculated by equation (4.14). It is observed that for first and third steps, change in entropy are either positive or negative for different Schiff bases but in second step, for all Schiff bases, ΔS^0 values are negative. The positive ΔS^0 indicates that the transition state is in less ordered state. Whereas the negative values for entropy of activation indicate that the activation complex has a more ordered or more rigid structure than the reactants and the reaction is slower than the normal[52].

Thus, the degradation in triazole Schiff bases is multi step process with different order of reaction. Further, thermal stability depends upon the type of substituent present. It is observed that presence of o-chloro (as in HAS-8) increases the stability whereas N,N dimethyl group (as in HAS-6) decreases the stability.

Table 4.1: TGA, DTA and DSC data for the synthesized triazole derivatives

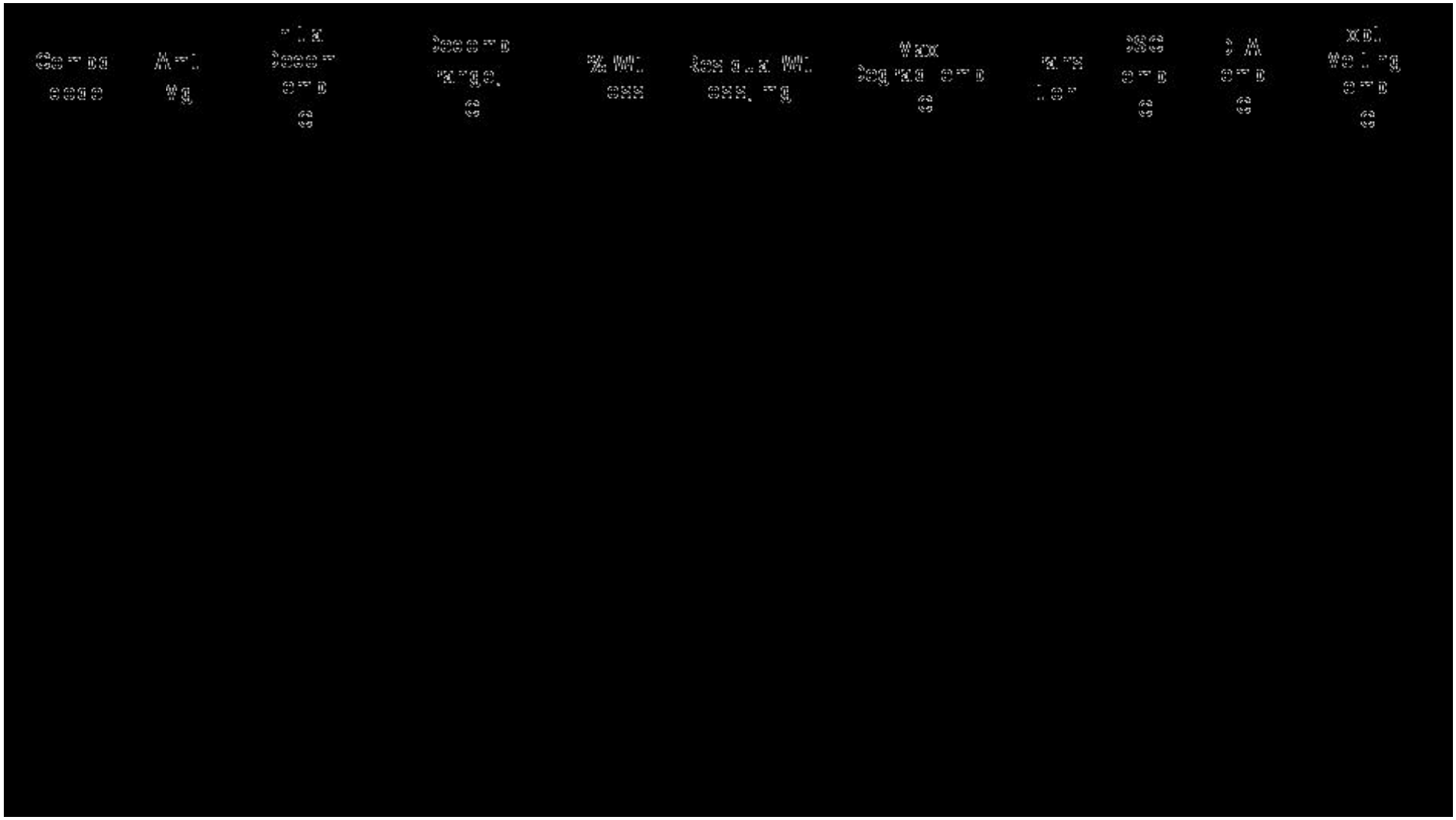


Table 4.2: The kinetic parameters for all the compounds for 1st step.

Comp. code.	n	E, KJ	A sec^{-1}	D**S°, JK^{-1}**	g
HAS-1	0.21	249.79	7.20×10^{20}	148.38	0.9662
HAS-2	4.33	75.68	3.2×10^{5}	-145.52	0.8841
HAS-3	1.63	202.98	6.01×10^{16}	70.30	0.9098
HAS-4	1.80	218.37	1.32×10^{18}	96.01	0.9721
HAS-5	4.29	83.86	1.76×10^{6}	-131.34	0.9425
HAS-6	1.62	271.87	5.95×10^{22}	185.08	0.9725
HAS-7	2.49	112.55	6.59×10^{8}	-82.08	0.9872
HAS-8	2.19	156.90	5.51×10^{12}	-6.99	0.9698
HAS-9	1.56	164.87	2.78×10^{13}	6.43	0.951
HAS-10	1.42	178.60	4.43×10^{14}	29.48	0.9445

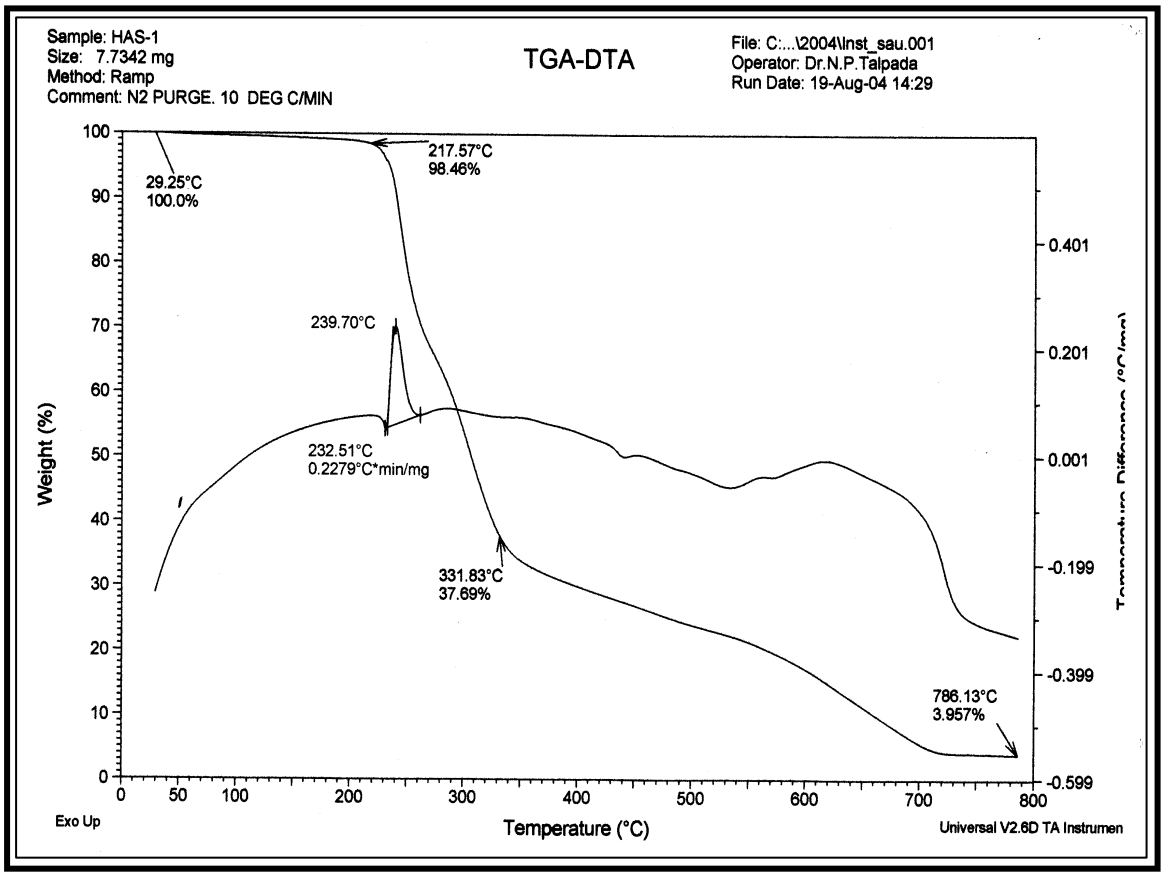
Table 4.3: The kinetic parameters for all the compounds for 2nd step.

Comp. code.	n	E, KJ	A sec^{-1}	D**S°, JK^{-1}**	g
HAS-1	1.55	46.81	36.59	-223.43	0.9855
HAS-2	3.07	14.12	0.09	-273.12	0.9313
HAS-3	3.35	16.70	0.16	-268.57	0.9899
HAS-4	3.88	11.37	0.05	-278.25	0.9977
HAS-5	3.23	10.86	0.04	-279.24	0.9976
HAS-6	4.08	12.43	0.06	-276.21	0.9913
HAS-7	3.85	15.04	0.11	-271.45	0.9892
HAS-8	3.01	12.92	0.07	-275.29	0.9846
HAS-9	4.90	16.85	0.17	-268.32	0.9899
HAS-10	2.10	21.38	0.40	-260.82	0.9869

Table 4.4: The kinetic parameters for all the compounds for 3rd step

Comp. code.	n	E, KJ	A, sec^{-1}	D**S°, JK^{-1}**	g
HAS-1	1.66	103.55	6.69×10^3	-182.22	0.9615
HAS-2	1.61	107.11	1.02×10^4	-178.68	0.9750
HAS-3	1.63	103.96	3.23×10^4	-168.24	0.9384
HAS-4	1.93	79.35	3.28×10^2	-207.30	0.9677
HAS-5	1.71	80.85	3.97×10^2	-205.70	0.9589
HAS-6	1.72	98.26	3.47×10^3	-187.68	0.9843
HAS-7	1.72	98.57	8.20×10^3	-180.02	0.9551
HAS-8	1.62	95.80	2.58×10^3	-190.14	0.9470
HAS-9	1.78	120.74	5.48×10^4	-164.74	0.9889
HAS-10	1.69	35.67	4.30	-241.51	0.9959

Figure 1.1: The TGA/DTA and DSC graphs of HAS-1.



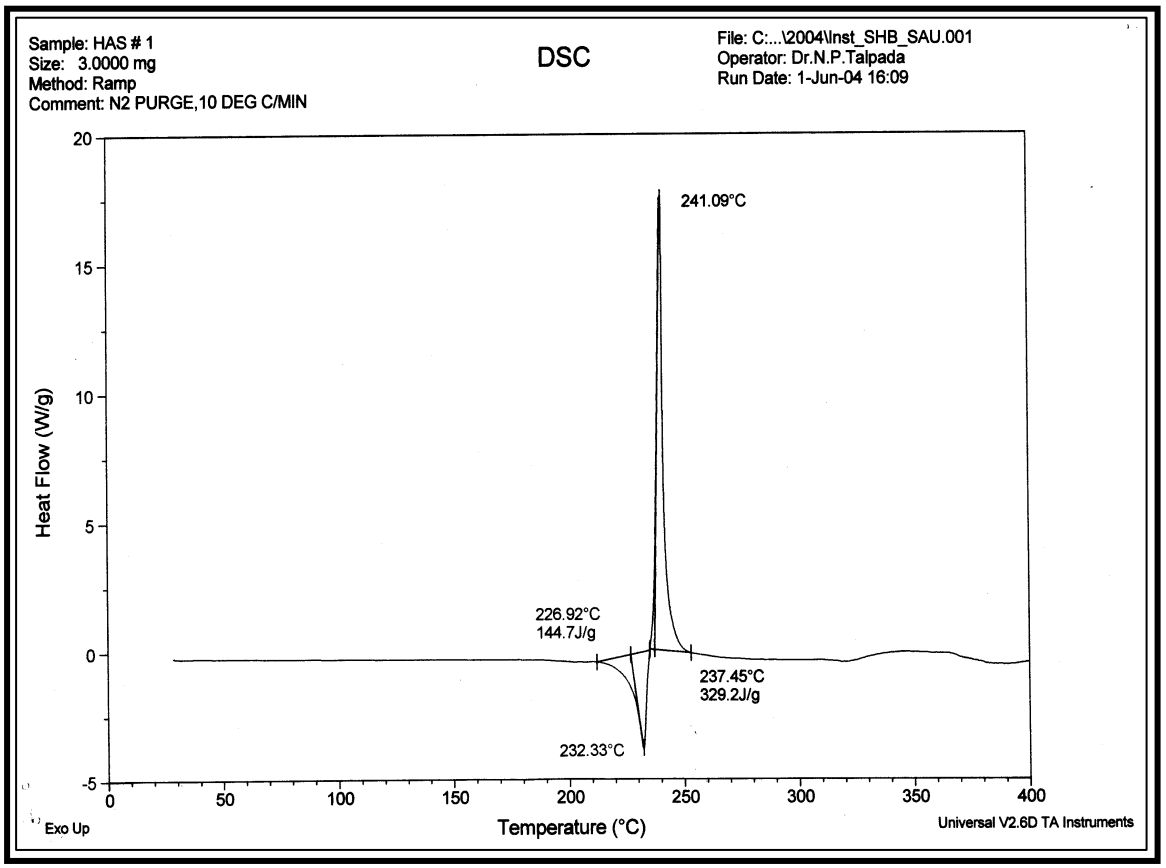
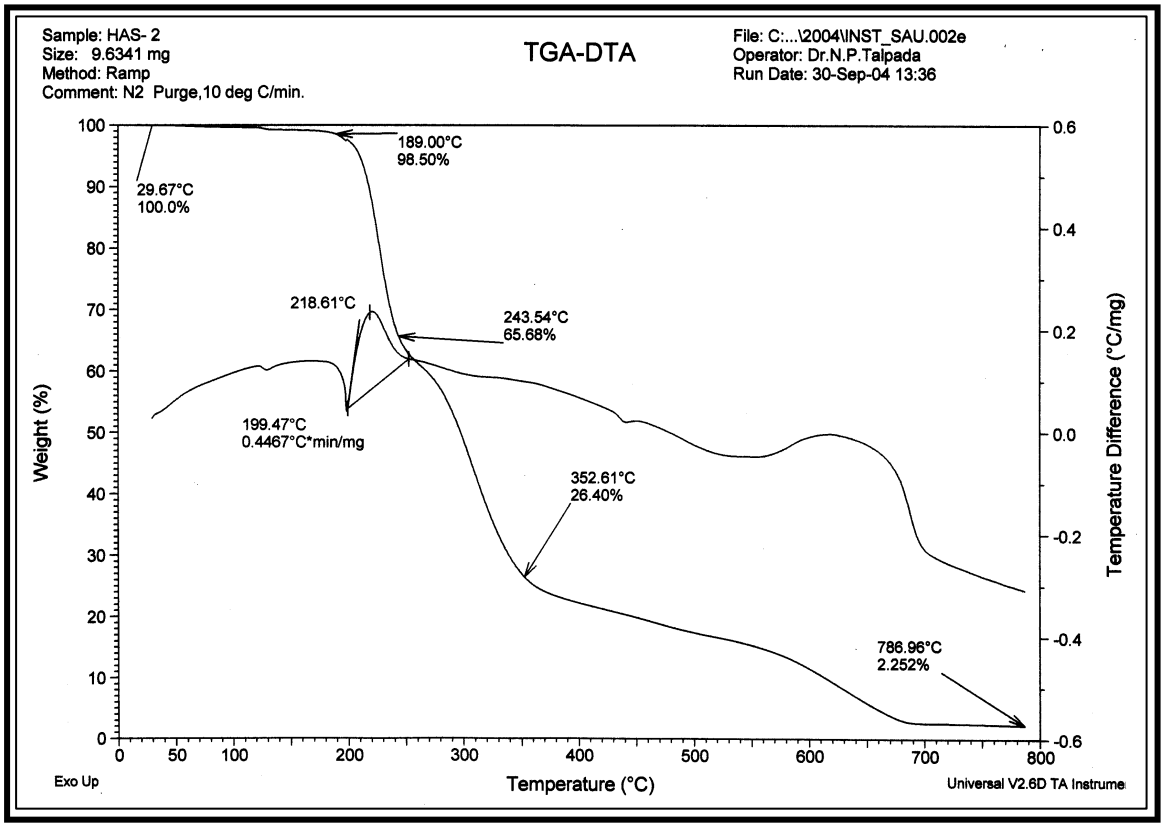


Figure 1.2: The TGA/DTA and DSC graphs of HAS-2.



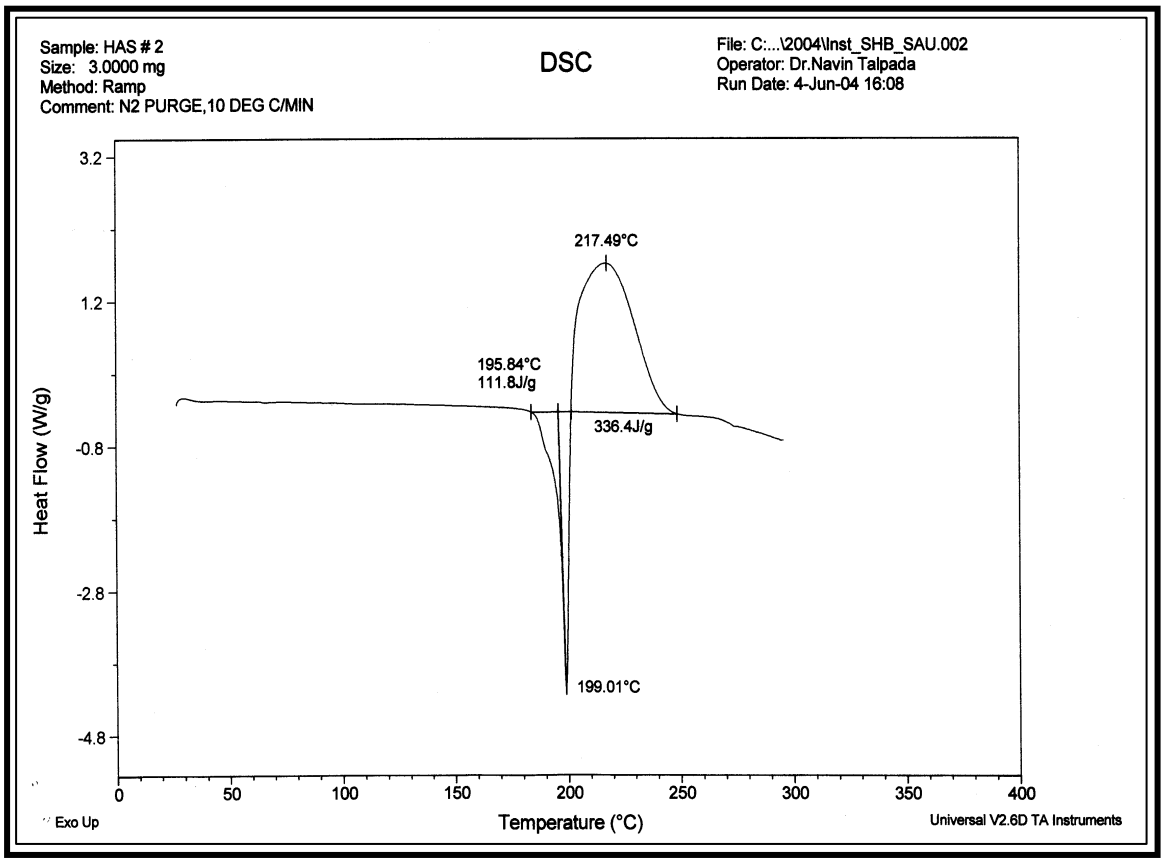
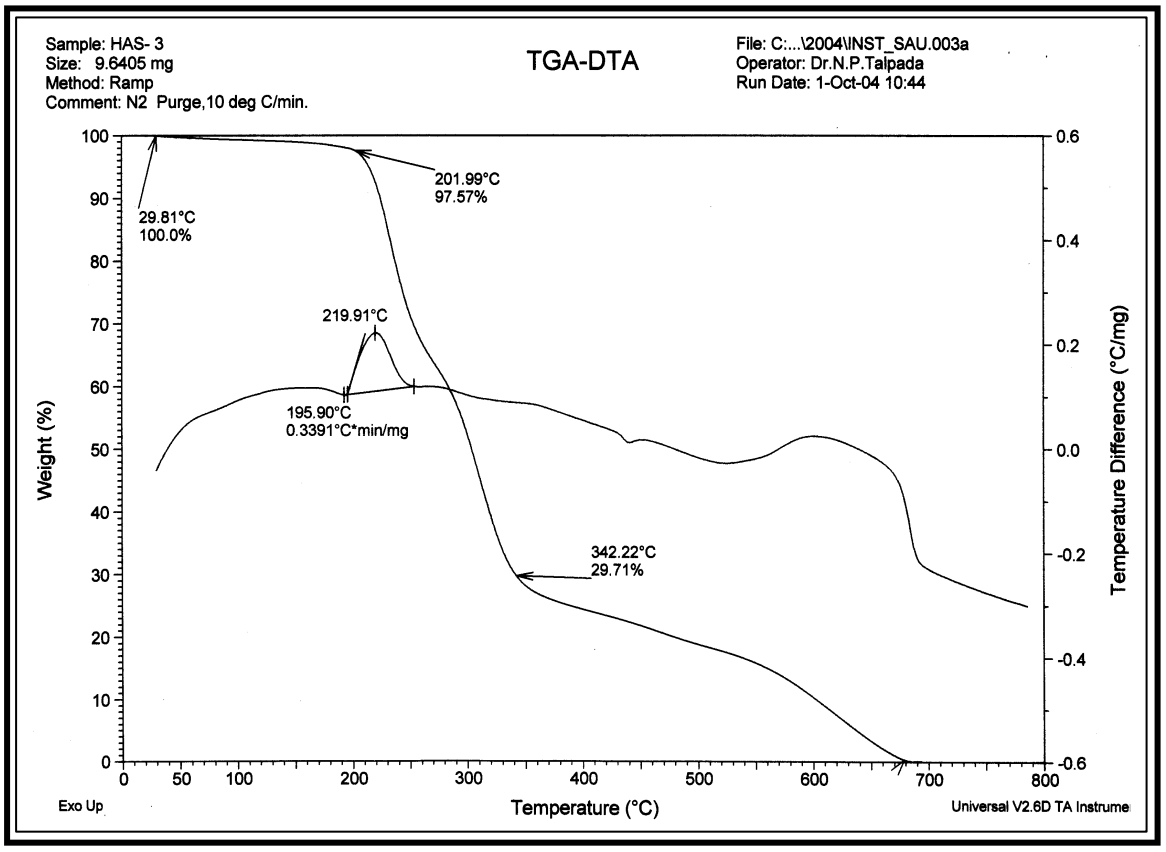


Figure 1.3: The TGA/DTA and DSC graphs of HAS-3.



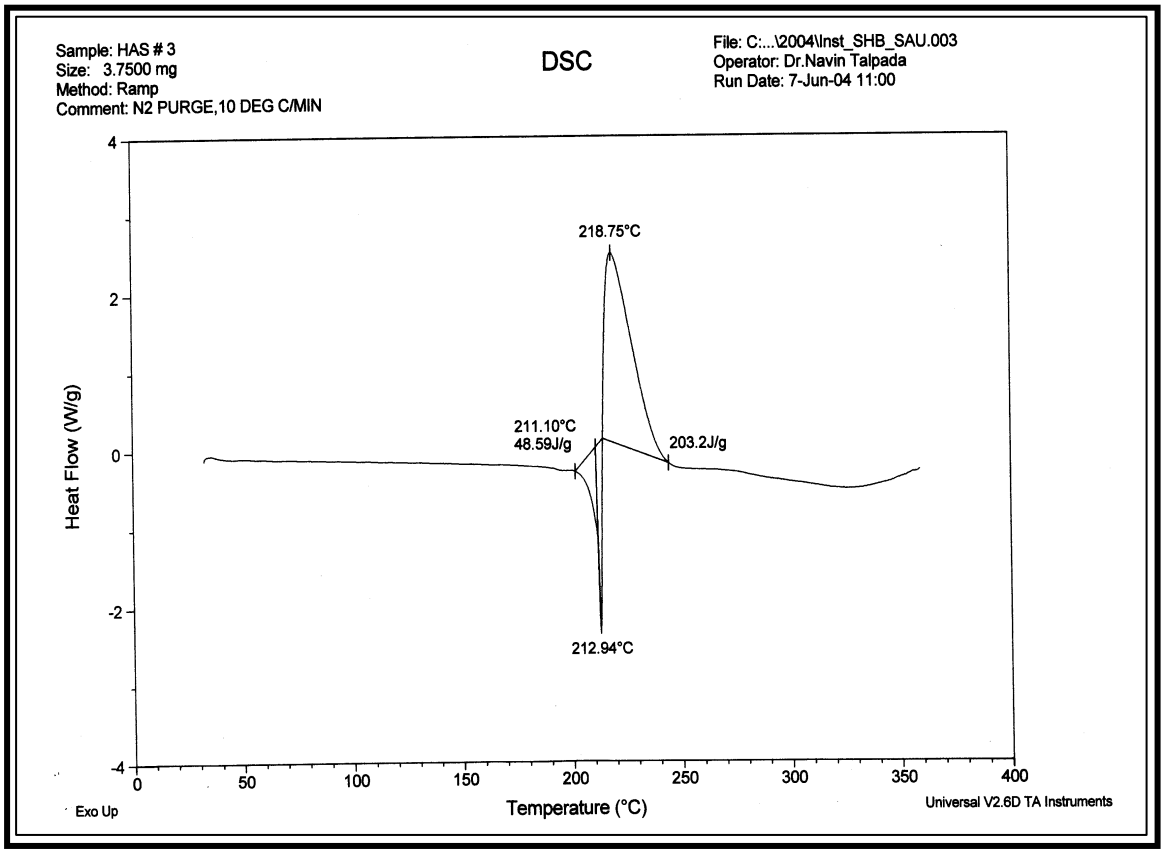
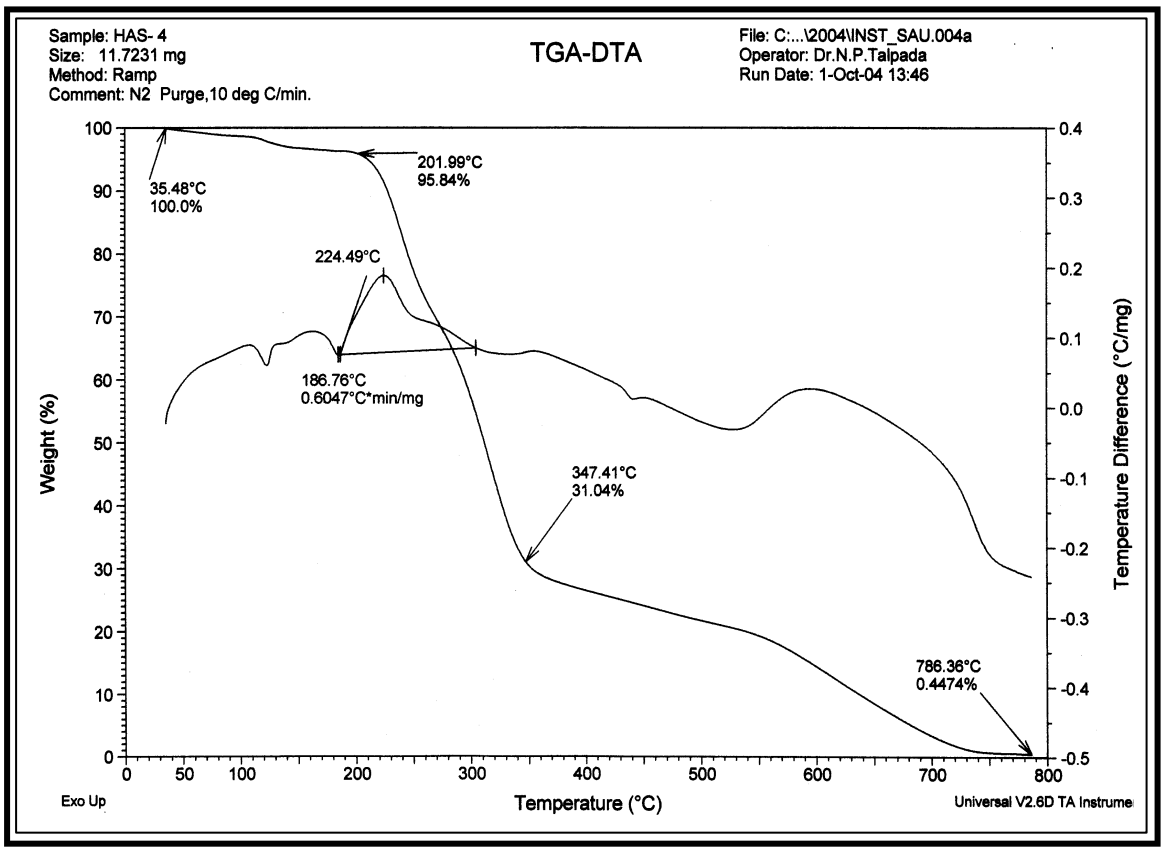


Figure 1.4: The TGA/DTA and DSC graphs of HAS-4.



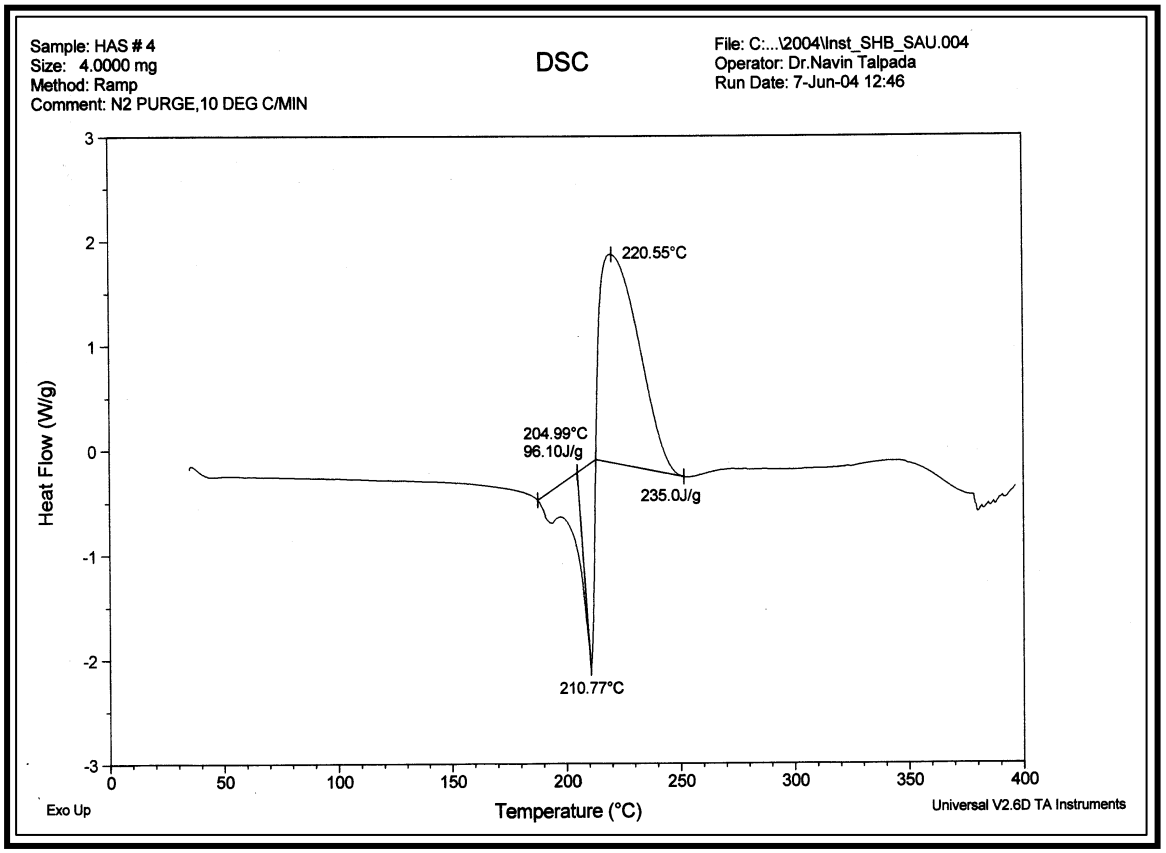
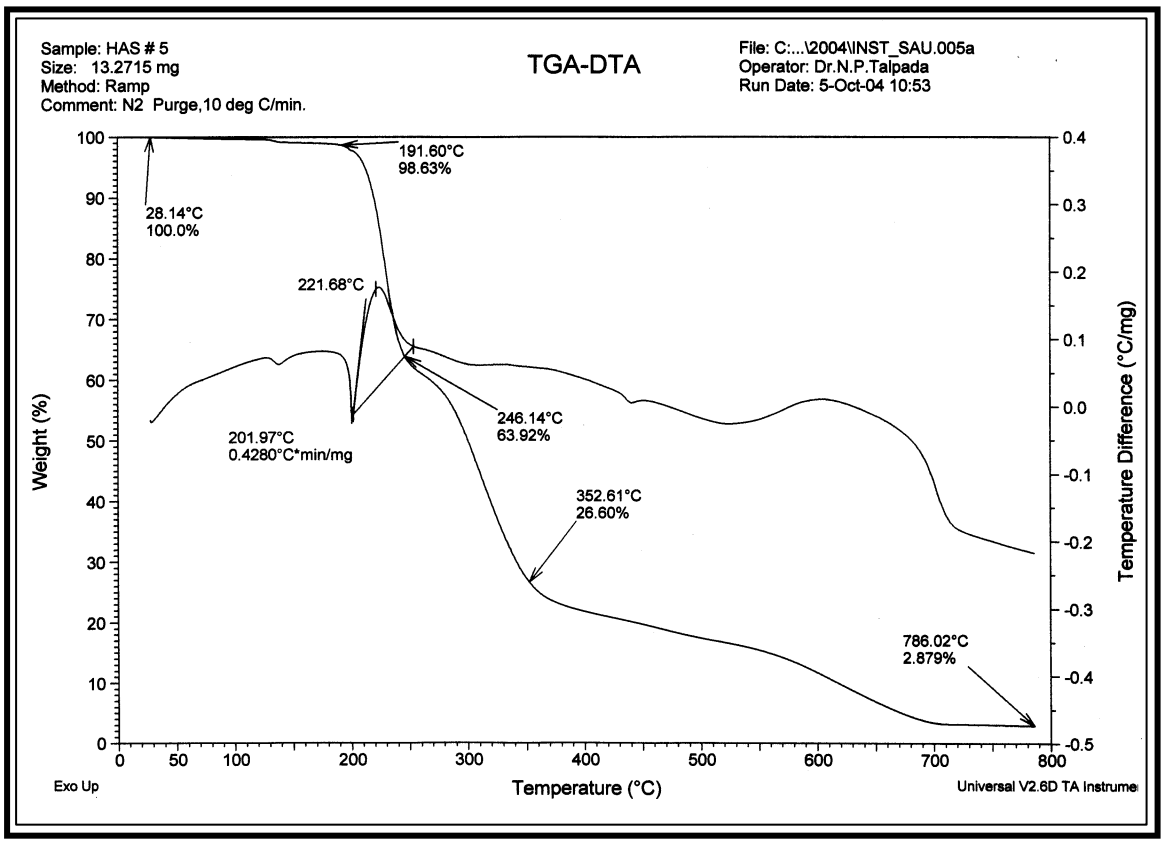


Figure 1.5: The TGA/DTA and DSC graphs of HAS-5.



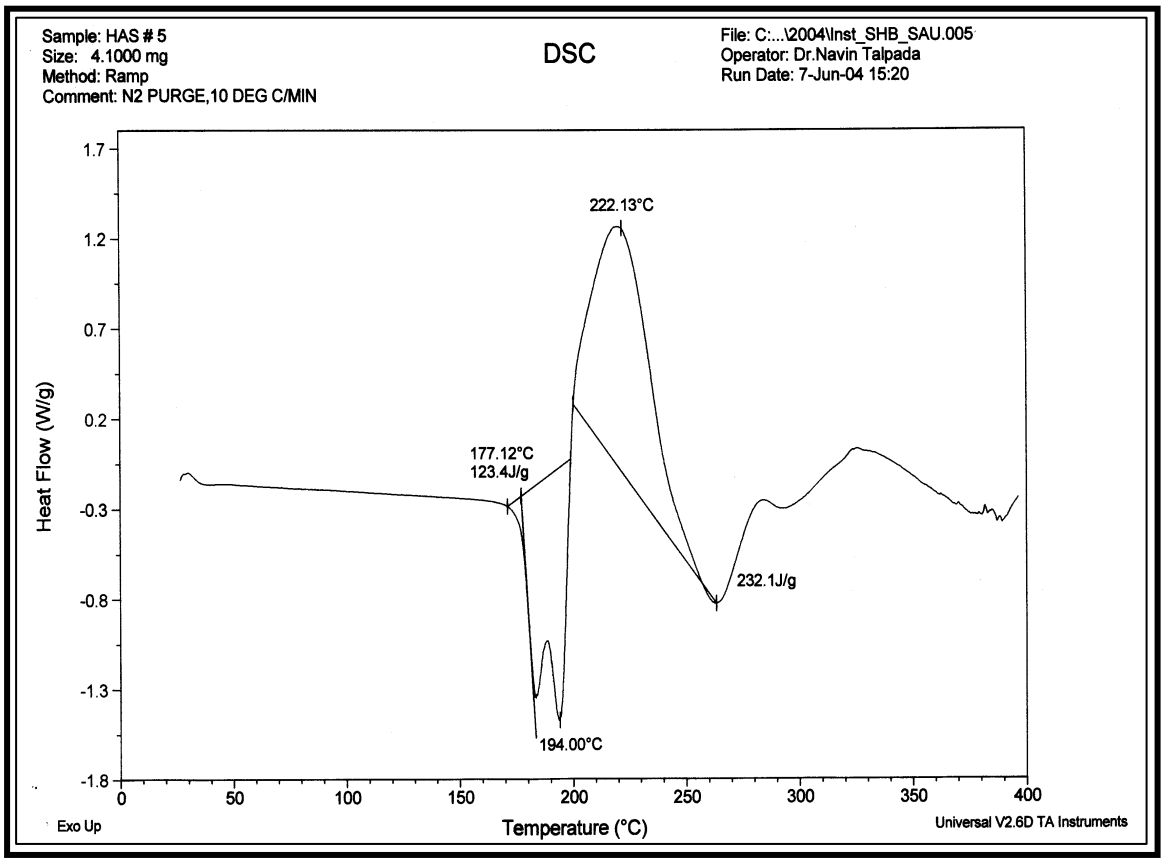
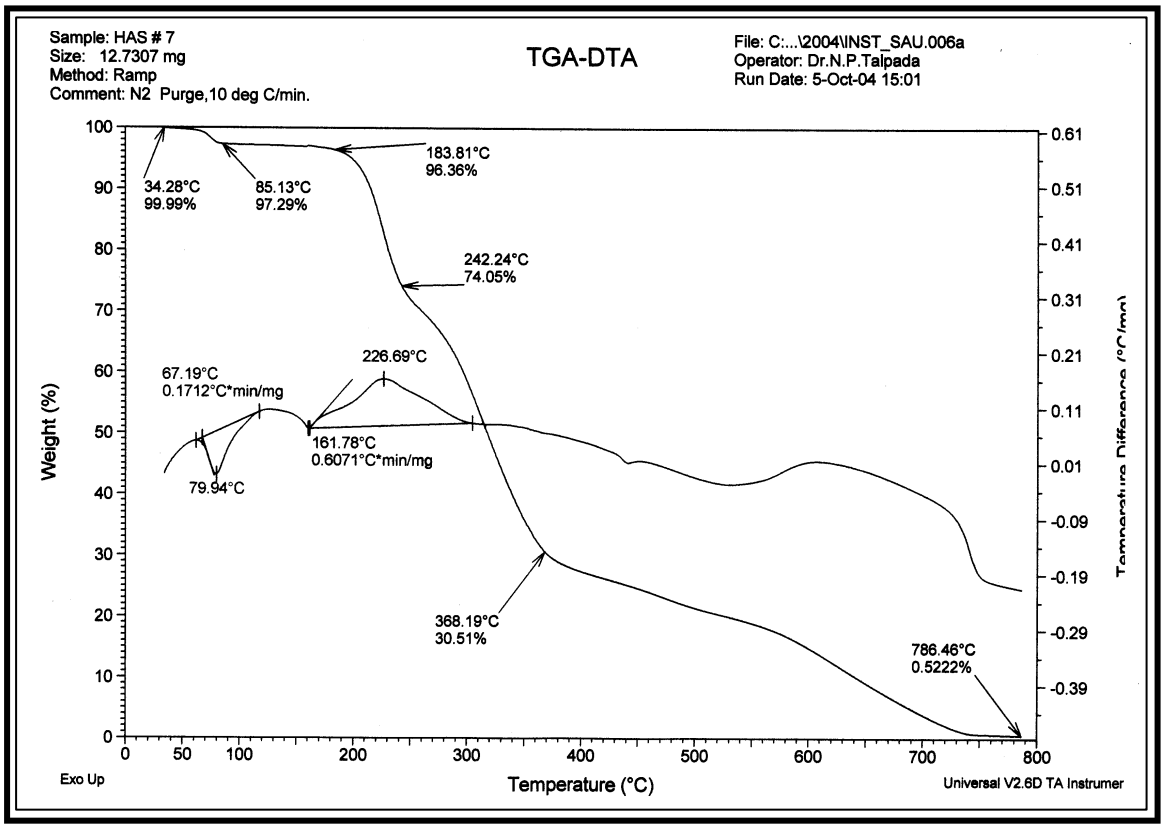


Figure 1.6: The TGA/DTA and DSC graphs of HAS-6.



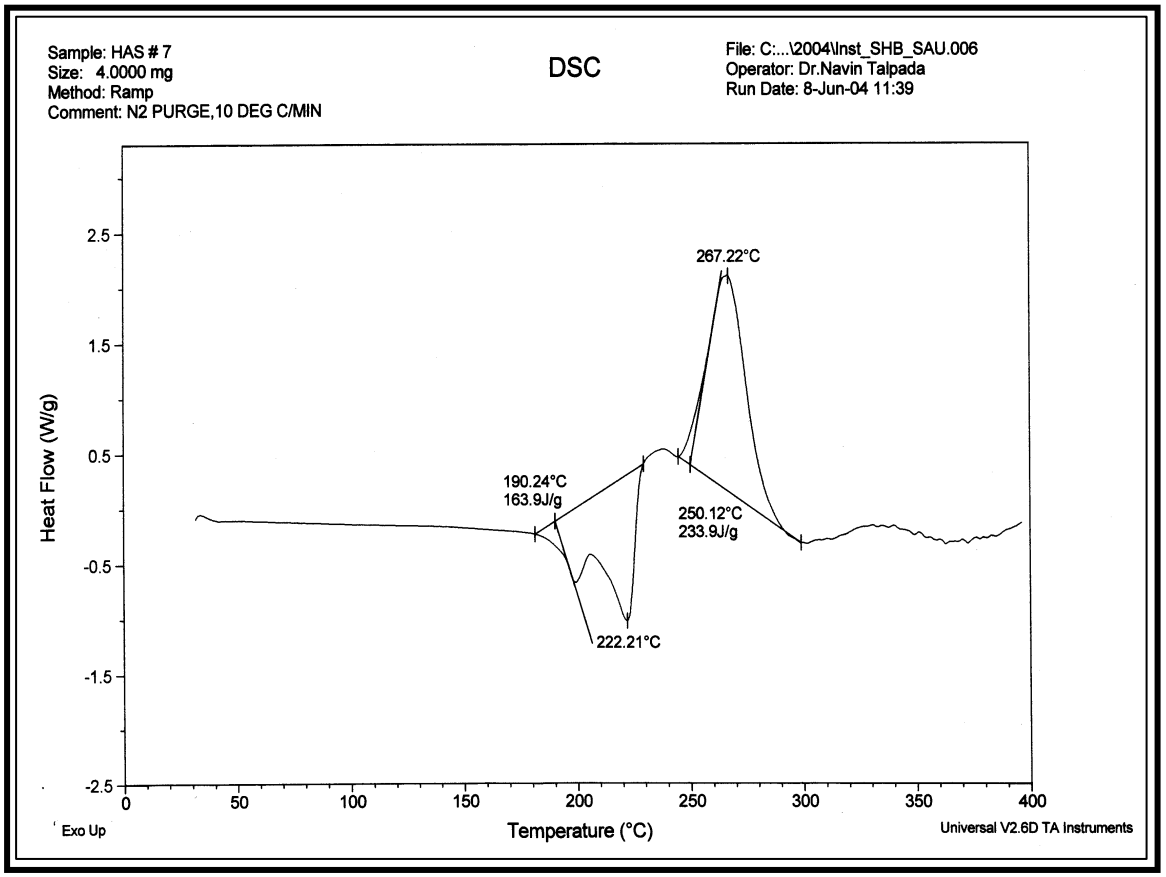
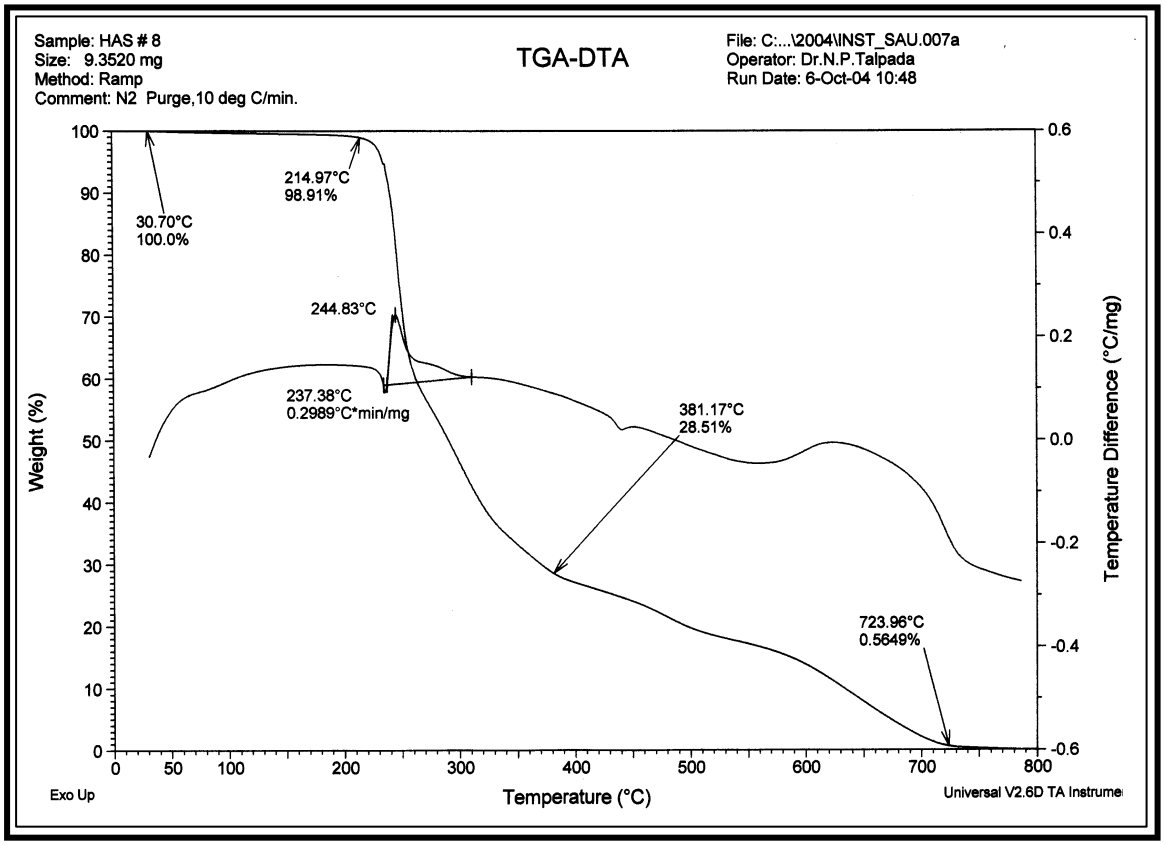


Figure 1.7: The TGA/DTA and DSC graphs of HAS-7.



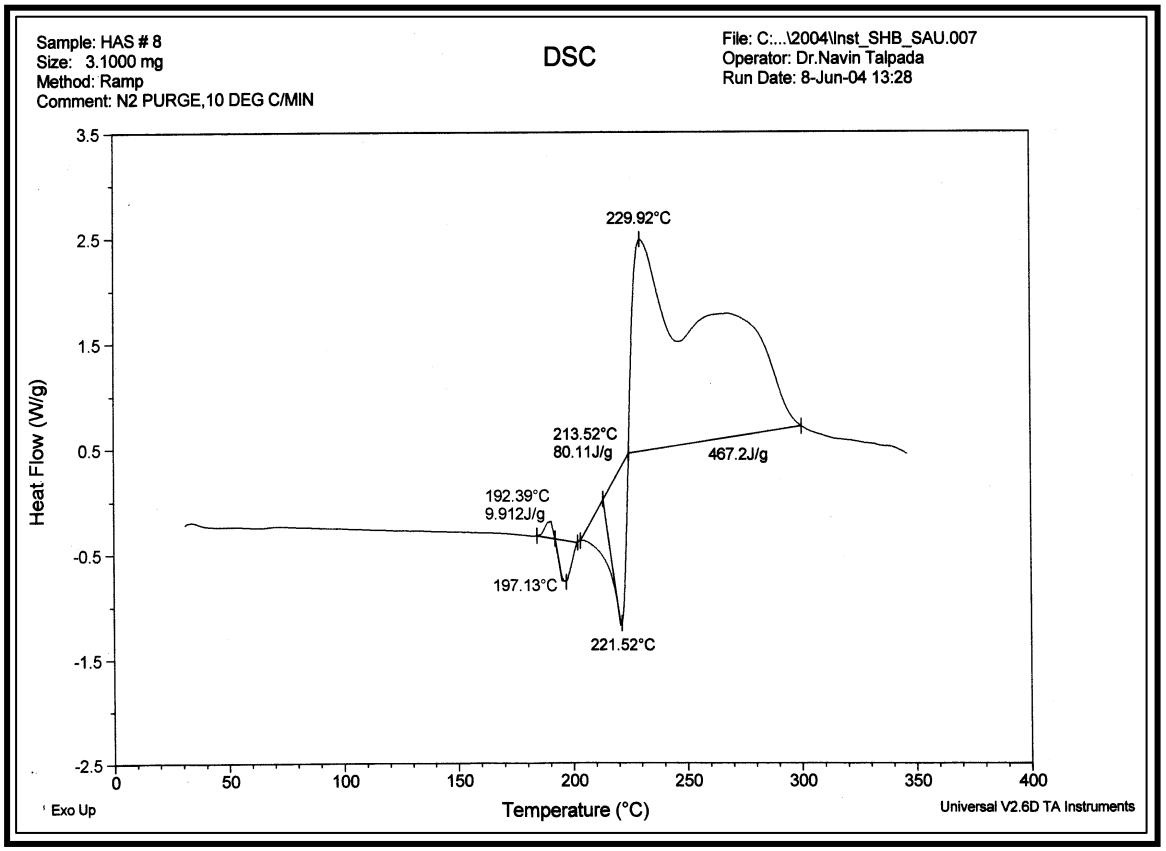
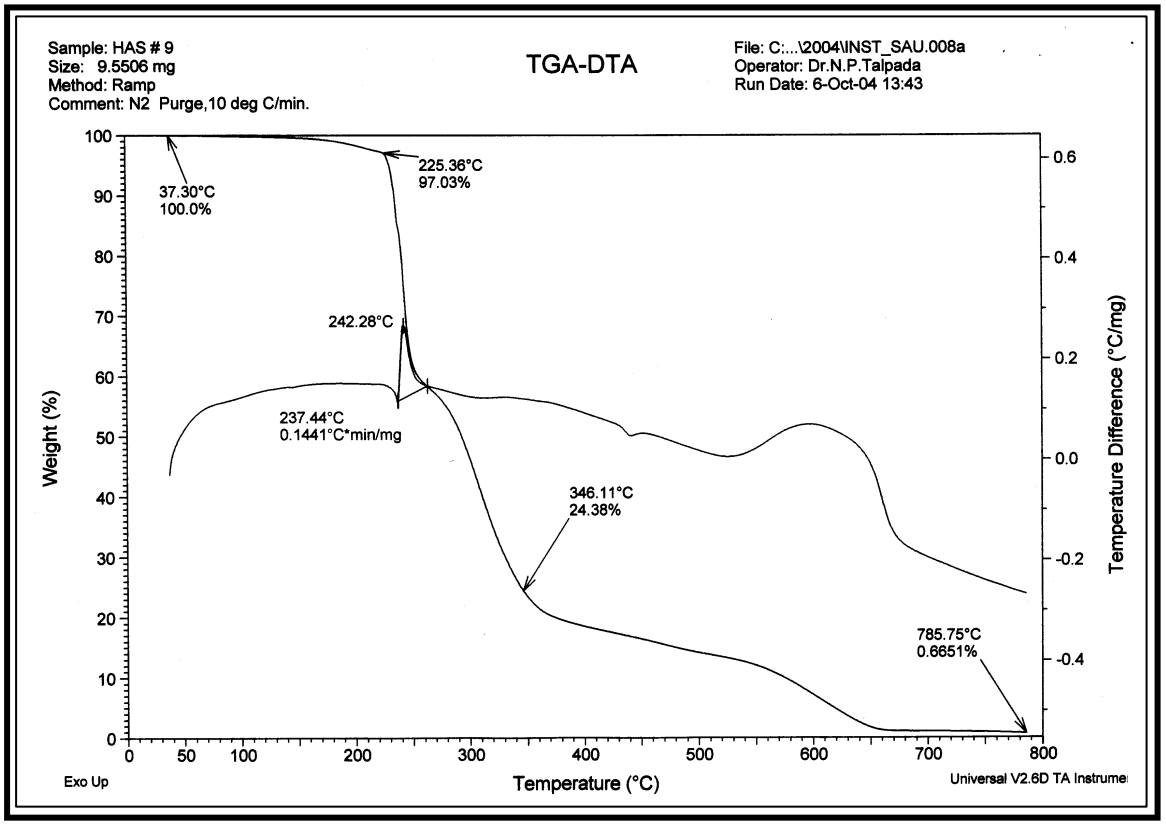


Figure 1. 8: The TGA/DTA and DSC graphs of HAS-8.



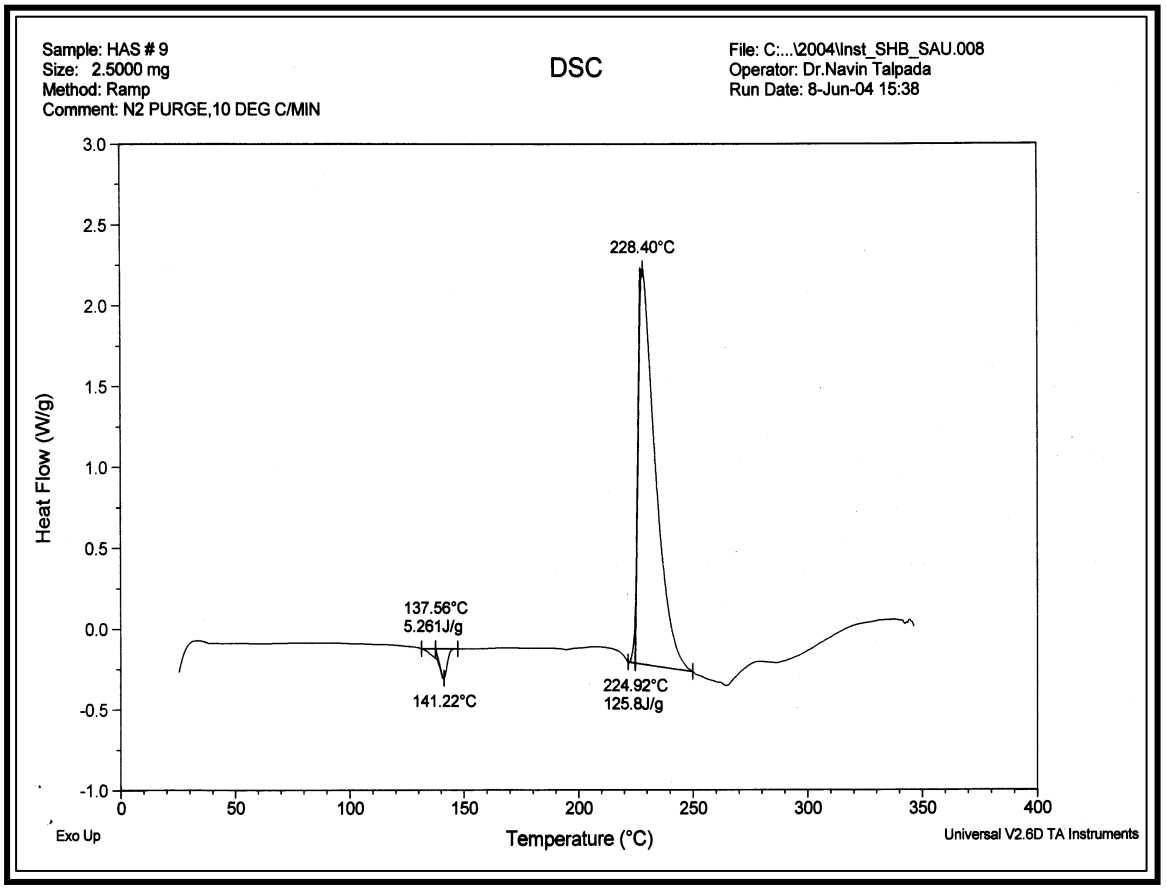
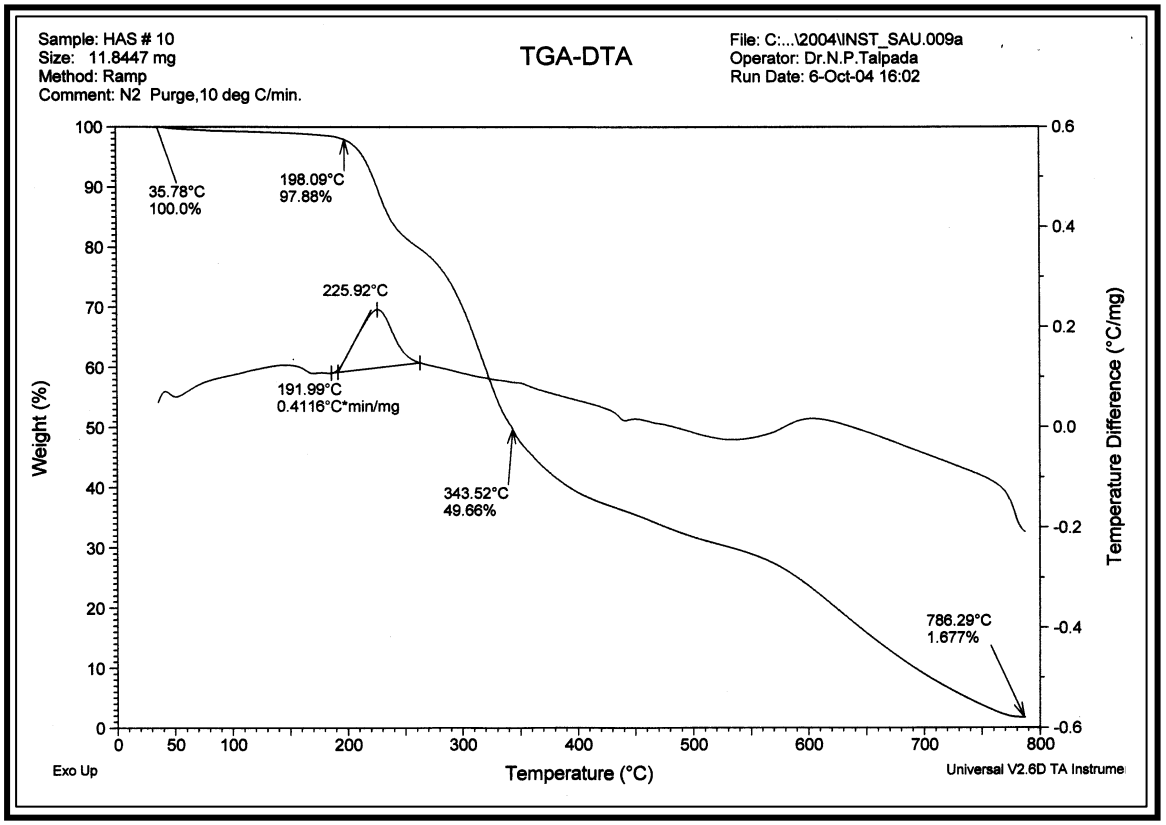


Figure 1.9: The TGA/DTA and DSC graphs of HAS-9.



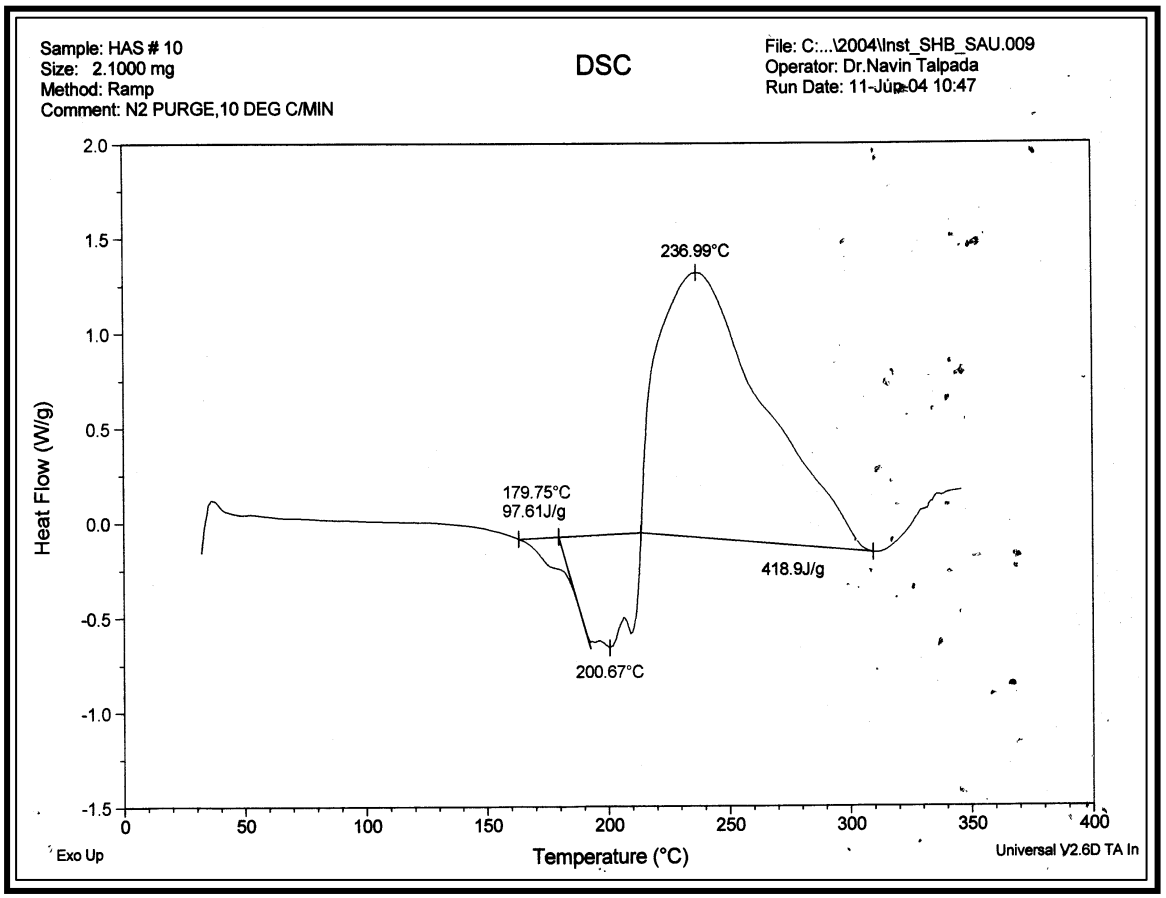
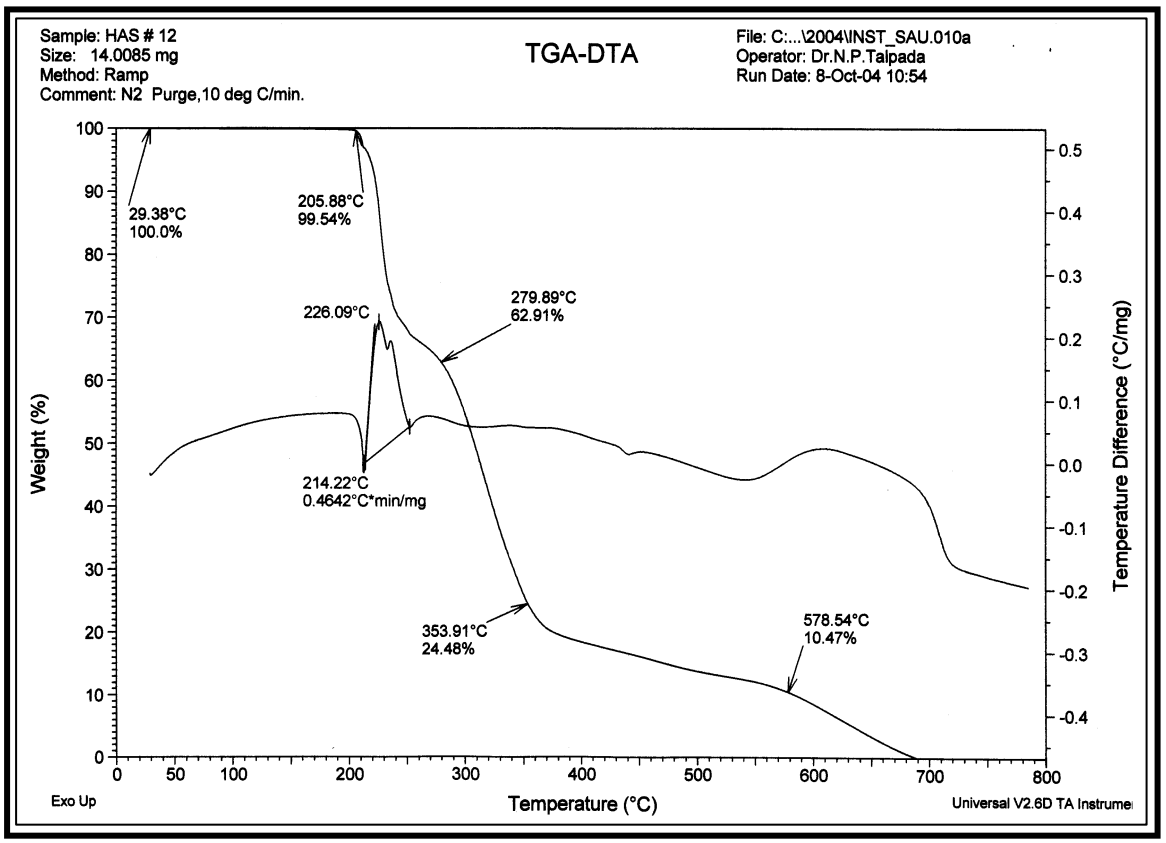


Figure 1.10: The TGA/DTA and DSC graphs of HAS-10.



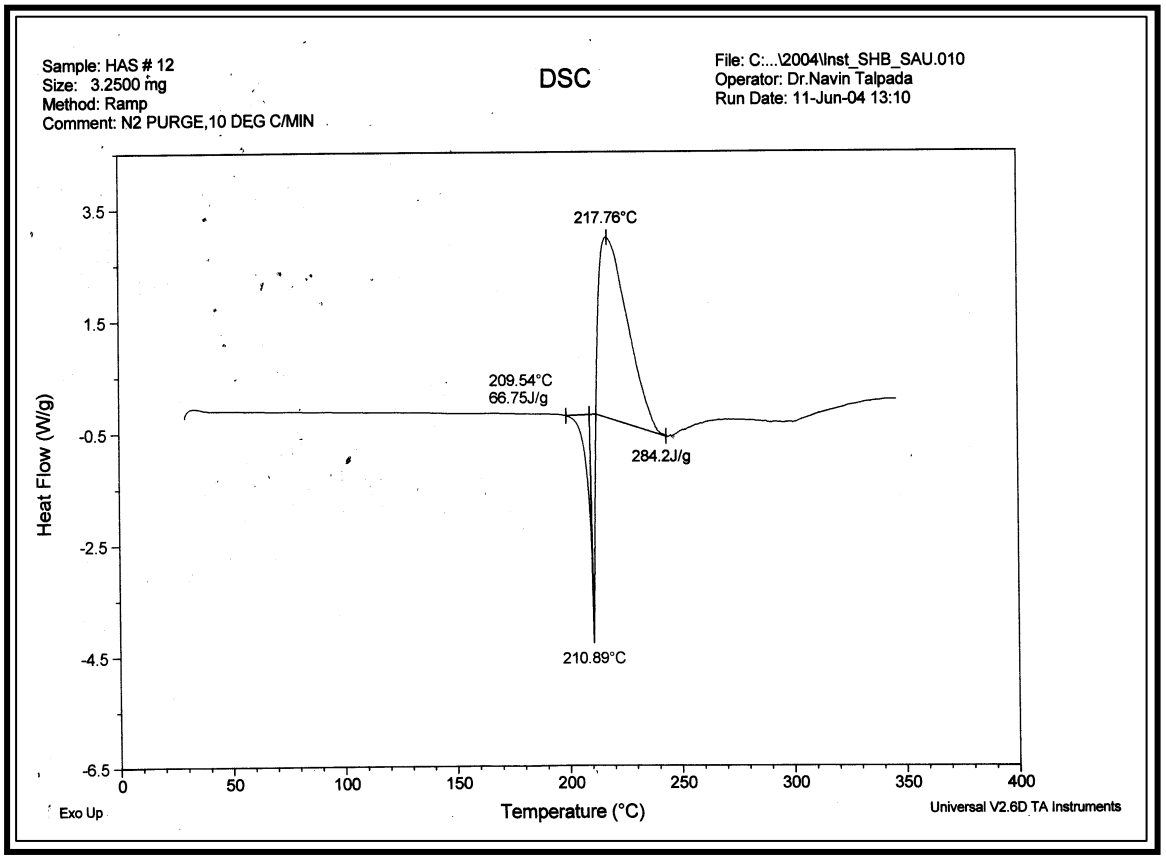
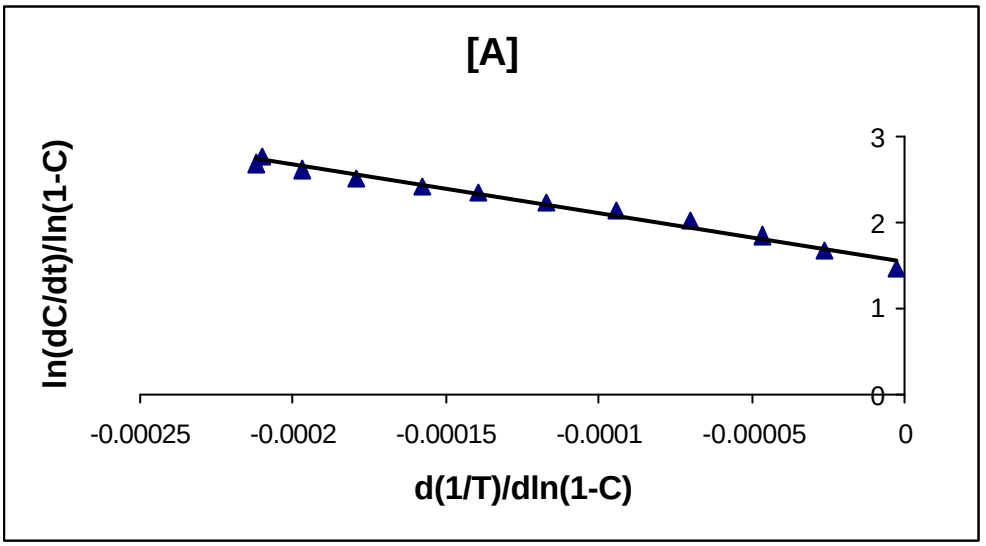
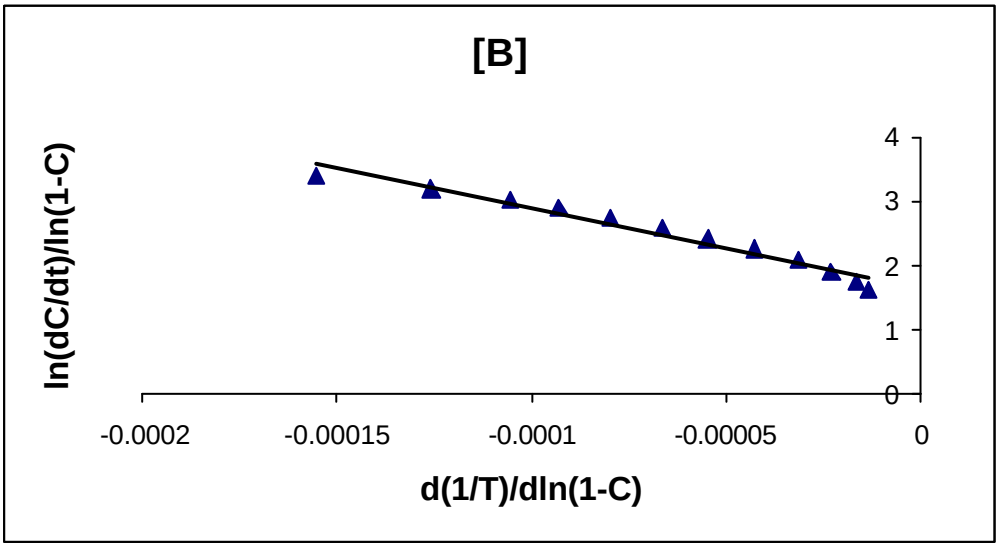


Figure 4.11: The Anderson-Freeman plots for HAS-1 for second [A] and third [B] step.





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INTRODUCTION

The energy change associated with the process in which a solute dissolves in a solvent is called the heat of solution. It is equal to difference between the energy that must be supplied to break up the crystal of the solute and the energy that released when the solute particles are taken into solution by the solvent. When the temperature will decrease, the heat of solution is negative where as increase of the temperature gives positive heat of solution. The heat of solution is defined as the change in enthalpy when one mole of substance is dissolved in specified quantity of solvent at a given temperature.

The molar heat of solution and melting temperature of a substance can be determined from the solubility measurements at different temperatures[1]. The heat of solution for many inorganic and organic compounds has been reported [2-13]. Meurs et al. studied the heat of solution of some polymers[14].

The thermodynamic properties of several electrolytes in different solvents have been studied by many workers[15-21]. In our laboratory, heat of solution of some Schiff bases has also been determined[22, 23].

In the present work, heat of solution for some triazole Schiff bases was determined in 1, 4-dioxane (DO) and tetrahydrofuran (THF) at different temperatures (308.15 to 328.15 K).

EXPERIMENTAL

The solvents used for the measurements were purified and fractionally distilled prior to use by the method reported in the literature[24]. The solubility of each Schiff base was determined by transferring 25 ml of saturated solution into a pre-weighed 50 ml beaker at a definite temperature. The weight of beaker along with solution was taken and the solvent was evaporated to dryness until constant weight is obtained. This gives the weight of solute present in 25 ml saturated solution. Three replicate measurements were carried out at a particular temperature and average value of weight was determined. The experiment was repeated at other temperatures also. Subtraction of weight of solute from the weight of solution gives the weight of solvent in 25 ml saturated solution.

RESULTS AND DISCUSSION

The solubility (N_2) of Schiff bases in 1, 4-dioxane and THF are given in Tables 5.1 and 5.2. It is evident from Tables 5.1 and 5.2 that the solubility of Schiff bases increases with temperature in both the solvents. Comparison of solubility of these bases in THF and 1,4-Dioxan (Table 5.1 and Table 5.2) shows that overall solubility is greater in THF than in 1, 4-dioxane. Further, in THF, solubility varies much for different bases whereas in 1,4-dioxan, except for HAS-5, HAS-8 and HAS-10, solubility does not differ much for different bases. Thus, the solvent polarity plays an important role on the solubility of Schiff bases studied.

The variation of solubility with temperature is given by:

$$[(\ln N_2) / \partial T]_P = \Delta H_S / RT^2 \quad \ldots\ldots\ldots (5.1)$$

where N_2 is the solubility or mole fraction, T is absolute temperature of the experiment, ΔH_S is the heat of solution and R is gas constant. Integration of equation (1) between temperature limits from T and T_m gives:

$$\ln N_2 = [\Delta H_S (T - T_m)] / RT.T_m \quad \ldots\ldots\ldots (5.2)$$

where T and T_m are the temperature of the experiment and melting temperature of the Schiff bases.

Figure 5.1 shows the variation of $\ln N_2$ with 1/T for a Schiff base (HAS-1) in [A] 1, 4-dioxane and [B] THF solutions.

From the plots, melting temperatures of Schiff bases were also calculated and are given in Table 5.3 along with experimental values determined by open capillary method. The melting points measured by DSC and DTA are also given in Table 5.3. Comparison of melting points calculated by different methods shows that in most of the cases, good agreement is observed between values calculated from solubility data and those observed by open capillary method and DSC/DTA. However, in some cases, discrepancies are observed, mostly in 1, 4-dioxan. For some Schiff bases, values could not be calculated due to non linear behavior of $\ln N_2$ against 1/T.

Further, heat of solution are observed to be positive for all the Schiff bases (Tables 5.1 and 5.2) indicating thereby endothermic behavior of these bases in both the solvents.

Table 5.1: The solubility and heat of solution of Schiff bases in Tetrahydrofuran at different temperatures.

Temp. K	N_2 ($.10^3$)	DHs (K.cals/mol)	N_2 ($.10^3$)	DHs (K.cals/mol)
	HAS-1		**HAS -6**	
308.15	15.0132	15.4232	14.7112	14.7212
318.15	15.1750	16.7558	15.1129	15.8608
328.15	15.4186	18.2177	15.3308	17.1660
	HAS -2		**HAS -7**	
308.15	16.8100	15.6242	11.0275	16.3997
318.15	17.3752	16.9421	18.4173	15.8162
328.15	17.6245	18.5015	18.6035	17.2021
	HAS -3		**HAS -8**	
308.15	23.5394	13.9981	9.1260	16.6758
318.15	17.4398	16.4903	9.4071	17.9921
328.15	18.0097	17.8840	9.6294	19.4737
	HAS -4		**HAS -9**	
308.15	15.5839	15.0471	3.4335	21.1142
318.15	16.7792	16.0756	4.1969	22.2110
328.15	17.0229	17.8840	15.1297	18.5862
	HAS -5		**HAS -10**	
308.15	11.3804	17.6187	5.0356	18.6220
318.15	11.7120	19.1894	5.4459	19.9081
328.15	12.5051	20.7839	5.7471	21.4144

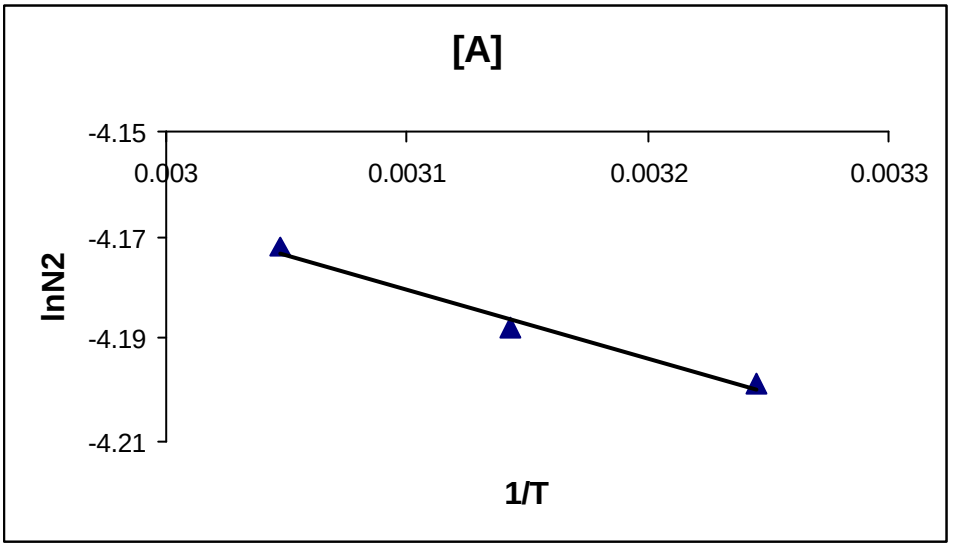
Table 5.2: The solubility and heat of solution of Schiff bases in 1, 4-dioxan at different temperatures.

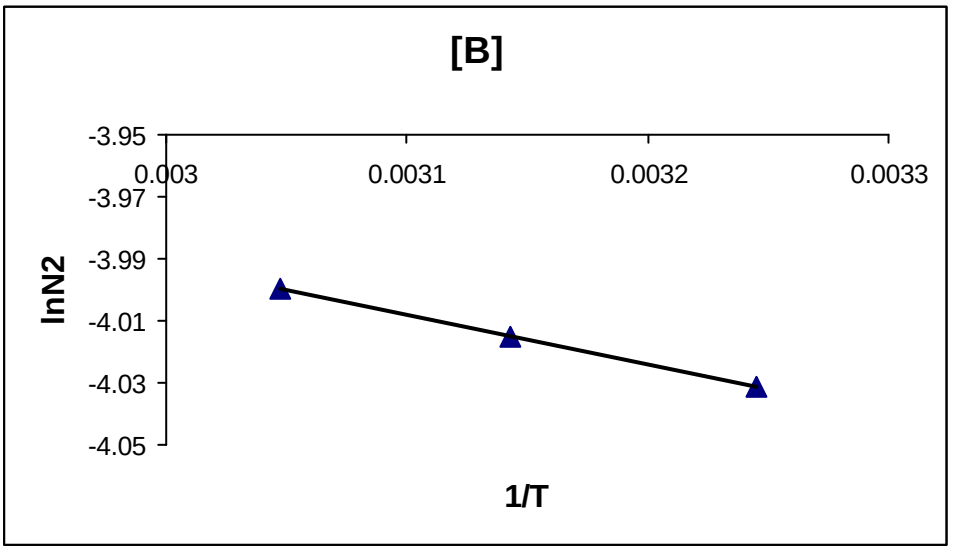
Temp. ^0C	N_2 ($.10^3$)	DHs (K.cal/mol)	N_2 ($.10^3$)	DHs (K.cal/mol)
	HAS-1		**HAS -6**	
308.15	17.7516	14.8078	17.4026	14.1350
318.15	18.0386	16.0642	17.8503	15.2309
328.15	18.3166	17.4656	18.1137	16.4807
	HAS -2		**HAS -7**	
308.15	19.9444	14.9706	21.4721	13.9751
318.15	20.2078	16.3108	21.7384	15.1598
328.15	20.2087	17.8747	21.8636	16.5050
	HAS -3		**HAS -8**	
308.15	20.4129	14.5302	10.6248	16.1359
318.15	20.9260	15.7481	10.8944	17.4261
328.15	20.9806	17.2042	11.1039	18.8761
	HAS -4		**HAS -9**	
308.15	18.4732	14.4322	17.2309	15.1127
318.15	18.5031	15.6910	20.3242	15.8097
328.15	19.0221	16.9800	20.5864	17.2204
	HAS -5		**HAS -10**	
308.15	13.3443	16.9923	5.5871	18.2563
318.15	13.6190	18.5384	5.8653	19.6248
328.15	13.9046	20.2807	6.1639	21.1238

Table 5.3: **Melting points of Schiff bases calculated from different methods.**

Code.	Open capillary Method ^{0}C	DSC/DTA ^{0}C	THF [cal. by eq^n.2] ^{0}C	DO [cal. by eq^n.2] ^{0}C
HAS-1	227	241/239	195.94	209.08
HAS-2	215	217/218	269.25	101.87
HAS-3	222	218/219	-	182.87
HAS-4	232	220/224	262.91	196.04
HAS-5	207	222/221	313.32	272.58
HAS-6	242	267/226	264.22	245.05
HAS-7	230	229/244	402.00	129.95
HAS-8	238	228/242	353.70	305.11
HAS-9	223	236/252	-	-
HAS-10	241	217/226	323.15	450.20

Figure 5.1: **The variation of lnN_2 against 1/T for HAS-1 Schiff bases in [A] THF and [B] 1,4-Dioxan.**





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INTRODUCTION

Biological Activity Spectrum of a compound represents the pharmacological effects, physiological and biochemical mechanisms of action, specific toxicity which can be revealed in compounds interaction with biological system. Further, it describes the intrinsic properties of the compound which depends on its structure. Most of known biologically active substances have many biological activities such as antibacterial, anti-inflammatory, antifungal, anti-HIV, antipyretic, antitumor etc.

A literature survey shows that a number of triazole derivatives have been tested for antimicrobial activities. Many of them have been found to exhibit bacteriostatic and fungistatic activities[1-5]. Further, the Schiff bases have been reported to demonstrate a wide range of pharmacological [6-10] activities, which include antibacterial[11-13], antifungal[14], anti-HIV[15], antitumor[16], anti-inflammatory[17], antipyretic[18-19] etc. They are found to be active against a wide range of both Gram positive and Gram negative bacteria[20-21]. Many Schiff bases have been known to be medicinally important and are used to design medicinal compounds[22-26]. Schiff bases of some triazoles have also been reported to have biological activities[27-30]. Considering these properties of triazole derivatives, in the present chapter, biological activities of some of these compounds were studied using strains of Gram positive and Gram negative bacteria.

EXPERIMENTAL

ANTIBACTERIAL ACTIVITY

The antibacterial activities of the triazole Schiff bases and 4-aryl triazoles were studied in dimethyl formamide (DMF), dimethylsulfoxide (DMSO) and 1,4-dioxan (DO). All these solvents were purified before use by standard methods. The synthesized compounds were also recrystallized. For comparison, the antibacterial activities of intermediates were also studied.

Preparation of test compounds

For Schiff bases, the solutions were prepared in 1,4-dioxan and DMF. These bases were dissolved at a concentration of 15 mg / ml in either of the two solvents (DO/DMF) in order to make the final concentration 1.5 mg / 0.1 ml.

For 4-aryl triazoles, the solutions were prepared in DMSO only. For these compounds, due to poor solubility, 1,4-dioxan or DMF could not be used. The 4-aryl triazole derivatives were dissolved at a concentration of 10 mg / ml in DMSO.

Test microorganisms

The bacterial strains studied are identified strains and were obtained from National Chemical Laboratory (NCL), Pune, India. The investigated micro organisms are *P. pseudoalcaligenes* ATCC 17440, *P. vulgaris* NCTC 8313, *C. freundii* ATCC 10787, *E. aerogenes* ATCC 13048, *S. subfava* NCIM 2178 and *B. megaterium* ATCC 9885.

Preparation of plates and microbiological assay

A loop full of the given test strain was inoculated in 25 ml of N-broth (Nutrient Broth) and was incubated for 24h in an incubator at 37^{o} C in order to activate bacterial strain 28-30 ml of the Mueller Hinton Agar No.2 media was added into the 100 mm diameter Petri-plate. Inoculation was done by the Pour-plate technique. 0.2 ml of the activated strain was inoculated into the media when it reached 40-45^{o} C. The complete

procedure of the plate preparation was done in the laminar airflow to maintain strict sterile and aseptic condition. The media was allowed to solidify. After solidification of the media, ditch / well[31] was made in the plates with the help of cup-borer (0.85 cm) and then it was filled with the solution of synthesized compounds. The controls were maintained (for each bacterial strain and each solvent), where pure solvent was inoculated into the well. The plates were incubated for 24 h at 37°C. The inhibition zone formed by these compounds against the particular test bacterial strain determined the antibacterial activity of the synthetic compounds. The mean value obtained for three individual replicates was used to calculate the zone of growth inhibition of each sample.

ANTIFUNGAL ACTIVITY

A total of 25 compounds were screened for *In vitro* antifungal activity against *Candida tropicalis (ATCC 4563), Candida albicans (ATCC 2091), Cryptococcus neoformans (ATCC 34664), Trichosporon beigelii (NCIM 3404) and Aspergillus flavus (NCIM 538) spores by* disc diffusion assay *a*t the concentrations 500 µg/disc. Fluconazole was used as standard drug. The test solutions were prepared in DMSO. Blank experiment with DMSO alone was done which also works as control.

From the antifungal screening, it was found that the compounds screened showed significant activity, some are equipotent to the standard drug whereas others are found to be more potent than the standard drug.

Antifungal assay

To evaluate the antifungal activity, sterile agar plates were used according to the disc diffusion assay. Activated cultures of fungal strains (*Candida tropicalis ATCC, Candida albicans ATCC2091, Cryptococcus neoformans ATCC34664, Trichosporon beigelli NCIM3404, and Aspergillus flavus NCIM538*) in Sabouraud's broth were adjusted to 1x 10^8 cfu/m as per Mcfarland standard. 100 µl of the inoculum was introduced to molten sabouraud dextrose agar and poured in the sterile petri plates. Sterile filter paper discs (7.0 mm diameter) were impregnated with 500 µg/disc of the

test compounds dissolved in 100% DMSO (dimethylsulphoxide) and dried. The discs were placed on fungal-seeded plates and incubated at 28°C for 48 hours. Discs impregnated with only 100% DMSO served as the negative control. As a positive control, fluconazole and ketoconazole were used. Following an incubation period of 48 hrs., plates were removed from the incubator and antifungal activity was evaluated by measuring zones of inhibition of fungal growth. Clear zones within which fungal growth was absent were measured and recorded as the diameter (mm) of complete growth-inhibition. The whole experiment was performed three times to minimize the error.

RESULTS AND CONCLUSION

ANTIBACTERIAL ACTIVITY

SCHIFF BASES

The antibacterial activity of triazole derivatives showed a differential activity against the bacterial strains investigated. The activity was also observed to be solvent dependent. The antibacterial activity of all the intermediates and Schiff bases in both the solvents DO and DMF against *E. coli* and *P. aeruginosa* is shown in Fig.1. None of the compounds in either of the solvent could inhibit *P. aeruginosa* except an intermediate HAS-B i.e., ester. On the other hand, considerable activity was envisaged against *E.coli* in both the solvents. The compounds in 1,4-dioxan showed better antibacterial activity than in DMF. It is observed that compounds HAS-A, HAS-B, HAS-C, HAS-D and HAS-E showed best antibacterial activity against this Gram negative bacteria i.e. *E.coli*. In fact, the best activity was shown by the very starting compound HAS-A i.e. 4-methoxy benzoic acid and HAS-D its salt, dithiocarbazate. However, both these compounds HAS-A and HAS-D did not show much antibacterial activity in DMF. The compound HAS-E i.e., 1,2,4 triazole showed comparatively less activity in both the solvents. However, In 1,4-dioxan, HAS-2, HAS-3 and HAS-5 showed some activity and in DMF HAS-2 and HAS-3 showed activity. But, these activities are less than the starting compounds and some intermediates. HAS-2 contains p-methoxy benzaldehyde as side chain and HAS-3 contains p-fluoro benzaldehyde as side chain.

Thus, these two side chains are effective to inhibit *E.coli*. This differential response of the compounds is because of the structural differences amongst them. In the present work, out of 15 compounds studied, HAS-A is starting compound and HAS-B to HAS-E are intermediates. Rest HAS-1 to HAS-10 are synthesized Schiff bases of triazoles in which, different side chains are attached to the compound HAS-E i.e. 1,2,4-triazole. The structures of all the compounds are given in part-1,chapter-1,Section-I,page (12). Thus, it is obvious that the group or the molecule that is attached to the central ligand play an important role in inhibiting the bacteria. The inhibition of bacterial growth also depends on the solubility of the compounds in a particular solvent, its diffusion capacity and penetration into the bacterial cell wall.

The antibacterial activity against two Gram positive bacteria *S. aureus* and *B. cereus* are shown in Fig. 2. None of the compounds in either of the solvent could inhibit the Gram positive bacteria *S. aureus* except a very negligible activity was shown by HAS-A and HAS-D. An entire different trend was observed against *B. cereus*. A considerable activity was shown by most of the compounds in both the solvents. Maximum activity was shown by compound HAS-D followed by compound HAS-A, though the activity was more in 1,4-dioxan. Compounds

HAS-1, HAS-4 and HAS-6 showed considerable activity against B. cereus in both solvents while the others could not inhibit this bacterial strain. HAS-1 contains hydroxyl benzaldehyde, HAS-4 contains Vanillin and HAS-6 has n, n-dimethyl benzaldehyde as side chain attached to triazole moiety. Thus, these three are more effective againsts *B. cereus* in both the studied solvents.

The antibacterial activity against Gram negative bacteria *A. fecalis* and *K. pneumoniae* are shown in Fig. 3. The antibacterial activity against *A. fecalis* is similar to that of *E. coli*. i.e., HAS-A to HAS-E showed considerable antibacterial activity in both the solvents. However, activity is more when the solvent used was non polar solvent 1,4-Dioxan. In DO HAS-2, HAS-3 and HAS-5 showed negligible activity while other compounds showed no activity at all against *A. fecalis.* In DMF also, only HAS-4 and HAS-5 showed negligible activity whereas others showed no activity at all. An entirely different trend was observed against *K. pneumoniae*. In DMF, all the studied compounds showed considerable activity. However, in DO, only HAS-1, HAS-7, HAS-8 and HAS-9 could inhibit *K. pneumoniae.* The compounds HAS-A to HAS-E, which showed antibacterial activity in 1,4-Dioxan against the other five bacterial strains, did not inhibit this bacteria at all whereas in DMF, these intermediates showed considerable activity. But, comparison of intermediates with synthesized Schiff bases show that only HAS-1, HAS-7 and HAS-10 showed better activity than intermediates. HAS-1 contains p-hydroxy benzaldehyde as side chain; HAS-7 contains 3-nitro benzaldehyde as side chain whereas HAS-10 has benzaldehyde as side chain. Thus, only hydroxyl and nitro groups attached to benzene ring inhibit *K. pneumoniae*. Other groups have less or almost no effect on this bacteria.

From the present work, it can be concluded that inhibition depends on the molecular structure of the compound, the solvent used and the particular bacterial strain.

Amongst the solvents used, 1,4-dioxan appears to be better than DMF. This is in agreement with our earlier work[30] that non-polar solvents may be beneficial in our attempt to search lead molecules for drug designing.

B. cereus appeared to be most susceptible bacteria while *P. aeruginosa* was the most resistant bacterial strain. Except *K. pneumoniae*, none of the newly synthesized triazole compounds could inhibit any of the bacterial strains investigated. Hence, though triazole compounds are reported to show many pharmacological activities but these studied compounds did not show much antibacterial activity.

Therefore, such screening of various organic compounds and identifying active agents is the need of the hour; because successful prediction of lead molecule and drug like properties at the onset of drug discovery will pay off later in drug development.

4-ARYL TRIAZOLES

The antibacterial activity of all the ten (HASD-1 to HASD-10) compounds in DMSO against above mentioned bacteria are shown in Fig.4. It is observed that HASD-6 shows maximum activity against *Bacillus cereus* followed by HASD-2. HASD-4, HASD-7, HASD-8 and HASD-9 also showed some negligible activity whereas HASD-1, HASD-3, HASD-5 and HASD-10 showed no activity at all. The response of synthesized compounds against different bacteria is because of different groups present in it. HASD-6 contains 2, 4-dimethyl group whereas HASD-2 contains p-methoxy group.

Thus 2, 4-dimethyl and p-methoxy groups affect *B.cereus* in DMSO. Against P.testosteroni, again HASD-6 showed maximum activity followed by HASD-2, HASD-10 and HASD-1 also showed activity. HASD-10 and HASD-1 contain o-methoxy and p-methyl group which are found to be effective against *P.testosteroni*. Other compounds had no effect at all against *P.testosteroni.* Again against *K.pneumoniae*, HASD-6 showed maximum activity. HASD-3 and HASD-9 showed no activity at all against this

bacteria. Other compounds showed some activity. Against *M.flavus* HASD-1 showed maximum activity followed by HASD-6 and HASD-7. All other compounds had no effect on *M.flavus*. HASD-1 contains p-methyl as side chain, HASD-6 contains 2,4-dimethyl as side chain and HASD-7 has 2,3-dichloro as side chain. The antibacterial activity against *C.freundii* was observed only by HASD-6 and HASD-4. Others had no effect at all.

The substituted groups present in different compounds have different effect against different bacteria. It is observed from above finding that 2, 4-dimethyl group present in HASD-6 are most effective. P-cl group and 3-chloro-4-fluoro group present in HASD-3 and HASD-9 respectively are not effective for the bacteria taken in the present study.

The most susceptible bacteria is *K.pneumoniae* and most resistant is *C.freundii*.

ANTIFUNGAL ACTIVITY

SCHIFF BASES

The inhibition against different fungal strains for different synthesized compounds along with starting material and intermediates are given in Figures 5 to 7. It is observed from Figure 5 that for all the fungal strains, starting material HAS-A showed maximum inhibition than intermediates. Against *Cryptococcus neoformans*, it showed more inhibition than standard drug Fluconazole whereas HAS-D and HAS-E showed no inhibition at all. The inhibition depends upon the fungal strain and on the structure of the compounds. HAS-B showed minimum inhibition against *Candida tropicalis*. HAS-B and HAS-C showed no inhibition against *Candida albicans.* HAS-E did not affect *Trichosporon beigelii* whereas *Aspergillus flavus* was not affected by HAS-C.

Figures 6 and 7 show that HAS-2 showed maximum inhibition against *Candida tropicalis* whereas HAS-1, HAS-5, HAS-6, and HAS-8 could not affect this fungal strains. All these compounds have same central moiety with different substituted groups. Thus, different substituted groups affect differently for different fungal strains.

However, *Candida albicans* was maximum affected by HAS-1 while HAS-2, HAS-3, HAS-4, HAS-9 and HAS-10 showed no effect on this. Against *Cryptococcus neoformans* HAS-3 showed maximum inhibition followed by HAS-4. HAS-2 and HAS-9 also showed inhibition whereas other had no affect.

Further, HAS-3 showed maximum inhibition against *Trichosporon beigelii* and *Aspergillus flavus* followed by HAS-4. For *Trichosporon beigelii* HAS-1, HAS-6, HAS-7, HAS-8, HAS-9 showed no activity whereas for *Aspergillus flavus* HAS-1, HAS-7 and HAS-10 showed no activity at all.

This observation suggests that overall fluoro benzaldehyde substitution (HAS-3) inhibited maximum whereas p-hydroxy benzaldehyde (HAS-1) could affect only *Candida albicans*. Out of all the 5 studied fungal strains, *Cryptococcus neoformans* is most resistant fungal and *Candida albicans* could be inhibited by most of the Schiff bases.

Comparison of all these HAS compounds with standard Fluconazole shows that these synthesized compounds inhibit the studied fungal strain less that that of Fluconazole. Thus, the synthesized compounds are not promising antifungal agents. Further, it is observed that against *Candida tropicalis* and *Candida albicans* there is only slight change in the activity of starting material and some Schiff bases. For *Cryptococcus neoformans*, *Trichosporon beigelii* and *Aspergillus flavus*, starting material showed maximum inhibition than most of the Schiff bases.

4-ARYL TRIAZOLES

However, different trend is observed for HASD compounds (Figures 6 and 7). It is observed that maximum inhibition was observed for HAS-D6 against all the studied fungal strains. Against *Candida tropicalis* HASD-3 showed no inhibition at all whereas against *Candida albicans*, HASD-1, HASD-5 and HASD-10 had no effect. HASD-8 showed maximum inhibition against *Cryptococcus neoformans* whereas HASD-3, HASD-9 and HASD-10 could not affect. For *Trichosporon beigelii* also HASD-3 and HAS-10 had no affect at all whereas only HASD-3 could not affect *Aspergillus flavus* , other compounds showed considerable inhibition against this fungal strain.

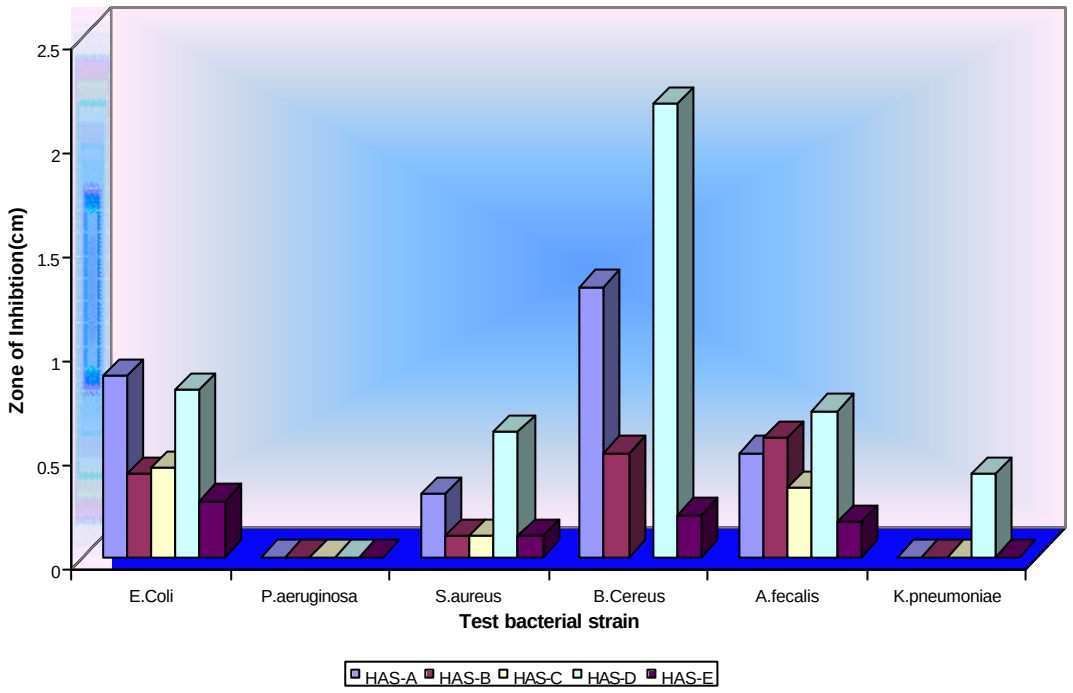
In all HASD compounds, central moiety in same with different substitutions. The 2,4- dimethyl aniline substitution (in HASD-6) is most effective for all the studied fungal strains. However, for *Cryptococcus neoformans* o-methyl aniline (in HASD-8) affected most, p-chloro aniline (in HASD-3) and o-methoxy aniline (in HASD-10) affect minimum.

When compared with Fluconazole, it is evident from Figures 4 and 5 that for *Cryptococcus neoformans*, Trichosporon *beigelii* and *Aspergillus flavus* some of these compounds are more active than Fluconazole. Highest activity was observed for HASD-8 followed by HASD-6 and HASD-7 against *Cryptococcus neoformans.* Further, it is observed that all the studied fungal strains are susceptible to the almost synthesized HASD compounds.

Comparison of inhibition zones by HASD with HAS compounds shows that HASD are more effective against the studied fungal strains than HAS. This again proves that the effect of structure of compounds. Out of all the 10 each HAS and HASD compounds, 3 of each series have common substituted groups but different central moiety. The comparison of inhibition produced again proved that presence of -C=N- group reduces the antifungal activity.

Figure 1: Antibacterial activity of inermediates in 1,4-dioxane (A) and DMF (B)

[A]



[B]

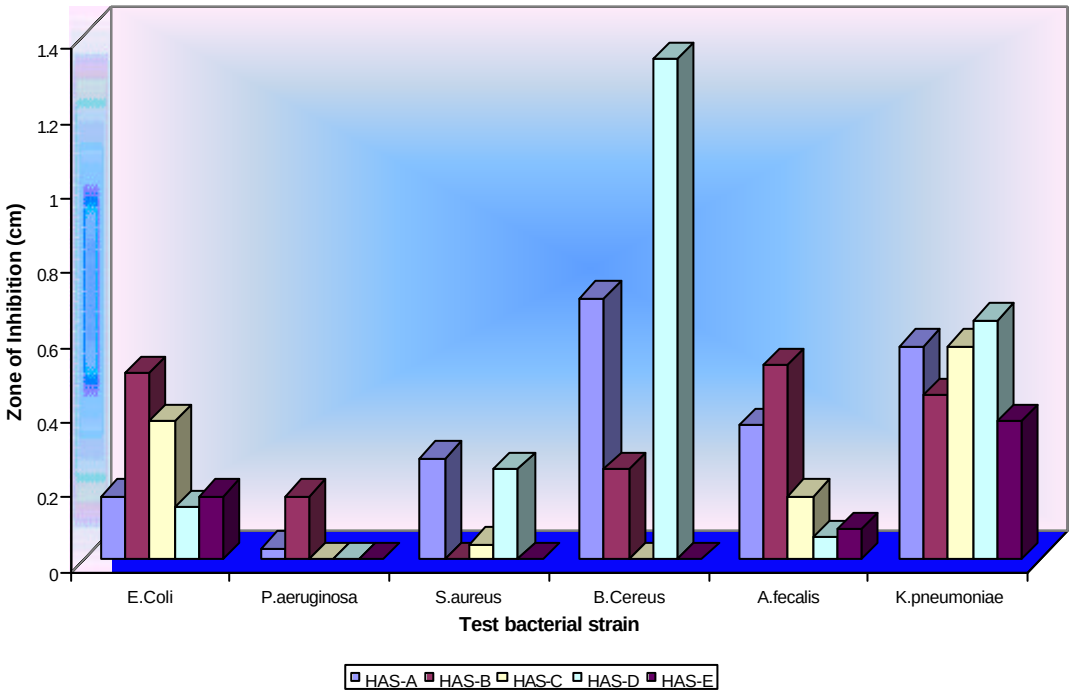
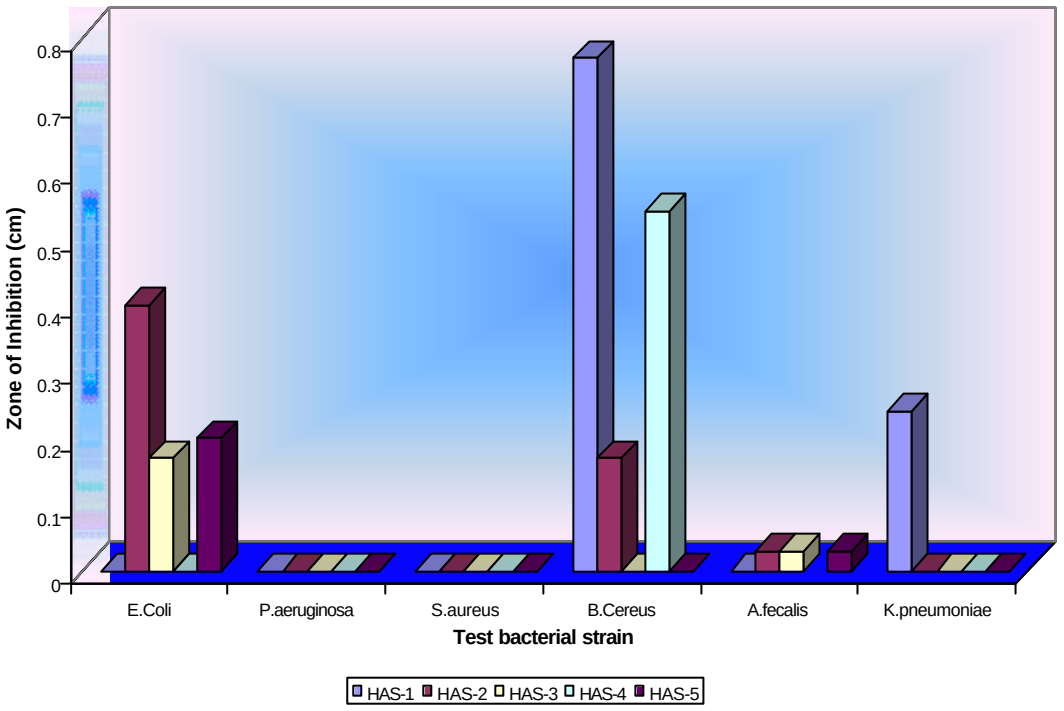


Figure 2: Antibacterial activity of Schiff bases in 1,4- dioxane (A) and DMF (B)

[A]



[B]

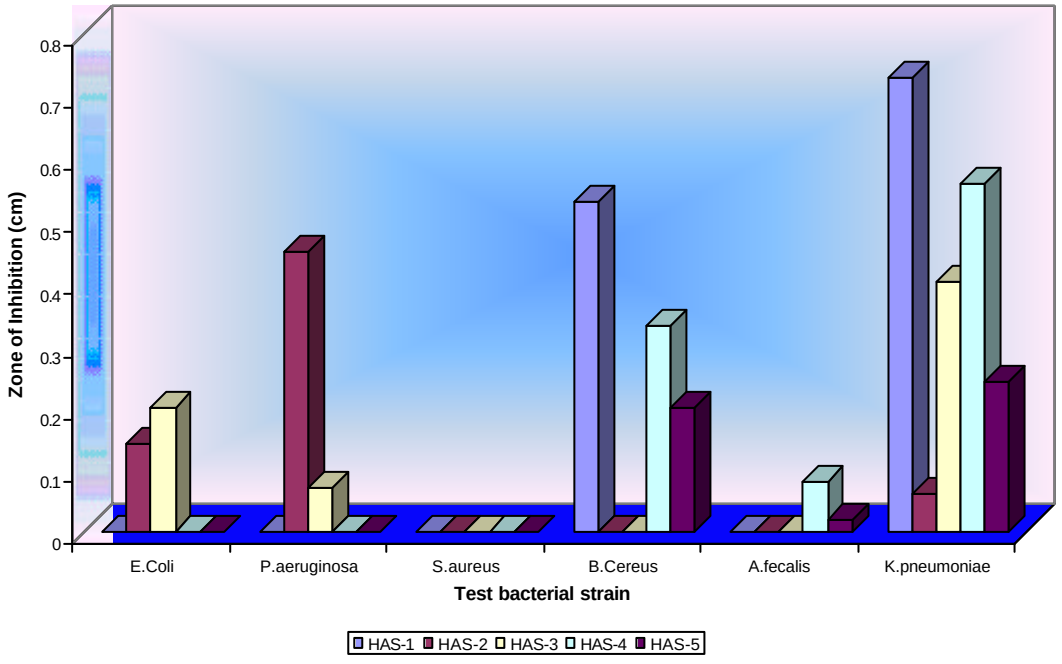
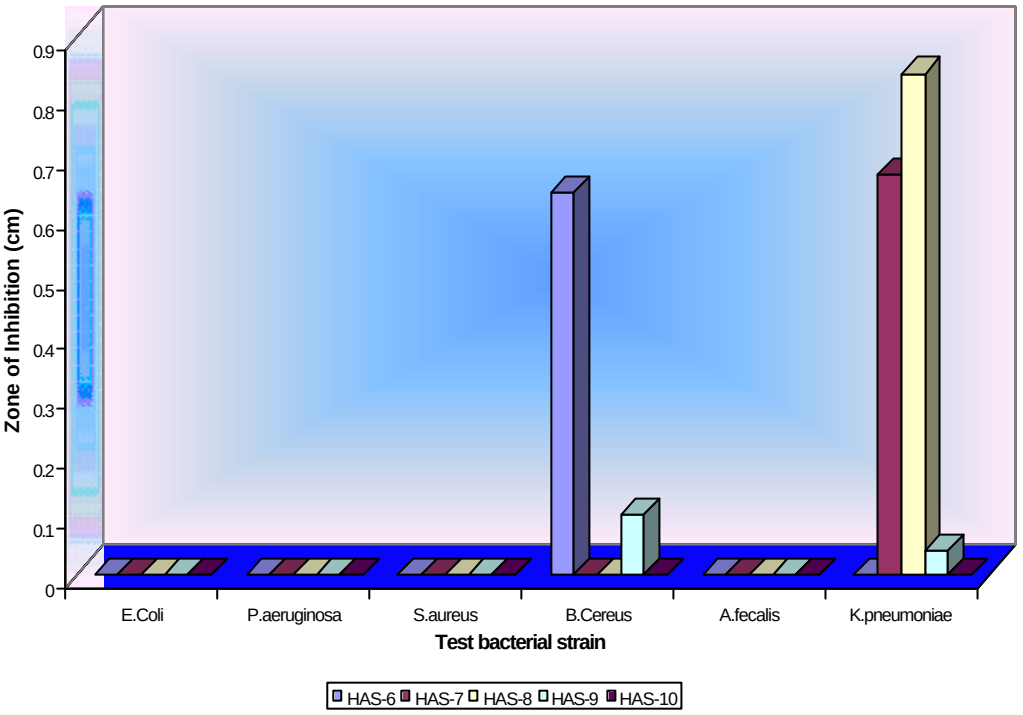


Figure 3: Antibacterial activity of Schiff bases in 1,4- dioxane (A) and DMF (B)

[A]



[B]

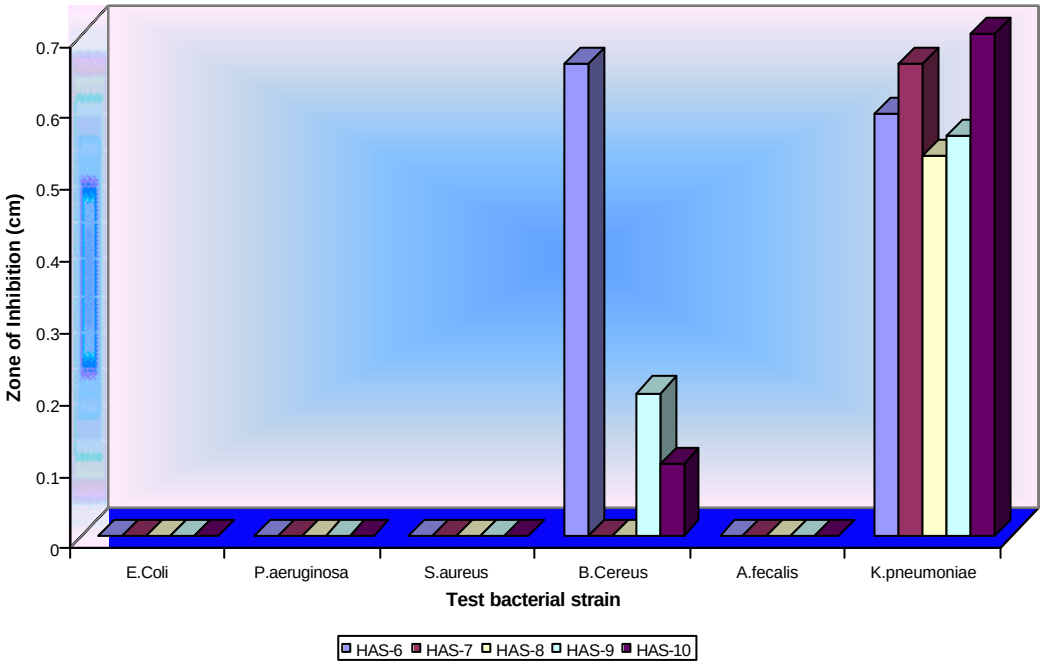
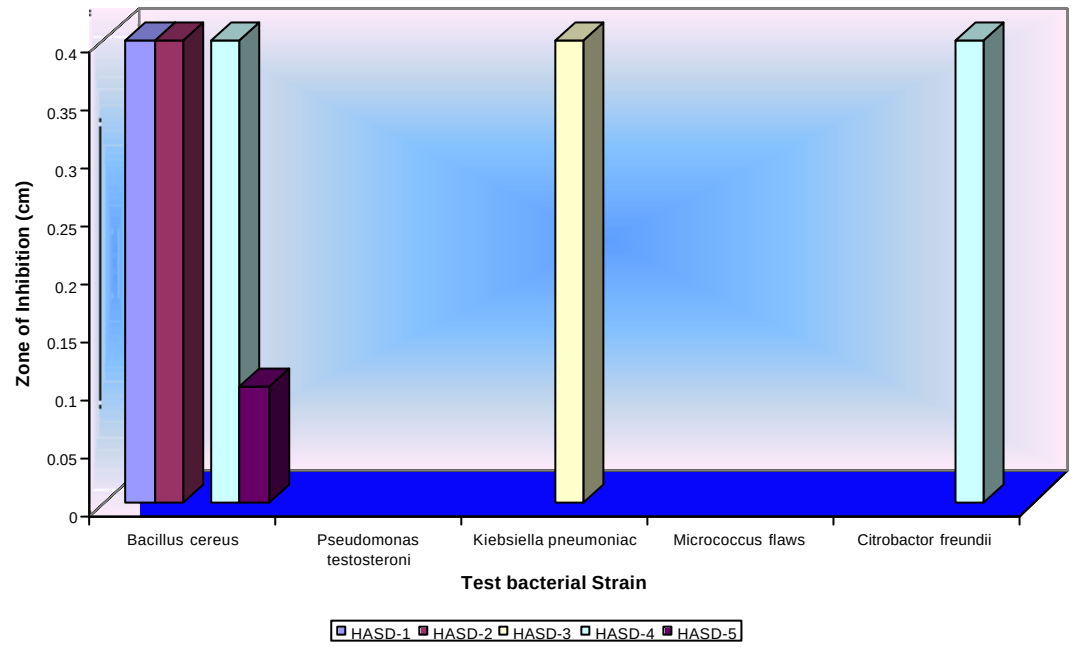


Figure 4: Antibacterial activity of 4-aryl triazoles in DMSO

[A]



[B]

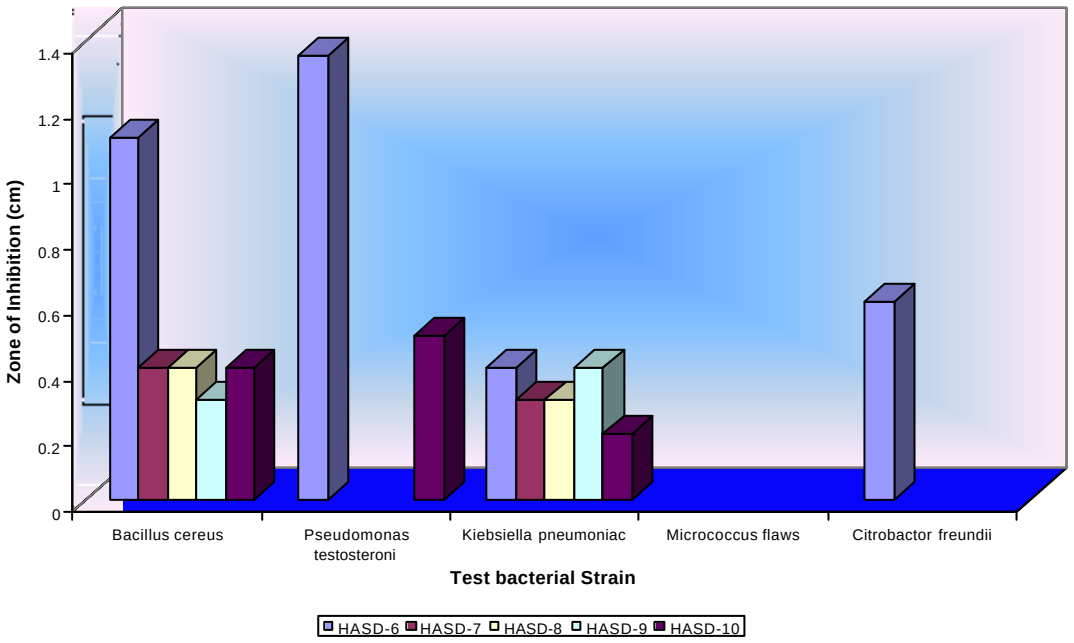


Figure 5: Antifungal activity of intermediates (A) and Schiff bases (B)

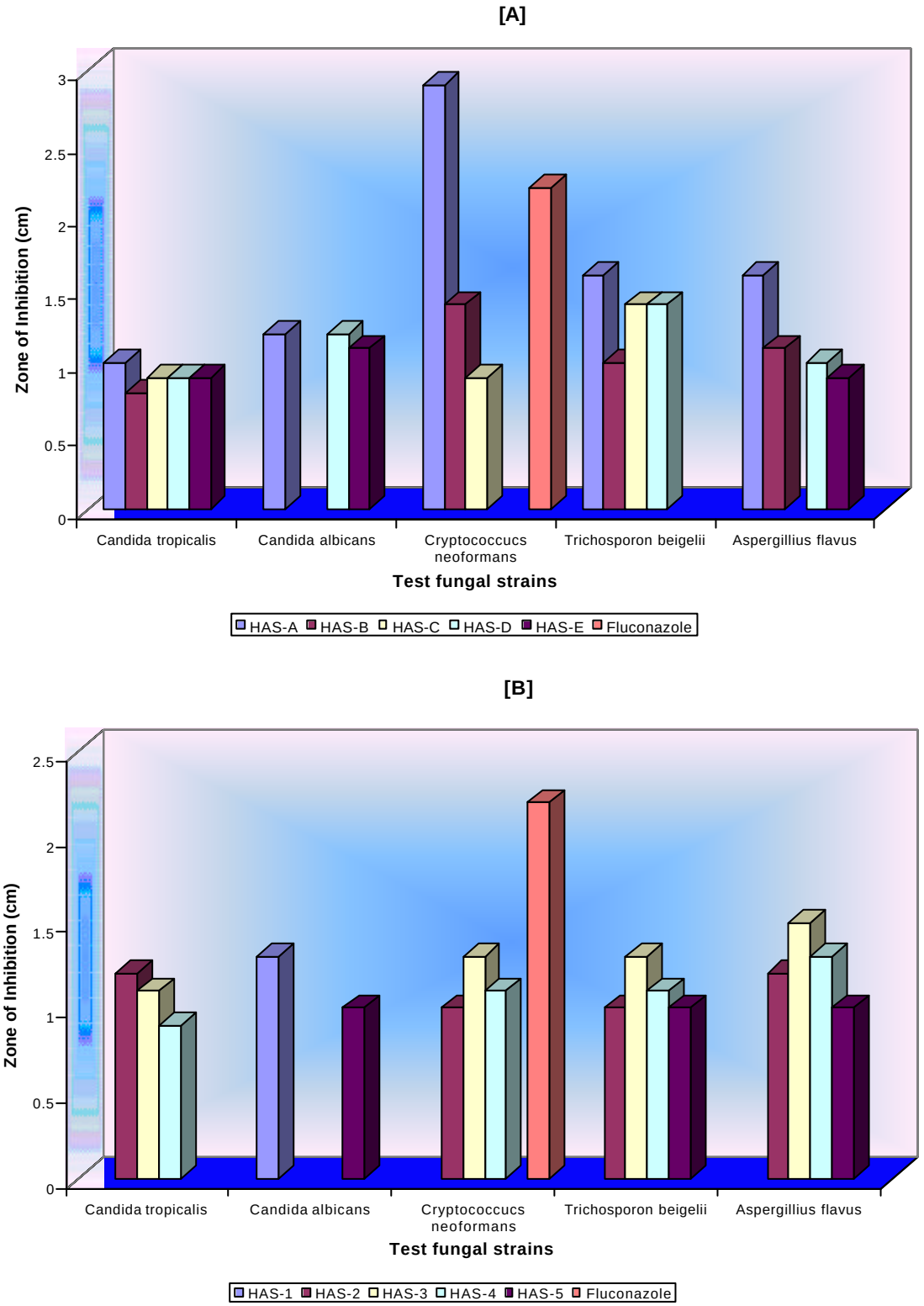
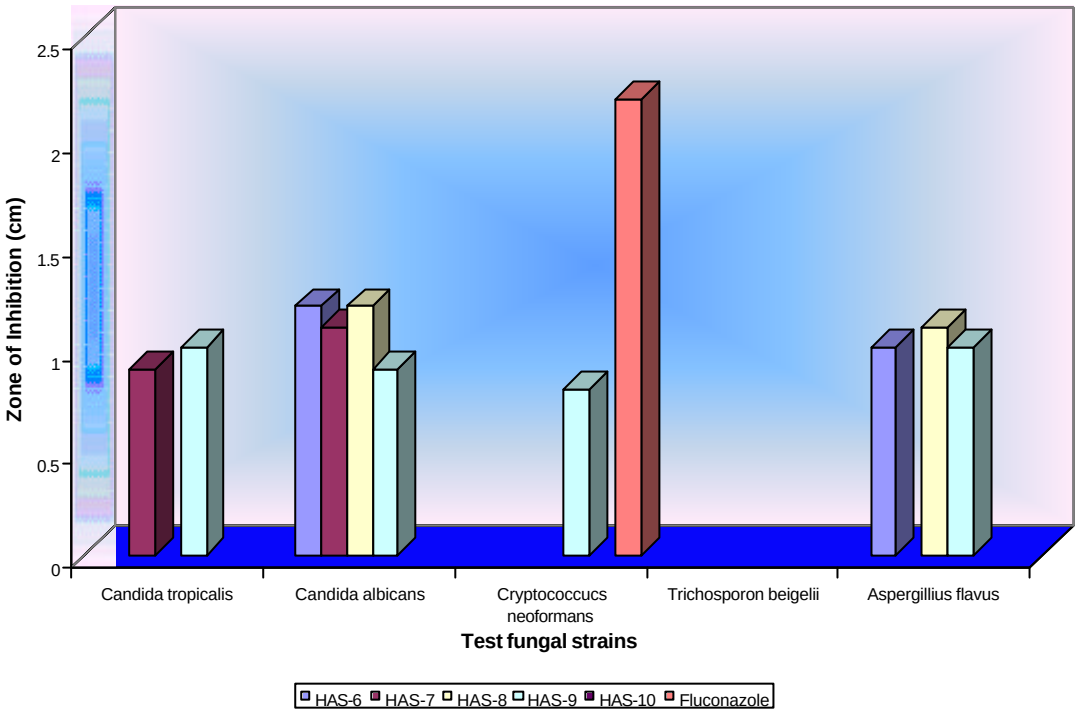


Figure 6: Antifungal activity of Schiff bases (C) and 4-aryl triazoless (B)

[C]



[D]

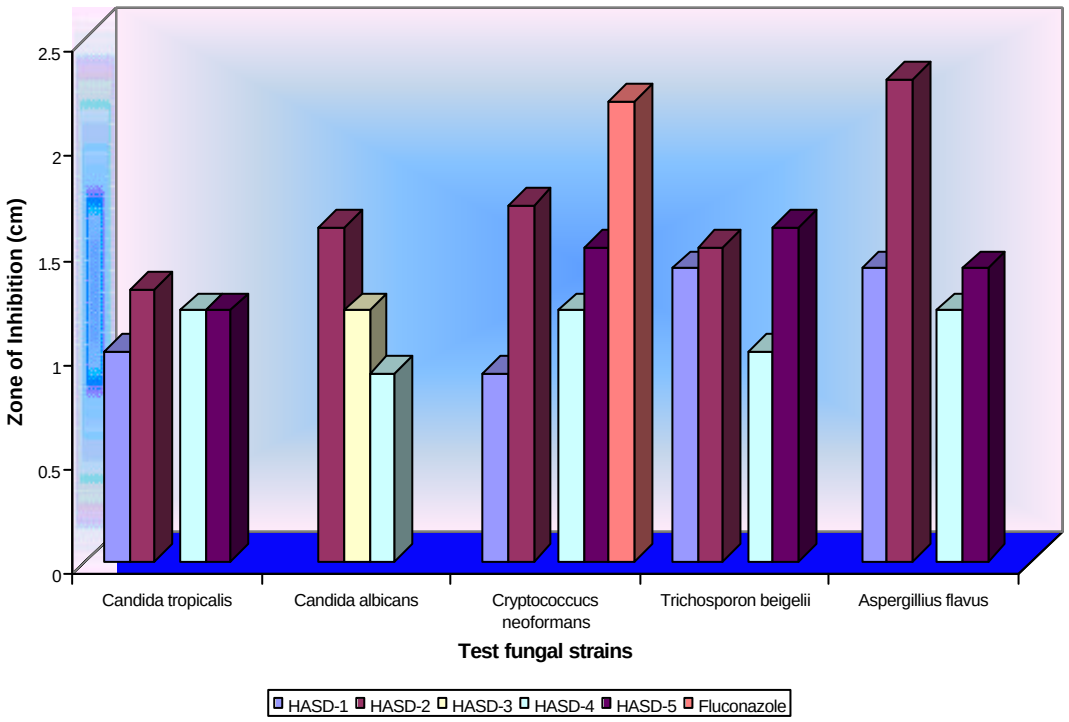
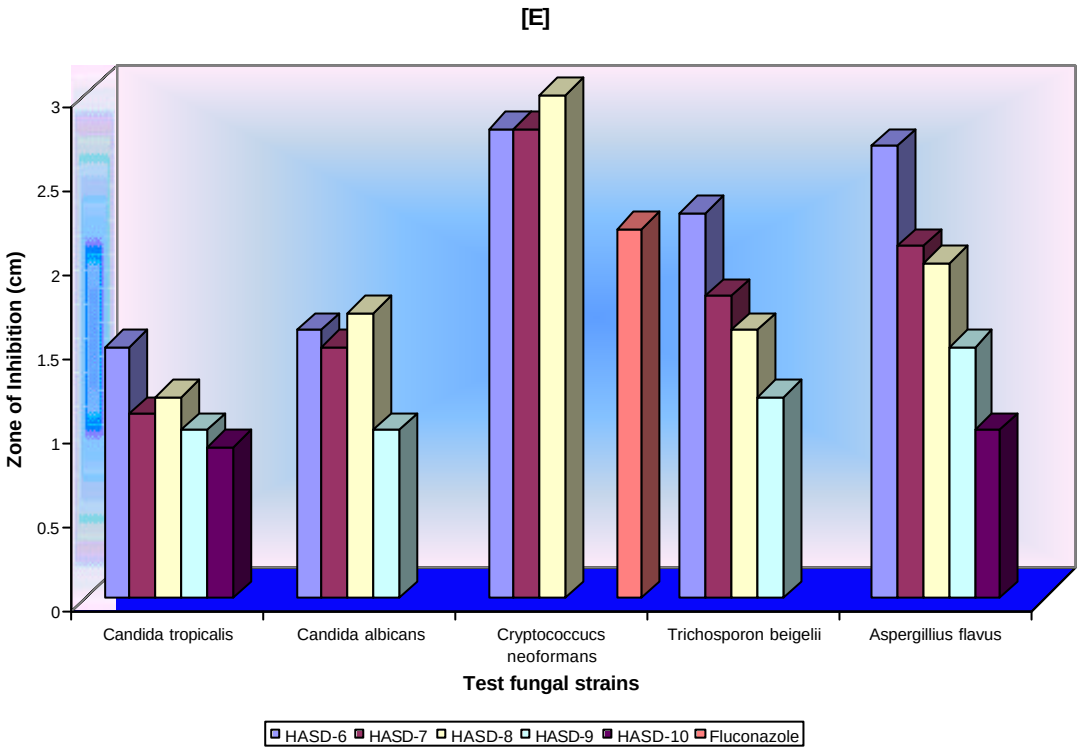


Figure 7: Antifungal activity of 4-aryl triazoless (E)



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A COMPREHENSIVE CONCLUSION OF THE WORK

The thesis is divided into three parts. First part comprised of synthesis and characterization of compounds. In the second part, physicochemical properties of some compounds have been studied whereas in the third part, biological activities of some compounds are reported.

PART-1: SYNTHESIS AND CHARACTERISATION

CHAPTER-1: This chapter describes the synthesis and characterization of some triazole derivatives, which is further mentioned by three different sections.

SECTION-I: In this section, literature, synthesis and characterization of some Schiff bases derived from 1, 2, 4-triazole are reported.

SECTION-II: Introduction of some 4-aryl triazoles is given here along with their synthesis and spectral data.

SECTION-III: The introduction, synthesis and spectral data of some 1,3,4-thiadiazole derivatives are reported in this section.

CHAPTER-II: In this chapter, synthesis of some pyazoles has been reported. Their characterization by IR, ^{1}H NMR and Mass spectroscopy was also done and given in this chapter. Further, it is divided into four sections.

SECTION-I: In this section, synthesis and characterization of some chalcones derived from pyrazoles are reported.

SECTION-II: This section describes the synthesis and characterization of some pyrazolines.

SECTION-III: Synthesis of some cyanopyridine derivatives are reported in this section along with their spectral data.

SECTION-VI: In this section, synthesis of some thiazolidinone derivatives has been reported along with their spectral data.

CHAPTER-3: In this chapter, some pyrazolines are synthesized by three different methods: conventional, microwave and ultrasonic techniques. Comparison of these methods shows that both microwave and ultrasonic methods give comparatively good yield of products than conventional method. Further, by using these techniques, reaction time is reduced to few minutes (in microwave) and to few hours (in ultrasonic technique). It is also observed that no catalyst is required for synthesis of compounds by ultrasonic technique.

PART-2: PHYSICO CHEMICAL PROPERTIES

This part is divided in five chapters.

CHAPTER-I: To understand the interaction occurring in the solution, the acoustical properties of Schiff bases are measured in DMF and THF at 308.15K. It is observed that solute-solute and solute-solvent interactions exist in all the solutions.

CHAPTER-II: In this chapter, the density and refractive index of Schiff bases are measured in DMF and THF at 308.15K. It is observed that, there is deviation between experimental and calculated values of densities, which again suggest the presence of intermolecular interactions between solute and solvent molecules. Further, the refractive index of Schiff bases has been evaluated from the experimental refractive index values of the solutions in DMF and THF.

CHAPTER-III: This chapter describes the conductance of Schiff bases in DMF and THF at 308.15K. The equivalent conductance is found to increases with dilution. The equivalent conductance is observed to depend on solvent and nature of solute rather than on its molecular weight. Further, it is observed that all the Schiff bases are weak electrolytes.

CHAPTER-IV: In this chapter, thermal properties of Schiff bases are studied. Thermal stability is found to be affected by the substituent groups. HAS-1 is observed to be more stable whereas HAS-4 is observed to be less stable. Various kinetics parameters such as order of reaction, energy of activation, frequency factor and entropy change were calculated. Each Schiff base follows multisteps decomposition. Further, the value of entropy change is observed to be positive which suggest the less ordered transition state.

CHAPTER-V: This chapter describes the heat of solution of Schiff bases in 1,4-dioxane and THF at different temperatures. It is observed that solubility of Schiff bases increases with temperature. The solubility of Schiff bases are observed to be greater in THF than in 1, 4-dioxane. The melting temperature of Schiff bases are also calculated by using solubility data. In most of the cases, good agreement is observed between calculated from solubility data and those observed experimentally, DCS and DTA data. Further, heat of solution is observed to be positive for all the Schiff bases in both the solvents indicating thereby exothermic behavior of Schiff bases.

PART-3: BIOLOGICAL ACTIVITIES

The biological activity i.e., antibacterial and antifungal activities of some Schiff bases and 4-aryl triazoles are studied in this chapter. For antibacterial activity, 1,4-dioxan and DMF are used for Schiff bases where as for 4-aryl triazoles, only DMSO is used. It is observed that substituent attached to the central moiety and solvent polarity play an important role in inhibiting the bacteria. Amongst the solvents used for Schiff bases, 1,4-dioxan is found to be better than DMF. *B*. *cereus* is found to be most susceptible bacteria while *P. aeruginosa* is most resistant bacterial strain for Schiff bases. In case of 4-aryl triazoles, most susceptible bacteria is *K. pneumoniae* and most resistant is *C. freundii*.

For antifungal activities, DMSO is used for both types of compounds. It is observed that in case of Schiff bases, overall HAS-3 containing fluoro benzaldehyde inhibited maximum whereas HAS-1 containing p-hydroxy benzaldehyde, inhibited minimum. However, in case of 4-aryl triazoles, HASD-6 containing 2,4-dimethyl aniline substitution is most effective for all the fungal strains.

Comparison of antifungal activity of Schiff bases and 4-aryl triazoles shows that 4-aryl triazoles are more effective against the studied fungal strains. This again proves that structure of compound plays an important role in activity. Thus, presence of C=N group reduces the activity. This is further proved by comparing the activity of these compounds with the standard Fluconazole. It is observed that most of 4-aryl triazoles are more active than Fluconazole whereas Schiff bases are less than that of Fluconazole.

LIST OF PAPERS

PUBLISHED PAPERS

(1) "Thermodynamic and acoustical studies of binary mixtures of diethyl malonate at 308.15K", Shipra Baluja, Nirmal Pandaya, Nikunj Kachhadia, Asif Solanki and Pranav Inamdar, Physics and Chemistry of Liquids, 43(3), 309-316 (2005).

(2) "Theoretical evaluation of refractive Index in binary liquid mixtures", Shipra Baluja, Nirmal Pandaya, Nikunj Kachhadia and Asif Solanki, E-Journal of Chemistry.

(3) "Theoretical evaluation of viscosity in quarternary systems."
Shipra Baluja, , Nikunj Kachhadia, Asif Solanki and Pranav Inamdar,
Ultra Science of Physical Sciences- INTERNATIONAL JOURNAL OF PHYSICAL SCIENCES. 16(2), 267-272(2004).

(4) "Theoretical evaluation of ultrasonic velocity in binary liquid mixtures of acetophenone using various approaches at 308.15K", Shipra Baluja, Nikunj Kachhadia and Asif Solanki, E-Journal of Chemistry, 2, 9 (2005).

(5) Viscous Behaviour of Methoxy Ethanol in Binary Mixtures; Shipra Baluja, Nikunj Kachhadia and Asif Solanki, E-Journal of Chemistry, 2,9 (2005).

COMMUNICATED PAPERS

(1) "Sonochemical Synthesis of Some Schiff Bases", S. Baluja*, N. Kachhadia and A. Solanki, Acta Chimica Sinica-China.

(2) "SYNTHESIS AND THERMODYNAMIC STUDIES OF SOME 1, 2, 4-TRIAZOLE DERIVATIVES IN DMF AND THF SOLUTIONS AT 308.15K.", *Shipra_Baluja, Nikunj Kachhadia and Asif Solanki, Physics and Chemistry of Liquids.

(3) "A FACILE SYNTHESIS AND ANTIMICROBIAL ACTIVITY OF SOME 4-ARYL TRIAZOLE RING SYSTEM", Shipra Baluja[1], Sumitra Chanda[2], Rajesh Chabhadiya[2], Nikunj Kachhadia[1] Rathish Nair[2] and Asif Solanki[1], Journal of Serbian Chemical Society.

(5) "An ultrasonic study of some drugs in solutions", Shipra Baluja, Asif Solanki and Nikunj Kachhadia, J. Molecular Liquids

(6) "Synthesis of some Pyrazoline derivatives by Conventional, Microwaves and Ultrasound waves: A step to Eco-friendly Synthesis", Shipra_Baluja, Nikunj Kachhadia and Asif Solanki (Green Chemistry)

(7) "Antibacterial studies of some metal chelates of 1,2,4-triazole Schiff bases", Shipra Baluja*, Nikunj Kachhadia, Asif Solanki, Sumitra Chanda and Nilesh Godvani.

(8) "Acoustical studies of binary mixtures of Acetophenone at 308.15K", Shipra Baluja, Nirmal Pandaya, Nikunj Kachhadia and Asif Solanki

(9) THERMAL PROFILE AND DECOMPOSITION KINETICS OF SOME NEW SCHIFF BASES, Shipra Baluja, Nikunj Kachhadia and Asif Solanki, Indian J. Chem. Technology-Delhi.

(10) Thermodynamic and acoustical studies of triazole derivatives in dimethylformamide and tetrahydrofuran at 308.15 K, Shipra Baluja, Nikunj Kachhadia and Asif Solanki.

(11) Preparation, Characterization and Antibacterial activities of some Metal Complexes Containing Triazole Schiff Bases, Shipra Baluja*, Nikunj Kachhadia, Asif Solanki, Sumitra Chanda and Parag Ajudia, *Molecules* 2005, *10*, XXX-YYY.

(12) "SYNTHESIS OF SOME SCHIFF BASES AND THEIR BIOLOGICAL ACTIVITY", Shipra Baluja[1], Sumitra Chanda[2], Vaghasiya Yogesh Kumar[2], Rathish Nair[2] and Asif Solanki[1]

(13) Synthesis and antibacterial activity of some new triazole derivatives, Jigna Parekh[a], Asif Solanki[b], Shipra Baluja[b] and Sumitra Chanda[a*]

(14) Evaluation of biological activities of some Schiff bases and metal complexes, Shipra Baluja[*], Asif Solanki and Nikunj Kachhadia