SYNTHESIS AND CHARACTERIZATION OF BIOLOGICALLY ACTIVE HETEROCYCLIC PYRIMIDINE DERIVATIVES

A

DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE DEGREE OF MASTER OF PHILOSOPHY IN ORGANIC CHEMISTRY AT UNIVERSITY OF DHAKA

THESIS PRESENTED
BY
TOSHIBA ZENNAT
EXAMINATION ROLL NO. 1
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ORGANIC RESEARCH LABORATORY
DEPARTMENT OF CHEMISTRY
UNIVERSITY OF DHAKA
BANGLADESH

IN THE NAME OF ALLAH
THE MOST BENEFICENT,
THE MOST MERCIFUL

DEDICATED TO

MY FAMILY MEMBERS AND TEACHERS

CERTIFICATE

It is to certify that Ms. Toshiba Zennat has submitted M.Phil thesis entitled "Synthesis and characterization of biologically active heterocyclic pyrimidine derivatives". Her registration number is 176 / 2014-2015.

The word described in this thesis was conducted at the Organic Research Laboratory, Department of Chemistry, University of Dhaka. It is an original work done by the author and has not been submitted in support of any other degree.

Supervisor	Co-Supervisor
Dr. Kawsari Akhter Professor, Department of Chemistry University of Dhaka. Dhaka-1000, Bangladesh	Dr. U. K. R. Romman Professor (Retired) Department of Chemistry University of Dhaka Dhaka-1000, Bangladesh

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The research work has been undertaken and completed as a part of the M. Phil Examination. However, it is required to know the subject matter, general and practical idea of organic synthesis which I have acquired through out the learning period in this department. Therefore, the successful completion of the research work is not only a consequence of my own effort, but also is a collective contribution from many others.

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I express gratitude to the office staffs, lab assistants and office-bearers of the Department of Chemistry and Registry Building of Dhaka University for their instant help when and where necessary in course of my work.

Finally, I am grateful to my family members for their love and continuous support throughout my entire study period and preparation of this thesis.

October, 2021 Toshiba Zennat
(Author)

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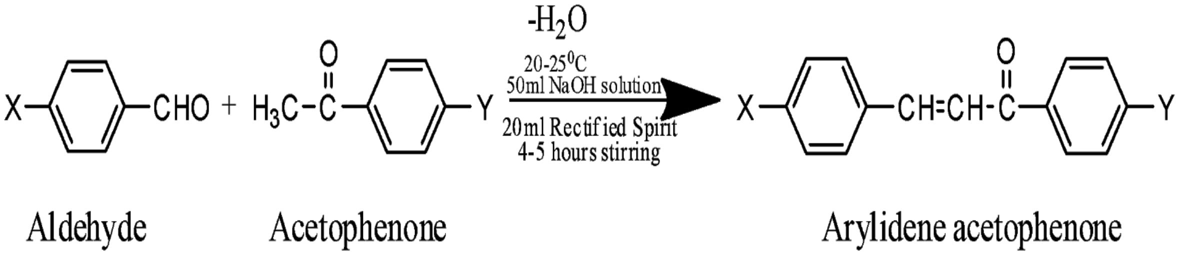
SUMMARY

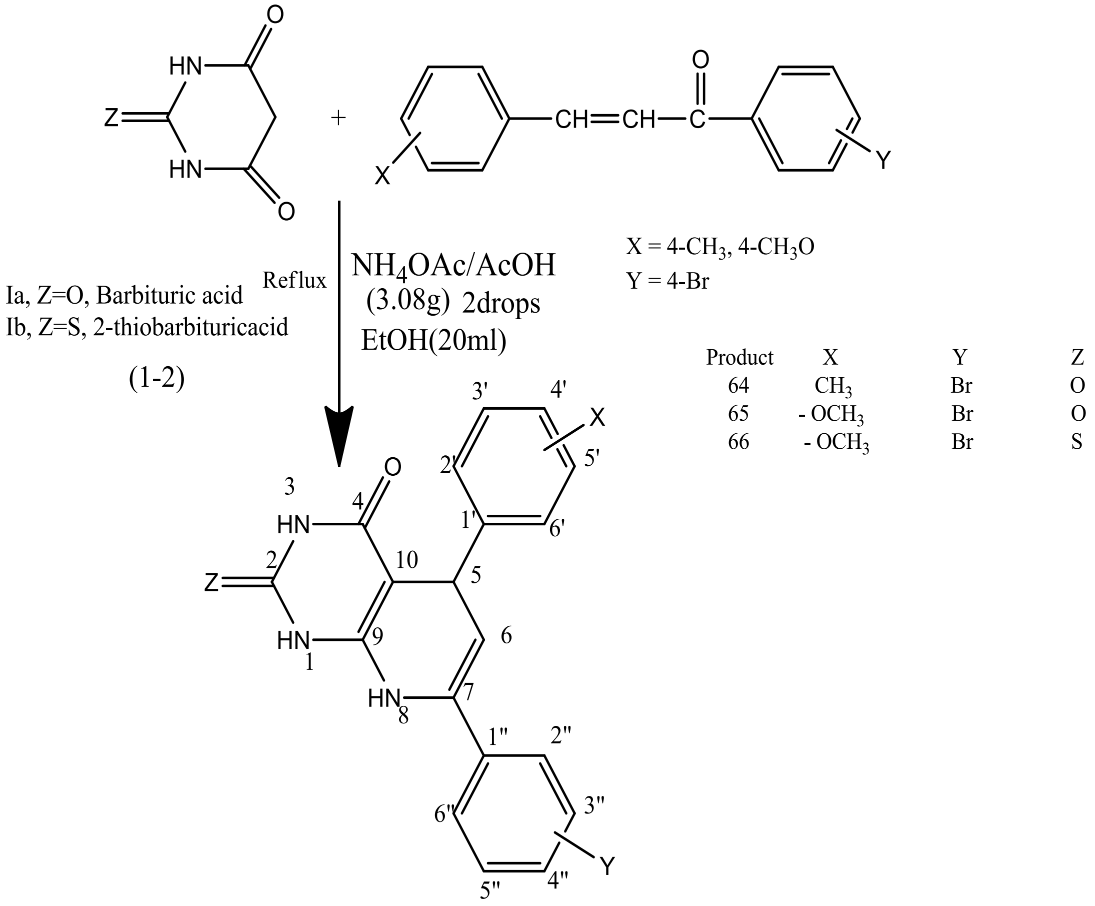
A number of pyridopyrimidines **64-66** were synthesized by the reaction of arylideneacetophenones **58-59** with barbituric acid **1** or 2-thiobarbituric acid **2** in presence of ammonium acetate (NH_4OAc) in ethanol (EtOH) and acetic acid (CH_3COOH). Spiro compounds **67-73** were also synthesized by the reaction of arylideneacetophenones **58-63** with barbituric acid **1** or 2-thiobarbituric acid **2** in presence of 4-methyl benzaldehyde/4-methoxy benzaldehyde, ammonium acetate (NH_4OAc) in ethanol (EtOH) and acetic acid (CH_3COOH). The structure of the compounds have been determined with the help of their chemical and spectroscopic analysis. The spectroscopic methods used were- UV, IR, ^{1}H NMR and ^{13}C NMR. The analysis of biological activity were also performed for some compounds.

For this purpose, at first substituted arylideneacetophenones **58-63** were prepared by carrying out reactions in sodium hydroxide between substituted benzaldehydes and acetophenones. The aldehydes were used 4-methylbenzaldehyde, 4-methoxybenzaldehyde, 4-chlorobenzaldehyde, 4-nitrobenzaldehyde. The acetophenones are 4-bromoacetophenone, 4-methylacetophenone, 4-nitroacetophenone.



Compound	X	Y
58.	4-CH_3	4-Br
59.	4-OCH_3	4-Br
60.	4-Cl	4-Br
61.	4-NO_2	4-Br
62.	4-OCH_3	4-NO_2
63.	4-Cl	4-CH_3

The reactions of substituted arylideneacetophenones with barbituric acid / 2-thiobarbituric acid in presence of ammonium acetate, acetic acid and ethanol is given below:



Ia, Z=O, Barbituric acid
Ib, Z=S, 2-thiobarbituricacid

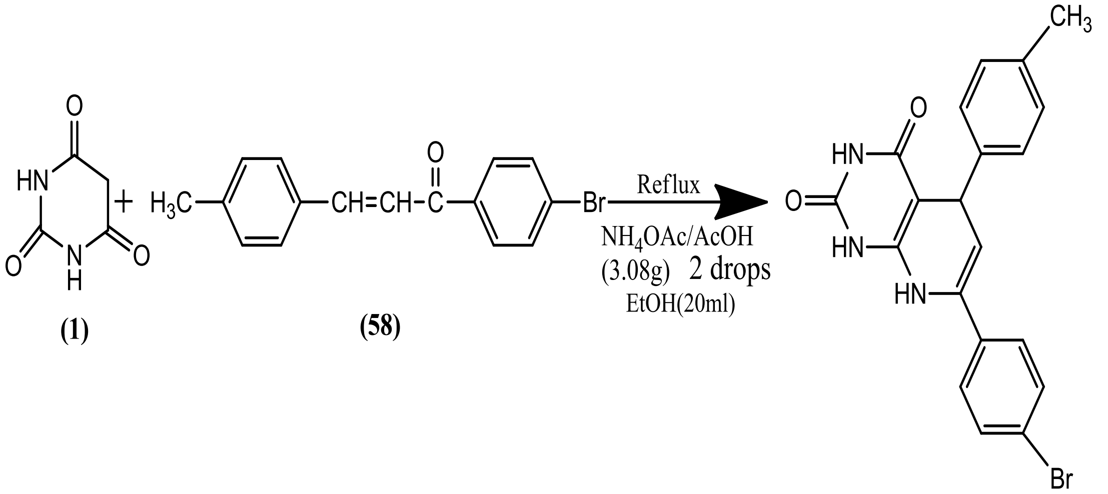
(1-2)

X = 4-CH_3, 4-CH_3O
Y = 4-Br

Product	X	Y	Z
64	CH_3	Br	O
65	- OCH_3	Br	O
66	- OCH_3	Br	S

64-66

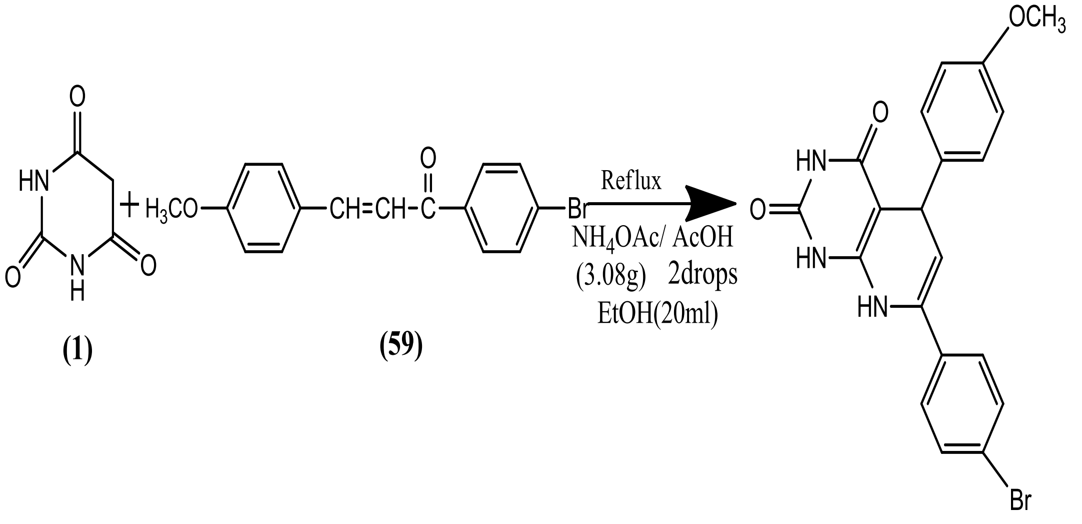
The reaction of 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one **(58)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid and ethanol under refluxing condition gave pyridopyrimidine compound **64**. The compound was recrystallized from ethanol. The melting point was 142-144^{0}C. The percentage of the yield was 68%.



7-(4-bromophenyl)-5-(*p*-tolyl)-5,8-dihydropyrido [2,3-*d*]pyrimidine-2,4(1*H*,3*H*)-dione

64

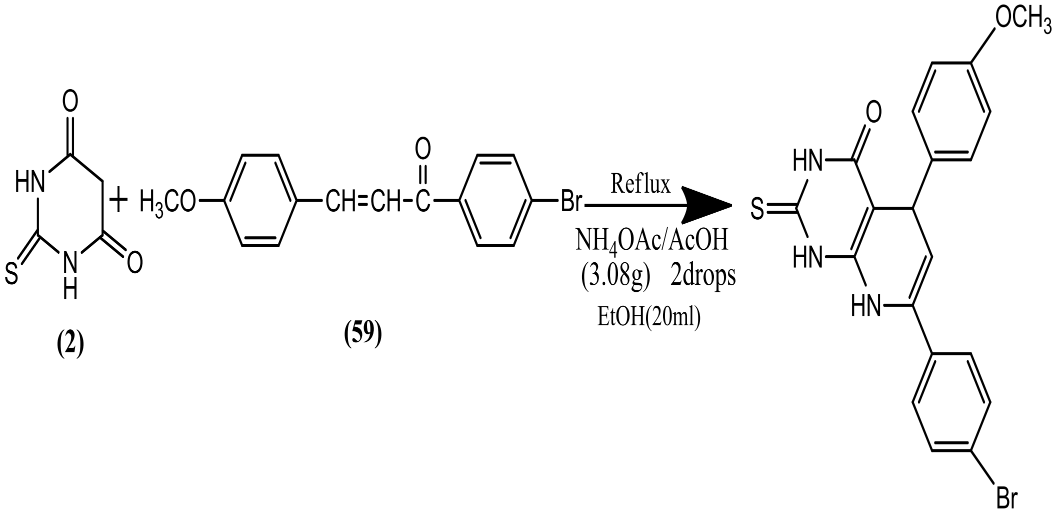
The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one **(59)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid and ethanol under refluxing condition gave pyridopyrimidine compound **65**. The compound was recrystalized from ethanol. The melting point was 159-160^{0}C. The percentage of the yield was 65%.



7-(4-bromophenyl)-5-(4-methoxyphenyl)-5,8-dihydropyrido[2,3-*d*]pyrimidine-2,4(1*H*,3*H*)-dione

(65)

The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one **(59)** and 2-thiobarbituric acid **(2)** in 1:1 molar ratio with ammonium acetate in acetic acid and ethanol under refluxing condition gave pyridopyrimidine compound **66**. The compound was recrystalized from ethanol. The melting point was 168-170^{0}C. The percentage of the yield was 63% .



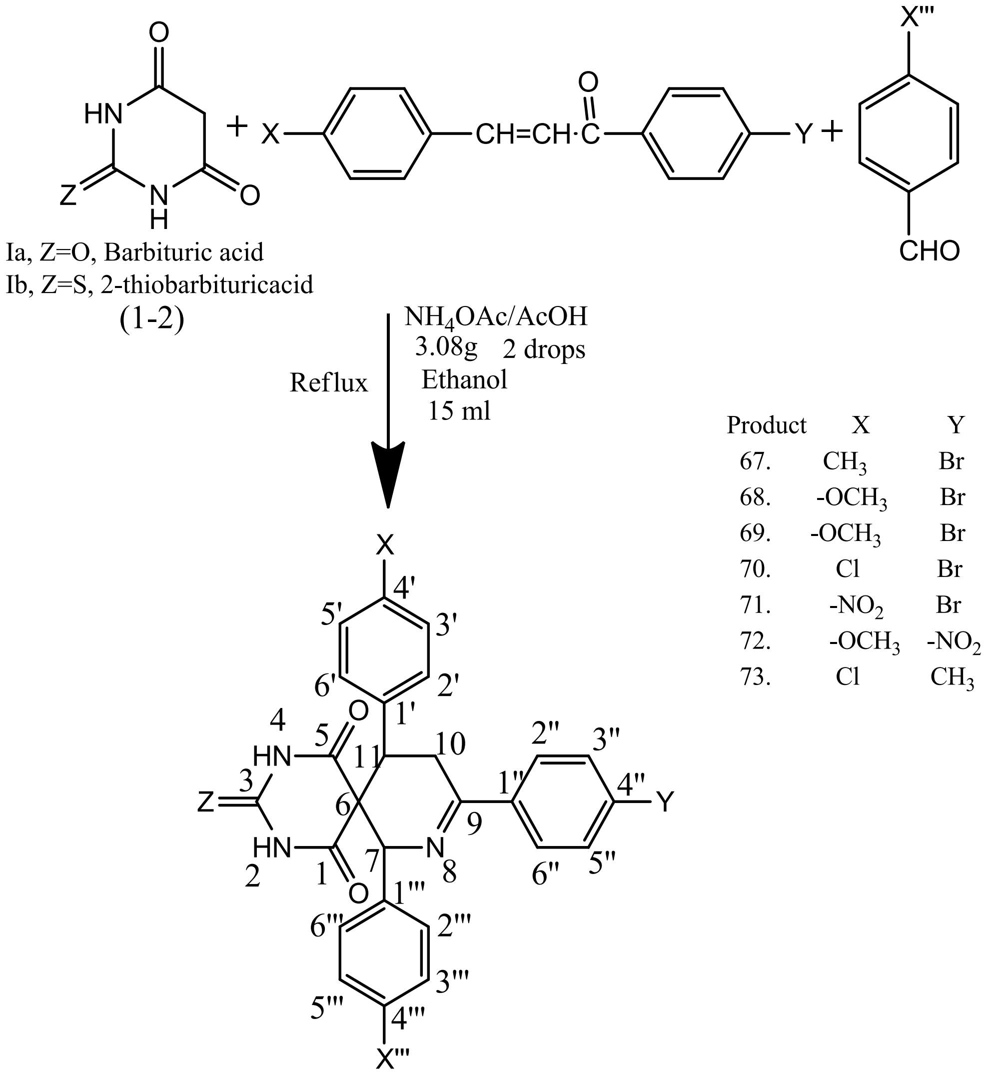
(2)

(59)

7-(4-bromophenyl)-5-(4-methoxyphenyl)-2-thioxo-2,3,5,8-tetrahydropyrido[2,3-*d*]pyrimidin-4(1*H*)-one

(66)

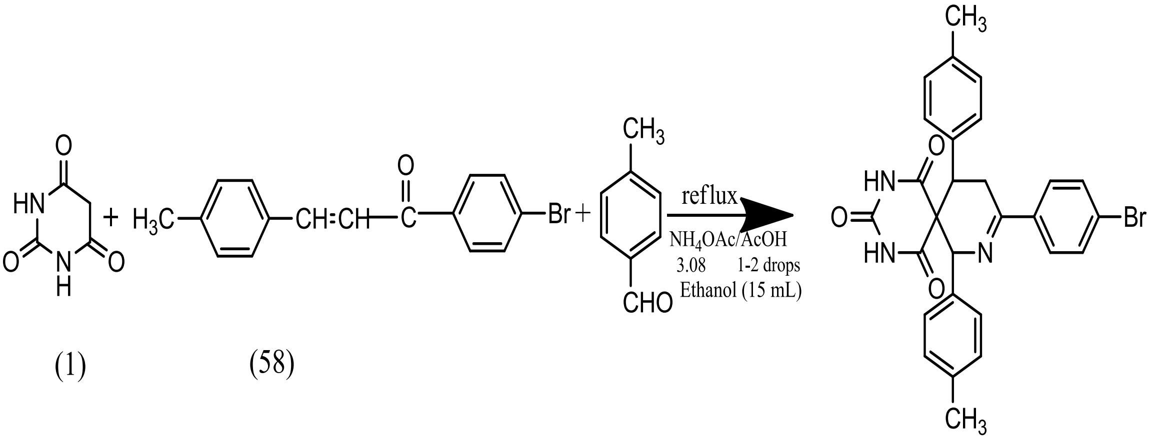
The reactions of substituted arylideneacetophenones with barbituric acid / 2-thiobarbituric acid, substituted benzaldehydes, ammonium acetate in acetic acid and ethanol is given below:



Product	X	Y	Z	X'''
67.	CH_3	Br	O	4-CH_3
68.	-OCH_3	Br	O	4-CH_3
69.	-OCH_3	Br	S	4-CH_3
70.	Cl	Br	O	-OCH_3
71.	-NO_2	Br	O	-OCH_3
72.	-OCH_3	-NO_2	O	-OCH_3
73.	Cl	CH_3	O	-OCH_3

67-73

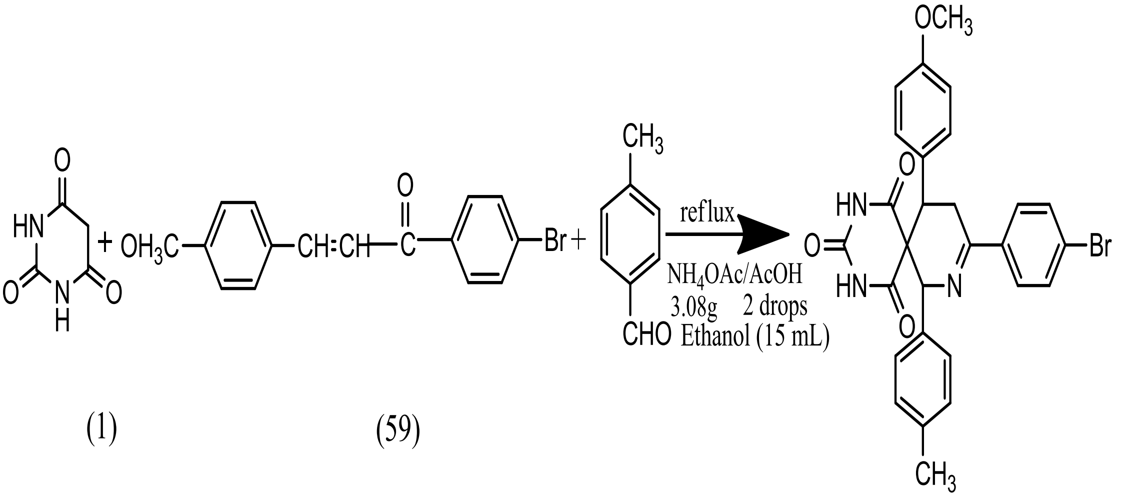
The reaction of 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one **(58)** and barbituric acid **(1)** in 1:1 molar ratio with 4-methylbenzaldehyde, ammonium acetate in acetic acid and ethanol, under refluxing condition gave spiro compound **67**. The compound was recrystallized from ethanol. The melting point was 150-151^{0}C. The percentage of the yield was 60%.



(7*R*,11*R*)-9-(4-bromophenyl)-7,11-di-*p*-tolyl-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(67)

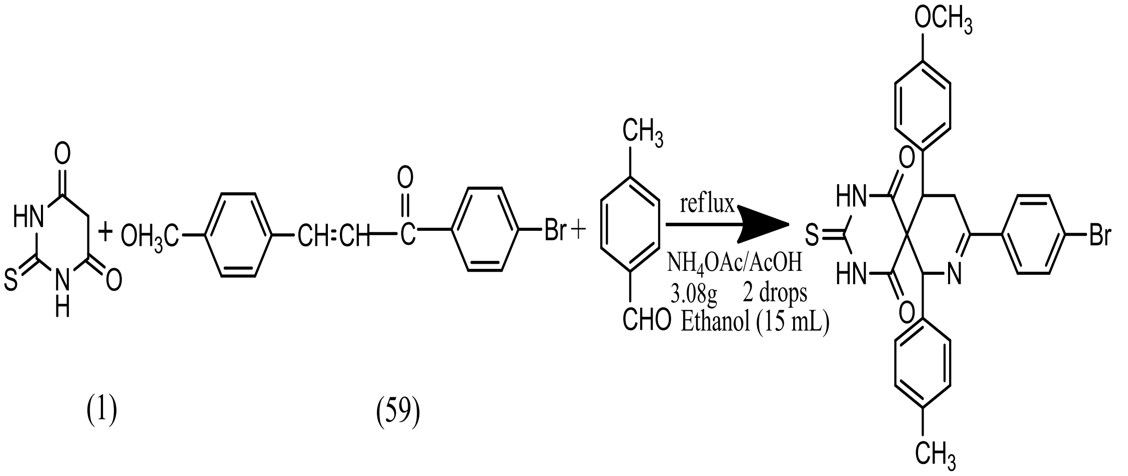
The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one **(59)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol and 4-methyl benzaldehyde under refluxing condition gave spiro compound **68**. The compound was recrystallized from ethanol. The melting point was 130-132^{0}C. The percentage of the yield was 64%.



(7*R*,11*R*)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(68)

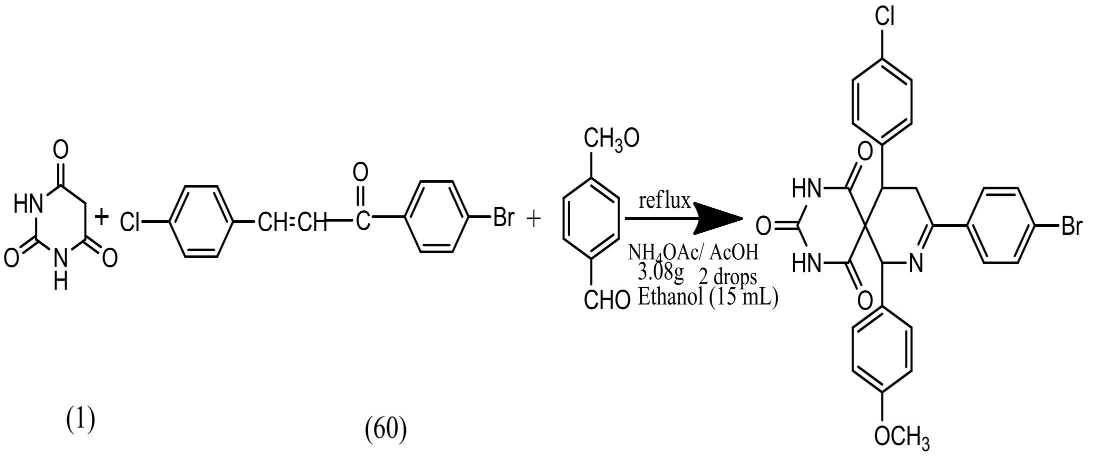
The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one **(59)** and 2-thiobarbituric acid **(2)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol, 4-methyl benzaldehyde under refluxing condition gave spiro compound **69.** The compound was recrystallized from ethanol. The melting point was 130-132^{0}C. The percentage of the yield was 65%.



(7*R*,11*R*)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-3-thioxo-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione

(69)

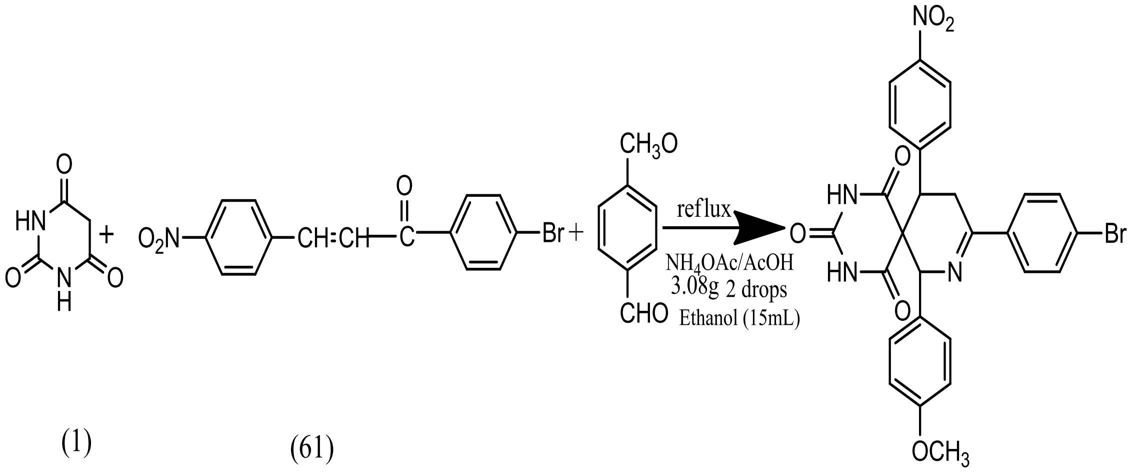
The reaction of 1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one **(60)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol and 4-methoxy benzaldehyde under refluxing condition gave spiro compound **70.** The compound was recrystallized from ethanol. The melting point was 184-186^{0}C. The percentage of the yield was 66%.



(7*R*,11*R*)-9-(4-bromophenyl)-11-(4-chlorophenyl)-7-(4-methoxyphenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(70)

The reaction of 1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one **(61)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol and 4-methoxy benzaldehyde under refluxing condition gave spiro compound **71.** The compound was recrystallized from ethanol. The melting point was 205-207^{0}C. The percentage of the yield was 59%.



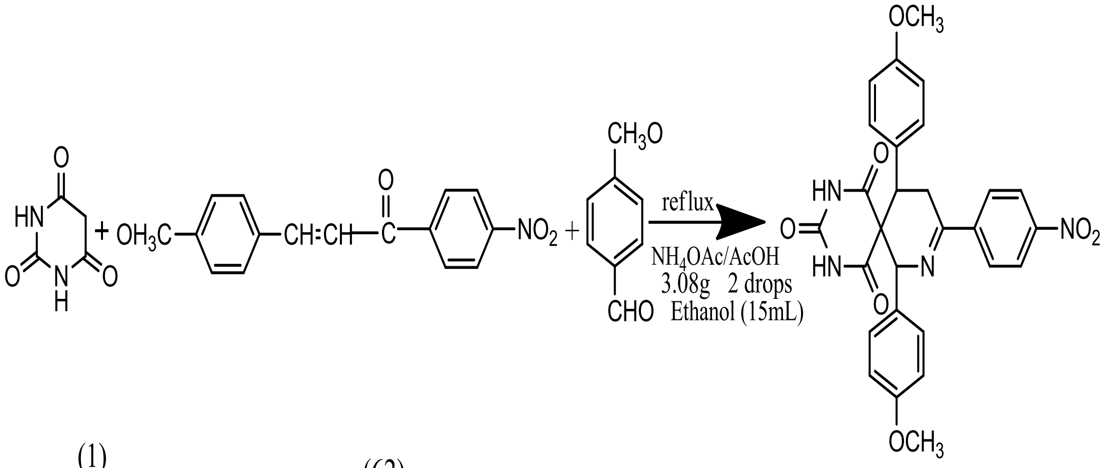
(1)

(61)

(7*R*,11*R*)-9-(4-bromophenyl)-7-(4-methoxyphenyl)-11-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(71)

The reaction of 3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one **(62)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol and 4-methoxy benzaldehyde under refluxing condition gave spiro compound **72**. The compound was recrystallized from ethanol. The melting point was 205-207^{0}C. The percentage of the yield was 69%.



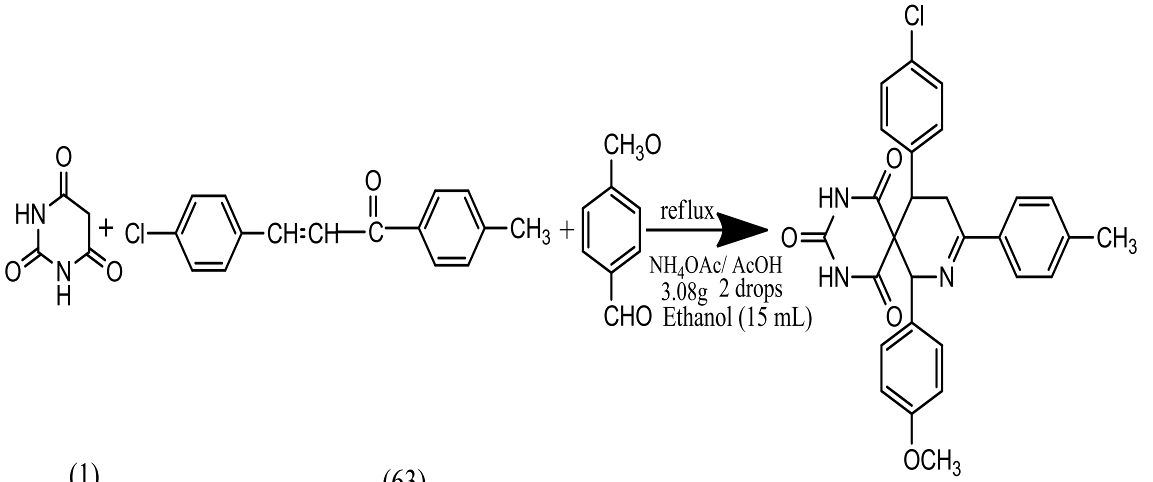
(1)

(62)

(7*R*,11*R*)-7,11-bis(4-methoxyphenyl)-9-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(72)

The reaction of 3-(4-chlorophenyl)-1-(*p*-toly)prop-2-en-1-one **(63)** and barbituric acid **(1)** in 1:1 molar ratio with ammonium acetate in acetic acid, ethanol and 4-methoxy benzaldehyde under refluxing condition gave spiro compound **73.** The compound was recrystallized from ethanol. The melting point was 188-190^{0}C. The percentage of the yield was 65%.



(1)

(63)

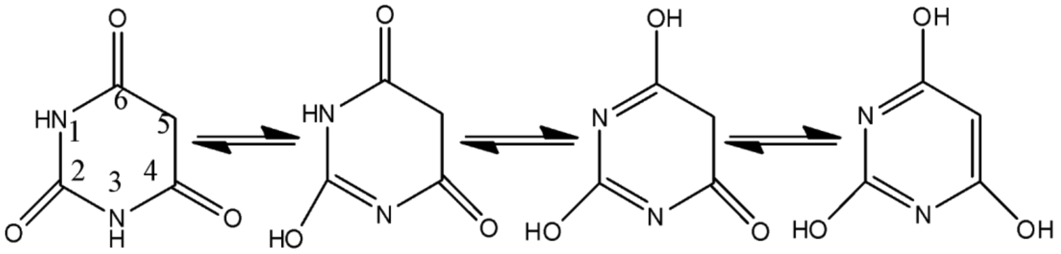
(7*R*,11*R*)-11-(4-chlorophenyl)-7-(4-methoxyphenyl)-9-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(73)

INTRODUCTION

Structural Features of Barbituric Acid and Thio-barbituric Acid :

Barbituric Acid: Barbituric acid structure has been proposed acidic nature. An active methylene group is present in barbituric acid, so it easily reaction with nitrous acid and forms an oximino derivatives. Based on physical and chemical properties barbituric acid is believed to exist as the following tautomeric structure :

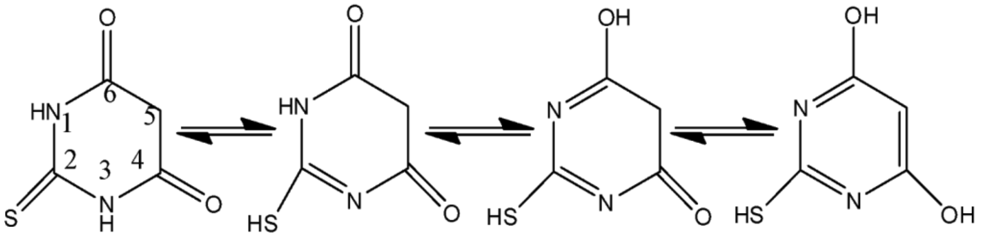


Barbituric acid Monohydroxy form Dihydroxy form Trihydroxy form

(1) (Monolactim) (Dilactim) (Trilactim)

2-Thiobarbituric acid

The carbonyl group is present in 2-position of barbituric acid, when this carbonyl group replaced by a thiocarbonyl group, the compound is called thiobarbituric acid or 2-thiobarbituric acid (2). The structures of 2-thiobarbituric acid (tautomeric from) :



Thiobarbituric acid (Monothiolactim) (Dilthioactim) (Trithioactim)

(2)

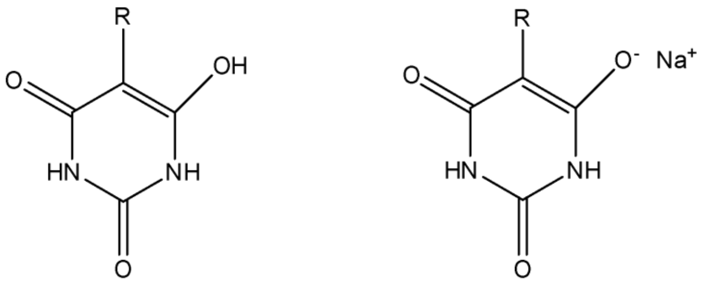
The active methylene group of 2-thiobarbituric acid at 5-position behaves similarly as barbituric acid.

As the methylene group in the 5-position of 1 or 2 is flanked by two carbonyl groups it may be regarded as an active methylene group and the methylene hydrogens can be replaced by suitable groups or structures.

Barbituric acid exits as the trioxo tautomer confirmed by X-ray analysis[1][2]. The trihydroxy tautomer (trilactim) was ruled out in aqueous solution, because no ultraviolet bands which are characteristic of a trihydroxyhexahydropyramid structure were found[3]. Ultraviolet spectroscopy also revealed that barbituric acid, 1-methylbarbituric acid and 1,3-dimethylbarbiturl, 1-methylbarbituric acid and 1,3-dimethylbarbituric acid show similar spectra, thereby providing further evidence against the existence of the trilactim. Barbituric acid in aqueous solution, therefore, may be characterized by equilibrium among barbituric acid, monolactim and dilactim.

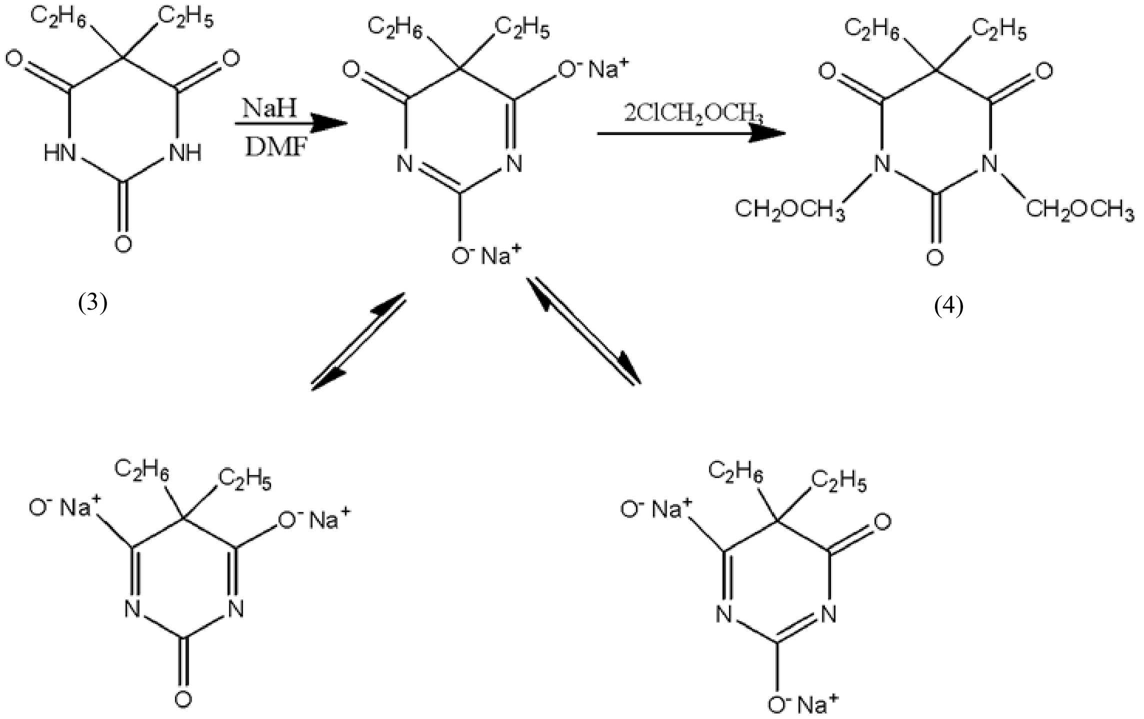
Ultraviolet spectroscopic studies were also conducted with monosubstituted and disubstituted barbituric acids[4-7].

Unsubstituted barbituric acids pK (dissociation constant) of ranges from 7.1 to 8.1[8]. Unsubstituted, 1-substituted, 5-substituted, 1,3-disubstituted and 1,5-disubstituted compounds are exist in the tautomeric form for this reason these compound are strongly acidic. This barbituric acid are easily converted as salts are readily obtained by the treatment with bases.



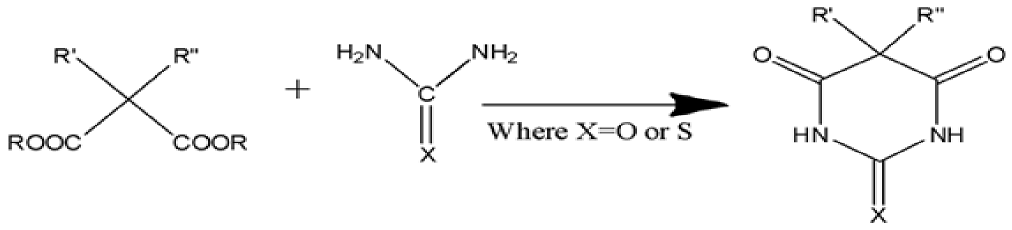
Tautomeric form of Salt of barbituric acid

The preparation of dialkail salt of phenobarbital has recently been reported.[9][10]



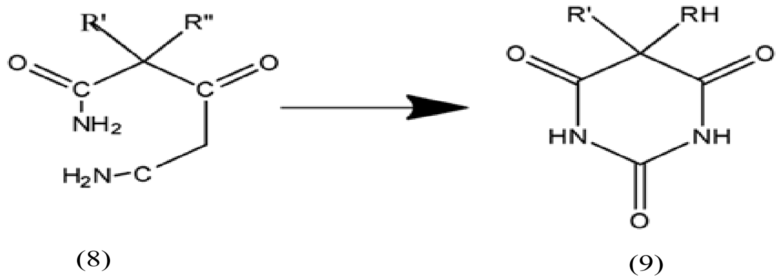
Preparation of C-5 substituted barbituric acids and 2-thiobarbituric acids:

Barbituric acid derivatives are easily prepared by condensation reactions. The media of this reactions are acidic, neutral or basic media. Condensation reactions in an alkaline medium involve malonic esters[11], cyanoacetic esters and malonic amides on the one hand and urea or thiourea on the other hand.



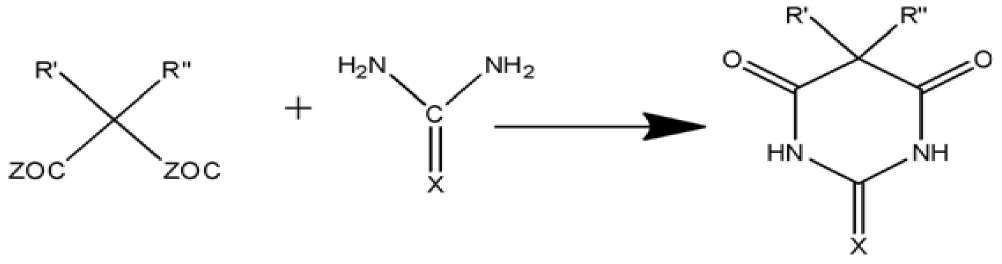
(5) (6) (7)

Cyclization of N-substituted ureas in an alkaline medium also produces barbiturates.



(8) (9)

Condensation reactions in a neutral or acidic medium take place readily between malonyl chlorides or malonic acids and urea or thiourea.

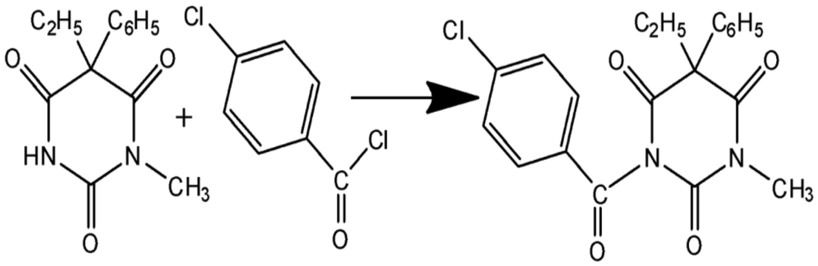


(10) (11) (12)

Where Z=OH or Cl and X=O or S

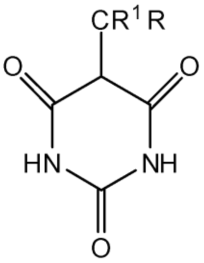
1.2 Literature Reviews of Pyrimidine Derivatives

In 1966, W. Kahl[12] and co-warker reported the reactions of barbituric acid with 2 and 4-chlorobenzoyl chloride. Benzoylation of 10 g 1-methyl-5-ethyl-5-phenyl barbituric acid **13** in 2.3 mL pyridine with 5.2 mL 4-Cl-C_6H_4COCl **14** for 5 hours at 135^0C led to 7 g 1-methyl-3-chlorobenzoyl-5-ethyl 5- phenyl barbituric acid **15**, m.p. 125^0C (method A). A suspention of 10 g **13**, 4 g salt and 3.7 mL **14** in 150 mL C_6H_6 refluxed for 5 hours gave 6.5 g **15** (method B). Similarly preparations were (compound, m.p. and method given): 1-methyl-3-2-chlorcbenzoyl-5-ethyl-5-phenyl barbitric acid, 101^0C, A and B; 1,5-dimethyl-3-4-chlorobenzoyl-5-cyclohexenyl barbituric acid, 146^0C, A and B; 1,5-dimethyl-3-2-cholorobenzoyl-5-cyclohexenyl barbituric acid, 104^0C, A and B; 1,3-bis-(2-chlorobenzoyl)-5,5-diethyl barbituric acid,128^0C, B; 1-2-chlorobenzoyl-5,5-diethyl barbituric acid, 124^0C, A; 1-4-chlorobenzoyl-5,5-diethyl barbituric acid, 173^0C, B; 1,3-bis(2-chlorobenzoyl)-5-ethyl-5-phenyl barbituric acid, 147^0C, B; 1-2-chlorobenzoyl-5-ethyl-5-phenyl barbituric acid, 144^0C, A; 1,3-bis(4-chlorobenzoyl)-5-ethyl-5-phenyl barbituric acid, 155^0C, B.



(13) **(14)** **(15)**

In 1969, V. M .Wedenskii[13] and his co-workers performed condensation of barbituric acid **1** with oxo compounds. It revealed that aliphatic aldehydes with exception of HCHO, react with the active 5-CH_2-group of **1** to yield the corresponding products **16**. Ketones in a 1:2 reaction with **1** to give **17.**



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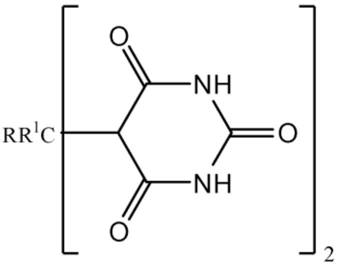
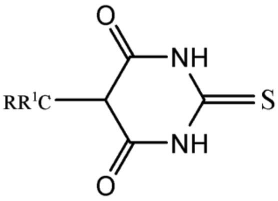
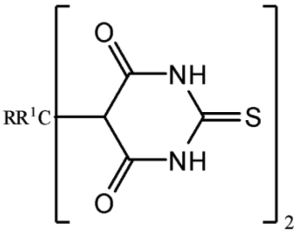


(17)

Again in 1969, V. M .Wedenskii[14] performed the condensation of thiobarbituric acid **2** with oxo compounds revealed that aldehydes react mostly with the active 5-CH_2- group of **2** to give 1:1 condensation products **18** (R^1=H). Several aldehydes and most ketones undergo 1:2 condensation to give **19.**

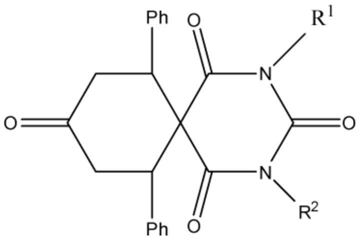


(18)



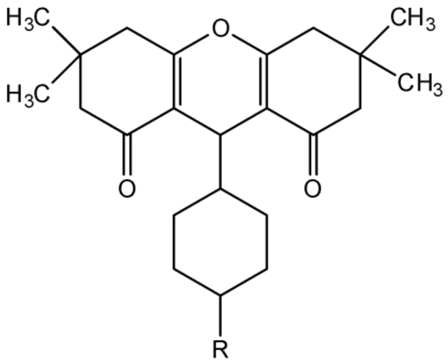
(19)

In 1976, H. H. Otto[15] and co-workers reported the synthesis of 7, 11-diphenyl-2,4-diazaspiro [5,5] undecan-1,3,5,9-tetraone **20** from 1,5-diphenyl-1,4-pentadiene-3-one with barbituric acids with or without basic catalyst.



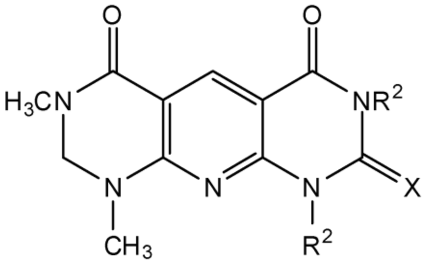
(20)

In 1985, I. Zilineee[16] and his co-workers performed condensation reaction of 4-RC_6H_4CHO (R=MeO, H, NO_2) with barbituric acid at 95^0C in DMF got the corresponding 5-arylidene barbituric acid **21** in 47.5-81.2% yield.



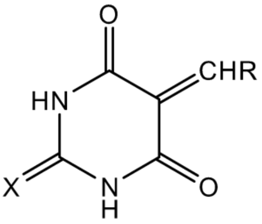
(21)

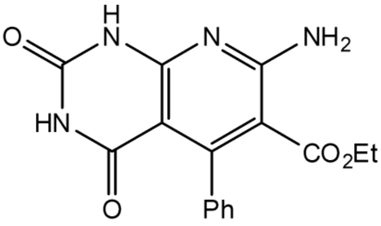
K. Hirota[17] in 1985 permormed reaction of 5-dimethyl aminimethylene-6-imino-1,3-dimethyluracil hydrochloride **22** with barbituric acids resulted in the formation of pyridodipyrimidinetetrone derivatives **23** (R^2=Me, H, X=O; R^2=H, X=S).



(22)

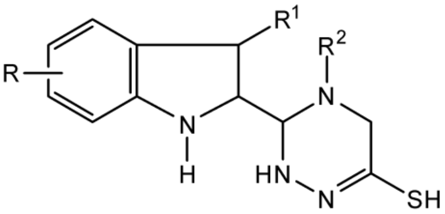
In 1991, M. EI-Badawi[18] and co-workers reported that arylidenepyrimidines **23** (R=Ph, X=O, S; R=4-MeOC_6H_4, 5-isatylidene, X=O; R=PhCH:CH, MeCH:CH, X=S) under went cyclocondensation with a number of active methylene and carbonyl compounds to give cyclic products. Thus, **23** (R=Ph, X=O) upon treatment with EtO_2CCH_2CN in pyridine in the presence of NH_4OH afforded 72%pyridopyrimidine, **24**.

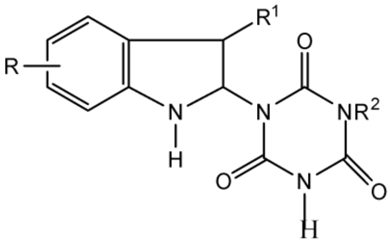




(23) **(24)**

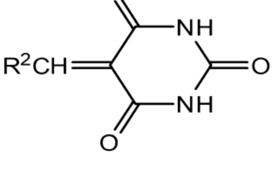
In 1992, S.P. Hiremath[19]and co-workers synthesized (indolyl) triazolethioles **25** (R=alkyl, alkoxy; R^1= alkyl, phenyl; R^2=aryl) and (indolyl) pyrimidinetriones **26** (R=halo, alkyl, alkoxy, aryl). The compound was also tested for antimicrobial activity.

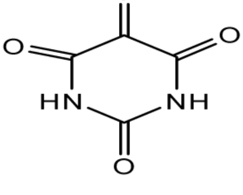




(25) **(26)**

In 1992, R. Cremlyn[20] and co-workers synthesized condensation of barbituric acid with aromatic aldehydes to yield 5-arylidene derivatives **27** (R^2=Ph, 2-, 3-, or 4-MeOC_6H_4, 4-FC_6H_4, 2, 3-, 2, 4-, 3, 4-, 3, 4-, or 2, 6-$Cl_2C_6H_3$, 2- or 4-$F_3CC_6H_4$, 4-PhCH:CH, 2-MeOC_6H_4CH:CH,PhCH:CMe, 2-thienyl, 5-nito-2-thienyl, 1-naphthyl). Chlorosulfonic acid with benzylidene barbituric acid **compound-27** (R^2=Ph) reaction of the sulfonyl chloride with amines, (R^2=2-, 3-, or 4-MeCOC_6H_4,4-PhC_6H_4,PhCH:CH, 2-thienyl, 1-naphthyl).

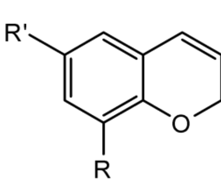




(27) **(28)**

In 1993 J. Prousek[21] synthesized condensation reaction of barbituric acid with RCHO to give 53-96% of the compound **28 (** R=nitrophenylfuryl; phenylthienyl).

Again, in 1993 J. D. Figueroa-Villaret. al [22] synthesized oxadeaz flavine derivatives **29** (R=R^1=H, R^1=Cl, R=MeO, R$^{1=}$H) barbituric acid, salicyldehydes **30** thiocyanidine products given **29** treated with AcOH-Ac$_2$O. 100^{0}C the dihydrochromenopyrimidinediones **31** were obtained.



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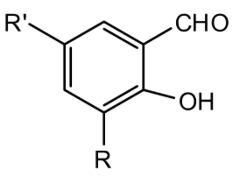

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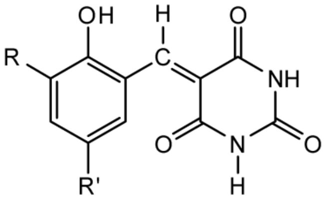
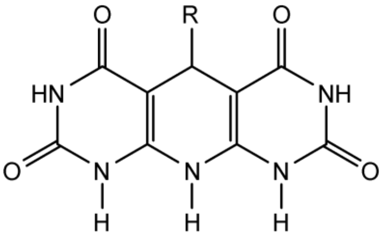


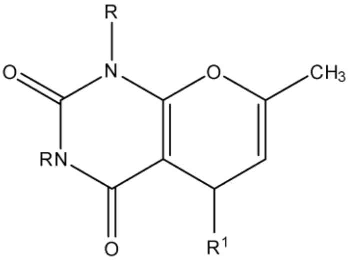
(31)

R. K.Kajuria[23] and his co-workers in 1993 had prepared compound **32** [R=3-OH-C$_6$H$_4$; 4-MeOC$_6$H$_4$; 2, 3, 4-O$_2$NC$_6$H$_4$; 3, 5-MeO (1) C$_6$H$_3$; 2, 3-, 2, 4-, 2, 5- or 3, 4- (HO)$_2$C$_6$H$_3$; 3, 4- or 3, 6-HO(O$_2$N)C$_6$H$_3$; 3,4- OR 3, 2- MeO(HO)- C$_6$H$_3$; 3, 4, 5-MeO(HO)(O$_2$N)C$_6$H$_2$; 3, 4- methylenedoxyphenyl] by condensation of substituted benzaldehyde RCHO with barbituric acid in presence of ammonium hydroxide in EtOH.



(32)

In 1993, V. K. Ahluwalia[24] and his co-workers reported a convenient one pot synthesis of 5-aryl-7-methyl-1, 2, 3, 4-tetrahydro-2, 4-dioxo-5H-pyrano[2,3-d] pyrimidines **33** barbituric acids **34** with benzylidene acetones, gl. Acetic acid in P$_2$O$_5$.



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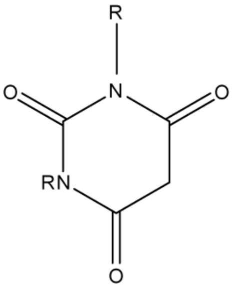
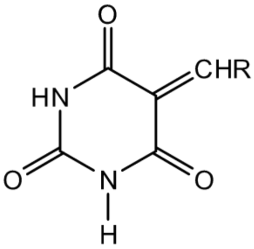


(34)

In the year 1995 Cao-Yun-Wei[25]and co-workers synthesized and characterized several electron donor-aceptor amphilic compounds **35 [**R=4-dodecycloxyphenyl, 4- (N,N-dioctadecylamino) phenyl] prepared barbituric acid and aldehydes with condensation reaction. Basic media, the reaction rates were measured by slow, however, in the neutral media, the rates were very fast.



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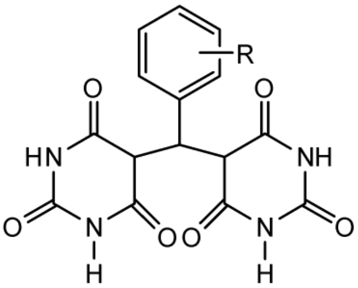
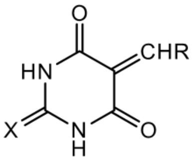


(36)

In 1995, A. V. Moskvin[26] along with his co-workers conducted studies on azoles and azines. Themolar ratio 2:1, reactant:barbituric acid and aromatic aldehydes with condensation reaction. The reactions in pyridine gave pyridinium salts of arylidenebis [barbituric acid] derivatives **(36**; R=H, 4-F, 3-Br, 2-NO_2, 3-NO_2, 4-NO_2**)**.

In 1995, EI Sayed I. Ibrahim[27] and co-workers studied on condensation of barbituric and thiobarbituric acids with RCHO (R=Ph, 4-ClC_6H_4, 4-$MeOC_6H_4$, 2-$O_2NC_6H_4$, X=O, S) gave arylidene derivatives **37** which were treated with $N_2H_4.H_2O$ to give benzalazines RCH: NN: CHR; similarly reaction with NH_2NHY (Y=Ph, Me) gave ECH:NNHY. Treating **37** (R=Ph, 4-ClC_6H_4, 4-$MeOC_6H_4$, X=O) with morpholine gave stereoisomeric (no data) barbituric acids **38.** Additional obtained were benzopyranopyrimidinedione **39,** pyranopyrimidinedione **40** (Z=O), and pyranopyrimidinedione **40** (Z=NNHPh).



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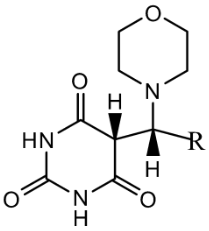

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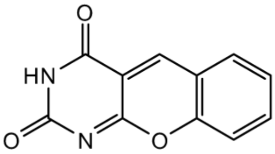

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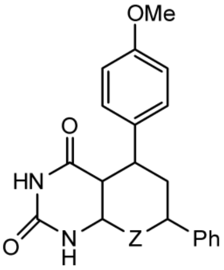
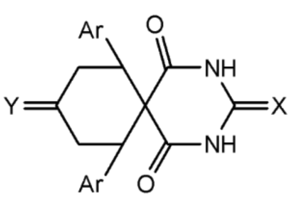


(40)

A. N. Osman[28] and co-workers in 1996 performed synthesis and anti convulsant activity of spiro compounds barbituric and thiobarbituric acids. Divinyl ketones ArCH: CHCOCH: CHAr (Ar=Ph, substituted phenyl), Michael addition with barbituric acid or thiobarbituric acid gave the desired spiro compounds **39** (X=O, S; Y=O; R=H). The ketoximes **41** (Y=HON) from **41 (**Y=O) on Beckmann transformation by treatment with PCl_5 furnish the spiro azepines **41**. Alkylaion of some of the comounds **41** (X=Y=O, R=H) afford the anticipated N-substituted products **42** (R=Et, CH_2:$CHCH_2$, $PhCH_2$).



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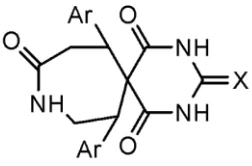

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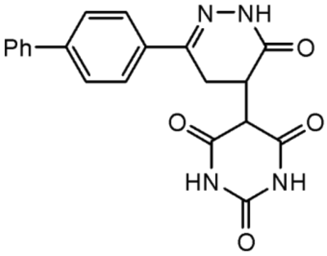
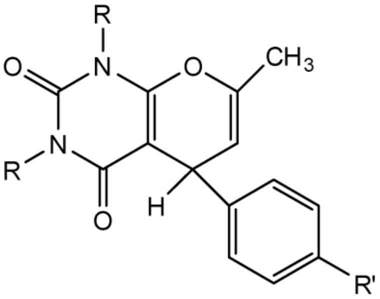


(43)

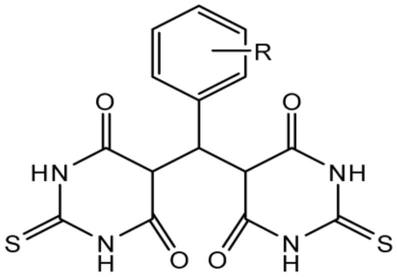
In 1996, A.M. Radwan[29] and co-workers synthesized some new pyridazinone derivatives containing the barbituric moiety via addition of barbituric acid to 4-$PhC_6H_4COCH:CH_3COOH$, followed by cyclization of the adduct with hydrazine, phenylhydrazine and semicarbazide. Reactions of pyridazinone **43** with *p*-anisaldehyde, bromine-acetic acid, $POCl_3$ and P_2S_5 were examined.

V. K. Ahluwalia[30] and his co-workers in 1996 carried out the condensation reaction of diethoxymethylenemalonate with approprite 1,3-diaryl-2-thiobarbituric acids **41** in acetic acid leads to 1,2,3,4-tetrahydro-4,7-dioxo-2-thioxo-7H-pyrano[2,3-d]pyrimidines in a single step. Alternatively, same compounds could be synthesized by the reaction of **44** with tri-Et ortho formate and aniline followed by the reaction of the resultant 5-anilinomethylene-1,3-diaryl-2-thiobarbituric acids with di-ethylmalonate, sodium ethoxide in ethanol.



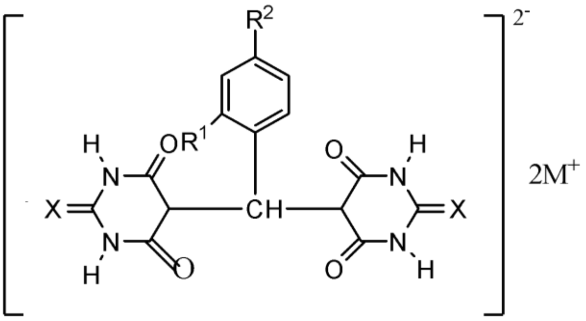
(44)

In 1998, A. V. Moskvin[31] and co-workers synthesized barbituric acid, 2-thiobarbituric acid with aromatic aldehydes in pyridine to from pyridinium salts of 5,5'-arylmethylene-bis(2-thiobarbituric acids), e.g. **45** (R=4-Me_2N, 4-OH, 4-Cl, 2-NO_2, 4-MeO). These salts can be isolated when the aldehyde contains both electron-acceptor and electron-donor substituents, including the dialkyl amino group, 5,5 '-arylmethylene-bis(2-thiobarbituric acids), are more stable than their oxo analogs and they can be synthesized directly from 2-thiobarbituric acid and an aromatic aldehyde.



(45)

In 1999, R. I. Ashkinazi[32] prepared compounds **46** [X=O, S; R^1=H, NO_2, alkoxy; R^2=H, NO_2, alkoxy, halo; M^+ =H^+ , pyridinium, (2-hydroxy ethyl)-ammonium] having antibacterial, antichlamydial, antiviral and immunomodulating activity. Thus, 3 mmol of 2-thiobarbituric acid and 1.5 mmole of 4-chlorobenzaldehyde were refluxed 1-2 hours in 10-15 mL of pyridine to give **89** (X=S, R^1=H, R^2=Cl, M=$C_5H_5NH^+$) in 89% yield.



(46)

In 2000, G. Alcerreca[33] and co-workers carried out condensation of several benzaldehydes with barbituric acid under IR irradiation, in absence of solvent affording 5-benzylidene barbituric acids.

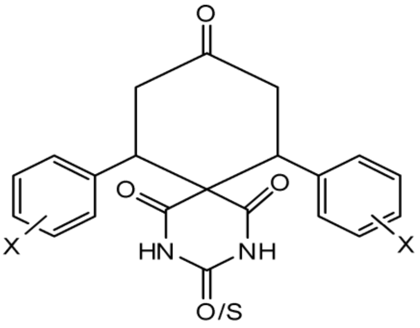
In 2001, Gogotor[34] and his co-worker products obtained from aromatic hydroxy aldehydes with barbituric acid by condensation reaction and this compound were tested as *p*-quinonedioxi methermal polymer of styrene based on.

In 2002, Dewan Sharma K[35] and his co-worker studied on the condensation of barbituric acid with aldehydes has been carried out in presence of K-1o clay, silica gel, Na_2SO_4 (anhyd), $MgSO_4$ (anhyd) catalyst under microwave irradiation to give barbiturates in high yields.

In 2003, Shi[36] and his co-worker synthesized condensation of aromatic aldehydes with acidic methylene compounds like as malononitrile, methylcyanoacetate, 5,5-dimethyl-1,3-cyclohexadione, barbituric acid 2-thiobarbituric acid proceed by efficently triethylbenzyl ammonium chloride in water. This product were isolated simply by filtration.

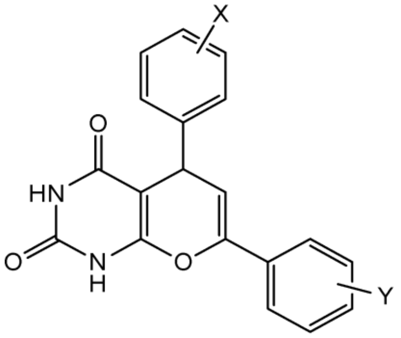
In 2004, Wan[37] and his co-worker obtained from aromatic aldehydes with acidic methylene compounds like as barbituric acid and 2-thiobarbituric acid. This product were isolated filtration.

In 2005[38] and 2011[39], M. G. Ahmed and co-workers reported the synthesis of 7,11-diaryl-3-oxo (or thioxo) -2,4-diazaspiro[5,5]undecane-1,5,9-triones **47** from the reaction 1,5-diaryl-1,4-pentadien-3-ones with barbituric acid and thiobarbituric acid.



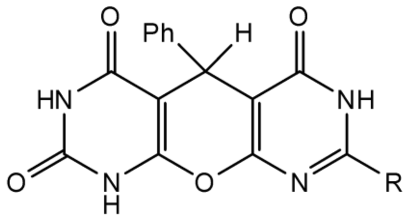
(47)

In 2006[40], 2011[41], 2012[42], 2013[43], 2016[44] and 2017[45], M. G. Ahmed and his co-workers synthesized 5,7-diaryl-1,2,3,4-tetrahydro-2,4-dioxo-5H-pyrano[2,3-d]pyrimidine **48** in single-step by the condensation of barbituric with arylideneacetophenone in gl. acetic acid in presence of P_2O_5.



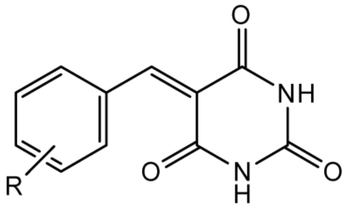
(48)

In 2007, M. Kidwai[46] and co-workers studied on pyrano [2,3-d]pyrimidines which have been cyclised using various aromatic acids on different solid supports to yield pyranodipyrimidines **49** selectively.



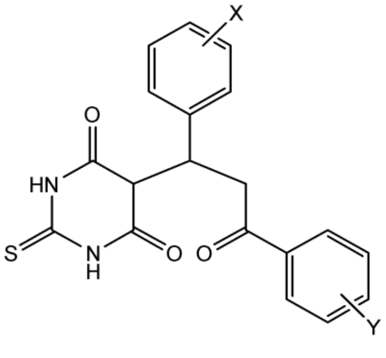
(49)

In 2007, C. S. Reddy[47] and co-workers reported a new and efficient method for the synthesis of 5-arylmethylene-pyrimide-2,4,6-trione **50** under solvent and catalyst free conditions.



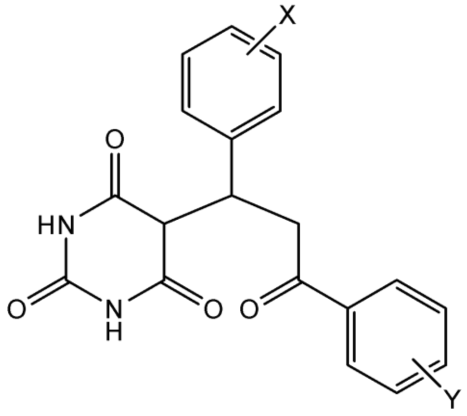
(50)

In 2007, M. G. Ahmed[48]and co-workers studied on the synthesis of 5-(1,3-diaryl-1-oxopropyl)-2- thioxo-pyrimidine(1H,3H,5H)-4,6-diones **51** from the reaction of 1,3-diaryl-2-propene-1-ones with 2-thiobarbituric acid under refluxing condition in 50% aq. ethanol.



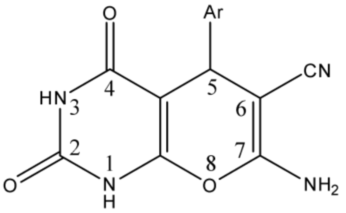
(52)

In 2007[49] and 2009[50], M. G. Ahmed and co-workers reported the synthesis of 5-(1,3-diaryl-1-oxopropyl) pyrimidine(1H,3H,5H)-2,4,6-triones **53** from the reaction of 1,3-diaryl-2-propene-1-ones with barbituric acid under refluxing condition in 50% aq. ethanol.



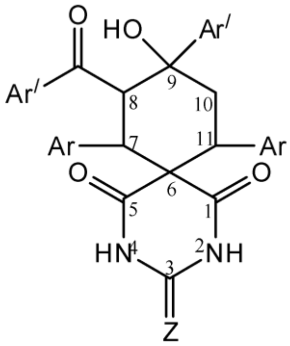
(53)

In 2009, S. Balalaie[51] and co-workers reported the synthesis of pyrano[2,3-d] pyrimidinone derivatives **54** catalyzed by L-pyroline in aqueous media.



(54)

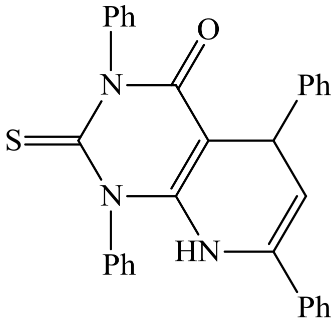
In 2012, S. M. Ahmed[52] and co-workers reported the synthesis of 8-aroyl-9-hydroxy-7,9,11-triaryl-3-oxo(or thioxo)-2,4-diazaspiro[5.5] undecane-1,5-diones **55** from the reaction of 1,3-diaryl-2-propene-1-ones with barbituric acid thiobarbituric acid under refluxing condition in 50% aq. ethanol.



Ar	Ar/	Z
C_6H_5	C_6H_5	O
C_6H_5	$4\text{-}H_3CC_6H_4$	O
$4\text{-}H_3COC_6H_4$	C_6H_5	O
$4\text{-}H_3CC_6H_4$	C_6H_5	O
C_6H_5	C_6H_5	S
C_6H_5	$4\text{-}H_3CC_6H_4$	S
$4\text{-}H_3COC_6H_4$	C_6H_5	S

(55)

In 2014, Anita Pati[53] and co-workers reported the synthesis of fused heterocyclic pyridopyrimidine **56** and azaspiro compound **57** from the reaction of 1,3-diphenylthiobarbituric acid and dimedone under refluxing condition in ethanol.



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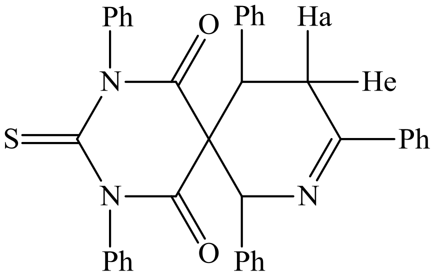


(57)

1.18 Objective of the Present Work:

Pyridopyrimidine is an organic heterobicyclic compound consisting of pyridine ring fused orthogonally at any position to a pyrimidine ring. **Azaspiro** compound is an organo nitrogen heterocyclic compound. The medicinal properties of the derivatives are **Pyridopyrimidine** and **azaspiro** show chemotherapeutic properties like as antitumor[54], antibacterial[55], antifungal[55] and antittuberculosis[55] activities. Due to the presence of thiazo group, it has been suggested to have antibacterial[55], antifungal[55] properties.

Having this background, we have been actively engaged in our laboratory, for several years, in the synthesis of potential bioactive heterocyclic compounds like adducts [48-50] pyranopyrimidines[40-45] and spiro structures[38], [39], [53] containing barbituric acid or 2-thiobarbituric acid moieties.

In the present work, we selected some substituted arylidenacetophenones as the choice of the substituents on the aromatic rings is to be made in such way so that the synthesized compounds may have biological activity. Apart from the synthesis of the expected potential medicinal compounds, our goal is also to investigate into the mechanism of the reactions leading to such products.

In addition to the synthesis of pyridopyrimidines and spiro compounds having barbituric acid and 2-thiobarbituric acid moieties which are expected to be biologically active compounds our aim was to investigate their route of formation by varying the reaction parameters like catalyst, solvents and temperature. The ultimate goal was to check the bioassay of the products and to find their application as drugs.

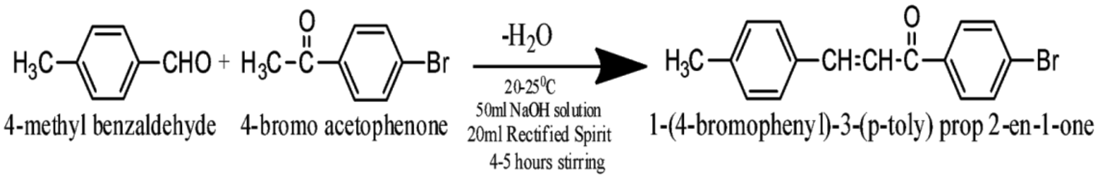
RESULT AND DISCUSSION

2.1 Preparation of starting materials:

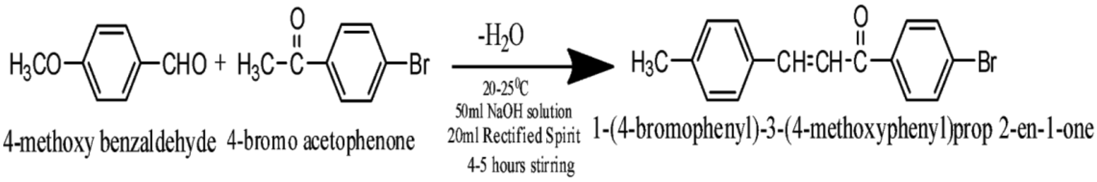
Barbituric acid, thiobarbituric acid, substituted benzaldehydes, substituted acetophenones.

Substituted arylideneacetophenones:

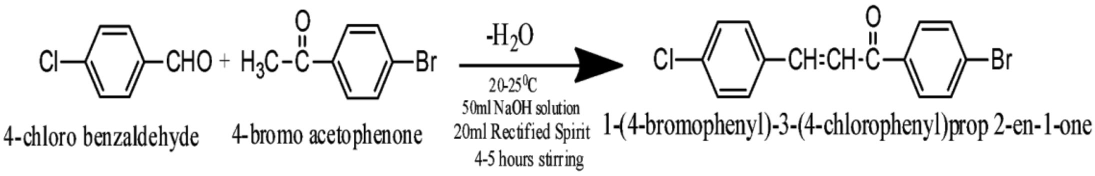
We selected a number of aromatic aldehydes: 4-methylbenzaldehyde, 4-methoxybenzaldehyde, 4-chlorobenzaldehyde and 4-nitrobenzaldehyde to react with acetophenones: 4-bromoacetophenone, 4-methylacetophenone and 4-nitroacetophenone to prepare the corresponding chalcones (**58**) 1-(4-bromophenyl)-3-(p-toly)prop 2-en-1-one, (**59**) 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop 2-en-1-one, (**60**) 1-(4-bromophenyl)-3-(4-chlorophenyl)prop 2-en-1-one, (**61**) 1-(4-bromophenyl)-3-(4-nitrophenyl)prop 2-en-1-one, (**62**) 3-(4-methoxyphenyl)-1-(4nitrophenyl)prop 2-en-1-one, and (**63**) 3-(4-chlorophenyl)-1-(p-toly)prop 2-en-1-one in presence of NaOH solution as following:



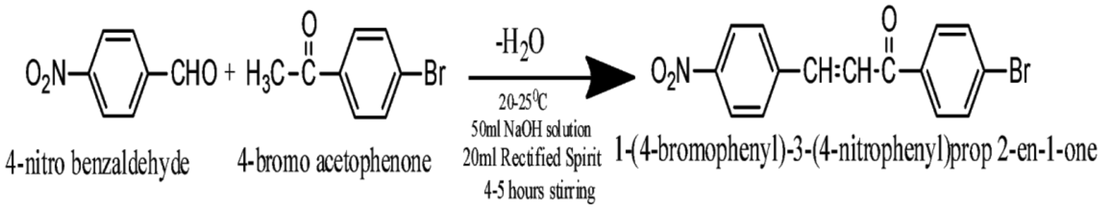
58



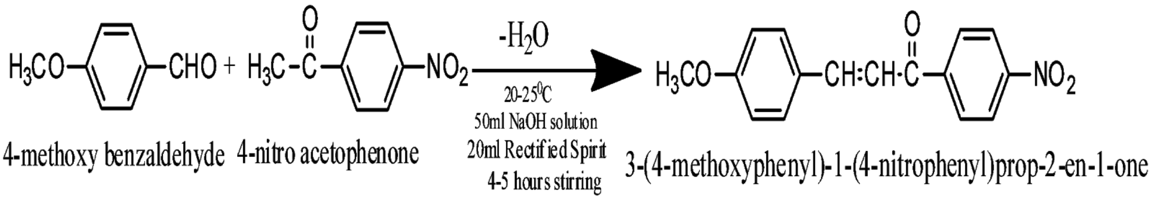
59



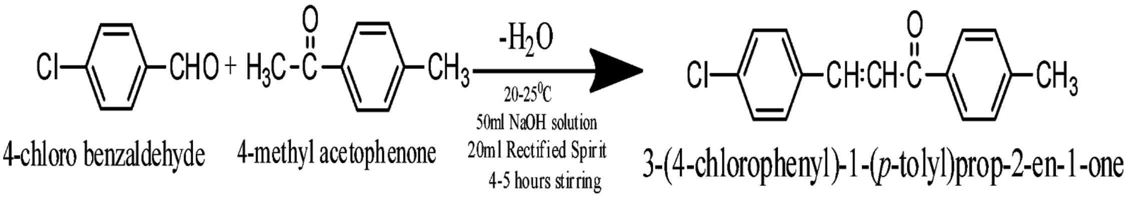
60


O₂N–C₆H₄–CHO + H₃C–CO–C₆H₄–Br
-H₂O
20-25⁰C
50ml NaOH solution
20ml Rectified Spirit
4-5 hours stirring
O₂N–C₆H₄–CH:CH–CO–C₆H₄–Br
4-nitro benzaldehyde
4-bromo acetophenone
1-(4-bromophenyl)-3-(4-nitrophenyl)prop 2-en-1-one

61


H₃CO–C₆H₄–CHO + H₃C–CO–C₆H₄–NO₂
-H₂O
20-25⁰C
50ml NaOH solution
20ml Rectified Spirit
4-5 hours stirring
H₃CO–C₆H₄–CH:CH–CO–C₆H₄–NO₂
4-methoxy benzaldehyde
4-nitro acetophenone
3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one

62


Cl–C₆H₄–CHO + H₃C–CO–C₆H₄–CH₃
-H₂O
20-25⁰C
50ml NaOH solution
20ml Rectified Spirit
4-5 hours stirring
Cl–C₆H₄–CH:CH–CO–C₆H₄–CH₃
4-chloro benzaldehyde
4-methyl acetophenone
3-(4-chlorophenyl)-1-(p-tolyl)prop-2-en-1-one

63

2.2 Synthesis of pyrimidine derivatives:

2.2.1 Synthesis of pyridopyrimidinederivatives:

The reactions of substituted arylideneacetophenones with barbituric acid / 2-thiobarbituric acid, ammonium acetate in acetic acid and ethanol.

Pyrido-pyrimidine compounds **64-66** were prepared from the reaction of substituted arylideneacetophenones **58-59** with barbituric acid **1** or 2-thiobarbituric acid **2** and ammonium acetate in ethanol under refluxing condition in presence of acetic acid. The purified products obtained by recrystallization from ethanol and their purity were checked by TLC.

The structures of these compounds **64-66** were determined with the help of their UV, IR, ^{1}H NMR and ^{13}C NMR spectral data.

2.2.2 SPECTROSCOPIC ANALYSIS OF THE COMPOUNDS, 64-66:

2.2.3 UV spectra:

In the UV spectra of the compounds 64-66, λ_{max} values were very close to the desired values. The bands due to π-π* of C=O in these compounds were observed in the range 347-330 nm. The bands due to weak n-π* of C=O may be hidden within same range of 347-330 nm.

2.2.4 IR spectra

The presence of N-H group of the compounds 64-66 pointed sharp as well as broad bands in the range ν_{max} 3150-3066 in their IR spectra. The presence of non-conjugated C=O stretching including the barbituric acid moieties[56] were observed at 1658 -1644 cm^{-1}. C=C of the aromatic rings and C=N of the conjugated form of barbituric acid part showed absorotion bands at 1598-1511 cm^{-1}. Other bands were observed at 1412.92-664.51 cm^{-1} due to these structural units.

2.2.5 NMR Spectra

^{1}H NMR spectra of the compounds 64-66:

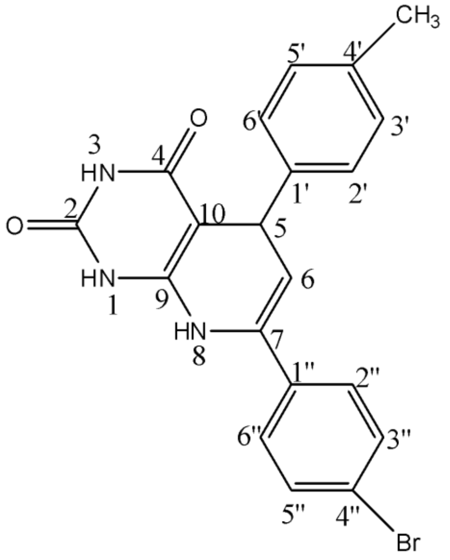
In their ^{1}H NMR spectra of compounds **64-66** were strongly deshielded (δ 10.31-8.09) and appeared as singlet due to N-H protons at positions 3 and 1. The N-H protons at position 3 in these compounds were found comparatively more deshielded than protons at position 1. The presence of thiocarbonyl group in compound (**66**), more deshielding of N-H protons were observed. This may be ascribed to the greater polarizability of sulfur than oxygen.

The anticipated doublet and double doublet for two protons at position 5 and 6 of these compounds appeared as multiplets at δ7.29-7.01. The existence of a singlet at δ 5.45-3.86 is designated to N-H protons at position 8.

The signals for the aromatic protons in **64-66** were found in good accord with the literature values.[57-58]

(64) The ^{1}H NMR spectra of the compounds 64 in DMSO gave the following chemical shifts (δ-values):

Chemical shift, δ (in ppm)	Protons
8.30	s, 1H, NH, 3-H
8.28	s, 1H, NH, 1-H
8.09-7.67	m, aromatic protons
7.29-7.06	m, 2H, 5-H and 6-H
5.45	s,1H, NH, 8-H
2.35	s, 3H, Ar-CH_3

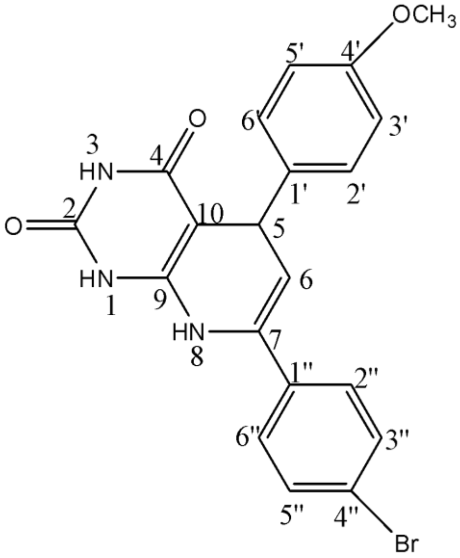


7-(4-bromophenyl)-5-(p-toly)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

Compound-64

(65) The^{1}H NMR spectra of the compounds 65 in DMSO gave the following chemical shifts ($\underline{\delta}$-values):

Chemical shift, $\underline{\delta}$ (in ppm)	Protons
9.87	s, 1H, N$\underline{H}$, 3-H
8.09	s, 1H, N$\underline{H}$, 1-H
7.87-7.71	m, aromatic protons
7.14-7.02	m, 2H, 5-H and 6-H
3.86	s,1H, N$\underline{H}$, 8-H
3.83	s, 3H, Ar -OCH_3

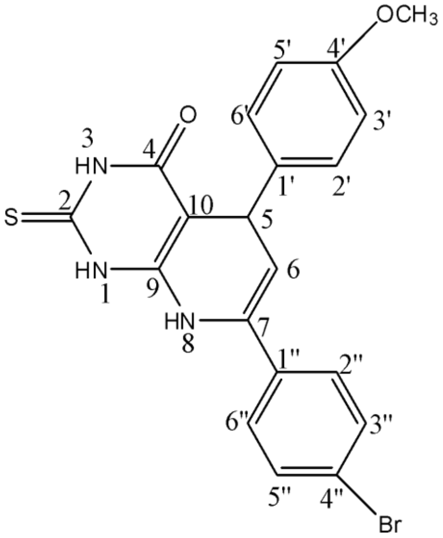


7-(4-bromophenyl)-5-(4-methoxyphenyl)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

Compound-65

(66) The^{1}H NMR spectra of the compounds 66 in DMSO gave the following chemical shifts (δ-values):

Chemical shift, δ (in ppm)	Protons
10.31	s, 1H, NH, 3-H
8.09	s, 1H, NH, 1-H
7.87-7.71	m, aromatic protons
7.14-7.01	m, 2H, 5-H and 6-H
4.05	s,1H, NH, 8-H
3.83	s, 3H, Ar -OCH_3



7-(4-bromophenyl)-5-(4-methoxyphenyl)-2-thioxo-2,3,5,8-tetrahydropyrido[2,3-d] pyrimidine-4(1H)-one

Compound-66

^{13}C NMR spectra of the compounds 64-66:

The ^{13}C NMR spectra were also recorded for elucidation of structures of the compounds **64-66**. The deshielding were detected in the chemical shifts of carbonyl carbon at position 4-C in the range of δ 188.78-174.69. The chemical shifts of 9-C were also deshielded (δ 145.10-145.05).

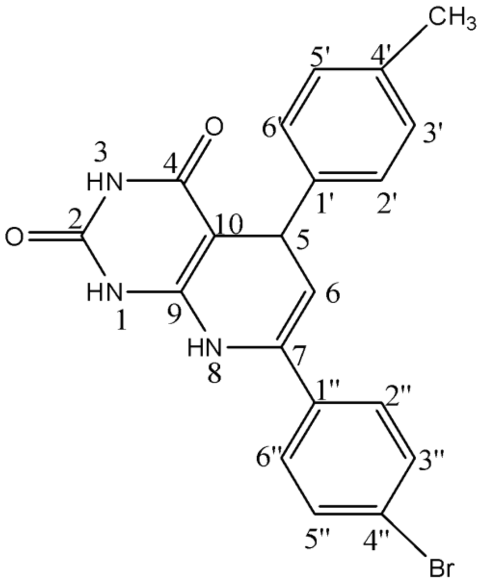
The frequency values of carbonyl carbons at 2-C and 4-C were found to be at δ 188.78-188.61 in the compounds **64-65.** The chemical shifts of thioxo carbon at 2-C were found to be at δ 188.62 in the compound 66. This justifies that the replacement of a carbonyl group by a thiocarbonyl group.

In these compounds, the chemical shift values for 7-C were observed at δ 137.29-137.12 and 6-C were observed δ 127.66-127.50. The 10-C of these compounds showed chemical shift values at δ 128.69-127.67. The chemical shift values for 5-C in these compounds were observed at δ 114.92-114.21. The frequency values for bromo-carbon in the aromatic ring for the compounds **64-66** were observed at δ 119.65-119.62.

The ^{13}C NMR chemical shifts for rest of the carbons of aromatic rings were designated based on a correlation chart available in the literature. [57-58]

(64) The ^{13}C NMR of the compound 64 showed the following signals (δ-values) at

Chemical shift, δ (in ppm)	Carbon position
188.78	C-2, C-4
145.10	C-9
141.39-119.24	aromatic carbons
137.12	C-7
128.69	C-10
127.66	C-6
114.21	C-5
21.57	Ar-$\underline{C}H_3$

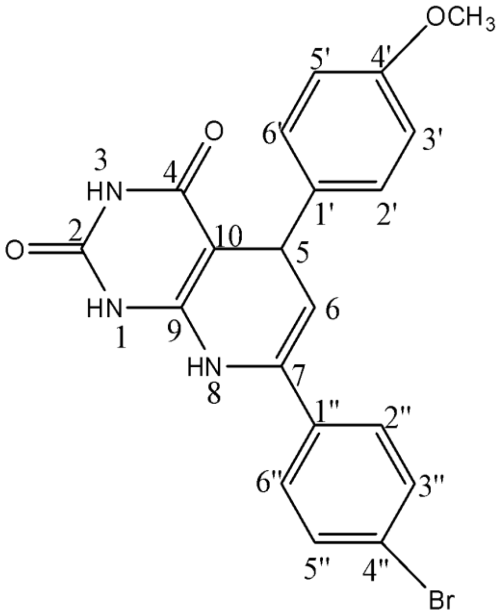


7-(4-bromophenyl)-5-(p-toly)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

Compound-64

(65) The ^{13}C NMR of the compound 65 showed the following signals ($\underline{\delta}$-values) at

Chemical shift, $\underline{\delta}$ (in ppm)	Carbon position
188.61	C-2,4
161.99-114.99	aromatic carbons
145.06	C-9
137.27	C-7
127.67	C-10
127.52	C-6
114.91	C-5
55.88	Ar-O$\underline{C}H_3$

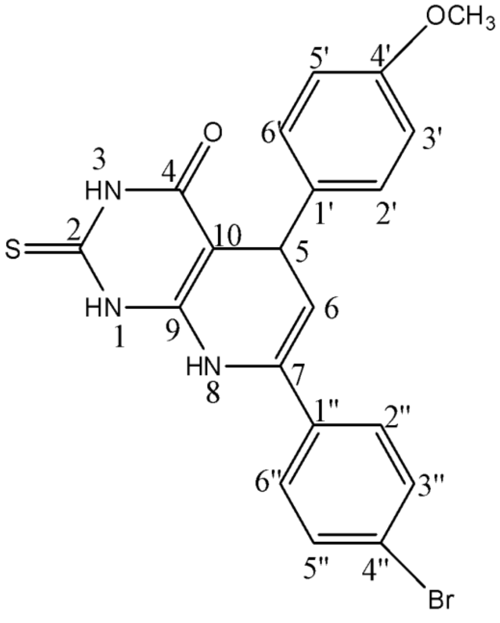


7-(4-bromophenyl)-5-(4-methoxyphenyl)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

Compound- 65

(66) The ^{13}C NMR of the compound 66 showed the following signals (δ-values) at

Chemical shift, δ (in ppm)	Carbon position
188.62	C-2
174.69	C-4
162.00-119.65	aromatic carbons
145.05	C-9
137.29	C-7
127.68	C-10
127.50	C-6
114.92	C-5
55.88	Ar-O$\underline{C}H_3$



7-(4-bromophenyl)-5-(4-methoxyphenyl)-2-thioxo-2,3,5,8-tetrahydropyrido[2,3-d] pyrimidine-4(1H)-one

Compound-66

2.2.6 Synthesis of Azaspiro Derivatives

The reaction of chalcones (arylideneacetophenones) with barbituric acid/2-thiobarbituric acid, substituted benzaldehydes and ammonium acetate in acetic acid and ethanol under refluxing condition.

The corresponding azaspiro compounds **67-73** were prepared from the reaction of substituted arylideneacetophenones **67-73** with barbituric acid **1** or 2-thiobarbituric acid **2**, substituted benzaldehydes, ammonium acetate in acetic acid and ethanol under refluxing condition. The purified products obtained by recrystallization from ethanol and their purity were checked by TLC.

The structures of these compounds **67-73** were determined with the help of their UV, IR, ^{1}H NMR and ^{13}C NMR spectral data.

2.2.7 SPECTROSCOPIC ANALYSIS OF THE COMPOUNDS, 67-73:

2.2.8 UV spectra:

In their UV spectra, the λ_{max} values of the compounds 67-73 correspond well to the anticipated values. The bands at 349-340 nm were due to π-π* of the C=O for these compounds. The n-π* transition due to C=O could not be observed separately. They were probably hidden within the π-π* absorption range in these compounds.

2.2.9 IR spectra:

The presence of N-H group of the compounds 67-73 pointed sharp as well as broad bands in the range ν_{max} 3405-3006 cm^{-1} in their IR spectra. The bands at 1754-1636 cm^{-1} in these compounds indicate the presence of non-conjugated C=O stretching including the barbituric acid moieties[56]. The bands at 1615-1500 cm^{-1} are due to C=C of the aromatic rings and C=N of the conjugated from of barbituric acid part. Extra bands were detected at 1258 cm^{-1} due to C=S stretching in thio compounds.

2.2.10 NMR Spectra

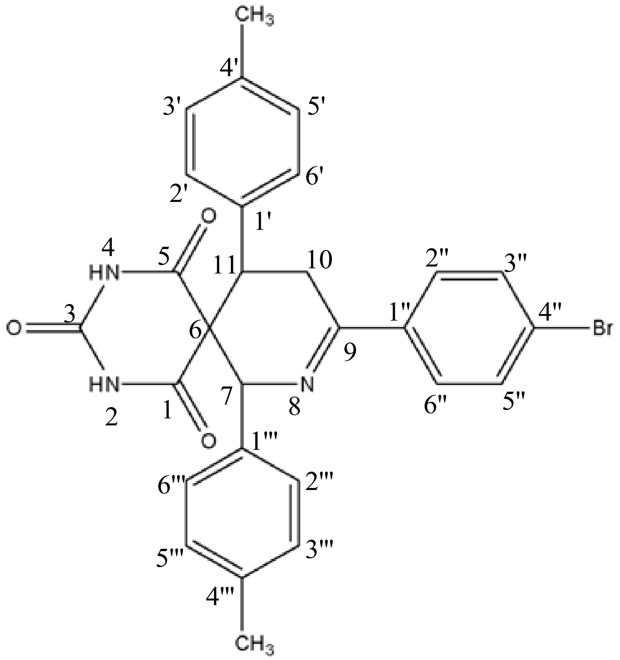
^{1}H NMR spectra of the compounds 67-73:

The N-H protons of the compound **67-73** at position 2 and 4 are strongly deshielded (δ 11.34-8.11) since they are flanked by two C=O groups. The non-uniformity of these protons are caused by the anisotropy of the C-1 and C-5 carbonyl groups owing to the geometry of spiro structures as reported[56][38] earlier. The N-H protons at position 2 and 4 in the compound **69** obtained from the reaction with **2** are more deshielded (δ 10.26-8.30) than those in the compounds **67-68** and **70-73** produced in the reactions with **1**. This may be ascribed to the greater polarizability of sulfur compounds than oxygen. This causes more deshielding of the N-H protons in the sulfur compound **69**.

The existence of a singlet at δ 5.57-4.21 is designated to C-7 protons. Two double doublet of each proton corresponding to C-10e and C-11, a doublet of doublet of doublet (ddd) for C-10a proton in the ^{1}H NMR spectrum of compounds **67-73**, appeared as multiplets, in the range δ 4.21-2.20 is assigned to C-10 and C-11 protons. Since these three protons of an ABC system relative to the fragment CH (11) - CH_2- (10) of spiro compounds is in imine form having double bond between N (8) - C (9) and not between N (8) - C (7).

(67) The ^{1}H NMR spectrum of the compound, **67** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, $\underline{\delta}$ (in ppm)	Protons	Coupling constant, J (in Hz)
10.12	s, 1H, N$\underline{H}$, 2-H	
9.45	s, 1H, N$\underline{H}$, 4-H	
8.09	d, 2H, H-3', 5'	J=8
7.81	d, 2H, H-2', 6'	J=8
7.65	d, 2H, H-3'', 5''	J=8
7.35	d, 2H, H-2'', 6''	J=8
7.28	d, 2H, H-3''', 5'''	J=8
7.11	d, 2H, H-2''', 6'''	J=8
5.57	s, 1H, H-7	
2.50-2.20	m, 3H, H-10 and H-11	
2.36	s, 3H, Ar-CH_3	
2.27	s, 3H, Ar-CH_3	

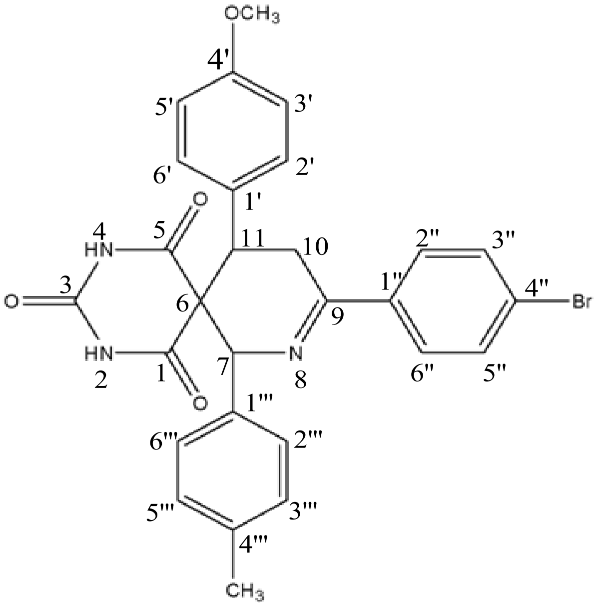


(7R,11R)-9-(4-bromophenyl)-7,11-di-p-toly-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

Compound-67

(68) The ^{1}H NMR spectrum of the compound, **68** in DMSO gave the following chemical shifts (*δ* values) at:

Chemical shift, δ (in ppm)	Protons	Coupling constant, J (in Hz)
8.30	s, 1H, NH, 2-H	
8.28	s, 1H, NH, 4-H	
8.07	d, 2H, H-3', 5'	J=8
7.85	d, 2H, H-2', 6'	J=8
7.65	d, 2H, H-3", 5"	J=8
7.28	d, 2H, H-2", 6"	J=8
7.02	d, 2H, H-3"', 5"'	J=8
6.88	d, 2H, H-2"', 6"'	J=8
5.57	s, 1H, H-7	
3.82	s, 3H, Ar-OCH_3	
2.51-2.26	m, 3H, H-10 and H-11	
2.35	s, 3H, Ar-CH_3	

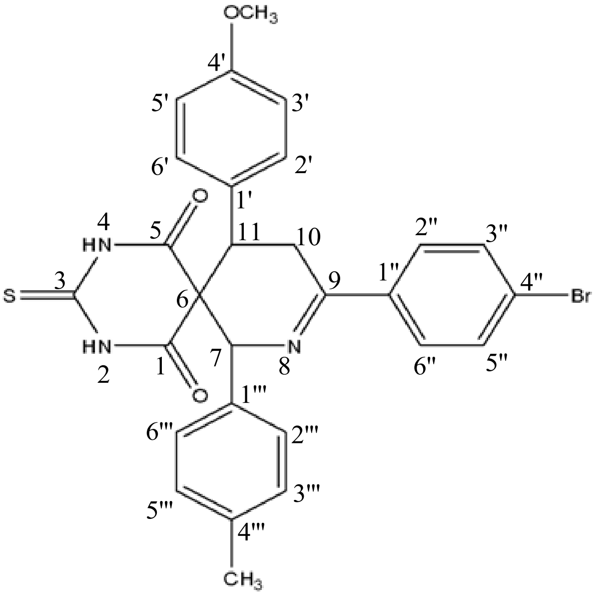


(7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione.

Compound-68

(69) The ^{1}H NMR spectrum of the compound, **69** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons
10.26	s, 1H, N<u>H</u>, 2-H
8.30	s, 1H, N<u>H</u>, 4-H
8.09-7.01	m, aromatic potons
4.21	s, 1H, H-7
3.82	s, 3H, Ar-OCH_3
2.51-2.26	m, 3H, H-10, H-11
2.35	s, 3H, Ar-CH_3

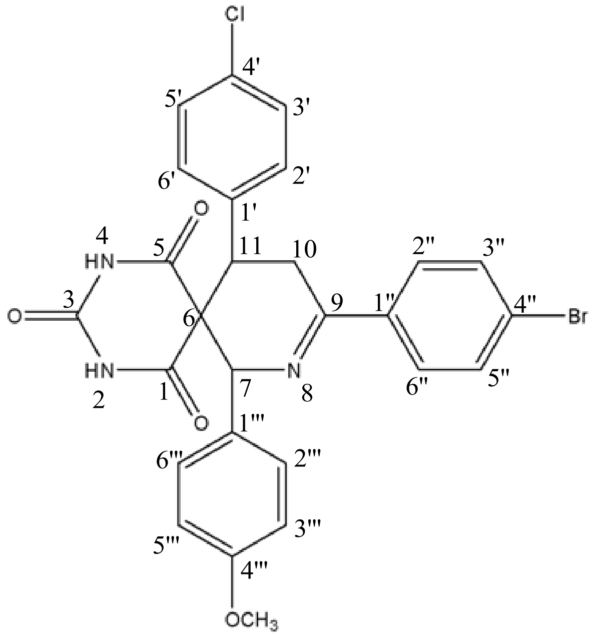


(7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-3-thioxo-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione

Compound-69

(70) The ^{1}H NMR spectrum of the compound, **70** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons	Coupling constant, J (in Hz)
11.19	s, 1H, NH, 2-H	
8.11	s, 1H, NH, 4-H	
7.96	d, 2H, H-3', 5'	J=8
7.91	d, 2H, H-2', 6'	J=8
7.86	d, 2H, H-3'', 5''	J=8
7.79	d, 2H, H-2'', 6''	J=8
7.74	d, 2H, H-3''', 5'''	J=8
7.53	d, 2H, H-2''', 6'''	J=8
5.52	s, 1H, H-7	
4.21-3.70	m, 3H, H-11 & H-10	
3.83	s, 3H, Ar-OCH$_3$	

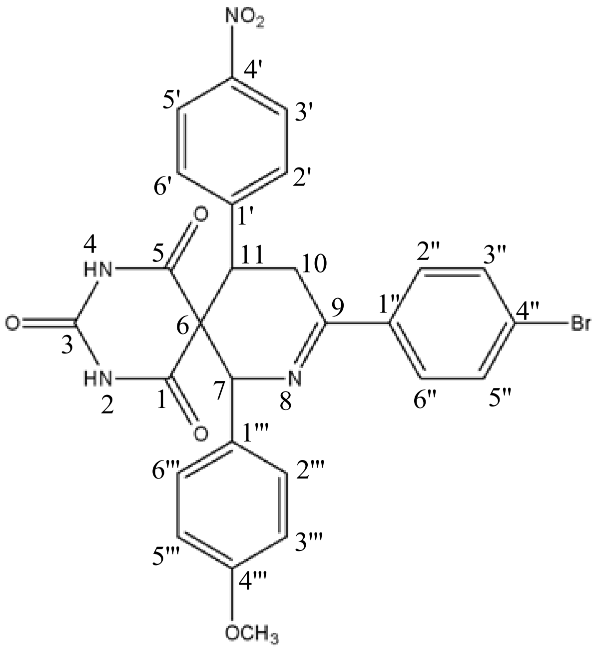


(7R, 11R)-9-(4-bromophenyl)-11-(4-Cholophenyl)-7-(4-methoxyhenyl)-2,4,8 - triazaspiro [5.5] undec-8-ene- 1,3,5 -trione.

Compound-70

(71) The ^{1}H NMR spectrum of the compound, **71** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons
11.34	s, 1H, NH, 2-H
9.87	s, 1H, NH, 4-H
8.39-7.01	m, aromatic protons
5.75	s, 1H, H-7
3.86-3.61	m, 3H, H-11 & H-10
3.82	s, 3H, Ar-OCH_3

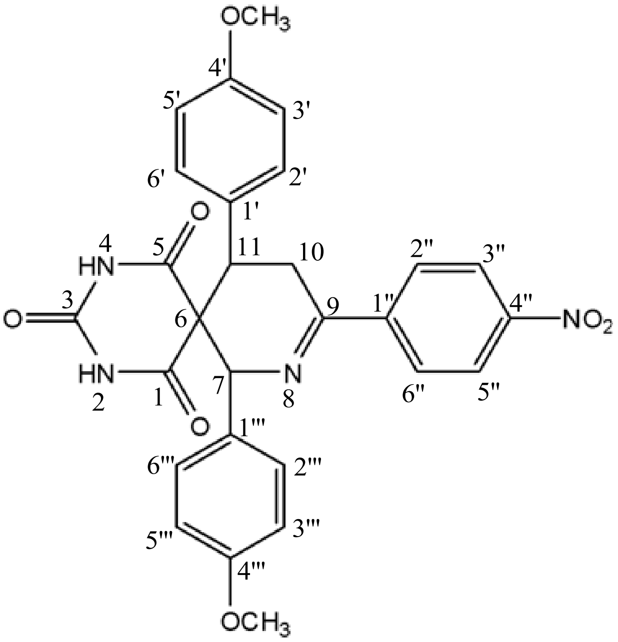


(7R,11R)-9-(4-bromophenyl)-7-(4-methoxyphenyl)-11-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5 -trione

Compound-71

(72) The ^{1}H NMR spectrum of the compound, **72** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons
11.10	s, 1H, NH, 2-H
8.38	s, 1H, NH, 4-H
8.36-6.88	m, aromatic protons
5.52	s, 1H, H-7
3.88-3.38	m, 3H, H-11 & H-10
3.83	s, 6H, Ar-OCH_3

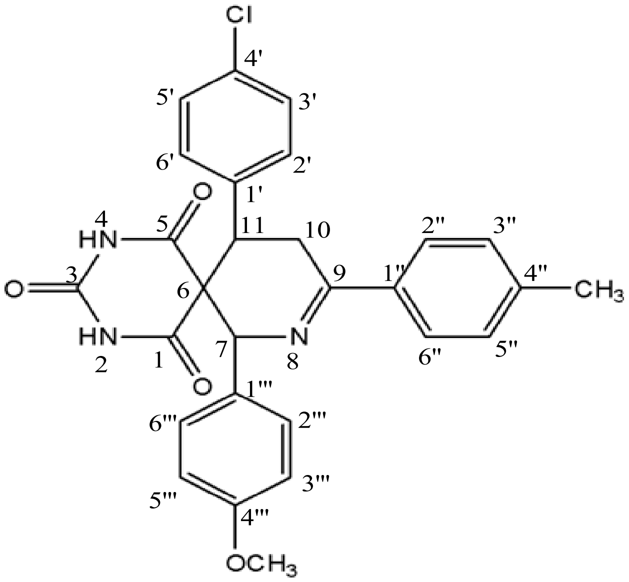


(7R, 11R)-7,11-bis(4-methoxyphenyl)-9-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

Compound-72

(73) The ^1H NMR spectrum of the compound, **73** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, $\underline{\delta}$ (in ppm)	Protons
10	s, 1H, N$\underline{H}$, 2-H
9.87	s, 1H, N$\underline{H}$, 4-H
8.23-7.09	m, aromatic protons
5.84	s, 1H, H-7
3.87	s, 3H, Ar-OCH_3
3.86-3.39	m, 3H, H-11 & H-10
2.43	s, 3H, Ar-CH_3



(7R,11R)-11-(4-chlorophenyl)-7-(4-methoxyphenyl)-9-(p-toly)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

Compound-73

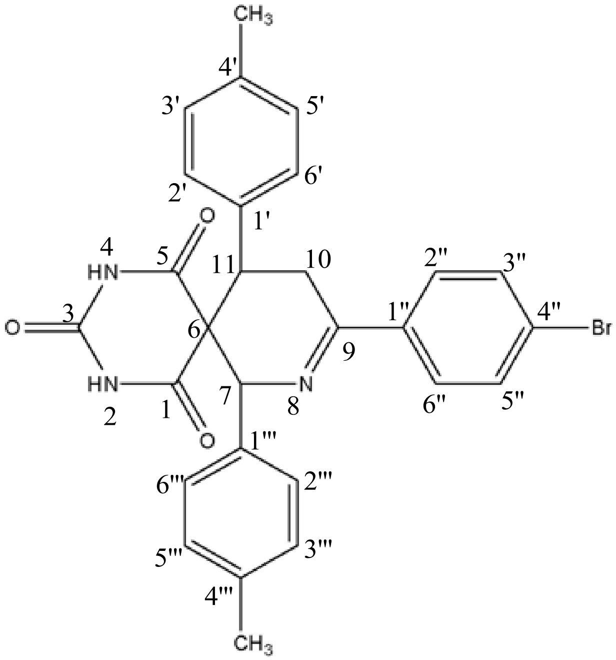
^{13}C NMR spectra of the compounds **67-73** :

The ^{13}C NMR spectra were also recorded for elucidation of structures of the compounds **67-69**. The frequency values of carbonyl carbons at C-3 were found to be at δ 188.62-161.79 and are relatively less deshielded due to the resonance of amide functional group in these compounds. The chemical shifts of thioxo carbon at C-3 were found to be at δ188.62 in the compounds **69**. It is evident from the above values that the replacement of a carbonyl group by a thiocarbonyl group results in a downfield shift. The signals for carbonyl carbons at position C-9 were δ 145.10-144.41 in these compounds. These values are in good harmony with the ^{13}C NMR chemical shift values available in the literature[58]. The frequency values for carbonyl carbon at positions C-1 and C-5 were δ188.98-188.62. The non-equalities of these carbons are caused by the anisotropy of the C-1 and C-5 carbonyl groups owing to the geometry of spiro structures.

The δ values of C-10 appeared peak at 32.58-32.15 in the compounds **67-73**. The chemical shift values of C-7 (δ 92.86-90.12) of these compounds, were slightly lower than those of C-11 (δ 45.66-45.12). The frequency signals of carbons of aromatic rings were allocated based on the correlation chart of ^{13}C NMR spectral data available in the literature.[59] The spiro carbon C-6 of the compounds **67-73** revealed frequency values at δ 57.91-56.14 which are comparable to the literature values.[60] The values for chloro-carbon in the aromatic ring for the compounds **70, 73** were noted at δ 132.00-131.10. The values for bromo-carbon in the aromatic ring for the compounds **67-71** were seen at δ 122.94-121.13. The value for nitro-carbon in the aromatic ring for the compounds **71-72** were detected at δ 150.18-148.63.

(67) The ^{13}C NMR of the compound **67** showed the following signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.77	C-1 and C-5
165.12	C-9
145.10	C-3
141.40--121.13	aromatic carbons
90.28	C-7
57.91	C-6
45.25	C-11
32.15	C-10
21.58	Ar-CH_3

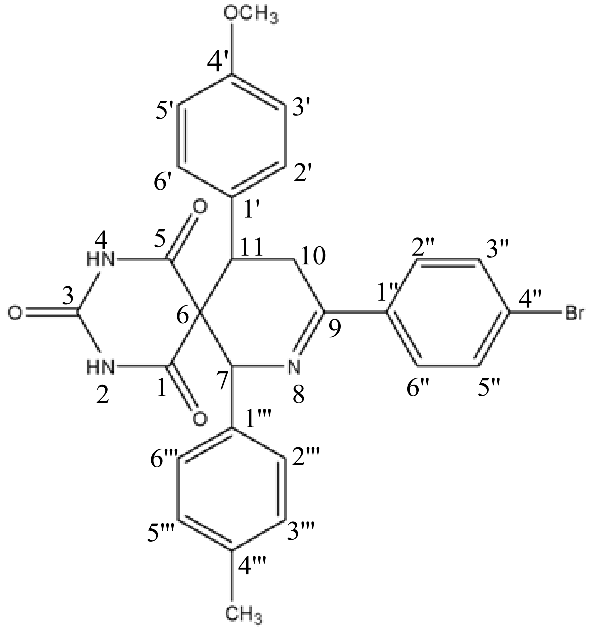


(7R,11R)-9-(4-bromophenyl)-7,11-di-p-toly-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

compound-67

(68) The ^{13}C NMR of the compound **68** showed the following signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.75	C-1, C-5
164.19	C-3
161.99-114.91	aromatic carbons
145.10	C-9
92.86	C-7
57.21	C-6
55.87	Ar-OCH_3
45.66	C-11
32.58	C-10
21.58	Ar-CH_3

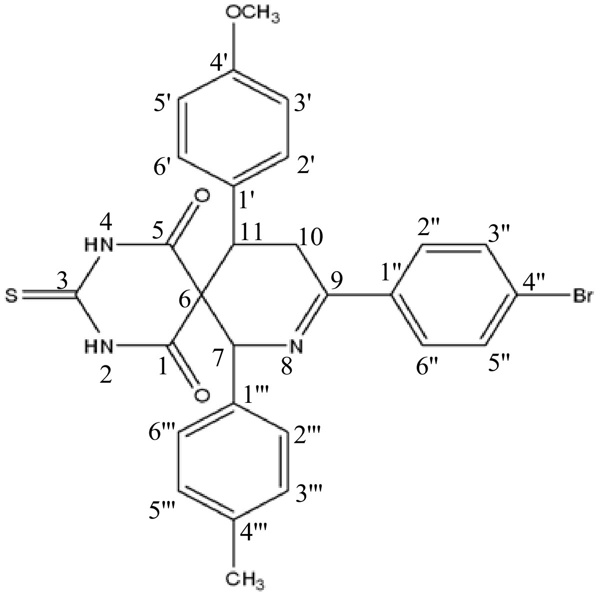


(7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione

compound-68

(69) The ^{13}C NMR of the compound **69** showed the following signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.62	C-3
164.18	C-1 and C-5
145.10	C-9
161.99-114.92	aromatic carbons
90.89	C-7
56.98	C-6
55.88	Ar-OCH$_3$
45.52	C-11
32.28	C-10
21.00	Ar-CH$_3$

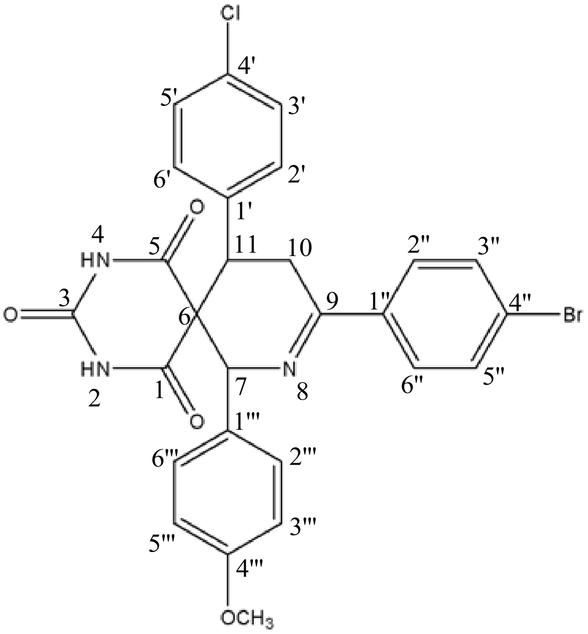


(7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-3-thioxo-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione

Compound-69

(70) The ^{13}C NMR of the compound **70** showed the following signals ($\underline{\delta}$-values) at

Chemical shift, $\underline{\delta}$ (in ppm)	Carbon position
188.73	C-1 and C-5
165.10	C-3
161.00-114.92	aromatic carbons
145.05	C-9
90.12	C-7
57.28	C-6
55.89	Ar-OCH_3
45.12	C-11
32.28	C-10

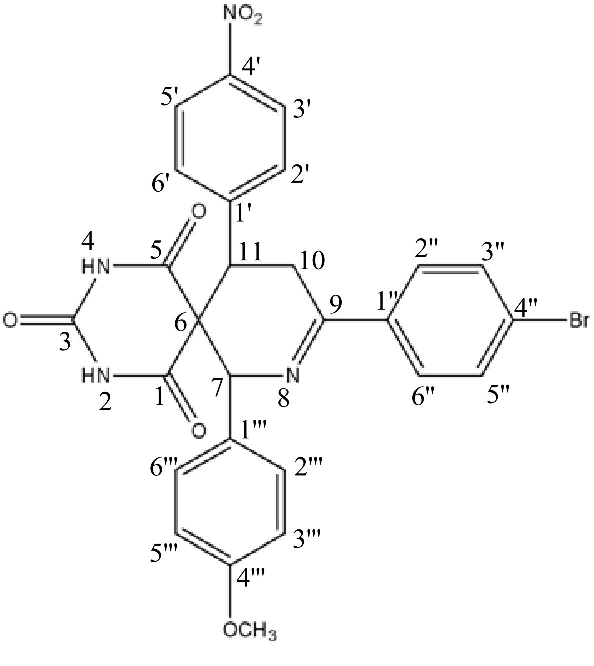


(7R, 11R)-9-(4-bromophenyl)-11-(4-Cholophenyl)-7-(4-methoxyhenyl)-2, 4, 8 -triazaspiro [5.5] undec-8-ene- 1,3,5 -trione.

Compound-70

(71) The ^{13}C NMR of the compound **71** showed the following signals ($\underline{\delta}$-values) at:

Chemical shift, $\underline{\delta}$ (in ppm)	Carbon position
188.69	C-1,5
161.99	C-3
145.04	C-9
142.05-114.91	aromatic carbons
90.24	C-7
56.16	C-6
55.87	Ar-OCH_3
45.58	C-11
32.41	C-10

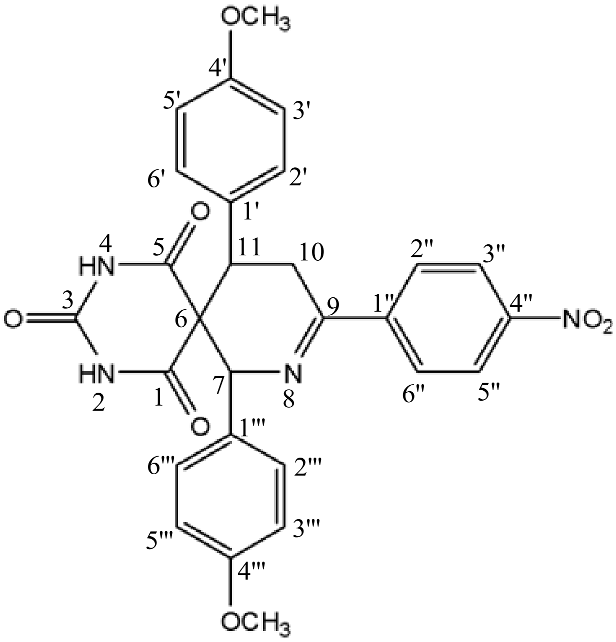


(7R, 11R)-9-(4-bromophenyl)-7-(4-methoxyphenyl)-11-(4-nitrophenyl)- 2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5 -trione

Compound-71

(72) The ^{13}C NMR of the compound 72 showed the following signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.66	C-1, 5
165.02	C-3
144.41	C-9
143.18-114.05	aromatic carbons
92.18	C-7
56.91	C-6
55.50	Ar-OCH_3
45.22	C-11
32.15	C-10

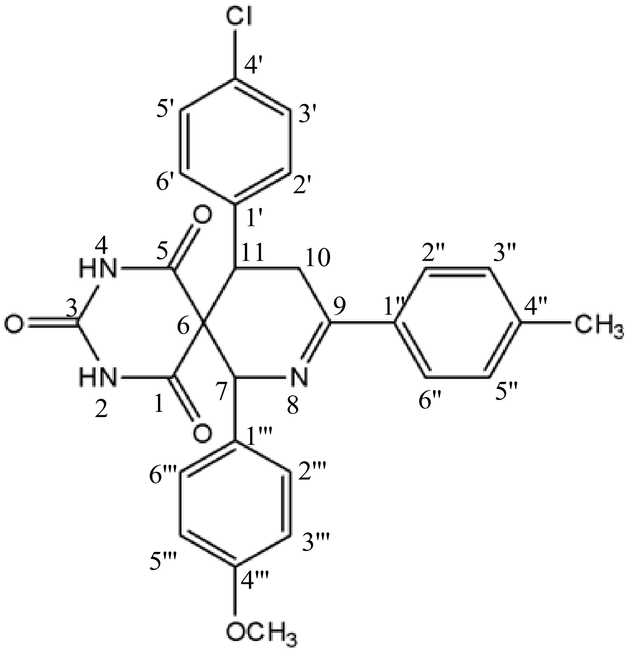


(7R,11R)-7,11-bis(4-methoxyphenyl)-9-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

Compound-72

(73) The ^{13}C NMR of the compound **73** showed the following signals (δ-values) at:

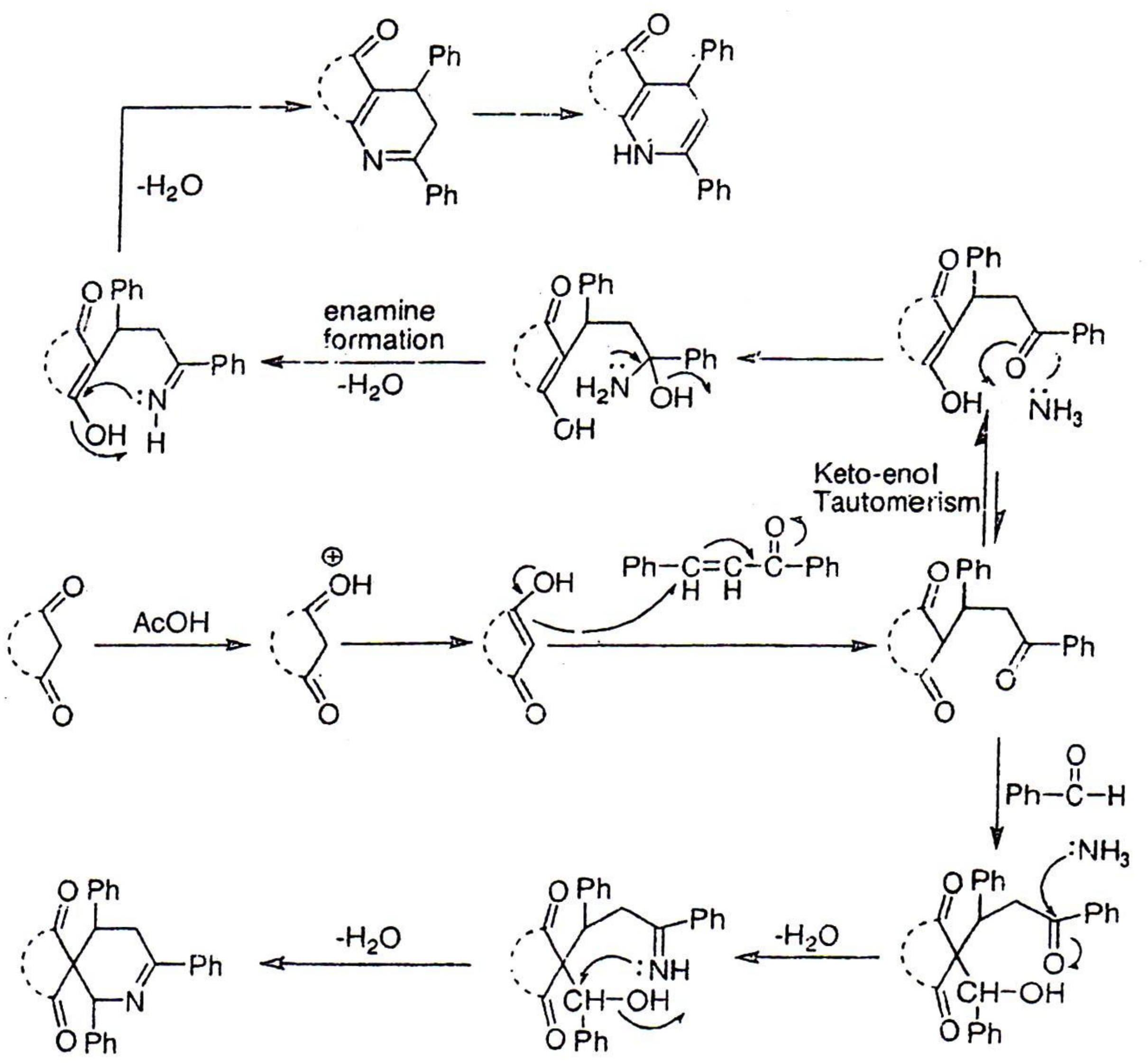
Chemical shift, δ (in ppm)	Carbon position
188.98	C-1, 5
161.79	C-3
144.18	C-9
143.76-114.87	aromatic carbons
92.85	C-7
56.14	C-6
55.83	Ar-OCH_3
45.18	C-11
32.18	C-10
21.30	Ar-CH_3



(7R, 11R)-11-(4-chlorophenyl)-7-(4-methoxyphenyl)-9-(p-toly)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

Compound-73

The mechanism of the formation of pyridopyrimidine and azaspiro compound



2.2.11 Biological activity test:

Antibacterial Test

Method of Analysis: Agar Diffusion Method by Kirby-Bauer,1985 was followed.

Table of Zone of Inhibition (mm) of samples is given below

Compound No	Bacteria specific diameter (mm) of inhibition zone			
	E. coli	Salmonella typhi	Bacillus subtilis	Staphylococcus aureus
64	6	6	6	6
69	6	6	6	6
71	6	6	6	6
73	6	6	6	6

Very weak antibacterial activity has been detected in all the samples against E. coli, Salmonella typhi, Bacillus subtilis, Staphylococcus aureus.

Antifungal Activity Test

Fungal strains used : Aspergillusniger

Sample no.	Compound No	Organism	Control	Control Result	Amount of sample used ( )	Result
1.	64	A.niger	10% DMSO+90% Methanol	Negative	30	Negative
2.	69	A.niger		Negative	30	Negative
3.	71	A.niger		Negative	30	Negative
4.	73	A.niger		Negative	30	Negative

No antifungal activity against Aspergillus niger was detected by the provided samples.

EXPERIMENTAL

3.1 Solvents and Reagents:

Solvents were used such as rectified spirit, ethyl acetate, methanol, chloroform, absolute alcohol, petroleum ether, n-hexane, dimethyl sulphoxide (DMSO). Barbituric acid, 2-thiobarbituric acid, substituted benzaldehydes, substituted acetophenones and all other reagents and solvent used in this work were purchased from E. Merck, Germany.

3.2 Purification of Solvents:

Drying of Solvent:

Ethanol: Commercially available absolute alcohol was dried and purified. It was distilled and the fraction distilling at 77-78^{0}C was collected and stored in a well-stopped bottle.

Petroleum ether: The petrol (motor fuel) collected from local petrol pump was distilled and the fractions between 40-60^{0}C and 60-80^{0}C were collected separately.

Ethyl acetate: The commercial grade of ethyl acetate was distilled and the fraction at 77^{0}C was collected.

Drying of Acetone

In a one liter reagent bottle containing 700 mL commercial grade acetone, a solution of silver nitrate (3 mg in 20 mL distilled water) was followed by 1M NaOH (20 mL) solution. The mixture was shaken well for about ten minutes. It was then filtered over anhydrous sodium sulfate. The filtrate was then distilled at 56-57^{0}C, collected and stored in a well-stoppered reagent bottle as super dry acetone.

3.3 Preparation of Reagents:

2,4-dinitrophenylhydrazine

2g of 2,4-dinitrophenylhydrazine was suspended in 100 mL of methanol, 4.0 mLof concentrated sulfuric acid was then added slowly and cautiously to this suspension. At this stage the solid dissolved completely and the mixture became warm. The mixture was cooled and then filtered with a suction pump on a sintered glass funnel. The reagent was then preserved in a stopper bottle as 2,4-dinitrophenylhydrazine reagent.

3.4 Chromatographic Technique:

Thin layer chromatography or TLC: In this technique commercially available precoated TLC plates (silica gel coated on aluminium sheets or glass plates) and prepated silica gel 60 GF_{254} plates (2.5 cm x 6 cm) were used. The TLC plates were prepared in our laboratory by an established method.[130]

Development of Plates: The TLC plates were developed in an iodine chamber. The UV active compounds were checked under UV lamp (350 nm) and R_f values were calculated.

3.5 Instruments Used:

Ultraviolet and visible spectra:

Ultraviolet-Visible spectra of the sample were recorded on a **SHIMUDZU-UV-160A ultraviolet spectrometer with a scanning range of 800-200nm**. The spectra were run using DMSO as solvents.

Infrared spectra:

Infrared spectra of the samples were recorded on an **IR Prestige-21, FT-IR 8400S, Shimadzu corporation infrared spectrophotometer within the range of 4000-400 cm^{-1}** solid samples were recorded as KBr pellets.

NMR spectra:

The ^{1}H and ^{13}C NMR spectra of the samples were recorded on a **BRUKER 400ULTRA SHIELD TM SPECTROMETER (WMSRC, Jahangirnagar University, Saver).** The solvents used were DMSO. TMS was used as an internal standard.

3.6 Abberviations Used:

UV : Ultraviolet

IR : Infrared

NMR : Nuclear magnetic resonance

TLC : Thin-Layer Chromatography

s : Singlet

d : Doublet

t : Triplet

m : Multiplet

j : Coupling constant

R_f : Retardation or Retention Factor

m.p : Melting point

b.p : Boiling point

Hz : Hertz

δ : Chemical Shift

TMS : Tetramethylsilane

Preparation of Starting Materials

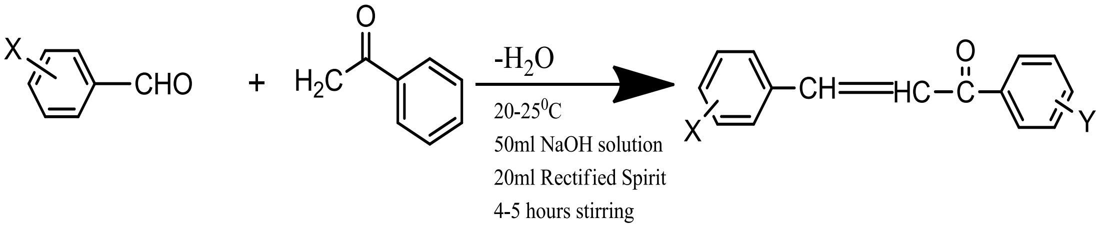
3.7 Preparation of Starting Materials

General Procedure:

For preparation of starting materials a general procedure reported in the literature [61] was followed with the modification of reaction conditions whenever necessary.

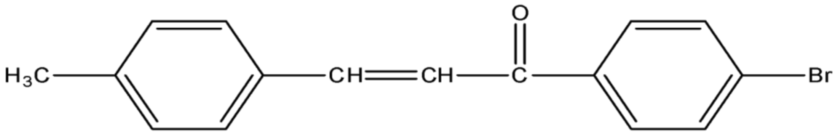
Substituted benzaldehydes (0.01 mole) and substituted acetophenones (0.01 mole) rectified spirit (20 mL) were placed in a 250 mL round bottomed flask equipped with a magnetic stirrer, during the period of vigorous stirring 50 mL NaOH solution (2g NaOH in 50mL H_2O) was added dropwise to the reaction mixture for 30 minutes when solution became turbid. The reaction temperature 20-25^{0}C was maintained. After (4-5 hours) vigorous stirring the reaction mixture was neutralized by 0.1N HCl, whereby the precipitation occurred. The crude chalcone after drying in the air was recrystallized from rectified spirit. The purity of the products confirmed by TLC.

Scheme of the Reactions:

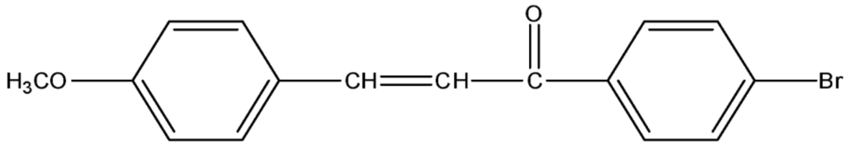


Compound	X	Y
58.	4-CH_3	4-Br
59.	4-CH_3O	4-Br
60.	4-Cl	4-Br
61.	4-NO_2	4-Br
62.	4-CH_3O	4-NO_2
63.	4-Cl	4-CH_3

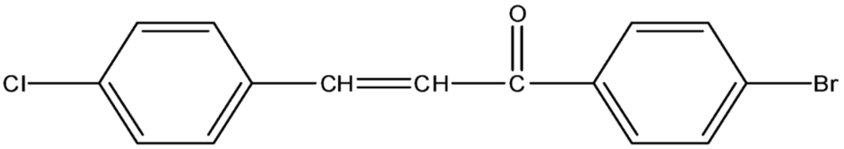
The aldehydes were used 4-methylbenzaldehyde, 4-methoxybenzaldehyde, 4-chlorobenzaldehyde, 4-nitrobenzaldehyde. The acetophenones are 4-bromoacetophenone, 4-methylacephenone, 4-nitroacetophenone.



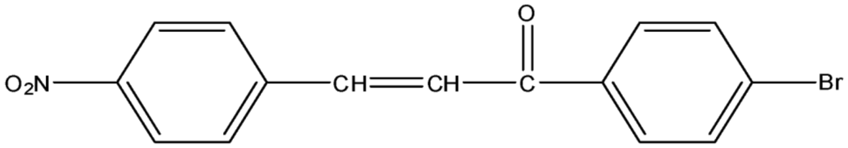
1-(4-bromophenyl)-3-(*p*-tolyl)prop-2-en-1-one



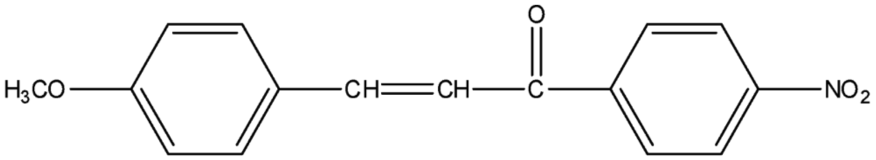
1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one



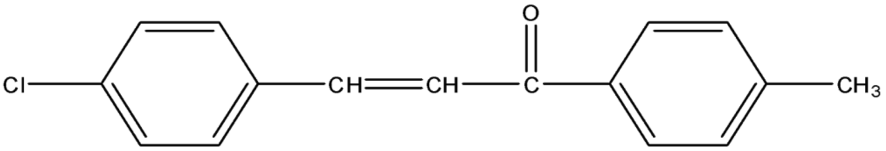
1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one



1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one



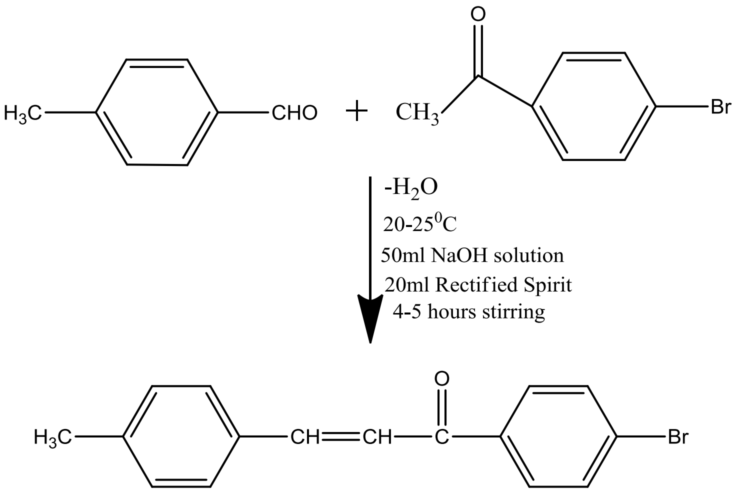
3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one



3-(4-chlorophenyl)-1-(*p*-tolyl)prop-2-en-1-one

3.7.1 Preparation of 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one:

Scheme of the Reaction:



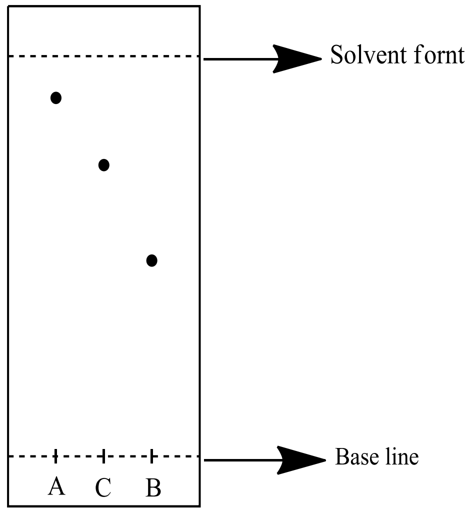
1-(4-bromophenyl)-3-(*p*-tolyl)prop-2-en-1-one

(58)

Reaction Conditions:

* Molar ratio of the reactants	: 1:1 (0.01 mole)
* Catalyst	: NaOH (2g in 50 mL H_2O)
* Solvent	: rectified spirit (20 mL)
* Temperature	: 20-25^{0}C
* Reaction time	: 4 hours

Behavior of TLC



A = *P*-bromoacetophenone

B = *P*-methyl benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 3:2

R_f value in TLC = 0.73

Characterization of Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 2.53 g

Melting point of the crude product = 160-164^{0}C

Recrystallizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.21 g

Yield of the recrystallized product = 73%

Melting point of the recrystallized product = 166-168^{0}C

Chemical behavior:

Test for carbonyl group:

The sample (5mg) was shaken well with freshly prepared 2, 4- DNP reagent (2mL) and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

FeCl$_3$test: On addition of neutral FeCl$_3$ solution (2-3drops) to the solution of the product (5 mL), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in chlorofrom showed (λ_{max}) at 328 nm due to n-π^* transition of C=O conjugated with C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3016 : C-H stretching (aromatic, alkene)

2911 : C-H stretching of alkane

1657 : C=O in conjugated with C=C

1597, 1512 : C=C stretching of phenyl ring

1482 : -CH$_2$ bending

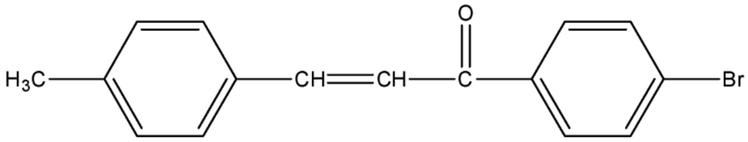
1330 : C-H bend for -CH$_3$

1178, 1222, 1288 : C-O stretching

663 : C-Br stretching

811, 832 : C-H bending of aromatic ring

The structure has been assigned to the compound depends spectral properties and chemical behavior, 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one, **58.**

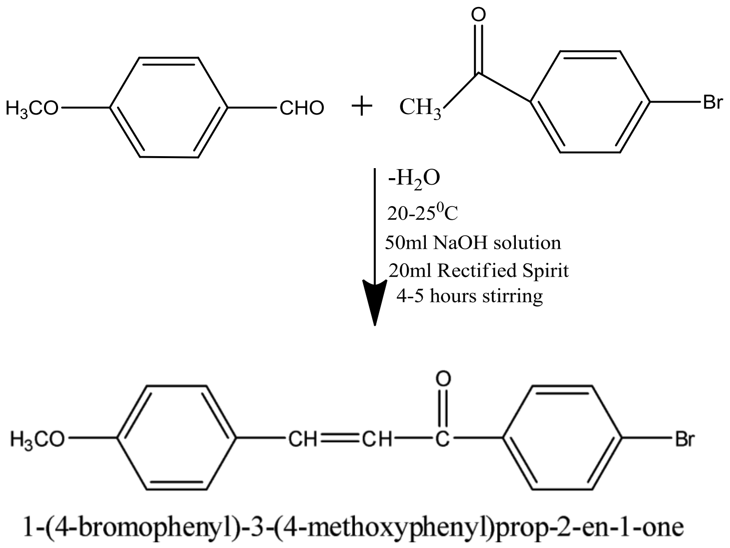


1-(4-bromophenyl)-3-(*p*-tolyl)prop-2-en-1-one

(58)

3.7.2 Preparation of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one:

Scheme of the Reaction:

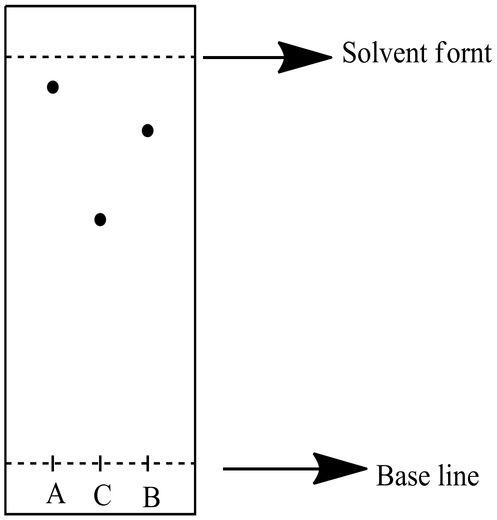


(59)

Reaction Conditions:

* Molar ratio of the reactants	:	1:1 (0.01 mole)
* Catalyst	:	NaOH (2g in 50mL H_2O)
* Solvent	:	rectified spirit (20 mL)
* Temperature	:	20-25^{0}C
* Reaction time	:	4 hours

Behavior of TLC



A = *P*-bromoacetophenone

B = *P*-methoxy benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 4:1

R_f value = 0.60

Characterization of Product:

Colour = Yellow

Physical state = Solid crystal

The weight of crude product = 2.90 g

Melting point of the crude product = 140-144^{0}C

Recrystalizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.70 g

Yield of the recrystallized product = 85%

Melting point of the recrystallized product = 146-148^{0}C

Chemical behavior:

Test for carbonyl group:

The sample (5 mg) in freshly prepared 2,4 -DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

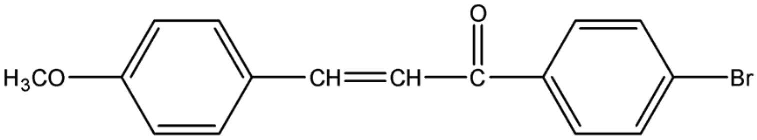
The UV spectrum of the compound in chloroform showed (λ_{max}) at 320 nm due to n-π* transition of the C=O and C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet show characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3005	: C-H stretching (aromatic, alkene)
2939	: C-H stretching of alkane
1656	: C=O conjugated with C=C
1593, 1511	: C=C stretching of phenyl ring
1492	: $-CH_2$ bending
1111	: $-OCH_3$ bending
1171, 1217, 1258	: C-O stretching
665	: C-Br stretching
836, 818, 737	: C-H bending of aromatic ring

The structure has been assigned to the compound depends spectral properties and chemical behavior, 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one, **59.**

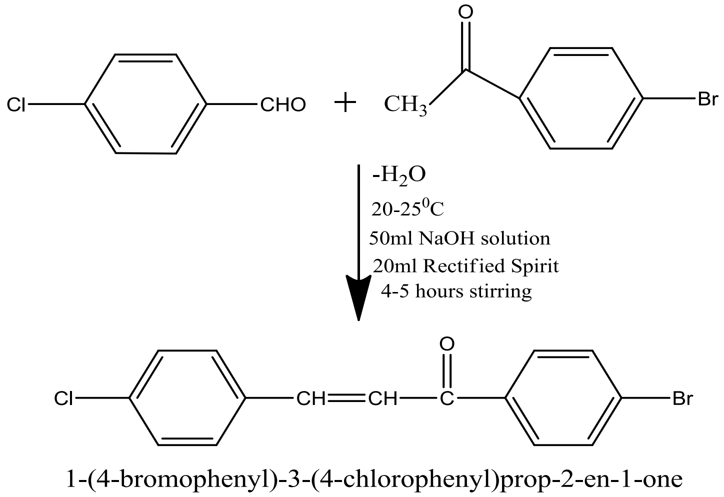


1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one

(59)

3.7.3 Preparation of 1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one:

Scheme of the Reaction:

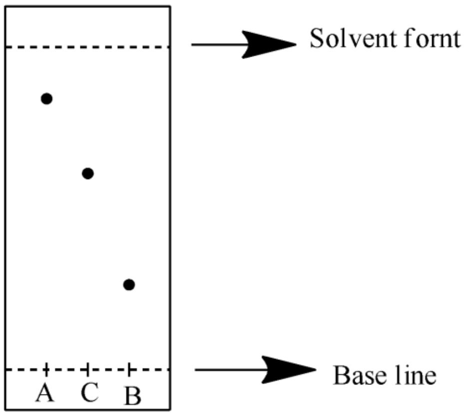


(60)

Reaction Conditions:

*	Molar ratio of the reactants	: 1:1 (0.01 mole)
*	Catalyst	: NaOH (2g in 50mL H_2O)
*	Solvent	: rectified spirit (20 mL)
*	Temperature	: 20-25^{0}C
*	Reaction time	: 4 hours

Behavior of TLC



A = *P*-bromoacetophenone

B = *P*-chloro benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 3:2

R_f value = 0.61

Characterization of Product:

Colour = Brownish

Physical state = Solid crystal

The weight of crude product = 2.81 g

Melting point of the crude product = 160-166^{0}C

Recrystalizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.58 g

Yield of the recrystallized product = 80%

Melting point of the recrystallized product = 168-170^{0}C

Chemical behavior:

Test for carbonyl group:

The sample (5mg) in freshly prepared 2,4-DNP reagent (2mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in chloroform showed (λ_{max}) at 318 nm due to n-π^* transition of the C=O conjugated with C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3083 : C-H stretching (aromatic, alkene)

2793 : C-H stretching of alkane

1656 : C=O conjugated with C=C

1593, 1511 : C=C stretching of phenyl ring

1492 : $-CH_2$ bending

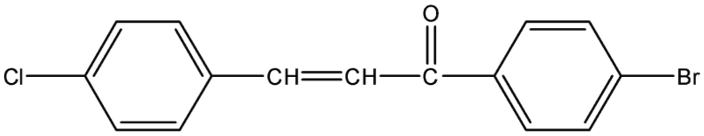
1178, 1217, 1275 : C-O Stretching

815, 739. : C-H bending of aromatic ring

775 : C-Cl bending

664 : C-Br Stretching

The structure has been assigned to the compound depends spectral properties and chemical behavior, 1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one, **60.**

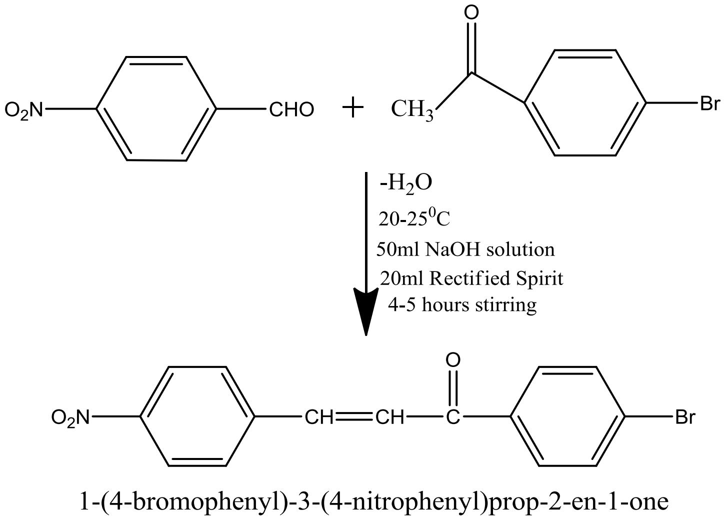


1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one

(60)

3.7.4 Preparation of 1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one:.

Scheme of the Reaction:

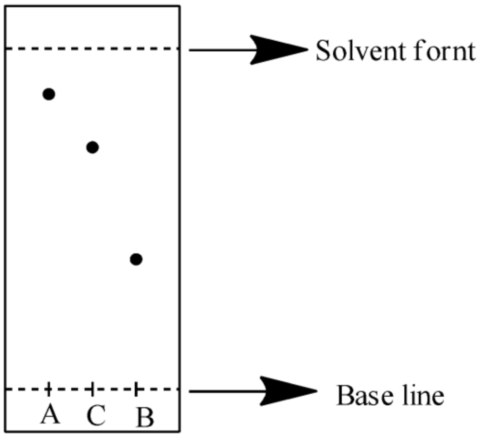


(61)

Reaction Conditions:

- * Molar ratio of the reactants : 1:1 (0.01 mole)
- * Catalyst : NaOH (2g in 50mL H_2O)
- * Solvent : rectified spirit (20 mL)
- * Temperature : 20-25^{0}C
- * Reaction time : 4 hours

Behavior of TLC



A = *P*-bromoacetophenone

B = *P*-nitro benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 3:2

R_f value = 0.71

Characterization of Product:

Colour = Red Brownish

Physical state = Solid crystal

The weight of crude product = 2.90 g

Melting point of the crude product = 158-162^{0}C

Recrystalizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.67 g

Yield of the recrystallized product = 80%

Melting point of the recrystallized product = 164-166^{0}C

Chemical behaviour:

Test for carbonyl group:

The sample (5mg) in freshly prepared 2,4-DNP reagent (2mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

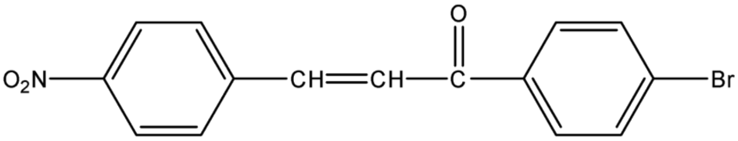
The UV spectrum of the compound in chloroform showed (λ_{max}) at 314 nm due to n-π^* transition of the C=O conjugated with C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3109	: C-H stretching (aromatic, alkene)
2939	: C-H stretching of alkane
1659	: C=O conjugated with C=C
1597, 1511	: C=C stretching of phenyl ring
1492	: $-CH_2$ bending
1560, 1346	: $-NO_2$ stretching
1179, 1215, 1291	: C-O stretching
660	: C-Br stretching
821, 857	: C-H bending of aromatic ring

The structure has been assign to the compound depends spectral properties and chemical behavior, 1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one, **61.**

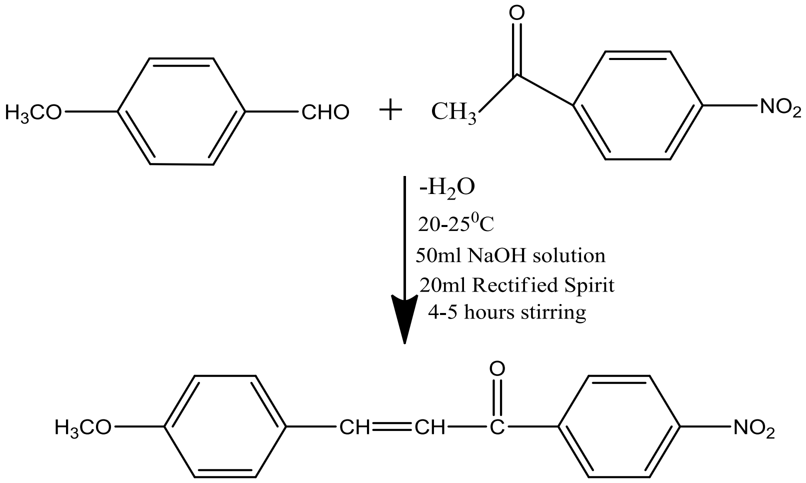


1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one

(**61)**

3.7.5 Preparation of 3-(4-nitrophenyl)-1-(4-methoxyphenyl)prop-2-en-1-one:

Scheme of the Reaction:



3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one

(62)

Reaction Conditions:

* Molar ratio of the reactants : 1:1 (0.01 mole)

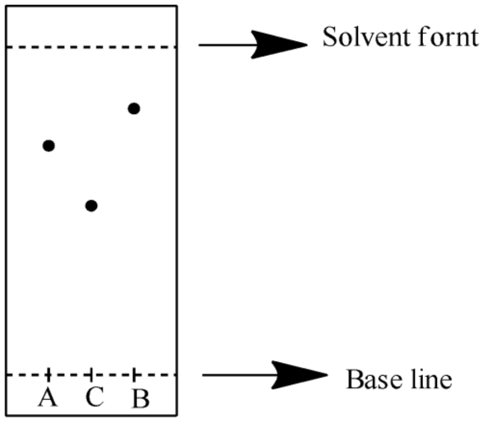
* Catalyst : NaOH (2g in 50mL H_2O)

* Solvent : rectified spirit (20 mL)

* Temperature : 20-25^{0}C

* Reaction time : 4 hours

Behavior of TLC



A = *P*-nitro acetophenone

B = *P*-methoxy benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 3:2

R_f value = 0.52

Characterization of Product:

Colour = Yellow

Physical state = Solid crystal

The weight of crude product = 2.53 g

Melting point of the crude product = 162-168^{0}C

Recrystalizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.15 g

Yield of the recrystallized product = 76%

Melting point of the recrystallized product = 170-172^{0}C

Chemical behavior:

Test for carbonyl group:

The sample (5mg) in freshly prepared 2,4-DNP reagent (2mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

UV spectram:

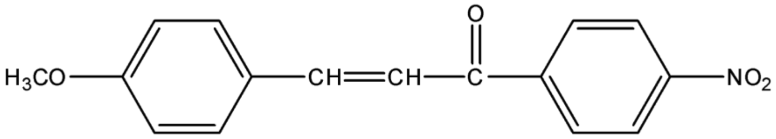
(A) The UV spectrum of the compound in chloroform showed (λ_{max}) at 364 nm due to n-π^* transition of the C=O conjugated with C=C.

IR spectram:

(B) The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3111	: C-H stretching (aromatic, alkene)
2975	: C-H stretching of alkane
1657	: C=O conjugated with C=C
1583	: C=C stretching of phenyl ring
1492	: $-CH_2$ bending
1104	: $-OCH_3$ stretching
1512, 1339	: $C-NO_2$ stretching
1186, 1211, 1257	: C-O stretching
855, 820, 766	: C-H bending of aromatic ring

The structure has been assign to the compound depends spectral properties and chemical behavior, 3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one, **62.**

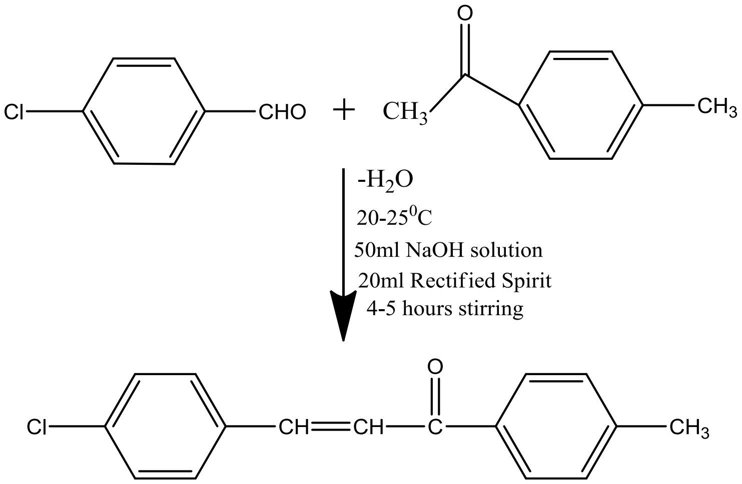


3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one

(62)

3.7.6 Preparation of 3-(4-chlorophenyl)-1-(*p*-toly)prop-2-en-1-one:

Scheme of the Reaction:



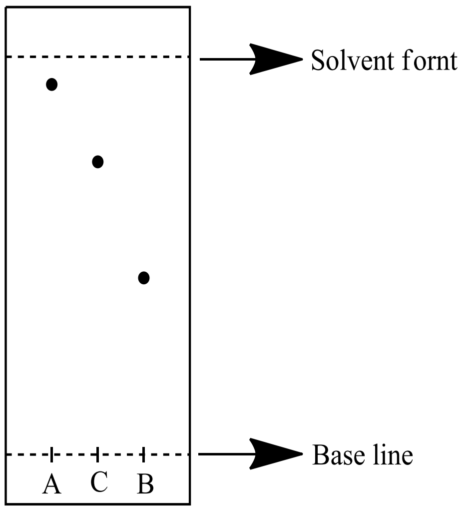
3-(4-chlorophenyl)-1-(*p*-tolyl)prop-2-en-1-one

(63)

Reaction Conditions:

*	Molar ratio of the reactants	: 1:1 (0.01 mole)
*	Catalyst	: NaOH (2g in 50mL H_2O)
*	Solvent	: rectified spirit (20 mL)
*	Temperature	: 20-25^{0}C
*	Reaction time	: 4 hours

Behavior in TLC



A = *P*-methyl acetophenone

B = *P*-chloro benzaldehyde

C = Product

Solubility = The product was soluble in chloroform

Eluting Solvent = Chloroform : Pet ether

= 4:1

R_f value = 0.80

Characterization of Product:

Colour = Off white

Physical state = Solid crystal

The weight of crude product = 2.31 g

Melting point of the crude product = 140-146^{0}C

Recrystalizing Solvent = Rectified spirit

Weight of the recrystallized product = 2.05 g

Yield of the recrystallized product = 80%

Melting point of the recrystallized product = 148-150^{0}C

Chemical behavior:

Test for carbonyl group:

The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectrum:

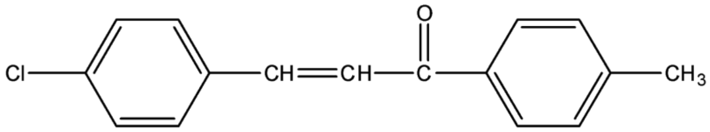
The UV spectrum of the compound in chloroform showed (λ_{max}) at 320 nm due to n-π^* transition of the C=O conjugated with C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3029	: C-H stretching (aromatic, alkene)
2980	: C-H stretching of alkane
1655	: C=O conjugated with C=C
1565	: C=C stretching of phenyl ring
1492	: - CH_2 bending
1331	: - CH_3 bending
736	: C-Cl stretching
1179, 1224, 1277	: C-O stretching
816	: C-H bending of aromatic ring

The structure has been assign to the compound depends spectral properties and chemical behavior, 3-(4-chlorophenyl)-1-(*p*-toly)prop-2-en-1-one, **63.**



3-(4-chlorophenyl)-1-(*p*-tolyl)prop-2-en-1-one

(63)

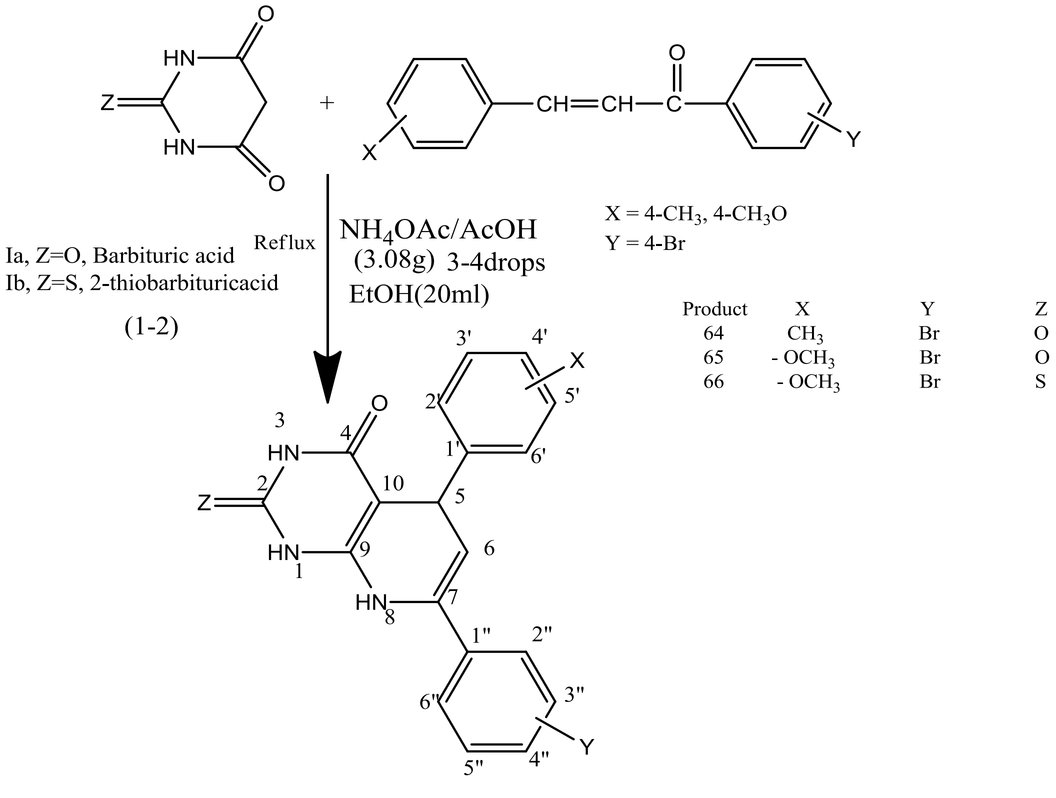
3.8 Synthesis of Pyrimidine Derivatives

Synthesis of Pyridopyrimidine Derivatives: The reaction of chalcones with barbituric acid/2-thiobarbituric acid, ammonium acetate in acetic acid and ethanol under refluxing condition.

General procedure:

Chalcones (1mmol), barbituric acid/2-thiobarbituric (1mmol), substituted benzaldehydes (1mmol), ammonium acetate (3.08 g), 3-4 drops acetic acid and ethanol (20 mL) were placed in a round-bottomed flask fitted with a refluxing condenser with a drying tube at the top of it. The reaction was heated to reflux for 6 hours. The reaction progress was followed by TLC. When reaction was complete, the reaction mixture than poured into ice cold water. The solid mass obtained it was than filtered, washed with ice cold water, dried, recrystallized from ethanol or other solvents depending on the solubility of crude product. The purity of the products were checked by TLC.

Scheme of the Reaction:

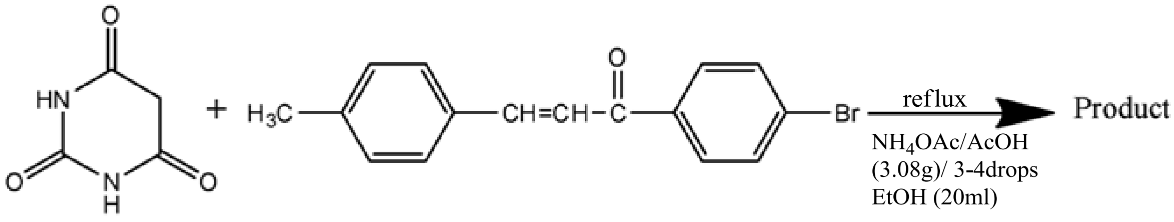


X = 4-CH_3, 4-CH_3O
Y = 4-Br

Product	X	Y	Z
64	CH_3	Br	O
65	- OCH_3	Br	O
66	- OCH_3	Br	S

3.8.1 The reaction of 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one with barbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(58)** **(64)**

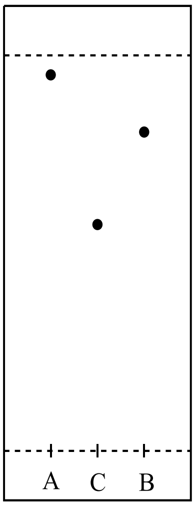
Conditions of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 80-85^{0}C

(c) Reaction time : 8 hours

Behavior in TLC:



A = 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one

B = Barbituric acid

C = Product

Eluting solvent = Acetone: $CHCl_3$= 4:1

R_f value = 0.57

Solubility = DMSO

Characterization of the Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 0.34 g

Melting point of the crude product = 138-140^{0}C

Recrystallizing solvent = Ethanol

Weight of the recrystallized product = 0.28 g

Yield of the recrystallized product = 68%

Melting point of the recrystallized product = 142-144^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectrum:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 330 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3150 : N-H stretching

2998 : C-H stretching of aromatic ring

2914 : C-H stretching of CH_3

1651 : C=O stretching frequency of -NH-C=C-CO-

1598 : C=O conjugated with C=C

1513 : C=C stretching of aromatic ring

1412 : C-H bending of $-CH_3$

1331 : C-N stretching

810 : C-H bending of aromatic ring

664 : C-Br stretching

(C) ^{1}H NMR Spectrum:

The ^{1}H NMR spectrum (Fig-15) of the product **64** in DMSO gave the following chemical shifts (δ-values):

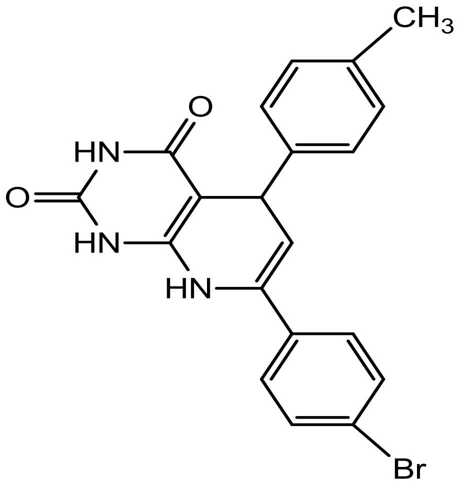
Chemical shift, δ (in ppm)	Protons
8.30	s, 1H, NH, 3-H
8.28	s, 1H, NH, 1-H
8.09-7.67	m, aromatic protons
7.29-7.06	m, 2H, 5-H and 6-H
5.45	s,1H, NH, 8-H
2.35	s, 3H, Ar-CH_3

(D) ^{13}C NMR Spectrum:

The ^{13}C NMR (Fig-16) showed gave signals δ-values at:

Chemical shift, δ (in ppm)	Carbon position
188.78	C-2, C-4
145.10	C-9
141.39-119.24	aromatic carbons
137.12	C-7
128.69	C-10
127.66	C-6
114.21	C-5
21.57	Ar-CH_3

The structure has been assign to the compound depends spectral properties and chemical behavior, 7-(4-bromophenyl)-5-(*p*-toly)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

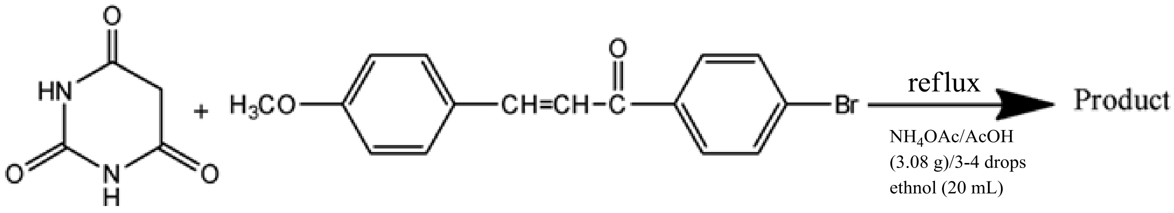


7-(4-bromophenyl)-5-(*p*-toly)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

(64)

3.8.2 The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one with barbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(59)** **(65)**

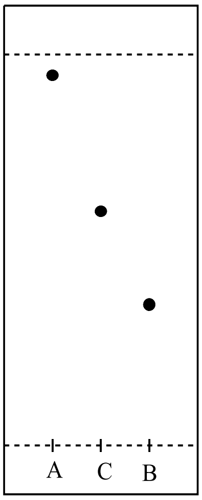
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 80-85^{0}C

(c) Reaction time : 8 hours

Characterization of TLC:



A =1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one

B = Barbituric acid

C = Product

Eluting solvent = Ethanol : Acetone = 4:1

R_f value = 0.60

Characterization of Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 0.34 g

Melting point of the crude product = 150-156^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.26 g

Yield of the recrystallized product = 65%

Melting point of the recrystallized product = 158-160^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 341 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3066 : N-H stretching

2974, 2910 : C-H stretching of aromatic ring

1658 : C=O stretching frequency of -NH-C=C-CO-

1593 : C=O conjugated with C=C

1511 : C=C stretching of aromatic ring

1343 : C-N stretching

1171 : C-O stretching of $-OCH_3$

818 : C-H bending of aromatic ring

665 : C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-19) of the product **65** in DMSO gave the following chemical shifts ($\underline{\delta}$-values):

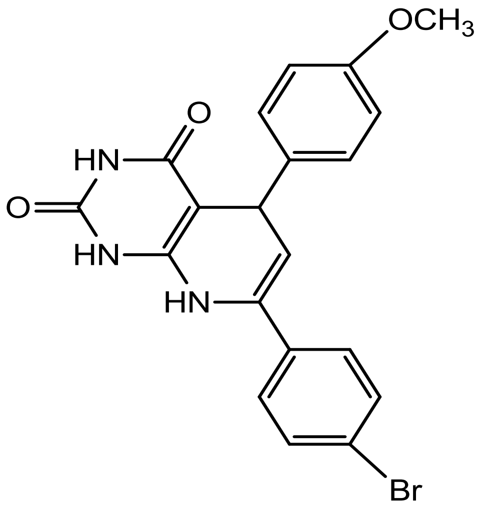
Chemical shift, $\underline{\delta}$ (in ppm)	Protons
9.87	s, 1H, N$\underline{H}$, 3-H
8.09	s, 1H, N$\underline{H}$, 1-H
7.87-7.71	m, aromatic protons
7.14-7.02	m, 2H, 5-H and 6-H
3.86	s,1H, N$\underline{H}$, 8-H
3.83	s, 3H, Ar -OCH_3

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-20) showed gave the signals δ-values at

Chemical shift, $\underline{\delta}$ (in ppm)	Carbon position
188.61	C-2,4
161.99-114.99	aromatic carbons
145.06	C-9
137.27	C-7
127.67	C-10
127.52	C-6
114.91	C-5
55.88	Ar-O$\underline{C}H_3$

The structure has been assign to the compound depends spectral properties and chemical behavior, 7-(4-bromophenyl)-5-(4-methoxyphenyl)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione.

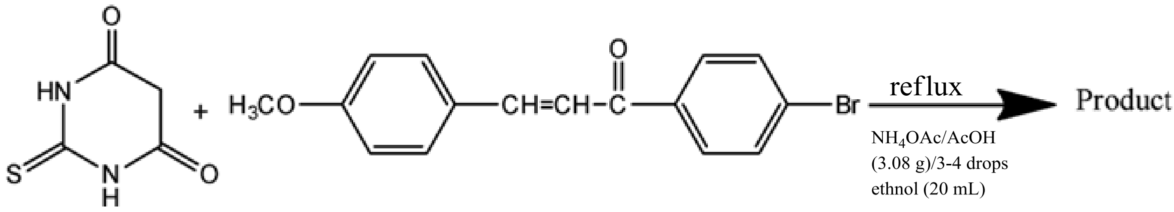


7-(4-bromophenyl)-5-(4-methoxyphenyl)-5,8-dihydropyrido[2,3-d]pyrimidine-2,4(1H,3H)-dione

(65)

3.8.3 The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one with 2-thiobarbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(2) **(59)** **(66)**

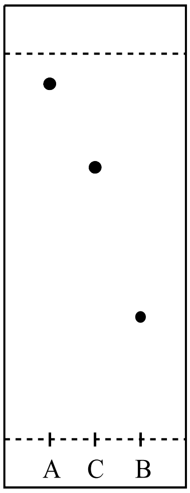
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 80-85^{0}C

(c) Reaction time : 8 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one

B = 2-thiobarbituric acid

C = Product

Eluting solvent = EtOAc:Acetone = 4:1

R_f value = 0.71

Characterization of Product:

Colour = Light brown

Physical state = Solid crystal

The weight of crude product = 0.31g

Melting point of the crude product = 162-166^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.29 g

Yield of the recrystallized product = 65%

Melting point of the recrystallized product = 168-170^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 347 nm due to π-π* transition of the C=O and C=C.

(B) IR spectram:

The IR spectram of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3069	: N-H stretching
2975, 2886	: C-H stretching of aromatic ring
1644	: C=S stretching
1594	: C=O conjugated with C=C
1511	: C=C stretching of aromatic ring
1334	: C-N stretching
1188	: C-O stretching of $-OCH_3$
819	: C-H bending of aromatic ring
665	: C-Br stretching

(C) ^{1}H NMR Spectrum:

The ^{1}**H NMR** spectrum (Fig-23) of the product **66** in DMSO gave the following chemical shifts ($\underline{\delta}$-values):

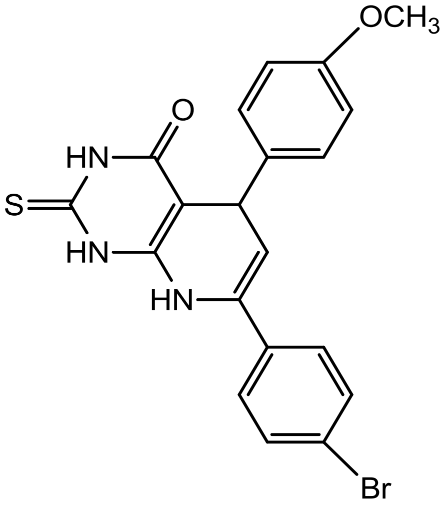
Chemical shift, $\underline{\delta}$ (in ppm)	Protons
10.31	s, 1H, N$\underline{H}$, 3-H
8.09	s, 1H, N$\underline{H}$, 1-H
7.87-7.71	m, aromatic protons
7.19-7.01	m, 2H, 5-H and 6-H
4.05	s,1H, N$\underline{H}$, 8-H
3.83	s, 3H, Ar -OCH_3

(D) ^{13}C NMR Spectrum:

The ^{13}**C NMR** (Fig-24) showed gave the signals δ-values at :

Chemical shift, $\underline{\delta}$ (in ppm)	Carbon position
188.62	C-2
174.69	C-4
162.00-119.65	aromatic carbons
145.05	C-9
137.29	C-7
127.68	C-10
127.50	C-6
114.92	C-5
55.88	Ar-$O\underline{C}H_3$

The structure has been assign to the compound on the basis of spectral properties and chemical behavior, 7-(4-bromophenyl)-5-(4-methoxyphenyl)-2-thioxo-2,3,5,8-tetrahydropyrido[2,3-d]pyrimidine-4(1H)-one.



7-(4-bromophenyl)-5-(4-methoxyphenyl)-2-thioxo-2,3,5,8-tetrahydropyrido [2,3-] pyrimidine-4(1H)-one

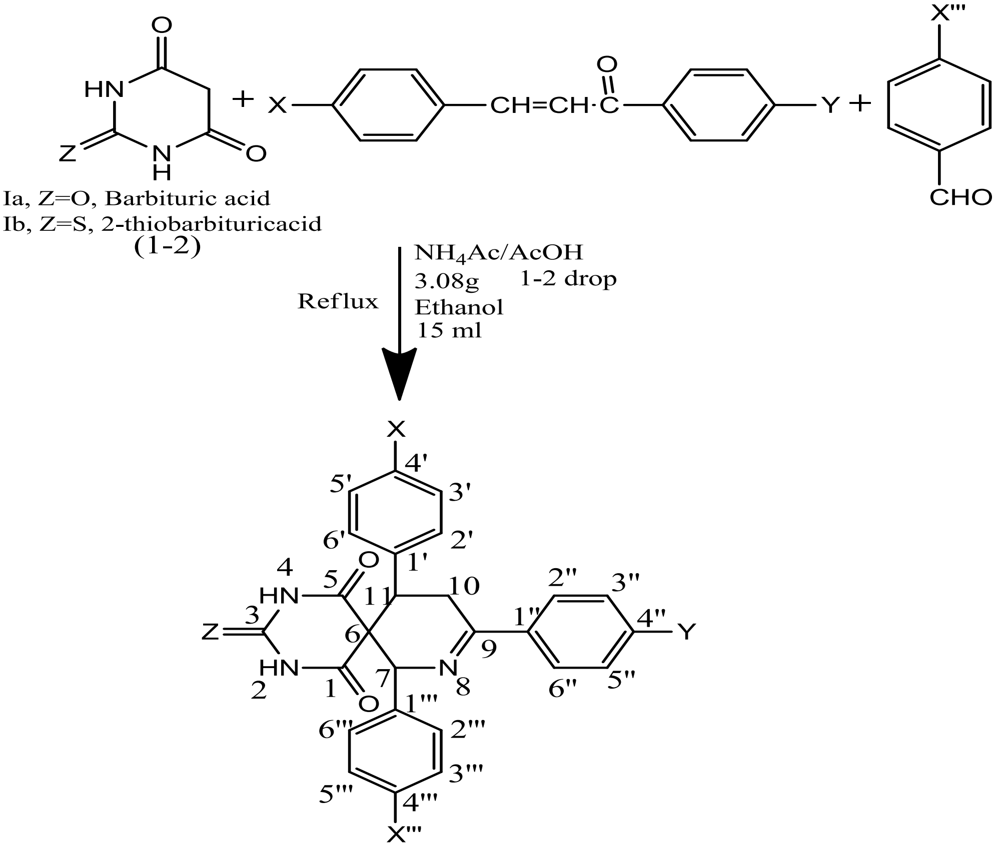
(66)

Synthesis of Azaspiro Derivatives: The reaction of chalcones with barbituric acid/2-thiobarbituric acid, substituted benzaldehydes, ammonium acetate in acetic acid and ethanol.

General procedure:

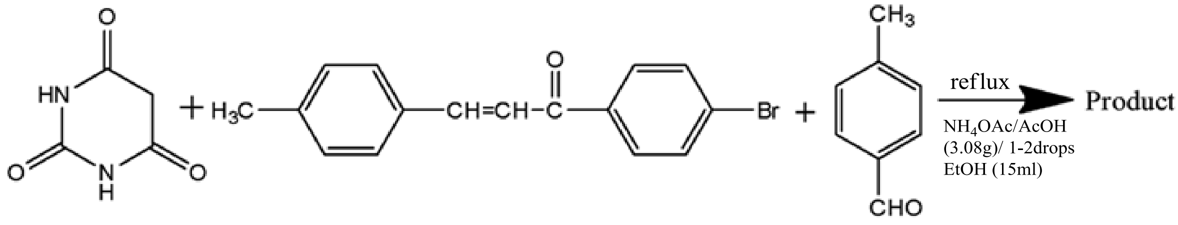
Chalcones (1mmol), barbituric acid/2-thiobarbituric (1mmol), substituted benzaldehydes (1mmol), ammonium acetate (3.08 g) and 2 drops acetic acid were added and ethanol (15 mL) were placed in a round-bottomed flask fitted with a refluxing condenser with a drying tube at the top of it. The reaction was heated to reflux for 4 hours. The reaction progress was followed by TLC. When reaction was complete, the reaction mixture than poured into ice cold water. The solid mass obtained it was than filtered, washed with ice cold water, dried, recrystallized from ethanol or other solvents depending on the solubility of crude product. The purity of the products were checked by TLC.

Scheme of the Reaction:



3.8.4 The reaction of 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one with barbituric acid, 4-methyl benzaldehyde, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(58)** **(67)**

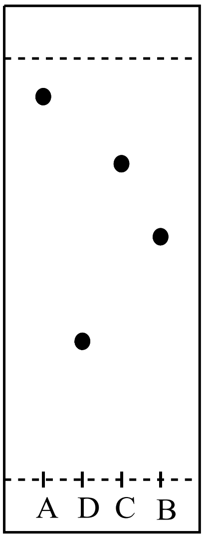
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 4 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one

B = Barbituric acid

C = 4-methyl benzaldehyde

D = Product

Eluting solvent = Acetone: $CHCl_3$ = 4:1

R_f value = 0.32

Characterization of the Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 0.42 g

Melting point of the crude product = 142-148^{0}C

Recrystallizing solvent = Ethanol

Weight of the recrystallized product = 0.32g

Yield of the recrystallized product = 60%

Melting point of the recrystallized product = 150-151^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectrum:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 342 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectrum:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3128 : N-H stretching

2917 : C-H stretching of aromatic ring

2857 : C-H stretching of CH_3

1657 : C=N stretching

1629 : C=O group frequency of -NH-C=C-CO-

811 : C-H bending of aromatic ring

664 : C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-27) of the product, **67** in DMSO gave the following chemical shifts (δ values) at:

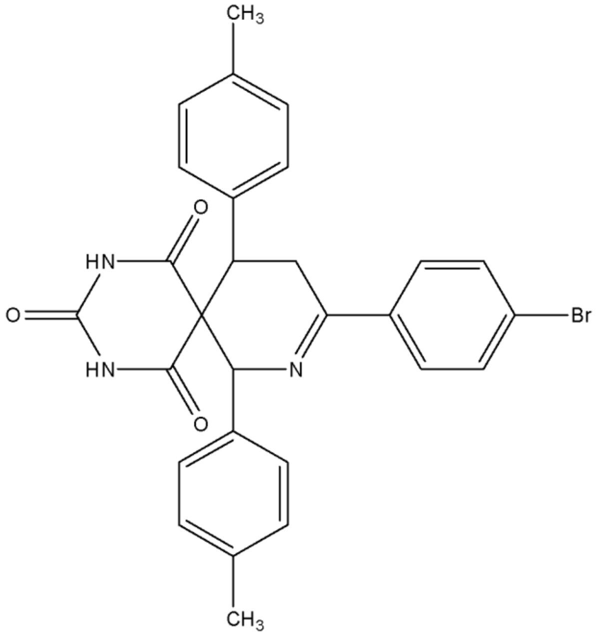
Chemical shift, δ (in ppm)	Protons	Coupling constant, J (in Hz)
10.12	s, 1H, NH, 2-H	
9.45	s, 1H, NH, 4-H	
8.09	d, 2H, H-3', 5'	J=8
7.81	d, 2H, H-2', 6'	J=8
7.65	d, 2H, H-3", 5"	J=8
7.35	d, 2H, H-2", 6"	J=8
7.28	d, 2H, H-3"', 5"'	J=8
7.11	d, 2H, H-2"', 6"'	J=8
5.57	s, 1H, H-7	
2.50-2.20	m, 3H, H-10 and H-11	
2.36	s, 3H, Ar-CH_3	
2.27	s, 3H, Ar-CH_3	

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-28) showed gave the signals δ values at:

Chemical shift, δ (in ppm)	Carbon position
188.77	C-1 and C-5
165.12	C-9
145.10	C-3
141.40--121.13	aromatic carbons
90.28	C-7
57.91	C-6
45.25	C-11
32.15	C-10
21.58	Ar-CH_3

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R,11R)-9-(4-bromophenyl)-7,11-di-p-toly-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione.

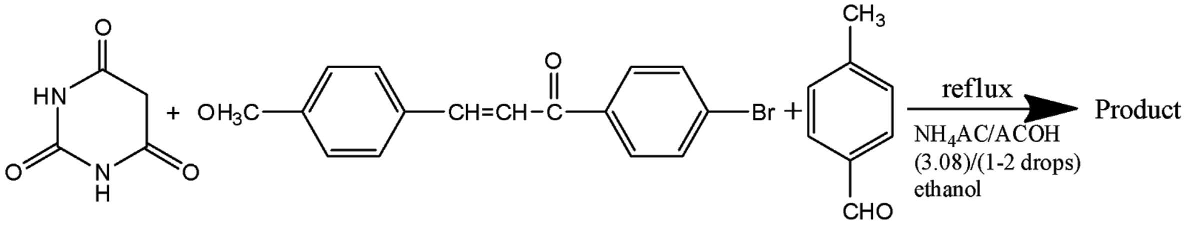


(7R,11R)-9-(4-bromophenyl)-7,11-di-p-toly-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(67)

3.8.5 The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one with barbituric acid, 4-methyl benzaldehyde, ammonium acetate in acetic acid and ethnol.

Reaction:



(1) **(59)** **(68)**

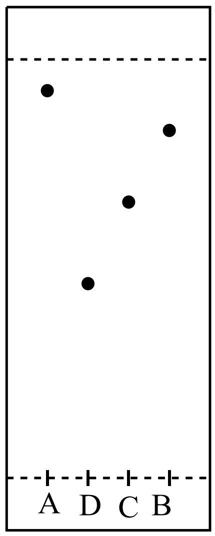
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 4 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one

B = barbituric acid

C = 4-methyl benzaldehyde

D = Product

Eluting solvent = Acetone : $CHCl_3$ = 3:2

R_f value = 0.46

Characterization of Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 0.42 g

Melting point of the crude product = 124-128^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.35 g

Yield of the recrystallized product = 64%

Melting point of the recrystallized product= 130-132^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 345 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectram:

The IR spectram of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3006	: NH stretching
2936	: C-H stretching of aromatic ring
2841	: C-H stretching of CH_3
1657	: C=N stretching
1628	: C=O group frequency of -NH-C=C-CO-
1172	: C-O stretching of $-OCH_3$
819	: C-H bending of aromatic ring
664	: C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-31) of the product **68** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons	Coupling constant, J (in Hz)
8.30	s, 1H, NH, 2-H	
8.28	s, 1H, NH, 4-H	
8.07	d, 2H, H-3', 5'	J=8
7.85	d, 2H, H-2', 6'	J=8
7.65	d, 2H, H-3'', 5''	J=8
7.28	d, 2H, H-2'', 6''	J=8
7.02	d, 2H, H-3''', 5'''	J=8
6.88	d, 2H, H-2''', 6'''	J=8
5.57	s, 1H, H-7	
3.82	s, 3H, Ar-OCH_3	
2.51-2.26	m, 3H, H-10 and H-11	
2.35	s, 3H, Ar-CH_3	

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-32) showed gave the δ-values at:

Chemical shift, δ (in ppm)	Carbon position
188.75	C-1, C-5
164.19	C-3
161.99-114.91	aromatic carbons
145.10	C-9
92.86	C-7
57.21	C-6
55.87	Ar-OCH_3
45.66	C-11
32.58	C-10
21.58	Ar-CH_3

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R, 11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undeec-8-ene-1,5-dione.

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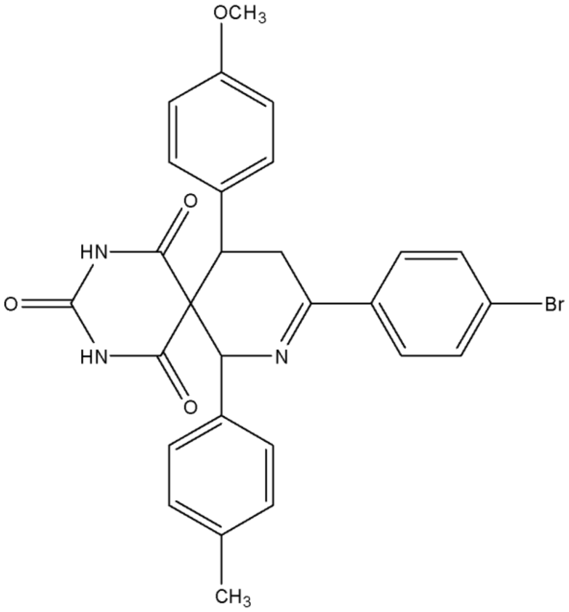
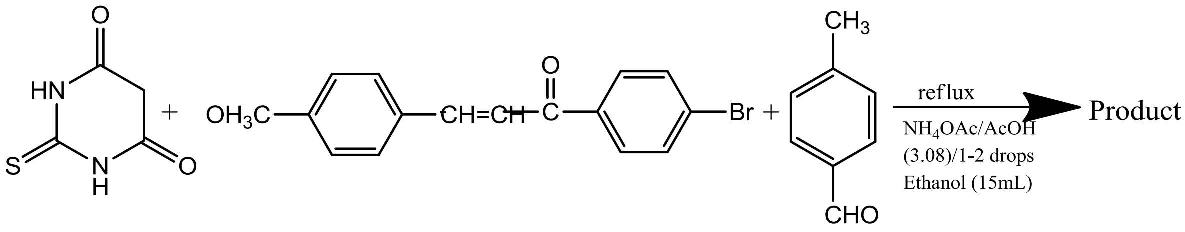


(7R, 11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione.

(68)

3.8.6 The reaction of 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one with 2-thiobarbituric acid, 4-methyl benzaldehyde, ammonium acetate in acetic acid and ethanol.

Reaction:



(2) **(59)** **(69)**

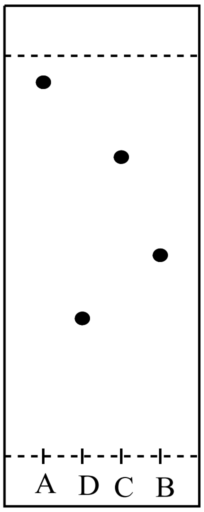
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 4.5 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(4-methoxyphenyl)prop-2-en-1-one

B = 2-thiobarbituric acid

C = 4-methyl benzaldehyde

D = Product

Eluting solvent = Acetone : $CHCl_3$ = 4:1

R_f value = 0.34

Characterization of Product:

Colour = Light orange

Physical state = Solid crystal

The weight of crude product = 0.45 g

Melting point of the crude product = 170-174^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.37 g

Yield of the recrystallized product = 65%

Melting point of the recrystallized product = 176-177^{0}C

Chemical behaviour:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 344 nm due to π-π* transition of the C=O and C=C.

(B) IR spectram:

The IR spectram of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3138	: NH stretching
2972	: C-H stretching of aromatic ring
2842	: C-H stretching of CH_3
1656	: C=N stretching
1593	: C=O stretching frequency of -NH-C=C-CO-
1258	: C=S stretching
1172	: C-O stretching of $-OCH_3$
819	: C-H bending of aromatic ring
668	: C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-35) of the product, **69** in DMSO gave the following chemical shifts (δ values) at:

Chemical shift, δ (in ppm)	Protons
10.26	s, 1H, NH, 2-H
8.30	s, 1H, NH, 4-H
8.09-7.01	m, aromatic potons
4.21	s, 1H, H-7
3.82	s, 3H, Ar-OCH_3
2.51-2.26	m, 3H, H-10, H-11
2.35	s, 3H, Ar-CH_3

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-36) showed gave the δ-values at:

Chemical shift, δ (in ppm)	Carbon position
188.62	C-3
164.18	C-1 and C-5
161.99-114.92	aromatic carbons
145.10	C-9
90.89	C-7
56.98	C-6
55.88	Ar-OCH_3
45.52	C-11
32.28	C-10
21.00	Ar-CH_3

The structure has been assign to the compound depends of spectral properties and chemical behavior, (7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-3-thioxo-7-(*p*-tolyi)-2,4,8- triazaspiro[5.5]undec-8-ene-1,5-dione.

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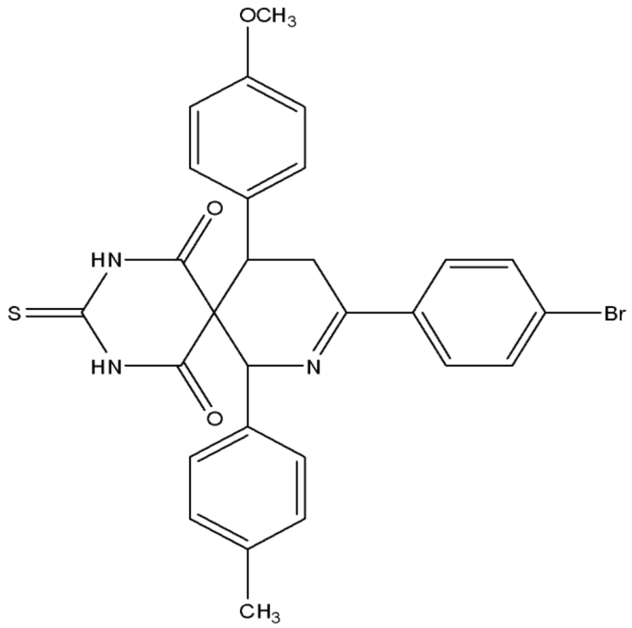
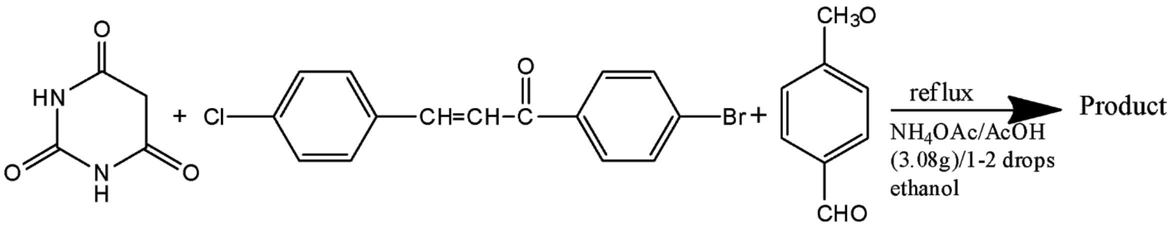


(7R,11R)-9-(4-bromophenyl)-11-(4-methoxyphenyl)-3-thioxo-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,5-dione

(69)

3.8.7 The reaction of 1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one with barbituric acid, 4-methoxy benzaldehyde, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(60)** **(70)**

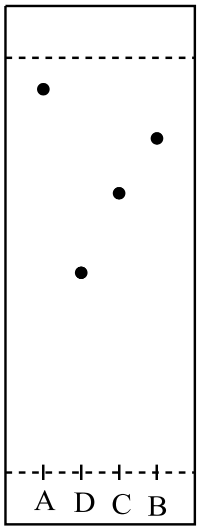
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 4 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(4-chlorophenyl)prop-2-en-1-one.

B = barbituric acid

C = 4-methoxy benzaldehyde

D = Product

Eluting solvent = Acetone : $CHCl_3$ = 3:2

R_f value = 0.48

Characterization of Product:

Colour = Light yellow

Physical state = Solid crystal

The weight of crude product = 0.456 g

Melting point of the crude product = 178-182^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.375 g

Yield of the recrystallized product = 66%

Melting point of the recrystallized product = 184-186^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 346 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectram:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3405 : NH stretching

1656 : C=N stretching

1583 : C=O group frequency of -NH-C=C-CO-

1170 : C-O stretching of $-OCH_3$

815 : C-H bending of aromatic ring

739 : C-Cl stretching

664 : C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-39) of the product, **70** in DMSO gave the following chemical shifts (δ values) at:

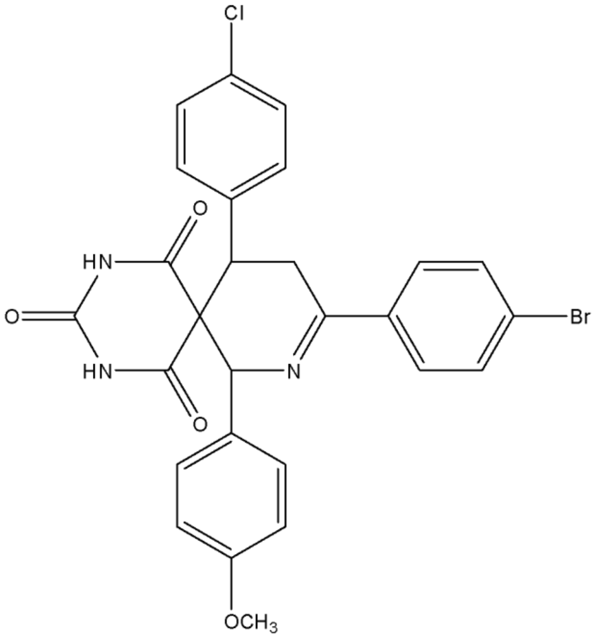
Chemical shift, δ (in ppm)	Protons	Coupling constant, J (in Hz)
11.19	s, 1H, NH, 2-H	
8.11	s, 1H, NH, 4-H	
7.96	d, 2H, H-3', 5'	J=8
7.91	d, 2H, H-2', 6'	J=8
7.86	d, 2H, H-3", 5"	J=8
7.79	d, 2H, H-2", 6"	J=8
7.74	d, 2H, H-3"', 5"'	J=8
7.53	d, 2H, H-2"', 6"'	J=8
5.52	s, 1H, H-7	
4.21-3.70	m, 3H, H-11 & H-10	
3.83	s, 3H, Ar-OCH_3	

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-40) showed gave the δ-values at:

Chemical shift, δ (in ppm)	Carbon position
188.73	C-1 and C-5
165.10	C-3
161.00-114.92	aromatic carbons
145.05	C-9
90.12	C-7
57.28	C-6
55.89	Ar-OCH_3
45.12	C-11
32.28	C-10

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R, 11R)-9-(4-bromophenyl)-11-(4-cholophenyl)-7-(p-tolyl) 2, 4, 8 -triazaspiro [5.5] undec-8-ene -1,3,5 -trione.

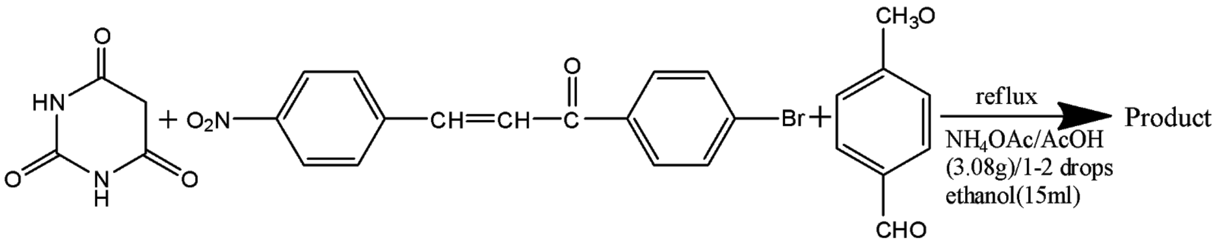


(7R, 11R)-9-(4-bromophenyl)-11-(4-cholophenyl)-7-(4-methoxyhenyl)-2, 4, 8 -triazaspiro [5.5] undec-8-ene- 1,3,5 -trione.

(70)

3.8.8 The reaction of 1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one with 4-methoxy benzaldehyde, barbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(61)** **(71)**

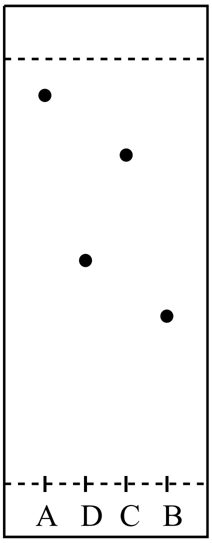
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 5 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(4-nitrophenyl)prop-2-en-1-one

B = barbituric acid

C = 4-methoxy benzaldehyde

D = Product

Eluting solvent = Acetone : EtOH = 4:1

R_f value = 0.53

Characterization of Product:

Colour = Brown

Physical state = Solid crystal

The weight of crude product = 0.46 g

Melting point of the crude product = 182-186^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 1.30g

Yield of the recrystallized product = 0.35

Melting point of the recrystallized product = 188-190^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 349 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectram:

The IR spectrum of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3073 : NH stretching

1657 : C=N stretching

1593 : C=O group frequency of -NH-C=C-CO-

1171 : C-O stretching of $-OCH_3$

1513,1346 : $C-NO_2$ stretching

664 : C-Br stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-43) of the product **71** in DMSO gave the following chemical shifts (δ values) at:

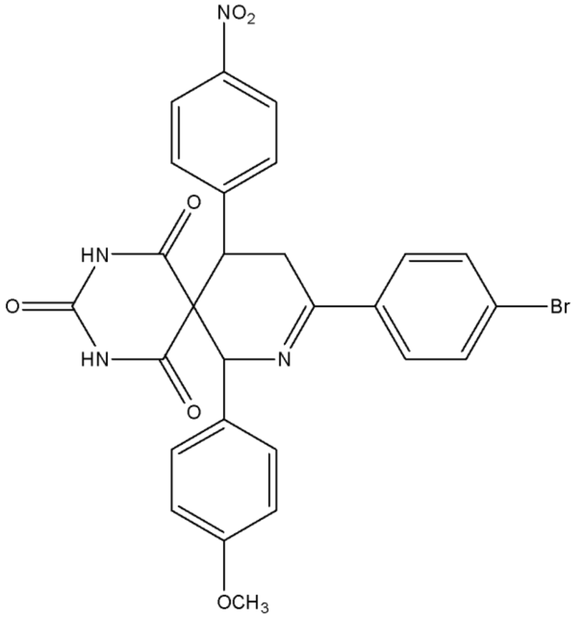
Chemical shift, δ (in ppm)	Protons
11.34	s, 1H, NH, 2-H
9.87	s, 1H, NH, 4-H
8.39-7.01	m, aromatic protons
5.75	s, 1H, H-7
3.86-3.61	m, 3H, H-11 & H-10
3.82	s, 3H, Ar-OCH_3

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR (**Fig-44) showed gave the δ-values at:

Chemical shift, δ (in ppm)	Carbon position
188.69	C-1,5
161.99	C-3
145.04	C-9
142.05-114.91	aromatic carbons
90.24	C-7
56.16	C-6
55.87	Ar-OCH_3
45.58	C-11
32.41	C-10

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R, 11R)-9-(4-bromophenyl)-11-(4-nitrophenyl)-7-(*P*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5 -trione.

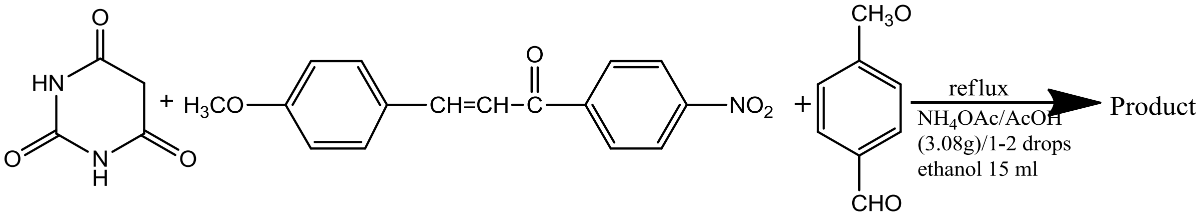


(7R, 11R)-9-(4-bromophenyl)-7-(4-methoxyphenyl)-11-(4-nitrophenyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5 -trione

(71)

3.8.9 The reaction of 3-(4-methoxyphenyl)-1-(4-nitrophenyl)prop-2-en-1-one with 4-methoxy benzaldehyde, barbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(62)** **(72)**

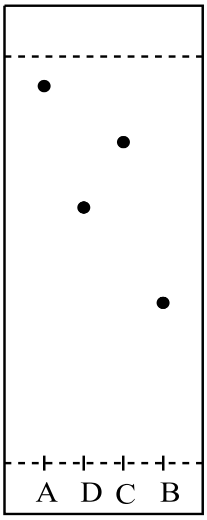
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : $98-99^0$C

(c) Reaction time : 4 hours

Characterization of TLC:



A = 3-(4-nitrophenyl)-1-(4-methoxyphenyl)prop-2-en-1-one

B = barbituric acid

C = 4-methoxy benzaldehyde

D = Product

Eluting solvent = Acetone : EtOH = 4:1

R_f value = 0.63

Characterization of Product:

Colour = Deep yellow

Physical state = Solid crystal

The weight of crude product = 0.41 g

Melting point of the crude product = 196-202^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.367 g

Yield of the recrystallized product = 69%

Melting point of the recrystallized product = 205-207^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 340 nm due to π-π^* transition of the C=O and C=C.

(B) IR spectram:

The IR spectram of the product run as KBr pellet showete characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3110 : NH stretching

1657 : C=N stretching

1593 : C=O group frequency of -NH-C=C-CO-

1584, 1341 : -NO_2 stretching

1185 : C-O stretching of -OCH_3

820 : C-H bending of aromatic ring

(C) ^{1}H NMR spectrum

The **^{1}H NMR** spectrum (Fig-47) of the product, **72** in DMSO gave the following chemical shifts (*δ* values) at:

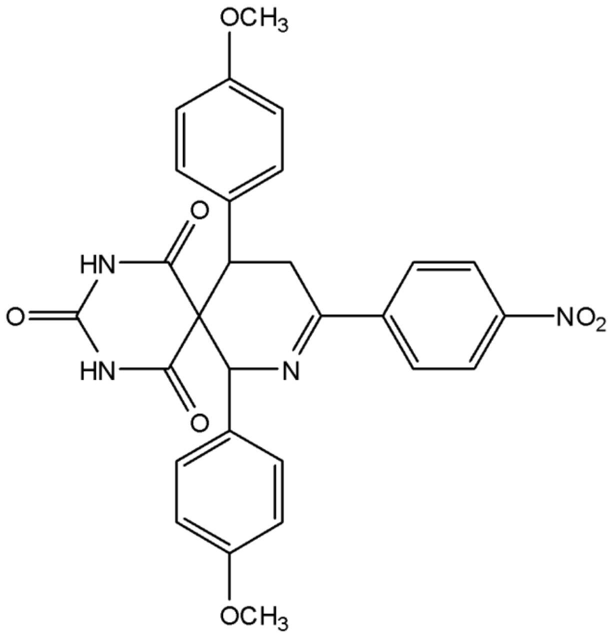
Chemical shift, δ (in ppm)	Protons
11.10	s, 1H, NH, 2-H
8.38	s, 1H, NH, 4-H
8.36-6.88	m, aromatic protons
5.52	s, 1H, H-7
3.88-3.38	m, 3H, H-11 & H-10
3.83	s, 6H, Ar-OCH_3

(D)^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-48) showed gave the signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.66	C-1, 5
165.02	C-3
144.41	C-9
143.18-114.05	aromatic carbons
92.18	C-7
56.91	C-6
55.50	Ar-OCH_3
45.22	C-11
32.15	C-10

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R, 11R)-11-(4-methoxyphenyl)-9-(4-nitrophenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione.

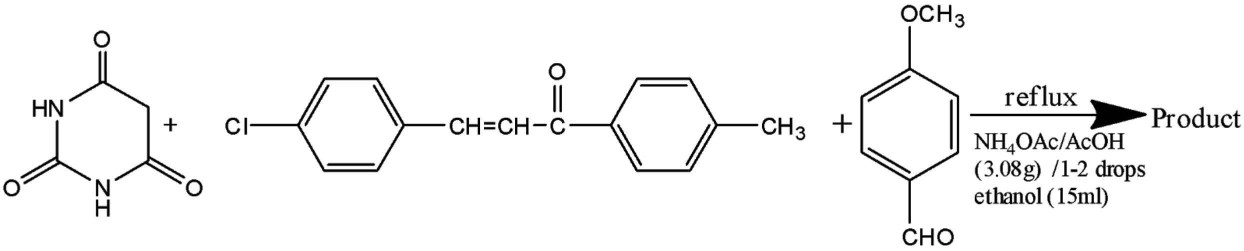


(7R, 11R)-11-(4-methoxyphenyl)-9-(4-nitrophenyl)-7-(*p*-tolyl)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione.

(72)

3.8.10 The reaction of3-(4-chlorophenyl)-1-(*p*-toly)prop-2-en-1-one with 4-methoxy benzaldehyde, barbituric acid, ammonium acetate in acetic acid and ethanol.

Reaction:



(1) **(63)** **(73)**

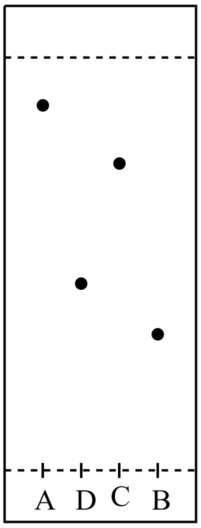
Condition of the reaction:

(a) Solvent : Ethanol

(b) Temperature : 90-95^{0}C

(c) Reaction time : 4.5 hours

Characterization of TLC:



A = 1-(4-bromophenyl)-3-(*p*-toly)prop-2-en-1-one

B = barbituric acid

C = 4-methoxy benzaldehyde

D = Product

Eluting solvent = Acetone : Ethanol = 4:1

R_f value = 0.45

Characterization of Product:

Colour = White

Physical state = Solid crystal

The weight of crude product = 0.42 g

Melting point of the crude product = 180-186^{0}C

Recrystalizing Solvent = Ethanol

Weight of the recrystallized product = 0.33 g

Yield of the recrystallized product = 65%

Melting point of the recrystallized product = 188-190^{0}C

Chemical behavior:

Test for carbonyl group: The sample (5 mg) in freshly prepared 2,4-DNP reagent (2 mL) was shaken well and allowed to stand for 1 hour. An orange precipitate was formed and upon standing for a long time it becomes orange crystalline solid.

$FeCl_3$ test: On addition of neutral $FeCl_3$ solution (2-3drops) to the solution of the product (5 cm^3), no colour was observed indicating the absence of enolic group.

Spectral Properties:

(A) UV spectram:

The UV spectrum of the compound in DMSO showed (λ_{max}) at 345 nm due to π-π* transition of the C=O and C=C.

(B) IR spectram:

The IR spectram of the product run as KBr pellet showed characteristic absorption peaks (ν_{max}) in cm^{-1} at:

3033	: NH stretching
2919	: C-H stretching of aromatic ring
2835	: C-H stretching of CH_3
1656	: C=N stretching
1599	: C=O group frequency of -NH-C=C-CO-
815	: C-H bending of aromatic ring
739	: C-Cl stretching

(C) ^{1}H NMR Spectrum:

The **^{1}H NMR** spectrum (Fig-51) of the product **73** in DMSO gave the following chemical shifts (*δ* values) at:

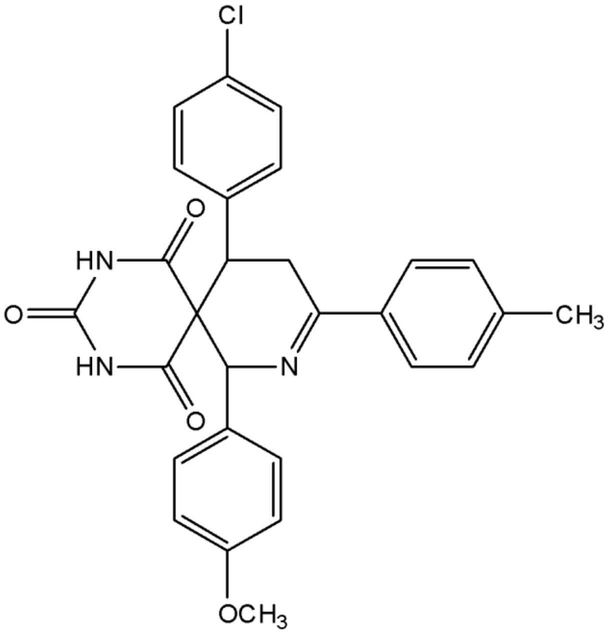
Chemical shift, δ (in ppm)	Protons
10	s, 1H, NH, 2-H
9.87	s, 1H, NH, 4-H
8.23-7.00	m, aromatic protons
3.86-3.39	m, 3H, H-11 & H-10
5.84	s, 1H, H-7
3.87	s, 3H, Ar-OCH_3
2.43	s, 3H, Ar-CH_3

(D) ^{13}C NMR Spectrum:

The **^{13}C NMR** (Fig-52) showed gave the signals (δ-values) at:

Chemical shift, δ (in ppm)	Carbon position
188.98	C-1, 5
161.790	C-3
144.184	C-9
143.76-114.87	aromatic carbons
92.85	C-7
56.14	C-6
55.83	Ar-OCH_3
45.18	C-11
32.18	C-10
21.30	Ar-CH_3

The structure has been assign to the compound depends spectral properties and chemical behavior, (7R, 11R)-11-(4-chlorophenyl)-7,9-di-*p*-tolyl-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

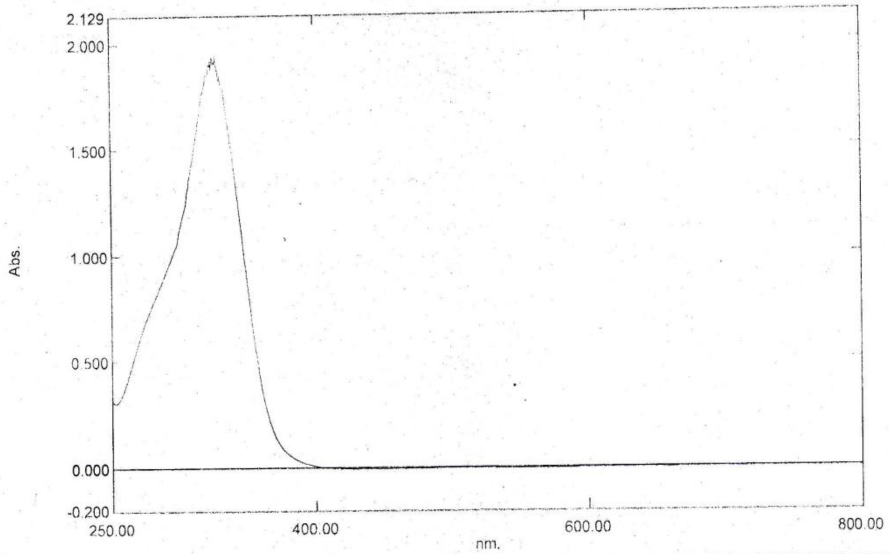


(7R, 11R)-11-(4-chlorophenyl)-7-(4-methoxyphenyl)-9-(*p*-toly)-2,4,8-triazaspiro[5.5]undec-8-ene-1,3,5-trione

(73)

Spectrum Peak Pick Report

Data Set: File_210310_141940.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	328.00	1.935	
2	↓	252.50	0.305	

[Measurement Properties]
Wavelengtn Range (nm.): 250.00 to 800.00
Scan Speed: Fast
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 1 UV spectrum of the compound 58

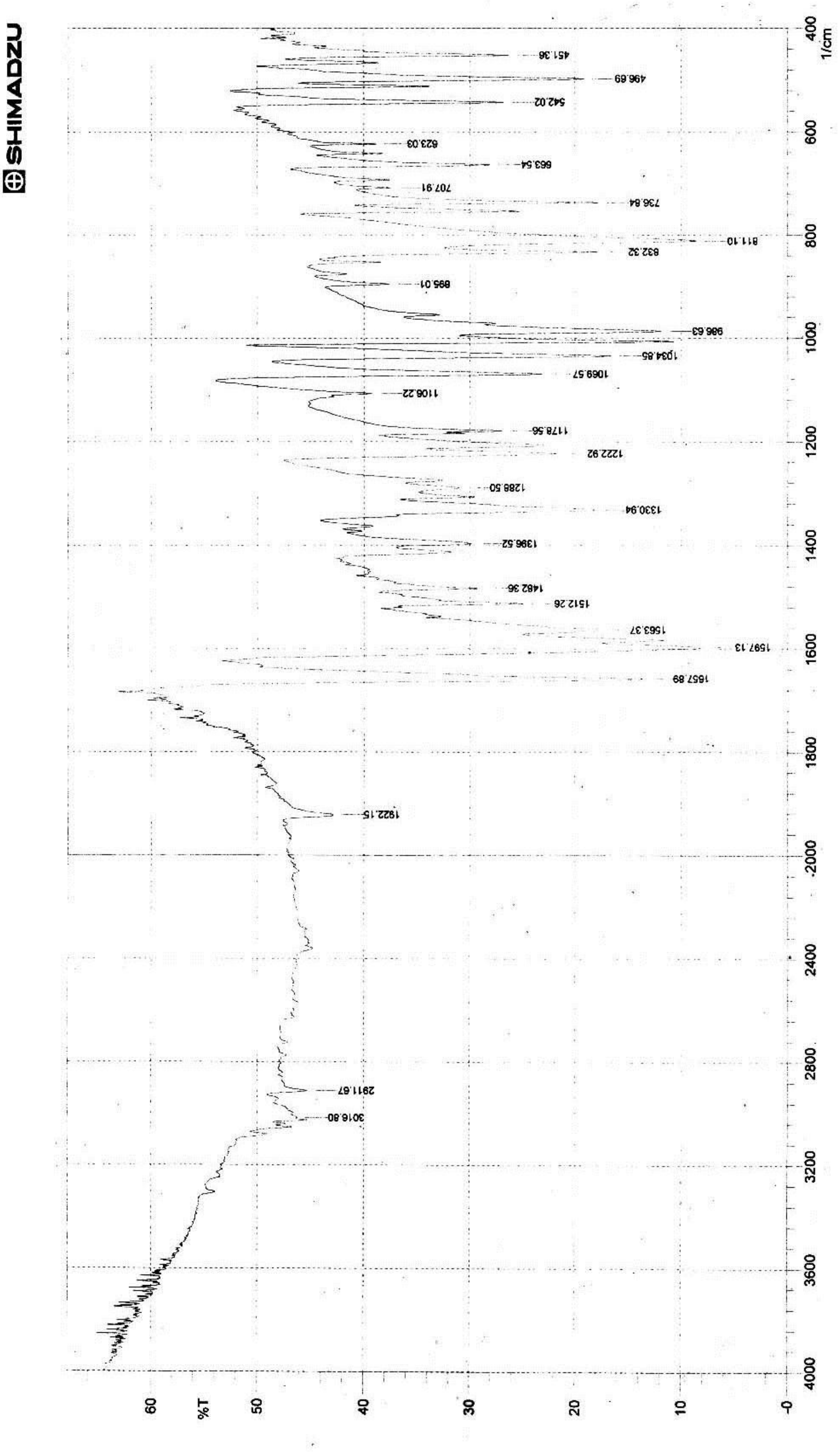
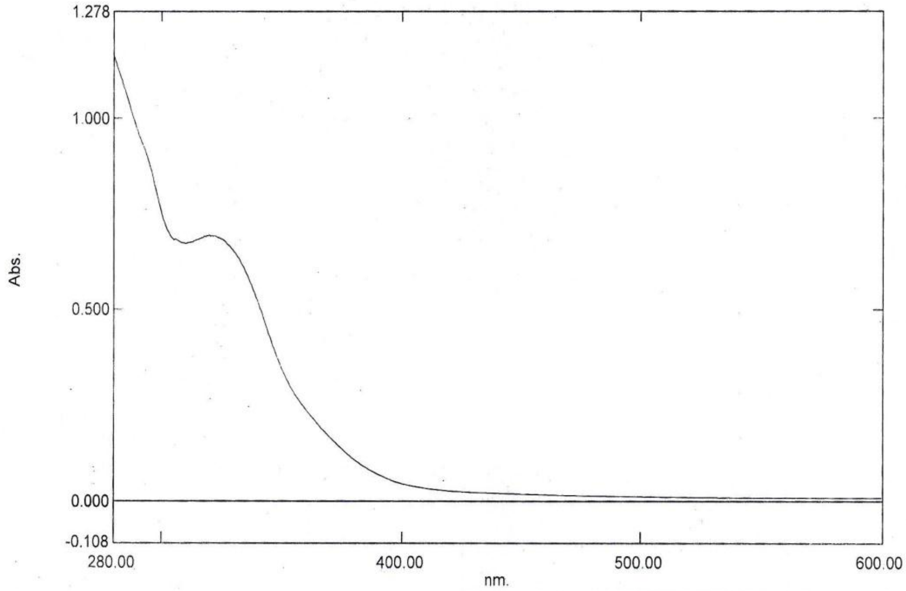


Figure - 2 IR spectrum of the compound 58

Spectrum Peak Pick Report

Data Set: File_210128_121628.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	320.20	0.692	
2	↓	310.40	0.670	

[Measurement Properties]
Wavelength Range (nm.): 280.00 to 600.00
Scan Speed: Fast
Sampling Interval: 0.2
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 3 UV spectrum of the compound 59

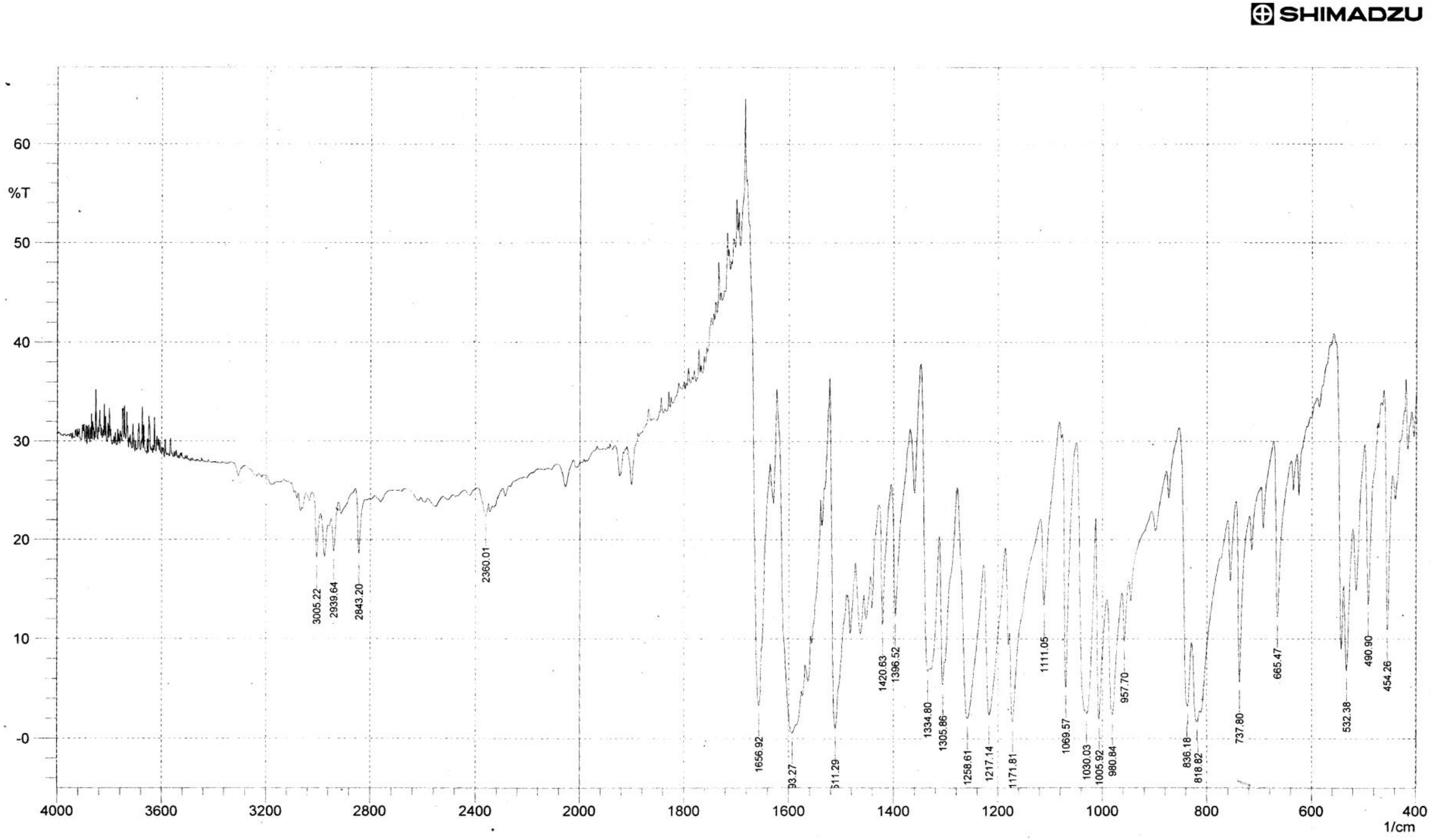
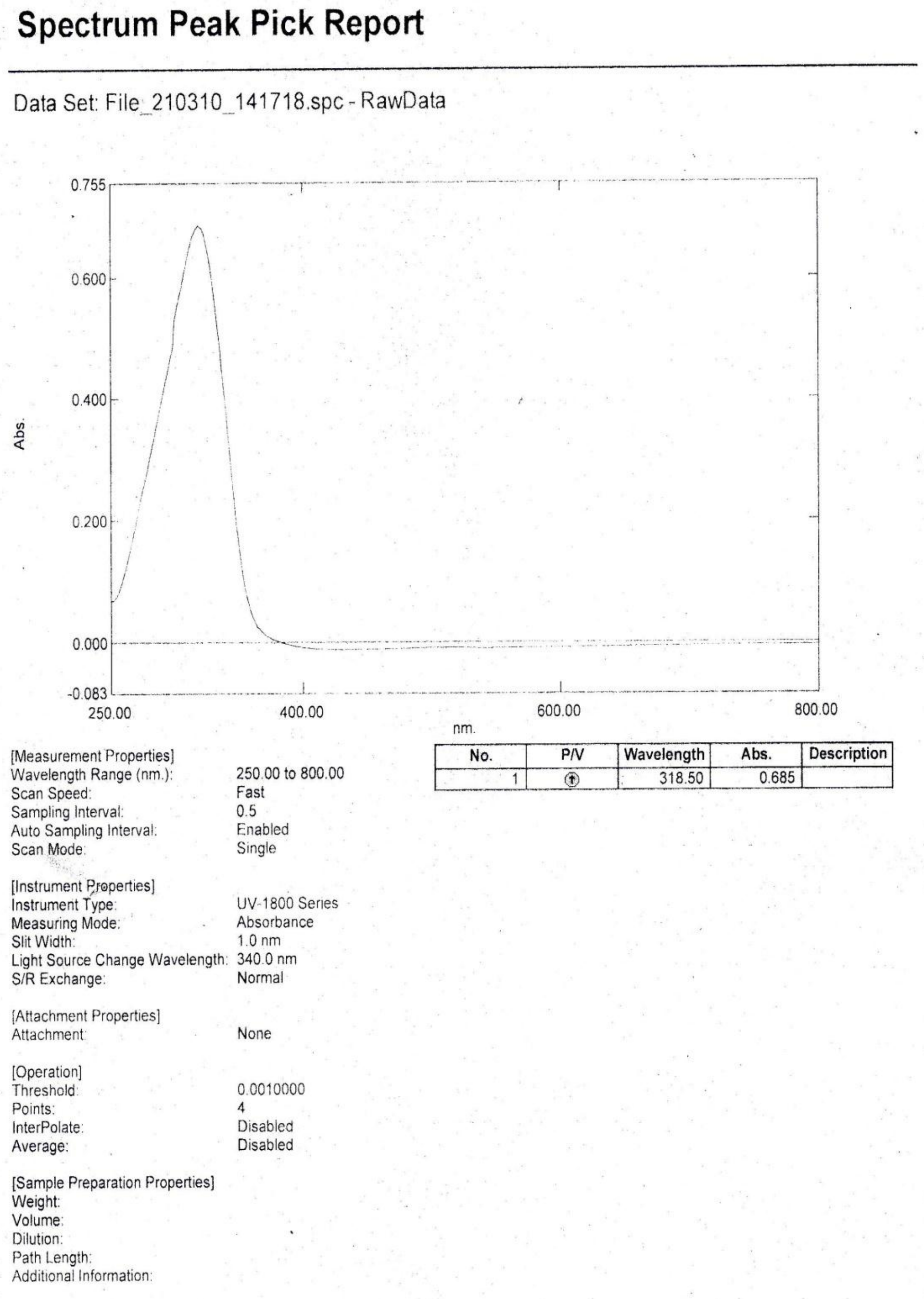


Figure - 4 IR spectrum of the compound 59



Spectrum Peak Pick Report

Data Set: File_210310_141718.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	318.50	0.685	

[Measurement Properties]
Wavelength Range (nm.): 250.00 to 800.00
Scan Speed: Fast
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 5 UV spectrum of the compound 60

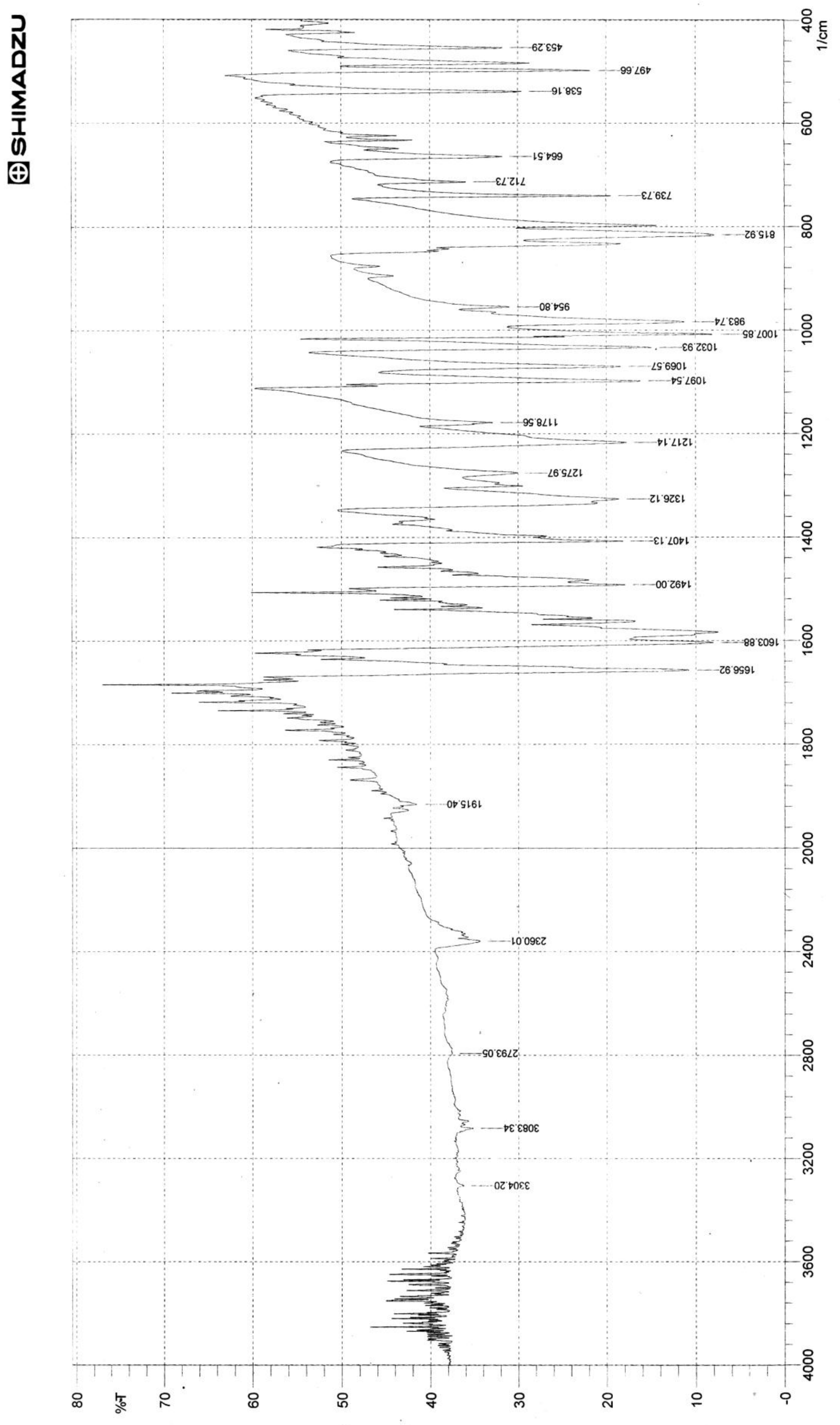
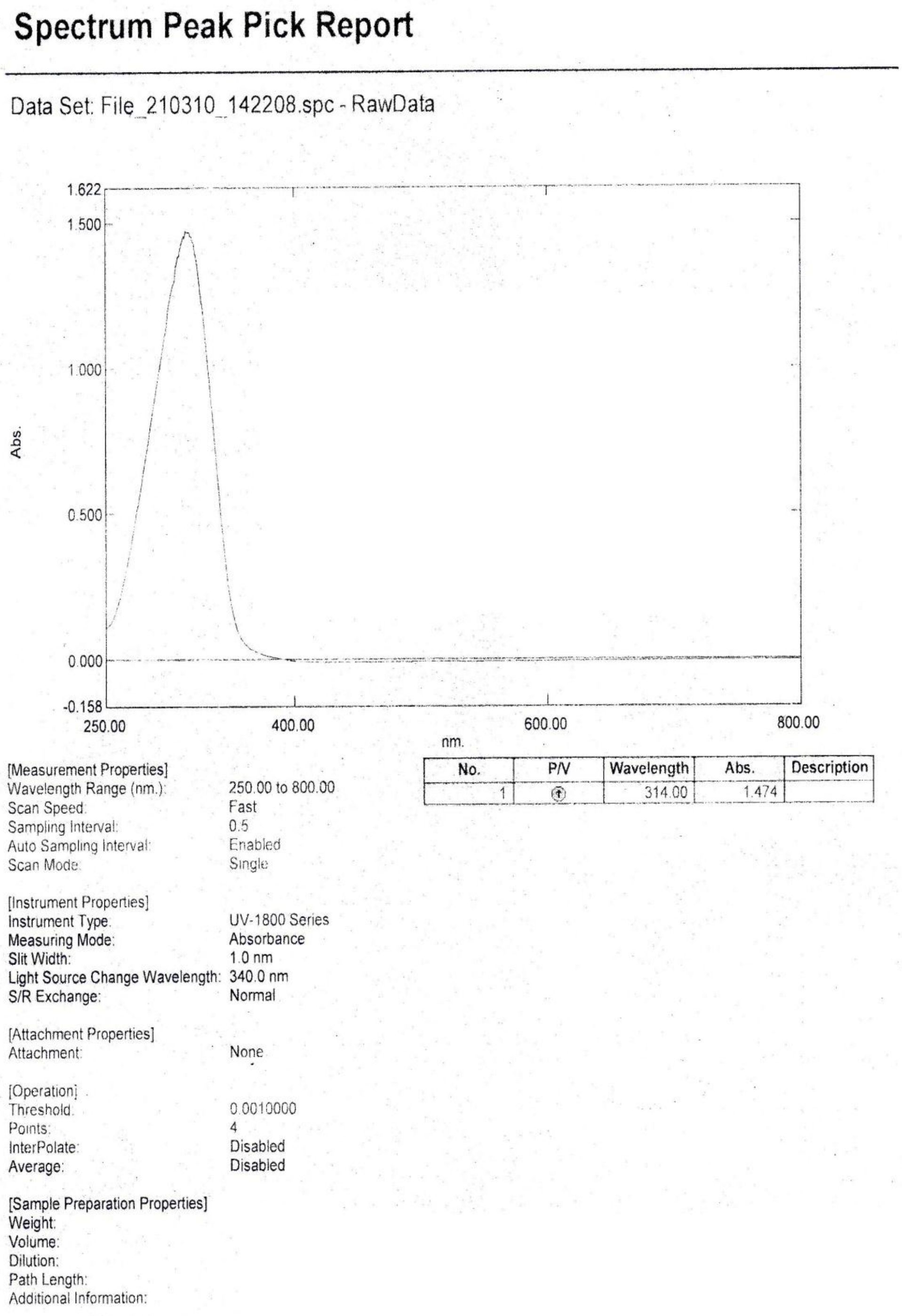


Figure - 6 IR spectrum of the compound 60



Spectrum Peak Pick Report

Data Set: File_210310_142208.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	314.00	1.474	

[Measurement Properties]
Wavelength Range (nm.): 250.00 to 800.00
Scan Speed: Fast
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 7 UV spectrum of the compound 61

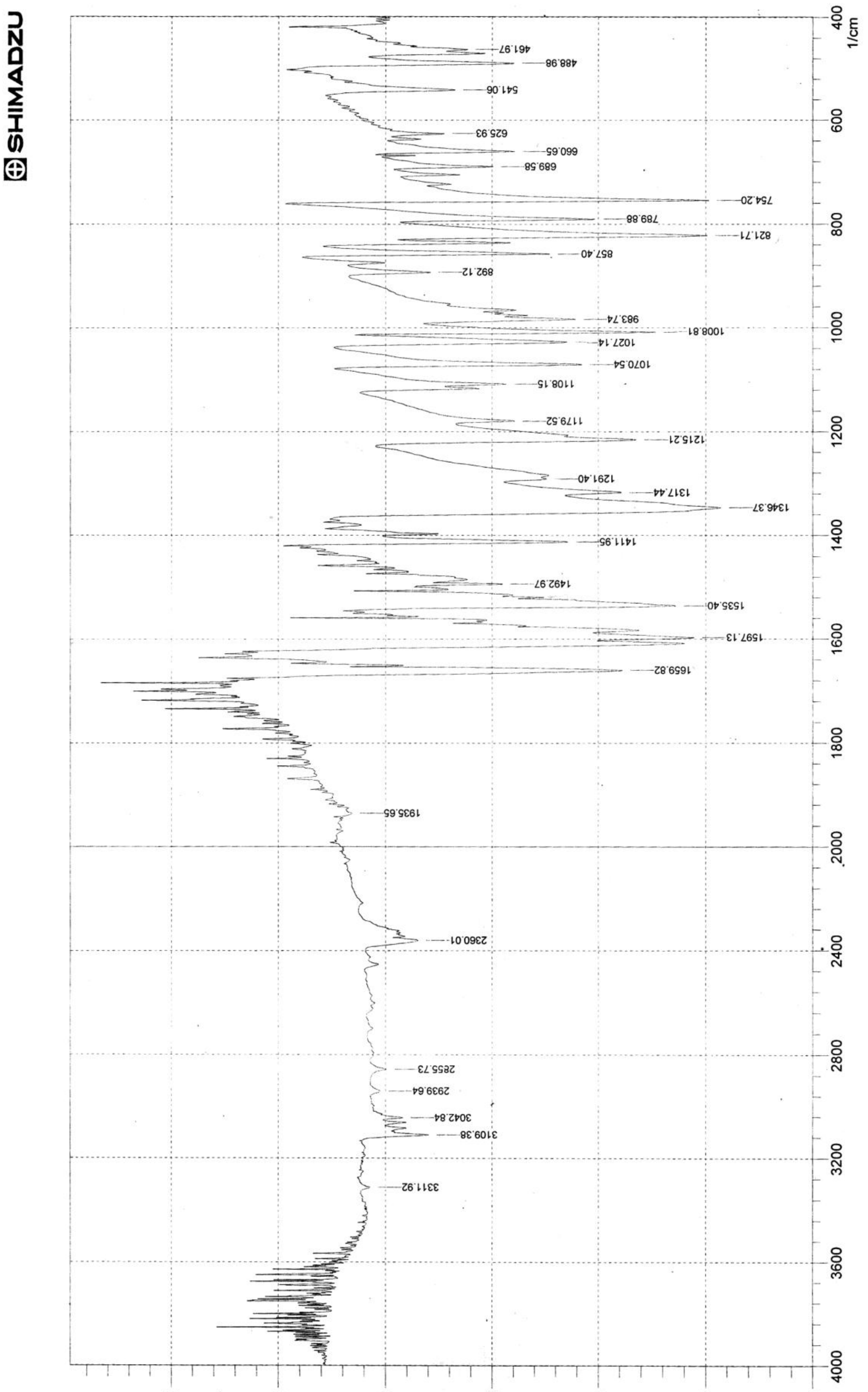
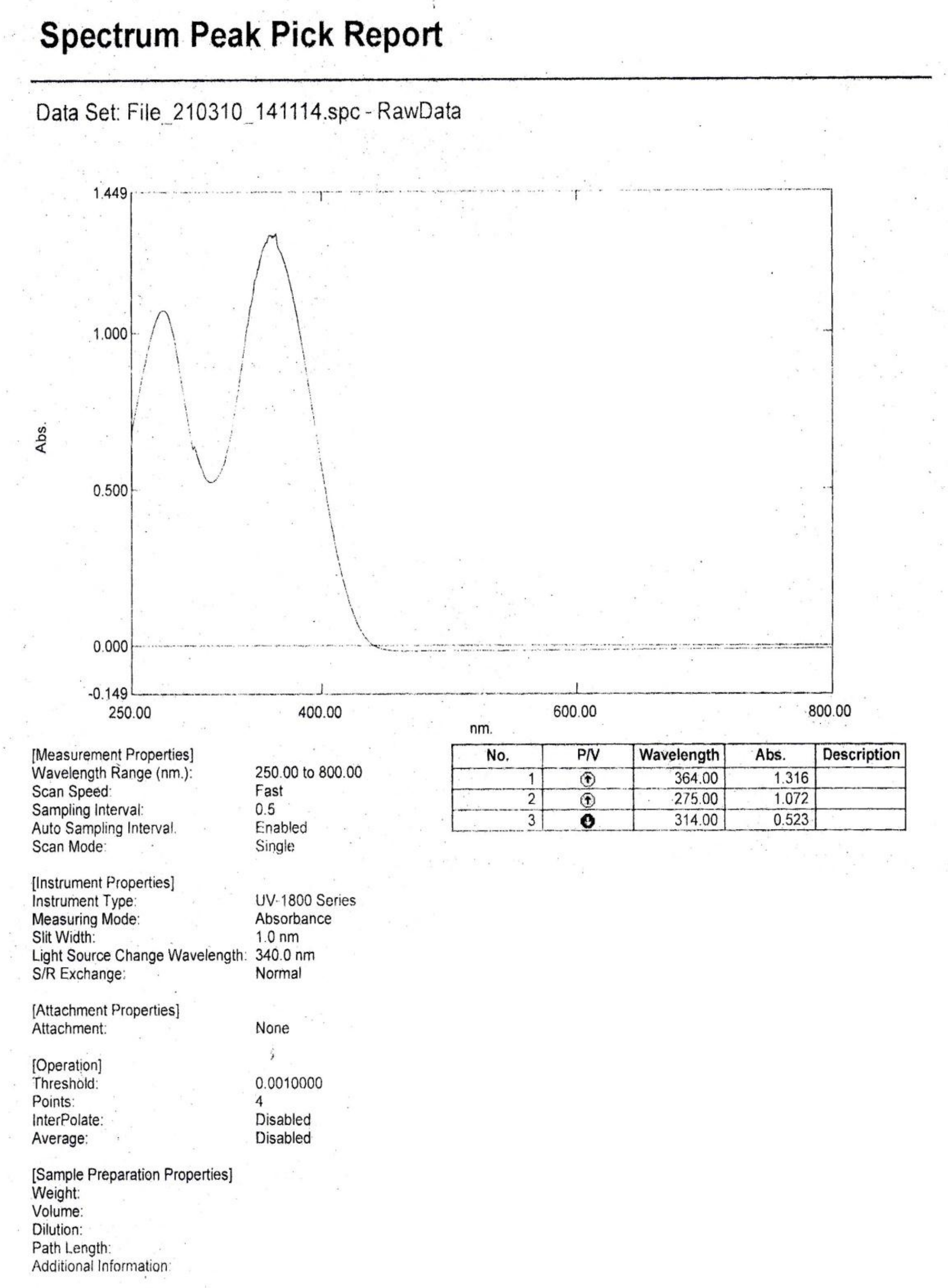


Figure - 8 IR spectrum of the compound 61



Spectrum Peak Pick Report

Data Set: File_210310_141114.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	⬆	364.00	1.316	
2	⬆	275.00	1.072	
3	⬇	314.00	0.523	

[Measurement Properties]
Wavelength Range (nm.): 250.00 to 800.00
Scan Speed: Fast
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 9 UV spectrum of the compound 62

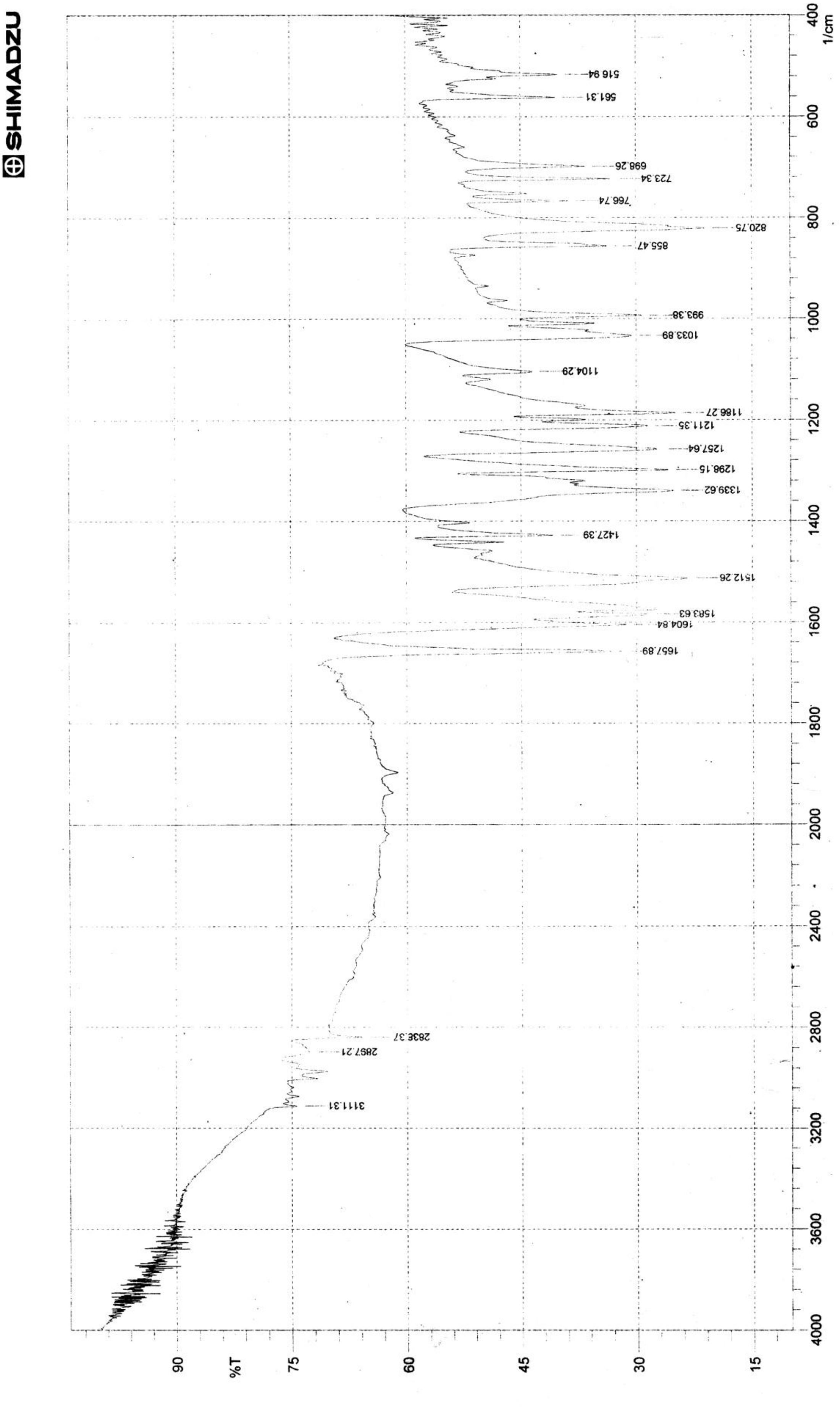
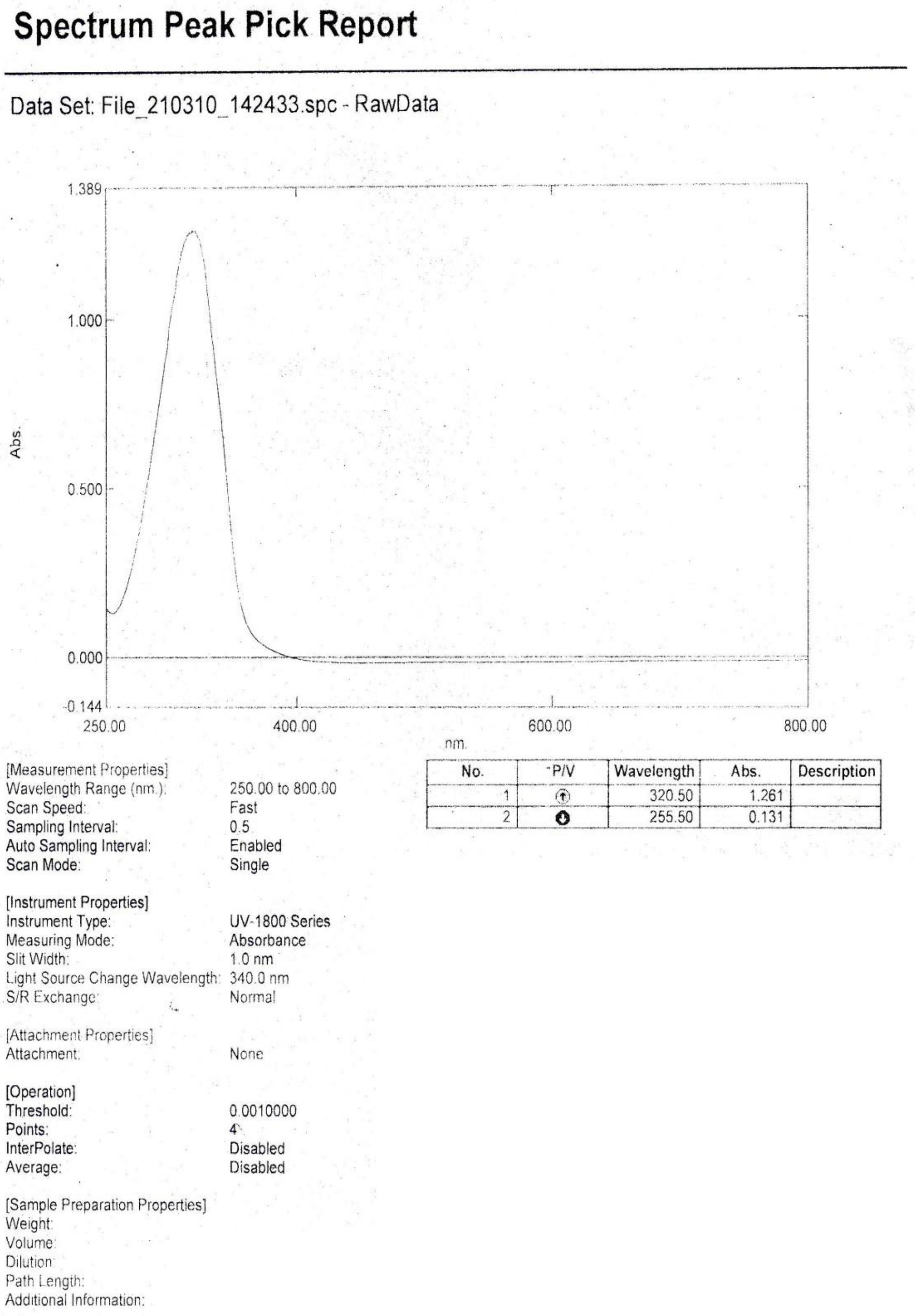


Figure - 10 IR spectrum of the compound 62



Spectrum Peak Pick Report

Data Set: File_210310_142433.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	320.50	1.261	
2	↓	255.50	0.131	

[Measurement Properties]
Wavelength Range (nm.): 250.00 to 800.00
Scan Speed: Fast
Sampling Interval: 0.5
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 11 UV spectrum of the compound 63

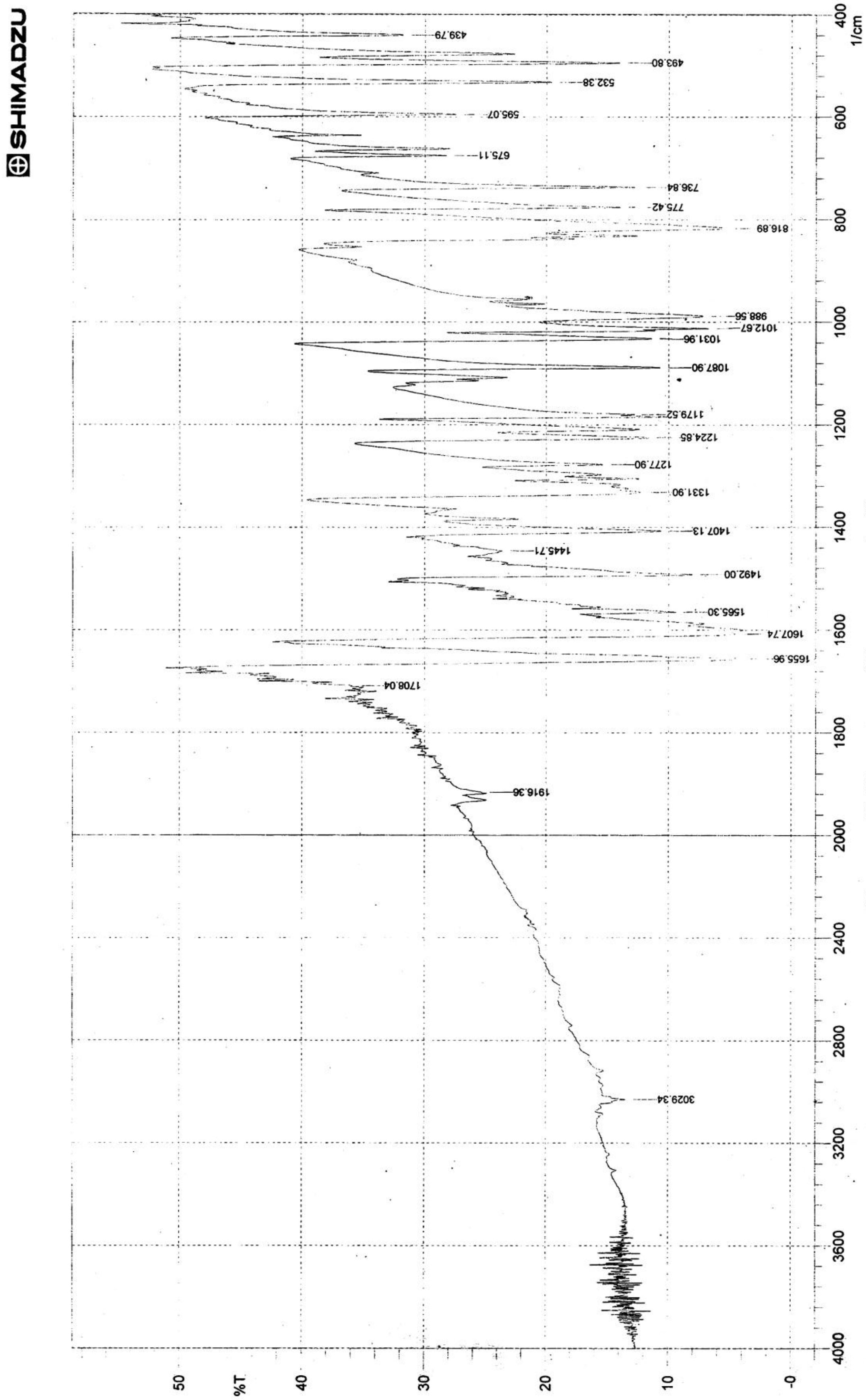
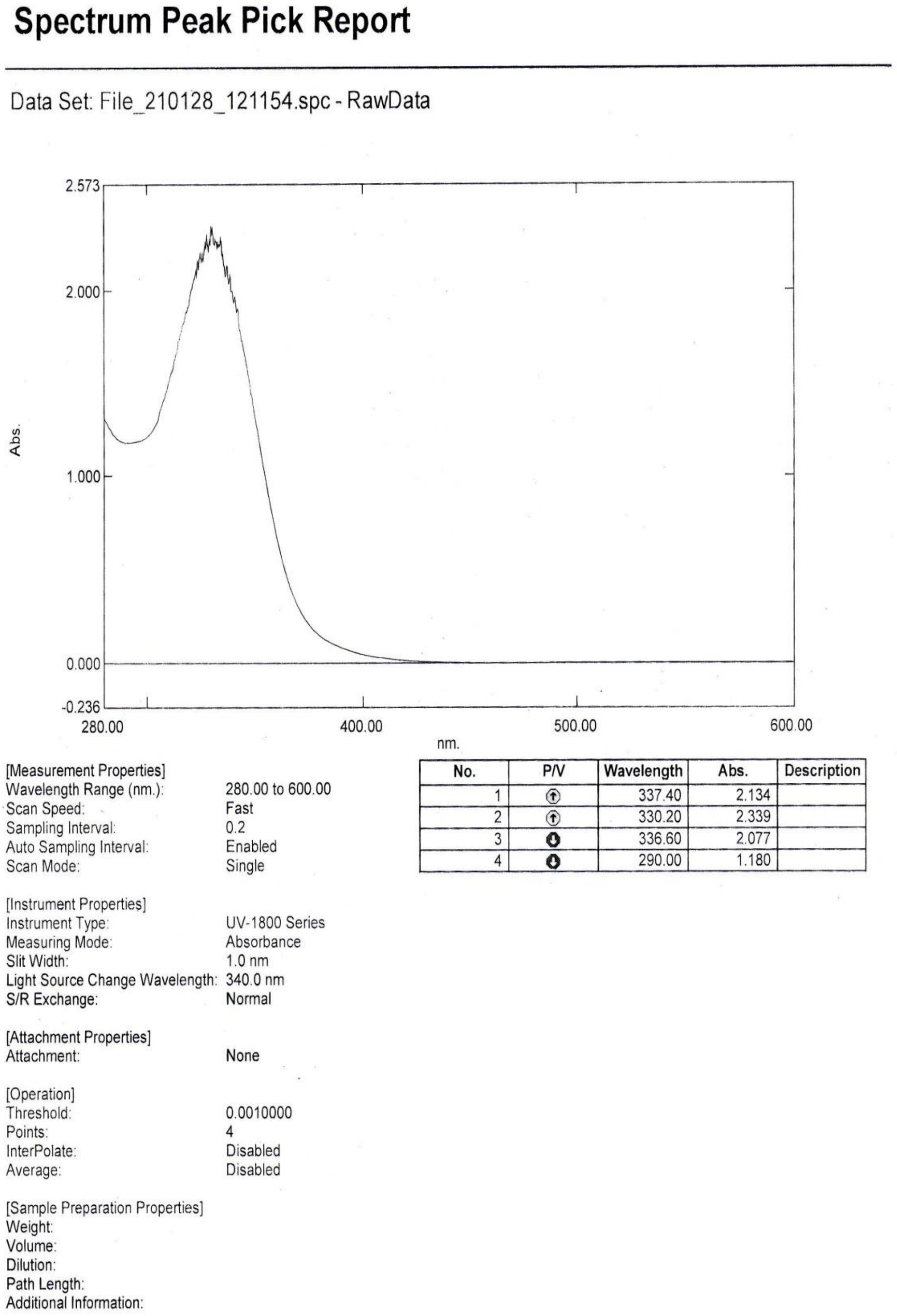


Figure - 12 IR spectrum of the compound 63



Spectrum Peak Pick Report

Data Set: File_210128_121154.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	337.40	2.134	
2	↑	330.20	2.339	
3	↓	336.60	2.077	
4	↓	290.00	1.180	

[Measurement Properties]	
Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single
[Instrument Properties]	
Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal
[Attachment Properties]	
Attachment:	None
[Operation]	
Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled
[Sample Preparation Properties]	
Weight:	
Volume:	
Dilution:	
Path Length:	
Additional Information:	

Figure- 13 UV spectrum of the compound 64

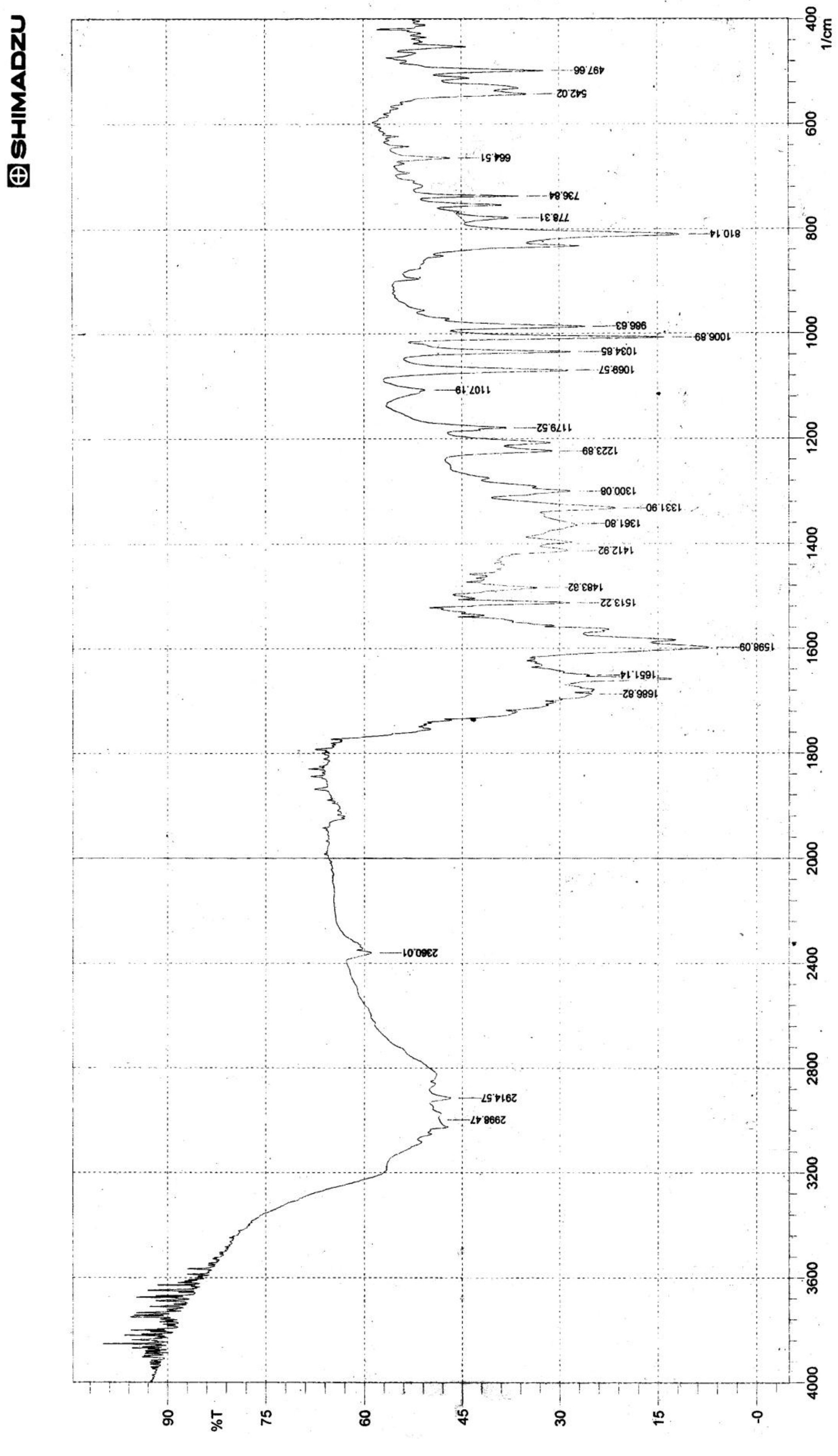
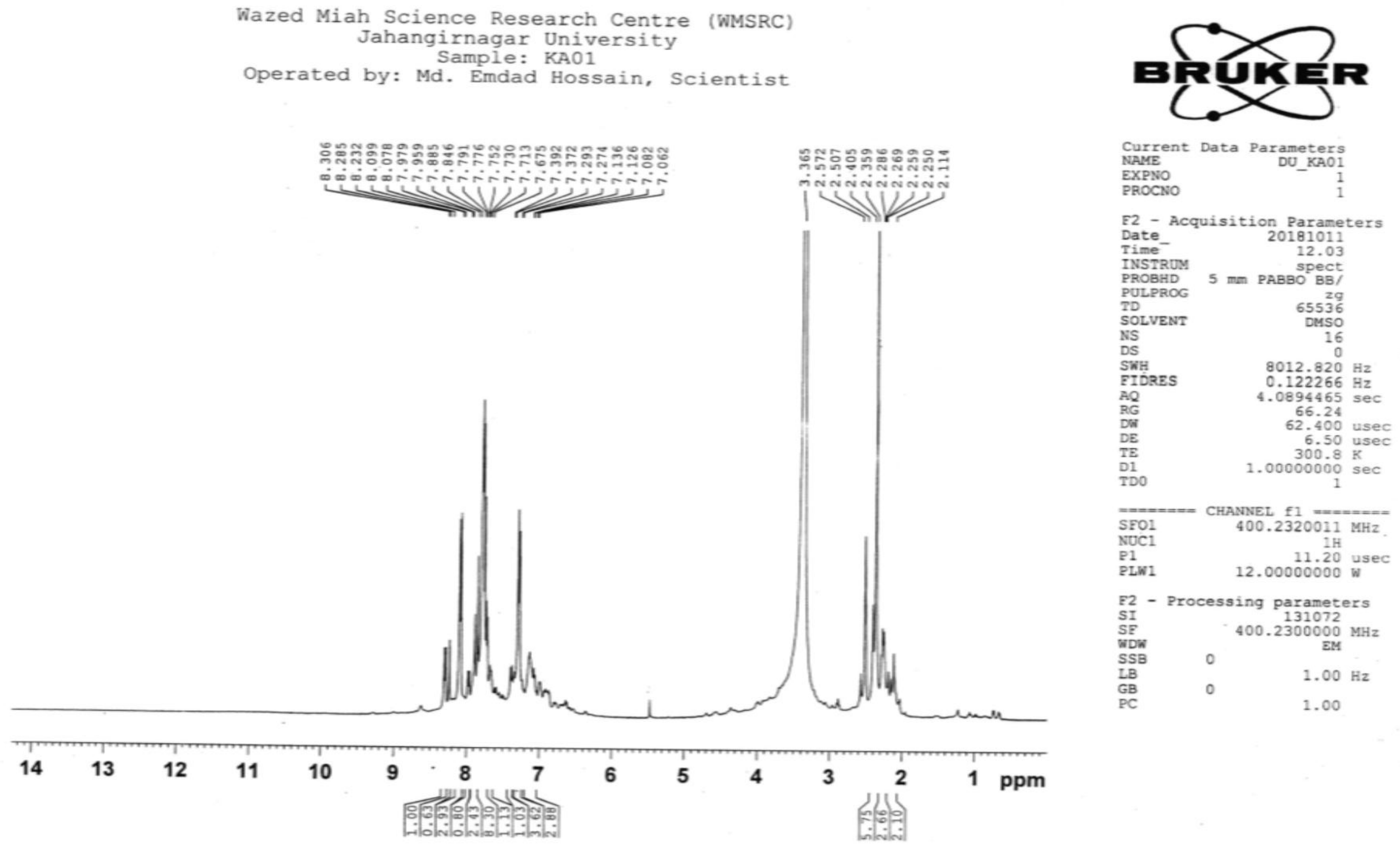


Figure - 14 IR spectrum of the compound 64

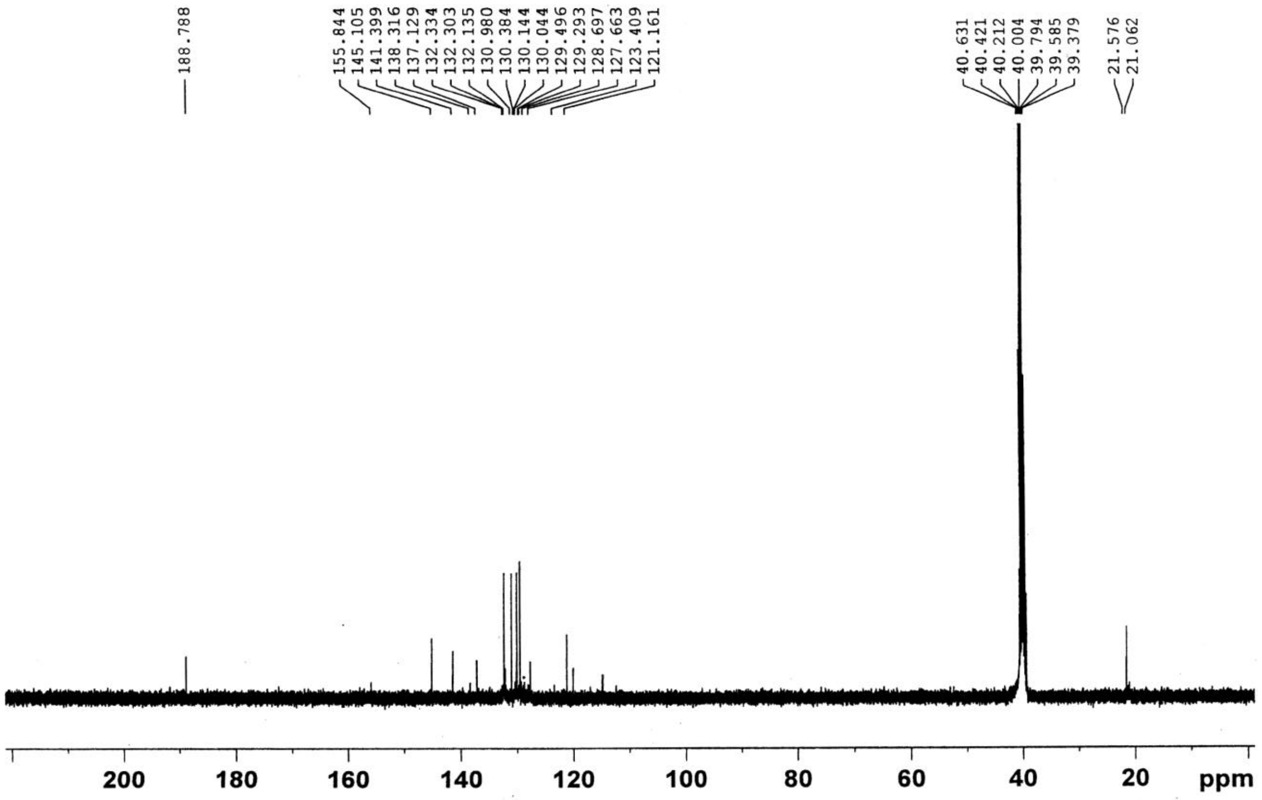


```
Wazed Miah Science Research Centre (WMSRC)
        Jahangirnagar University
             Sample: KA01
Operated by: Md. Emdad Hossain, Scientist
```

```
Current Data Parameters
NAME              DU_KA01
EXPNO                   1
PROCNO                  1

F2 - Acquisition Parameters
Date_            20181011
Time                12.03
INSTRUM             spect
PROBHD    5 mm PABBO BB/
PULPROG                zg
TD                  65536
SOLVENT              DMSO
NS                     16
DS                      0
SWH              8012.820 Hz
FIDRES           0.122266 Hz
AQ              4.0894465 sec
RG                  66.24
DW                 62.400 usec
DE                   6.50 usec
TE                  300.8 K
D1             1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.2320011 MHz
NUC1                   1H
P1                  11.20 usec
PLW1          12.00000000 W

F2 - Processing parameters
SI                 131072
SF            400.2300000 MHz
WDW                    EM
SSB      0
LB                   1.00 Hz
GB       0
PC                   1.00
```

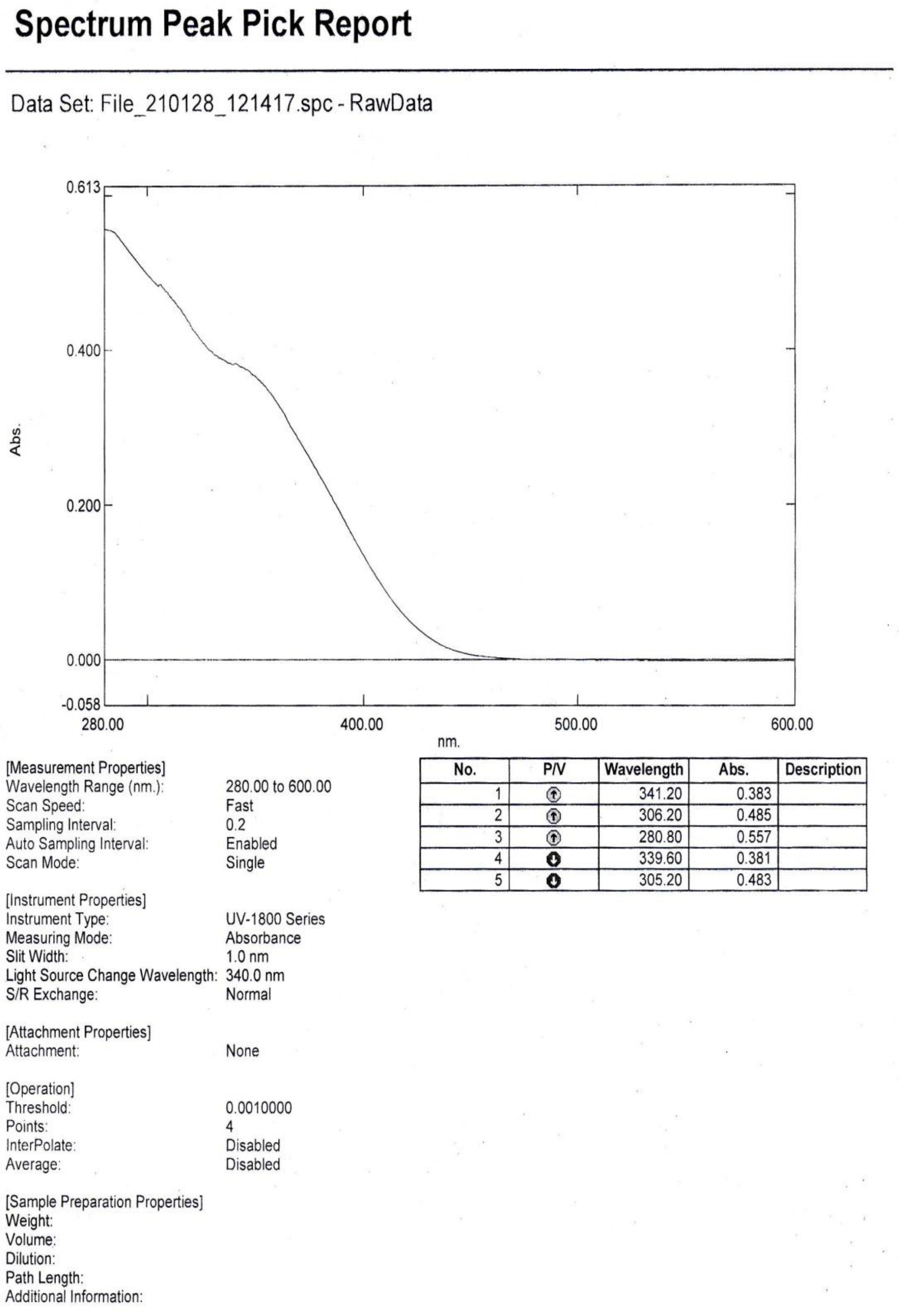
Figure- 15 The ^{1}H NMR spectrum of the compound 64

Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: KA01, 13C
Operated by: Md. Emdad Hossain, Scientist



```
Current Data Parameters
NAME             DU_KA01
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20181011
Time               12.34
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zgpg
TD                524288
SOLVENT             DMSO
NS                   256
DS                     0
SWH            25252.525 Hz
FIDRES          0.048165 Hz
AQ            10.3809023 sec
RG                 208.5
DW                19.800 usec
DE                  6.50 usec
TE                 302.7 K
D1            1.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6479778 MHz
NUC1                 13C
P1                 10.00 usec
PLW1         49.00000000 W

======== CHANNEL f2 ========
SFO2         400.2320011 MHz
NUC2                  1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         12.00000000 W
PLW12         0.18584000 W
PLW13         0.15053000 W

F2 - Processing parameters
SI               1048576
SF           100.6379135 MHz
WDW                   EM
SSB      0
LB                  0.30 Hz
GB       0
PC                  1.40
```

Figure- 16 The ^{13}C NMR of the compound 64



Spectrum Peak Pick Report

Data Set: File_210128_121417.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	341.20	0.383	
2	↑	306.20	0.485	
3	↑	280.80	0.557	
4	↓	339.60	0.381	
5	↓	305.20	0.483	

[Measurement Properties]	
Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single
[Instrument Properties]	
Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal
[Attachment Properties]	
Attachment:	None
[Operation]	
Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled
[Sample Preparation Properties]	
Weight:	
Volume:	
Dilution:	
Path Length:	
Additional Information:	

Figure- 17 UV spectrum of the compound 65

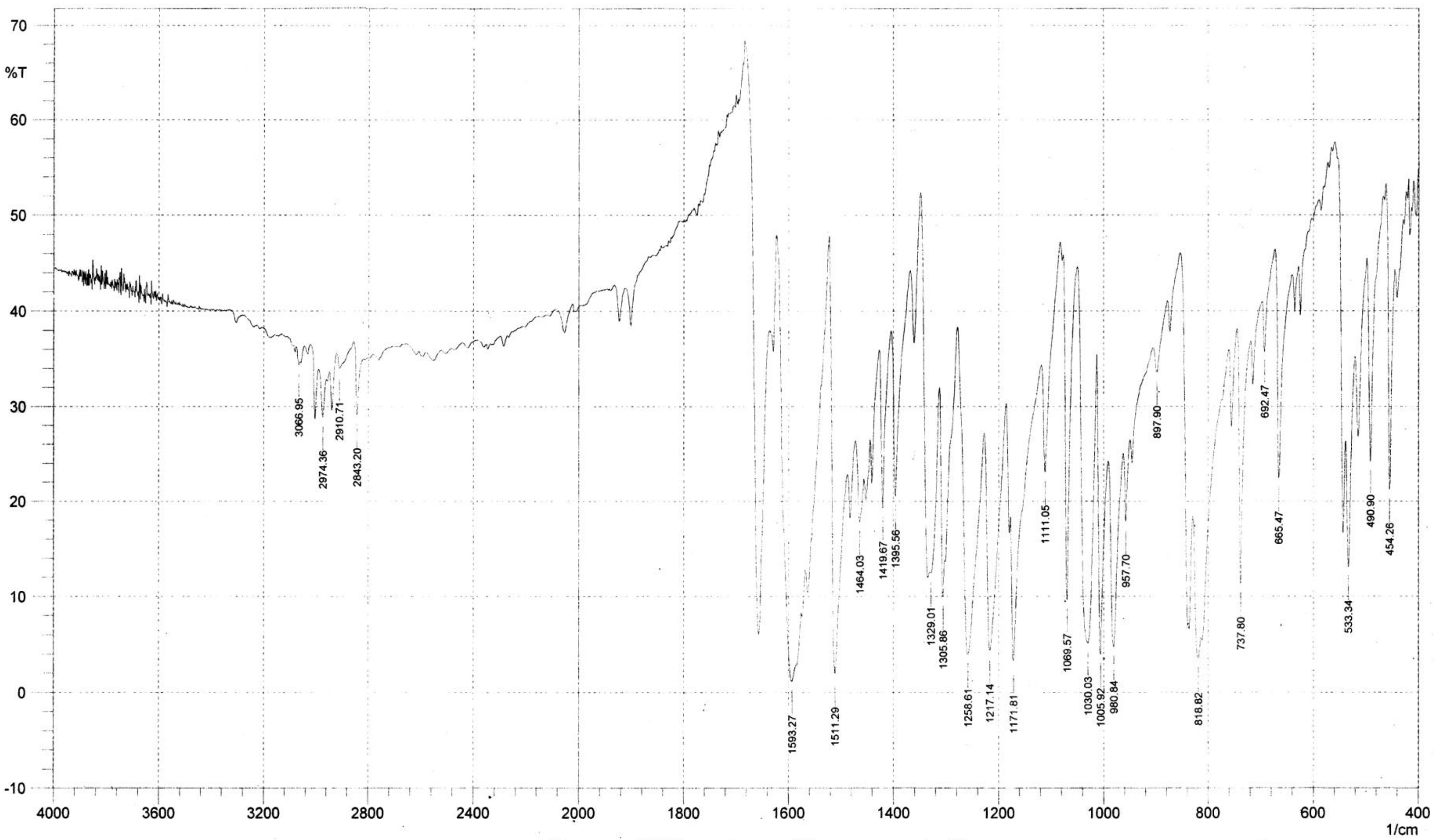
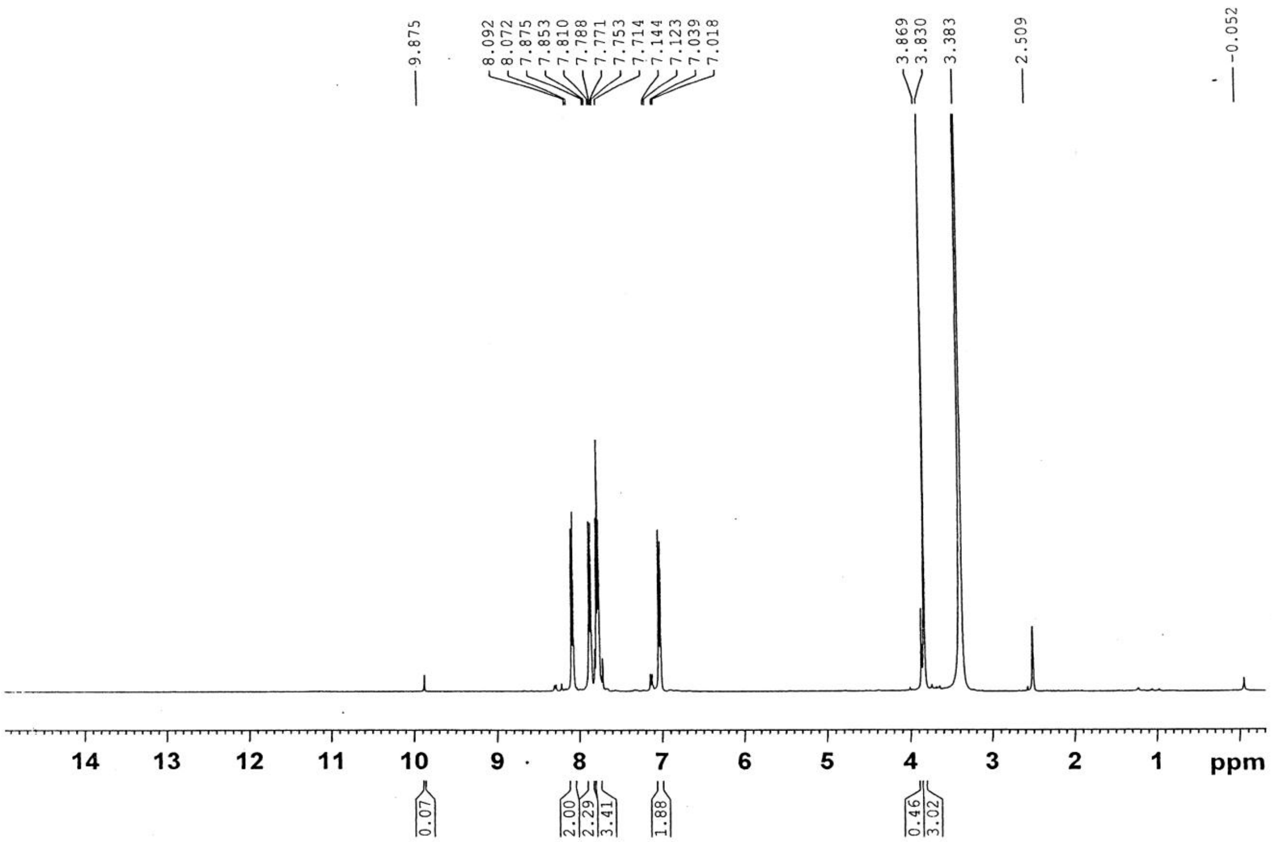


Figure - 18 IR spectrum of the compound 65

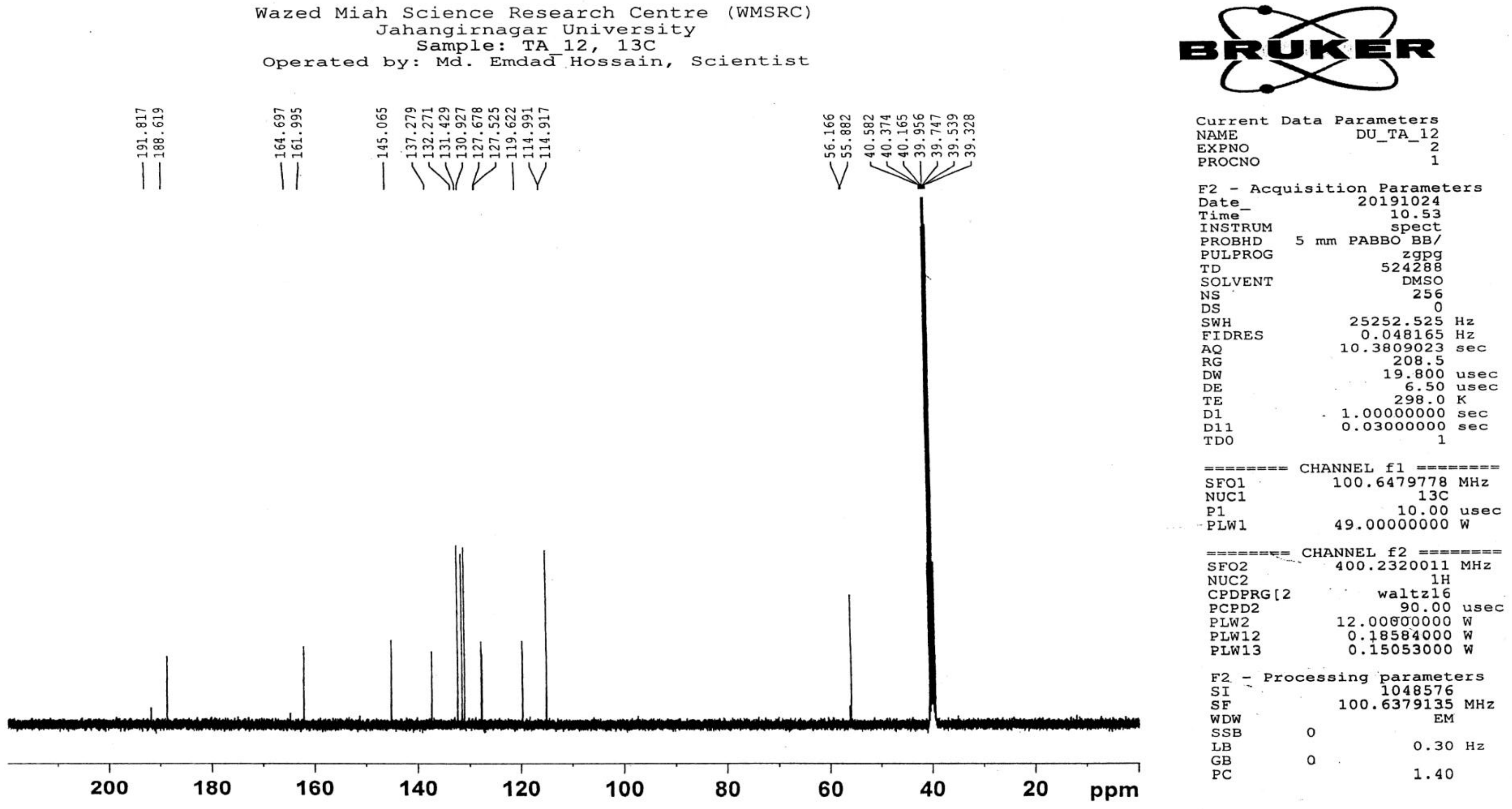
Wazed Miah Science Research Centre (WMSRC)
Jahanginagar University
Sample: TA_12
Operated by: Md. Emdad Hossain, Scientist



BRUKER

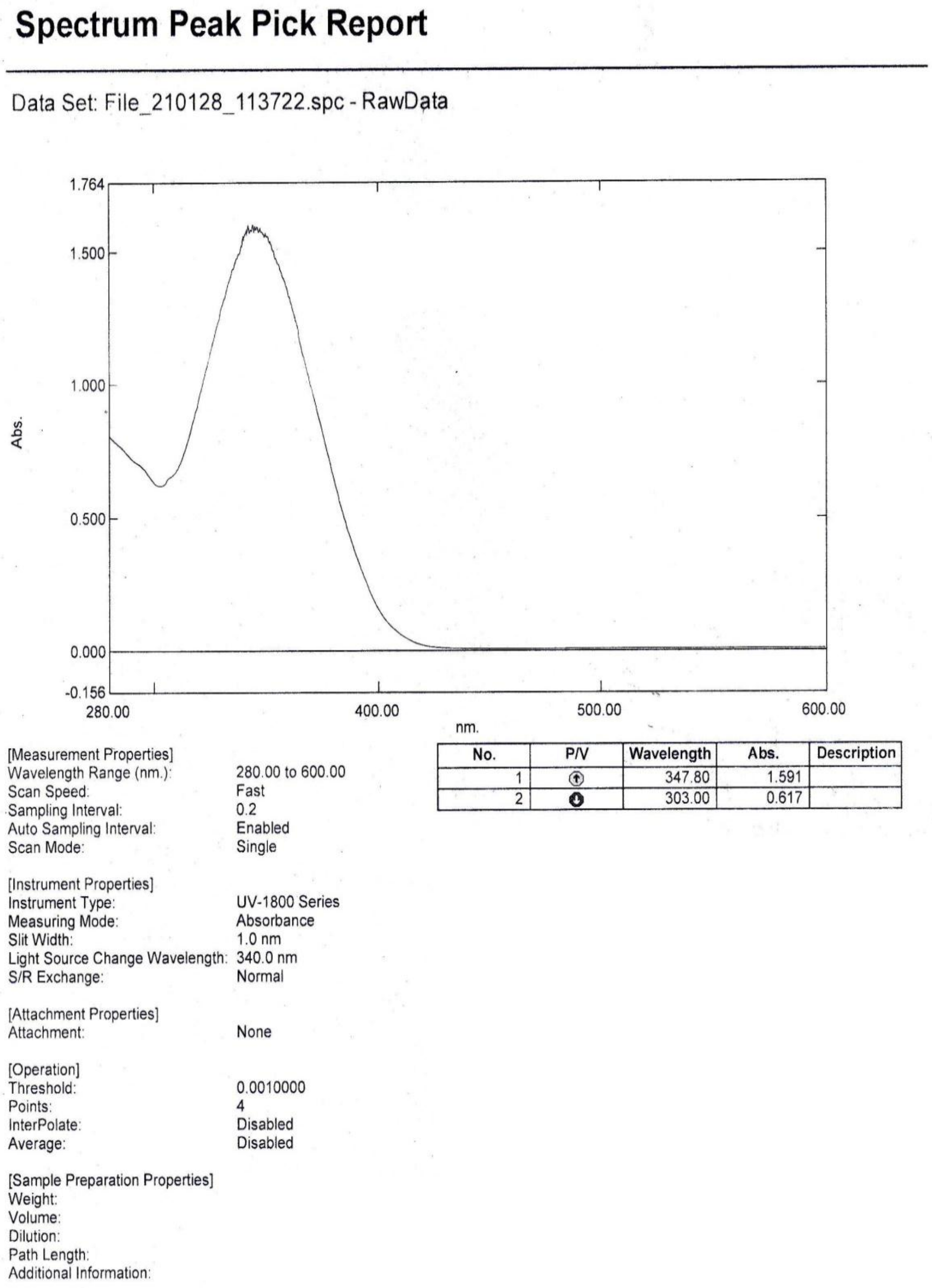
```
Current Data Parameters
NAME             DU_TA_12
EXPNO                   1
PROCNO                  1

F2 - Acquisition Parameters
Date_            20191024
Time                10.50
INSTRUM             spect
PROBHD   5 mm PABBO BB/
PULPROG                zg
TD                  65536
SOLVENT              DMSO
NS                     16
DS                      0
SWH             12019.230 Hz
FIDRES           0.183399 Hz
AQ              2.7262976 sec
RG                  74.64
DW                 41.600 usec
DE                   6.50 usec
TE                  298.0 K
D1             1.00000000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1          400.2340023 MHz
NUC1                   1H
P1                  11.20 usec
PLW1          12.00000000 W

F2 - Processing parameters
SI                 131072
SF            400.2300000 MHz
WDW                    EM
SSB      0
LB                   1.00 Hz
GB       0
PC                   1.00
```

Figure- 19 The ^{1}H NMR spectrum of the compound 65



```
Current Data Parameters
NAME              DU_TA_12
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20191024
Time_                10.53
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     256
DS                       0
SWH             25252.525 Hz
FIDRES           0.048165 Hz
AQ             10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   298.0 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          100.6479778 MHz
NUC1                  13C
P1                   10.00 usec
PLW1           49.00000000 W

======== CHANNEL f2 ========
SFO2          400.2320011 MHz
NUC2                    1H
CPDPRG[2           waltz16
PCPD2                90.00 usec
PLW2           12.00000000 W
PLW12           0.18584000 W
PLW13           0.15053000 W

F2 - Processing parameters
SI                 1048576
SF            100.6379135 MHz
WDW                     EM
SSB            0
LB                    0.30 Hz
GB             0
PC                    1.40
```

Figure- 20 The ^{13}C NMR of the compound 65



Spectrum Peak Pick Report

Data Set: File_210128_113722.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	347.80	1.591	
2	↓	303.00	0.617	

[Measurement Properties]
Wavelength Range (nm.): 280.00 to 600.00
Scan Speed: Fast
Sampling Interval: 0.2
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 21 UV spectrum of the compound 66

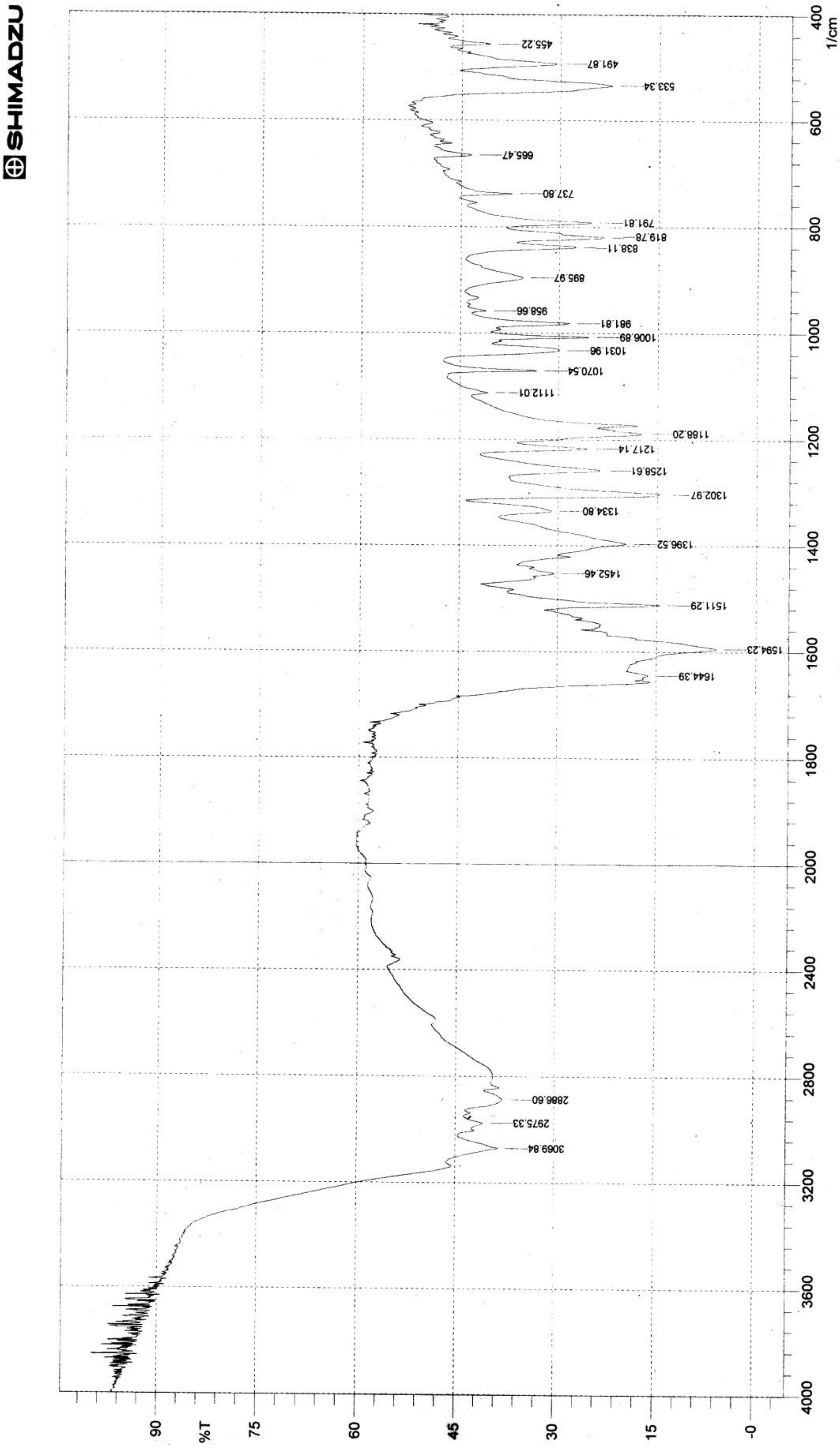
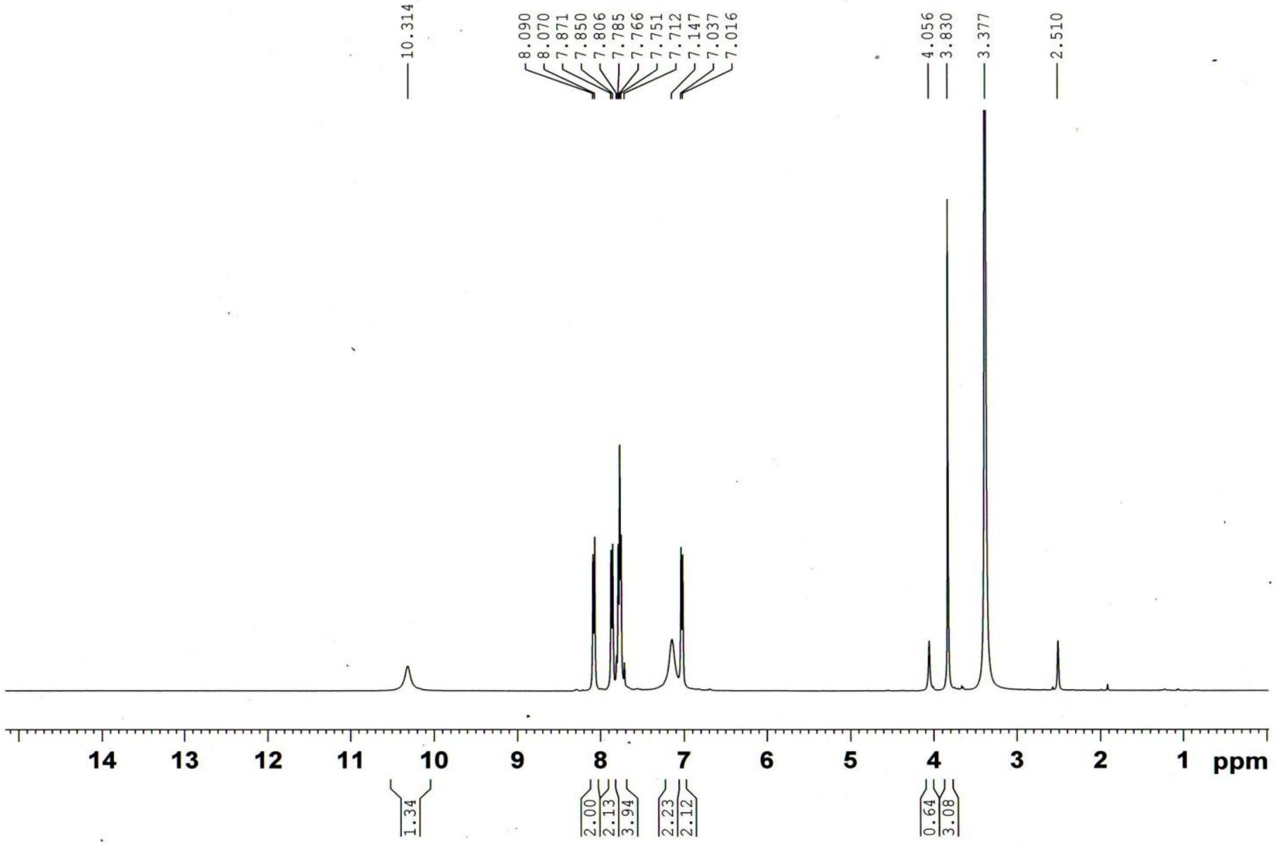


Figure - 22 IR spectrum of the compound 66

Wazed Miah Science Research Centre (WMSRC)
Jahanginagar University
Sample: TA_05
Operated by: Md. Emdad Hossain, Scientist



```
Current Data Parameters
NAME              DU_TA_05
EXPNO                    1
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190804
Time                 13.30
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg
TD                   65536
SOLVENT               DMSO
NS                      16
DS                       0
SWH              12019.230 Hz
FIDRES            0.183399 Hz
AQ               2.7262976 sec
RG                   52.16
DW                  41.600 usec
DE                    6.50 usec
TE                   299.2 K
D1              1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1           400.2340023 MHz
NUC1                    1H
P1                   11.20 usec
PLW1           12.00000000 W

F2 - Processing parameters
SI                  131072
SF             400.2300000 MHz
WDW                     EM
SSB       0
LB                    1.00 Hz
GB        0
PC                    1.00
```

Figure- 23 The ^1H NMR spectrum of the compound 66

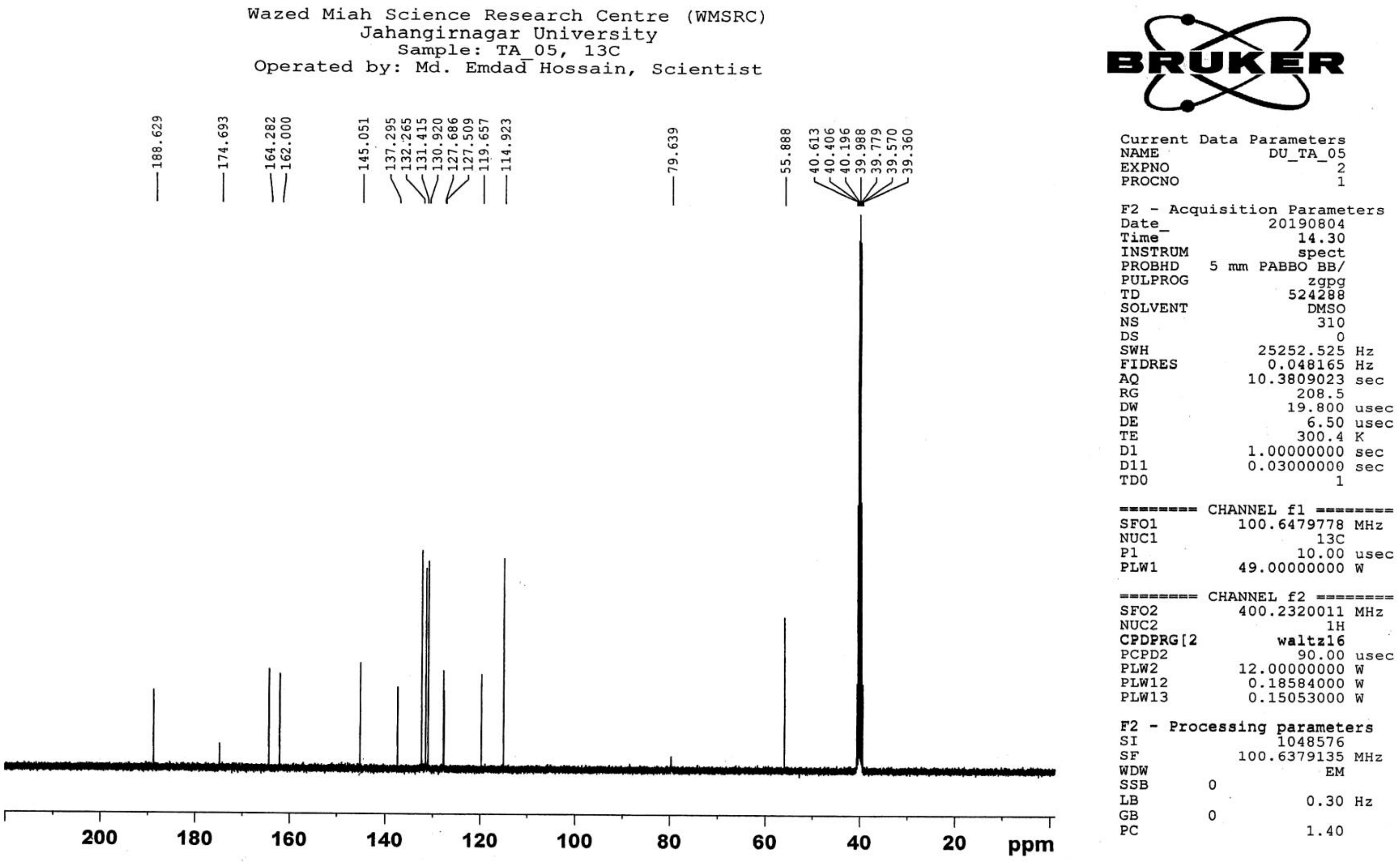
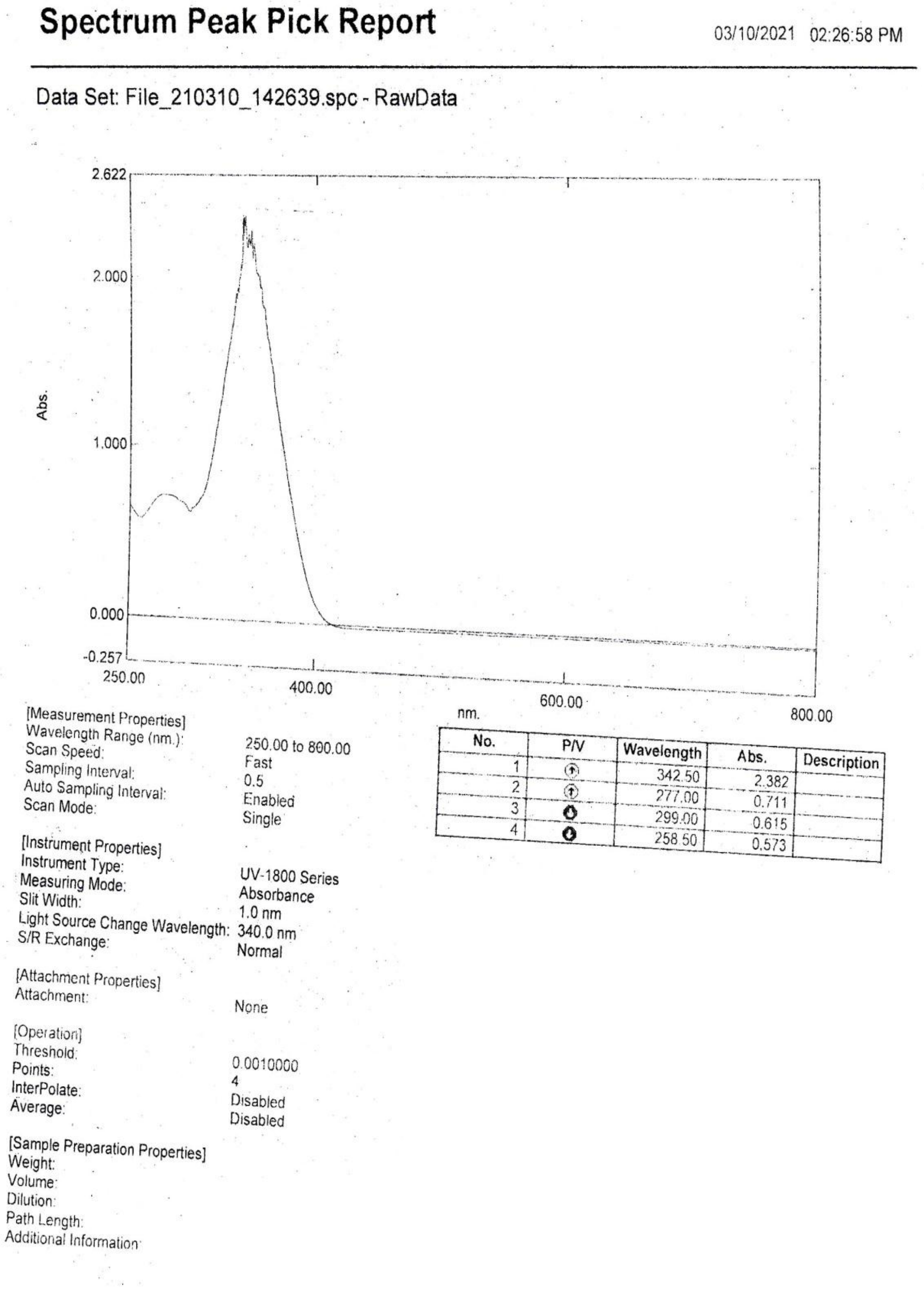


Figure- 24 The ^{13}C NMR of the compound 66



Spectrum Peak Pick Report

03/10/2021 02:26:58 PM

Data Set: File_210310_142639.spc - RawData

No.	P/V	Wavelength	Abs.	Description
1	↑	342.50	2.382	
2	↑	277.00	0.711	
3	↓	299.00	0.615	
4	↓	258.50	0.573	

[Measurement Properties]

Wavelength Range (nm.):	250.00 to 800.00
Scan Speed:	Fast
Sampling Interval:	0.5
Auto Sampling Interval:	Enabled
Scan Mode:	Single

[Instrument Properties]

Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal

[Attachment Properties]

Attachment:	None

[Operation]

Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled

[Sample Preparation Properties]

Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 25 UV spectrum of the compound 67

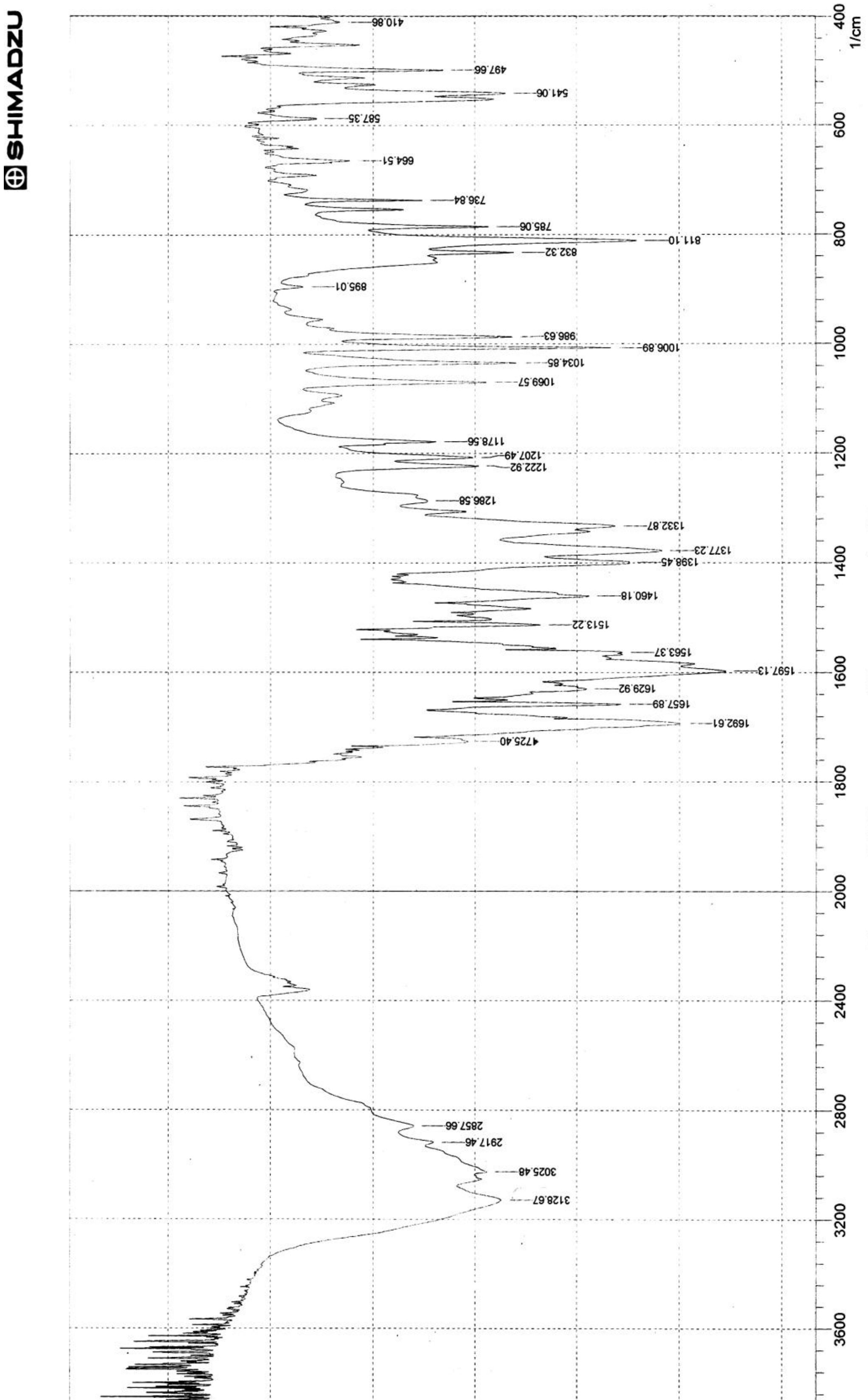
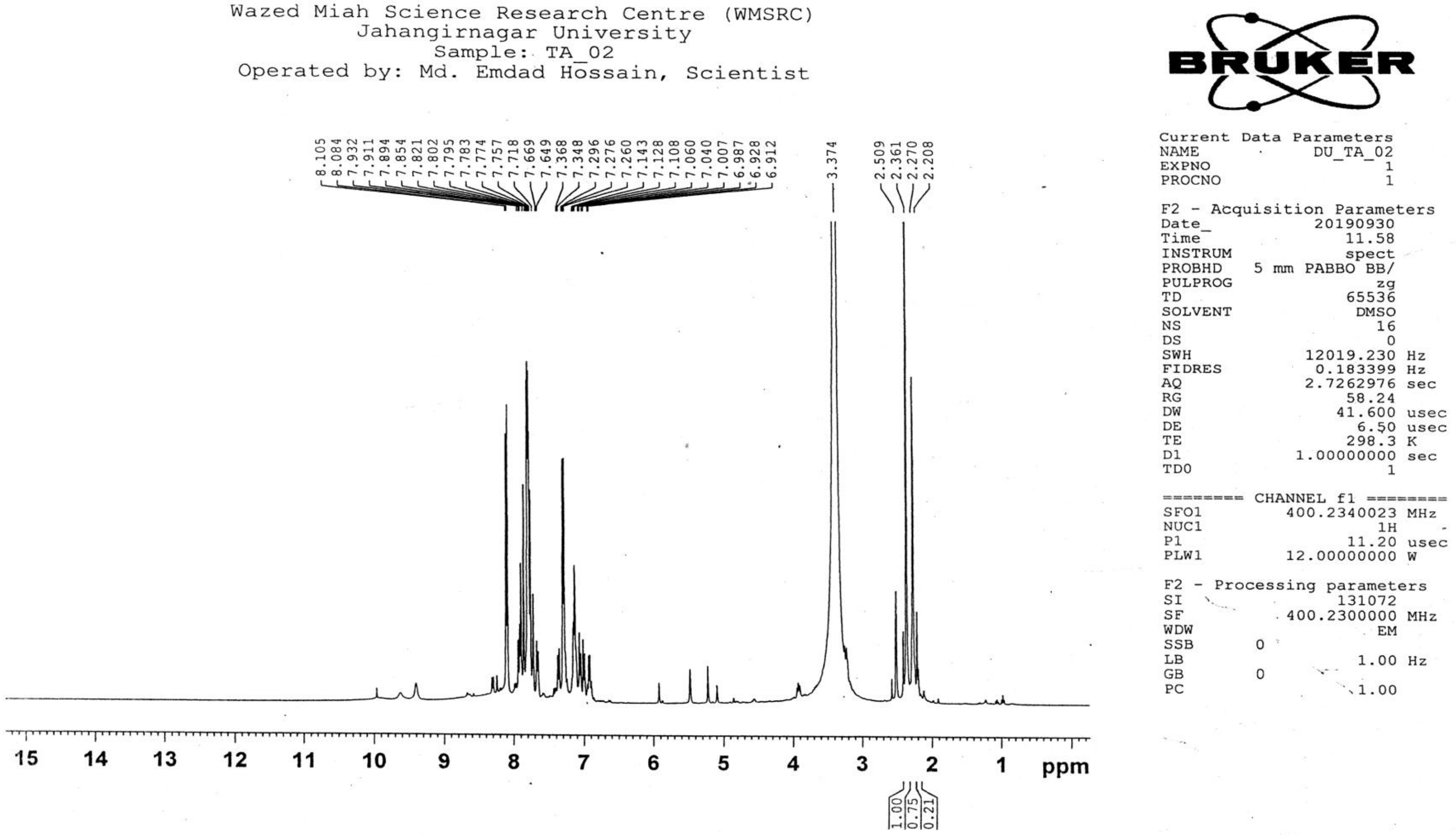


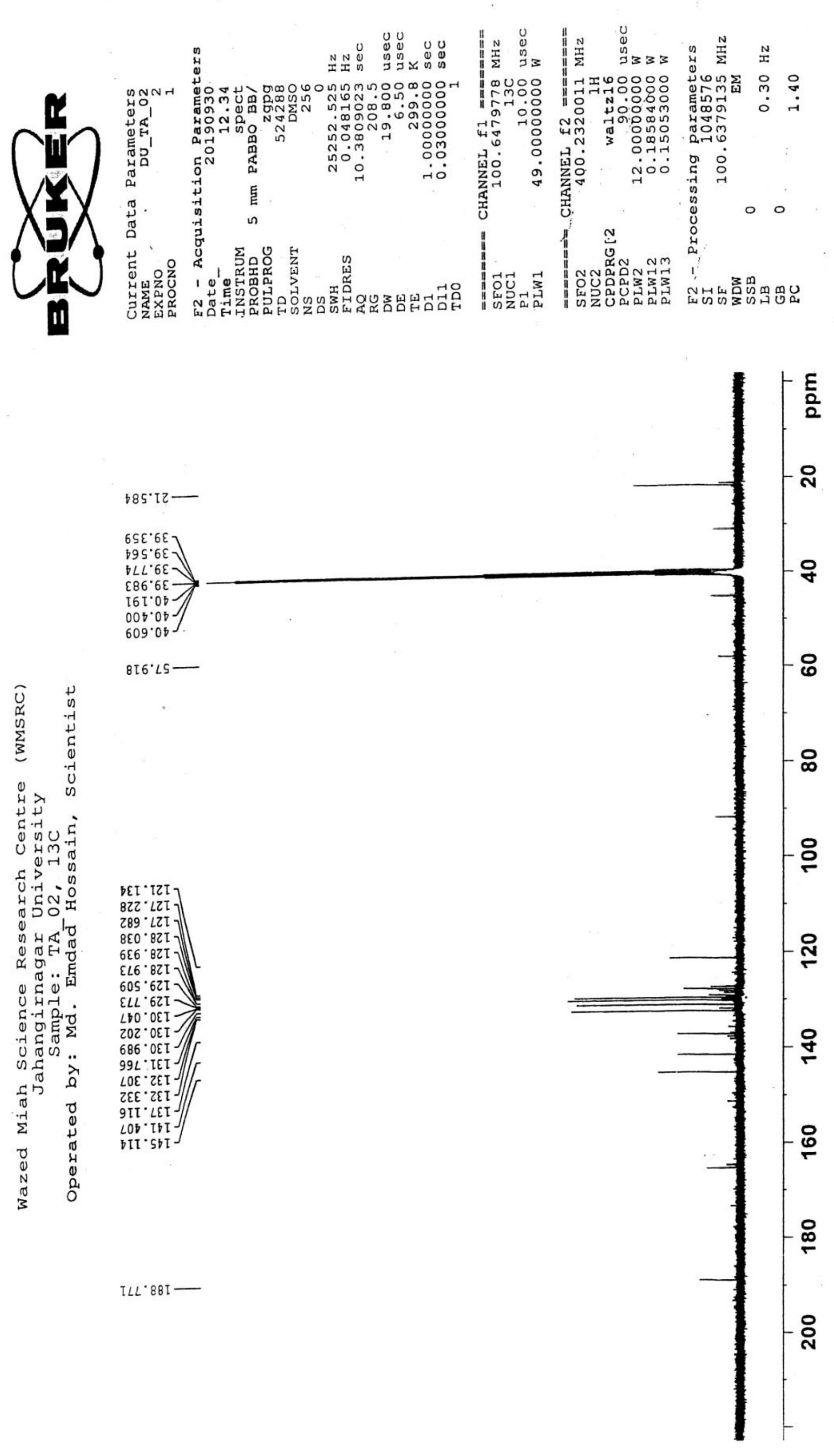
Figure - 26 IR spectrum of the compound 67



```
Wazed Miah Science Research Centre (WMSRC)
        Jahangirnagar University
            Sample: TA_02
Operated by: Md. Emdad Hossain, Scientist
```

```
Current Data Parameters
NAME          DU_TA_02
EXPNO                1
PROCNO               1

F2 - Acquisition Parameters
Date_          20190930
Time              11.58
INSTRUM           spect
PROBHD   5 mm PABBO BB/
PULPROG              zg
TD                65536
SOLVENT            DMSO
NS                   16
DS                    0
SWH           12019.230 Hz
FIDRES         0.183399 Hz
AQ            2.7262976 sec
RG                58.24
DW               41.600 usec
DE                 6.50 usec
TE                298.3 K
D1           1.00000000 sec
TD0                   1

======== CHANNEL f1 ========
SFO1       400.2340023 MHz
NUC1                1H
P1                11.20 usec
PLW1        12.00000000 W

F2 - Processing parameters
SI               131072
SF          400.2300000 MHz
WDW                  EM
SSB      0
LB                 1.00 Hz
GB       0
PC                 1.00
```

Figure- 27 The ^{1}H NMR spectrum of the compound 67



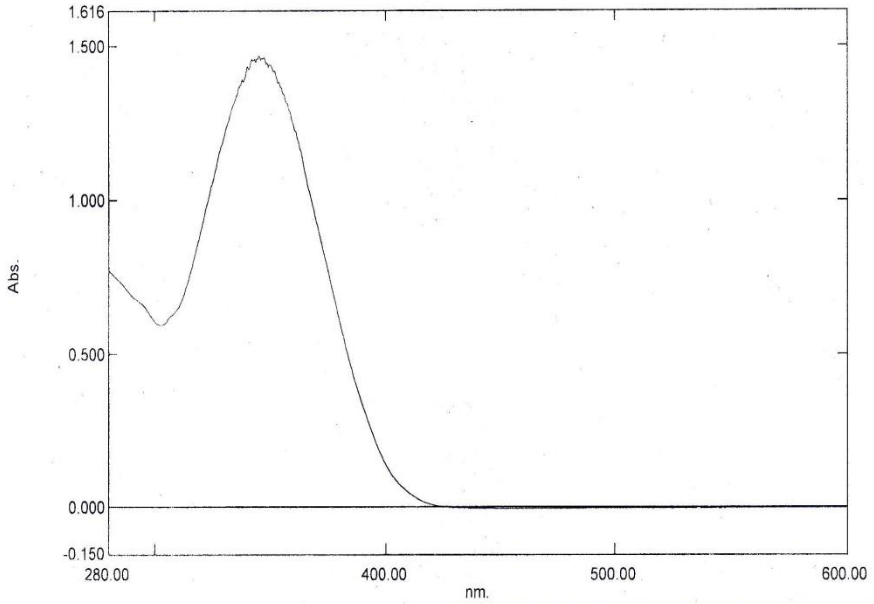
Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_02, 13C
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME              DU_TA_02
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190930
Time                 12.34
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     256
DS                       0
SWH              25252.525 Hz
FIDRES            0.048165 Hz
AQ              10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   299.8 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          100.6479778 MHz
NUC1                  13C
P1                  10.00 usec
PLW1          49.00000000 W

======== CHANNEL f2 ========
SFO2          400.2320011 MHz
NUC2                   1H
CPDPRG[2             waltz16
PCPD2               90.00 usec
PLW2          12.00000000 W
PLW12          0.18584000 W
PLW13          0.15053000 W

F2 - Processing parameters
SI                 1048576
SF             100.6379135 MHz
WDW                     EM
SSB      0
LB       0            0.30 Hz
GB       0
PC                    1.40
```

Figure- 28 The ^{13}C NMR of the compound 67

Spectrum Peak Pick Report

Data Set: File_210128_115506.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	350.20	1.439	
2	↑	345.20	1.469	
3	↓	349.40	1.432	
4	↓	302.80	0.591	

[Measurement Properties]

Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single

[Instrument Properties]

Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal

[Attachment Properties]

Attachment:	None

[Operation]

Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 29 UV spectrum of the compound 68

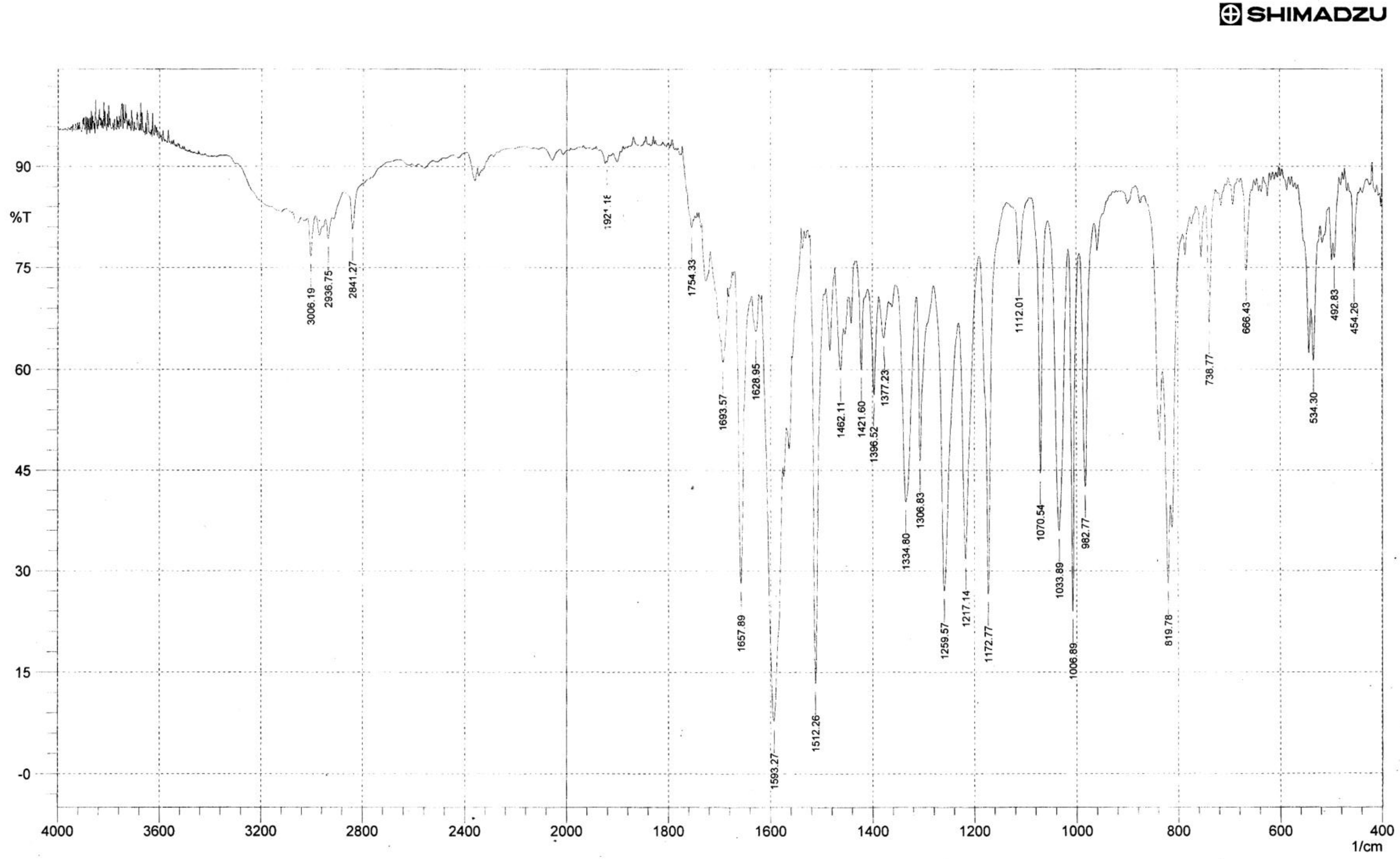
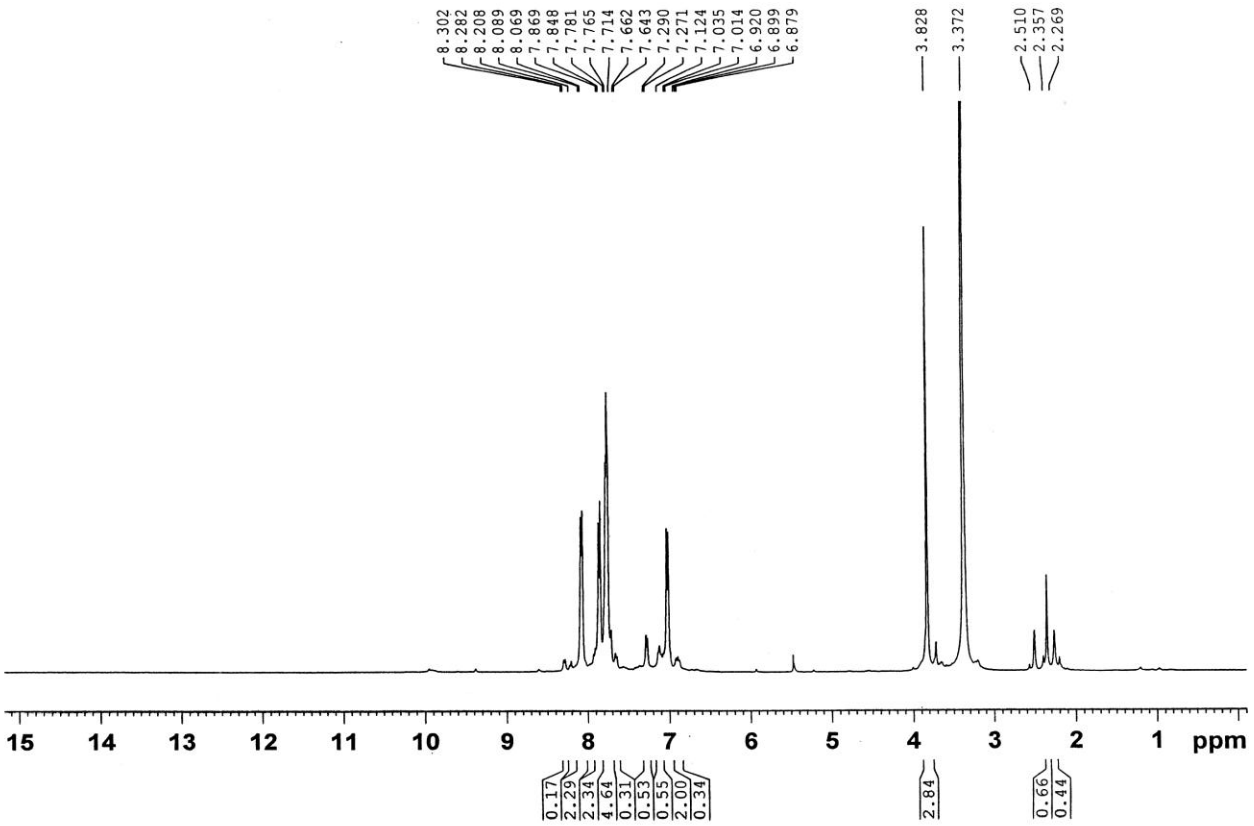


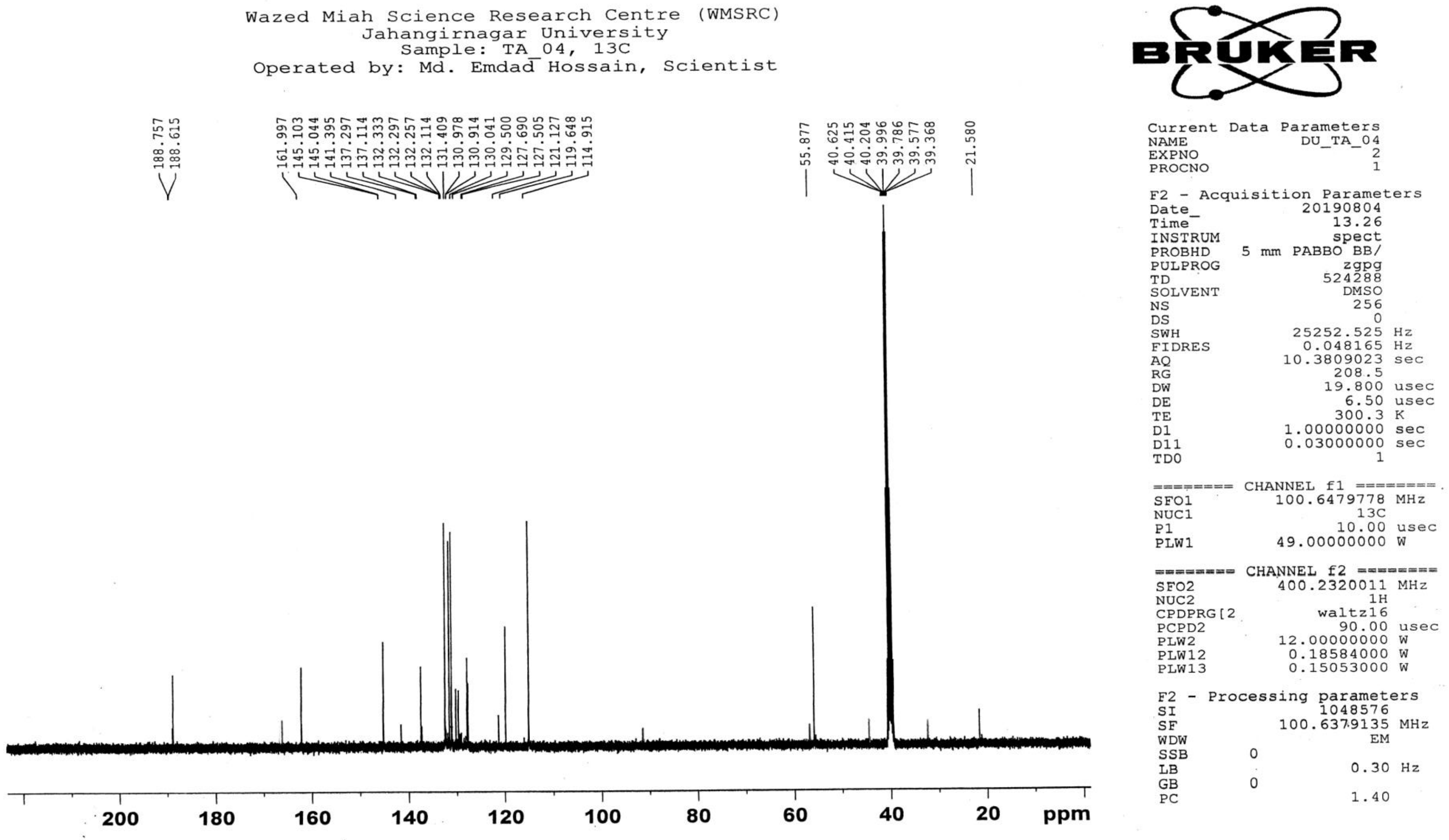
Figure - 30 IR spectrum of the compound 68

Wazed Miah Science Research Centre (WMSRC)
Jahanginagar University
Sample: TA_04
Operated by: Md. Emdad Hossain, Scientist



```
Current Data Parameters
NAME            DU_TA_04
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20190804
Time               12.37
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG               zg
TD                 65536
SOLVENT             DMSO
NS                    16
DS                     0
SWH            12019.230 Hz
FIDRES          0.183399 Hz
AQ             2.7262976 sec
RG                 52.16
DW                41.600 usec
DE                  6.50 usec
TE                 299.0 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.2340023 MHz
NUC1                  1H
P1                 11.20 usec
PLW1         12.00000000 W

F2 - Processing parameters
SI                131072
SF           400.2300000 MHz
WDW                   EM
SSB      0
LB                  1.00 Hz
GB       0
PC                  1.00
```

Figure - 31 The ^{1}H NMR spectrum of the compound 68



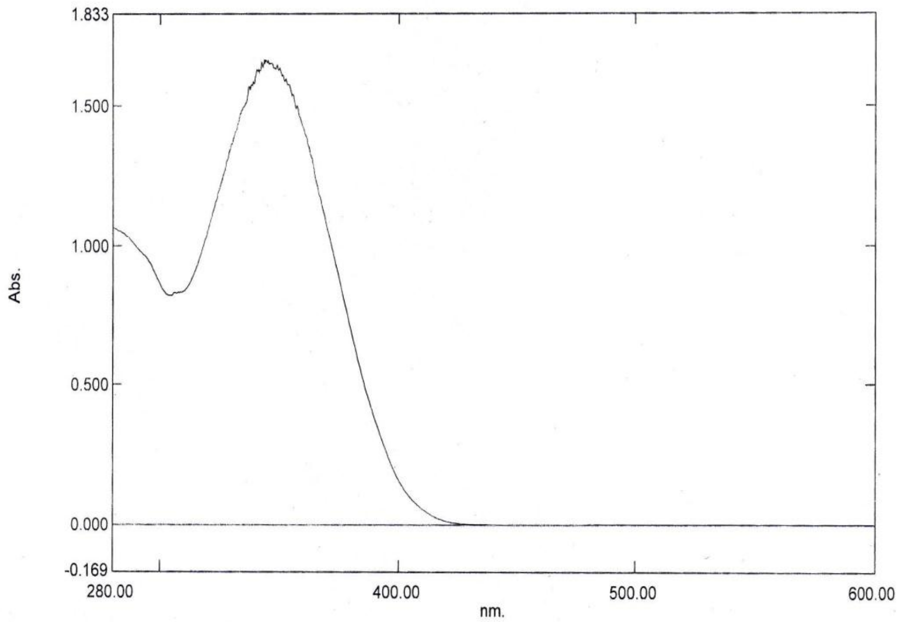
Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_04, 13C
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME              DU_TA_04
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190804
Time                 13.26
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     256
DS                       0
SWH              25252.525 Hz
FIDRES            0.048165 Hz
AQ              10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   300.3 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          100.6479778 MHz
NUC1                  13C
P1                  10.00 usec
PLW1          49.00000000 W

======== CHANNEL f2 ========
SFO2          400.2320011 MHz
NUC2                   1H
CPDPRG[2           waltz16
PCPD2               90.00 usec
PLW2          12.00000000 W
PLW12          0.18584000 W
PLW13          0.15053000 W

F2 - Processing parameters
SI                 1048576
SF            100.6379135 MHz
WDW                     EM
SSB      0
LB                    0.30 Hz
GB       0
PC                    1.40
```

Figure- 32 The ^{13}C NMR of the compound 68

Spectrum Peak Pick Report

Data Set: File_210128_121001.spc - RawData



[Measurement Properties]	
Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single
[Instrument Properties]	
Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal
[Attachment Properties]	
Attachment:	None
[Operation]	
Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled
[Sample Preparation Properties]	
Weight:	
Volume:	
Dilution:	
Path Length:	
Additional Information:	

No.	P/V	Wavelength	Abs.	Description
1	↑	344.20	1.666	
2	↑	306.40	0.831	
3	↓	307.20	0.828	
4	↓	305.00	0.820	

Figure- 33 UV spectrum of the compound 69

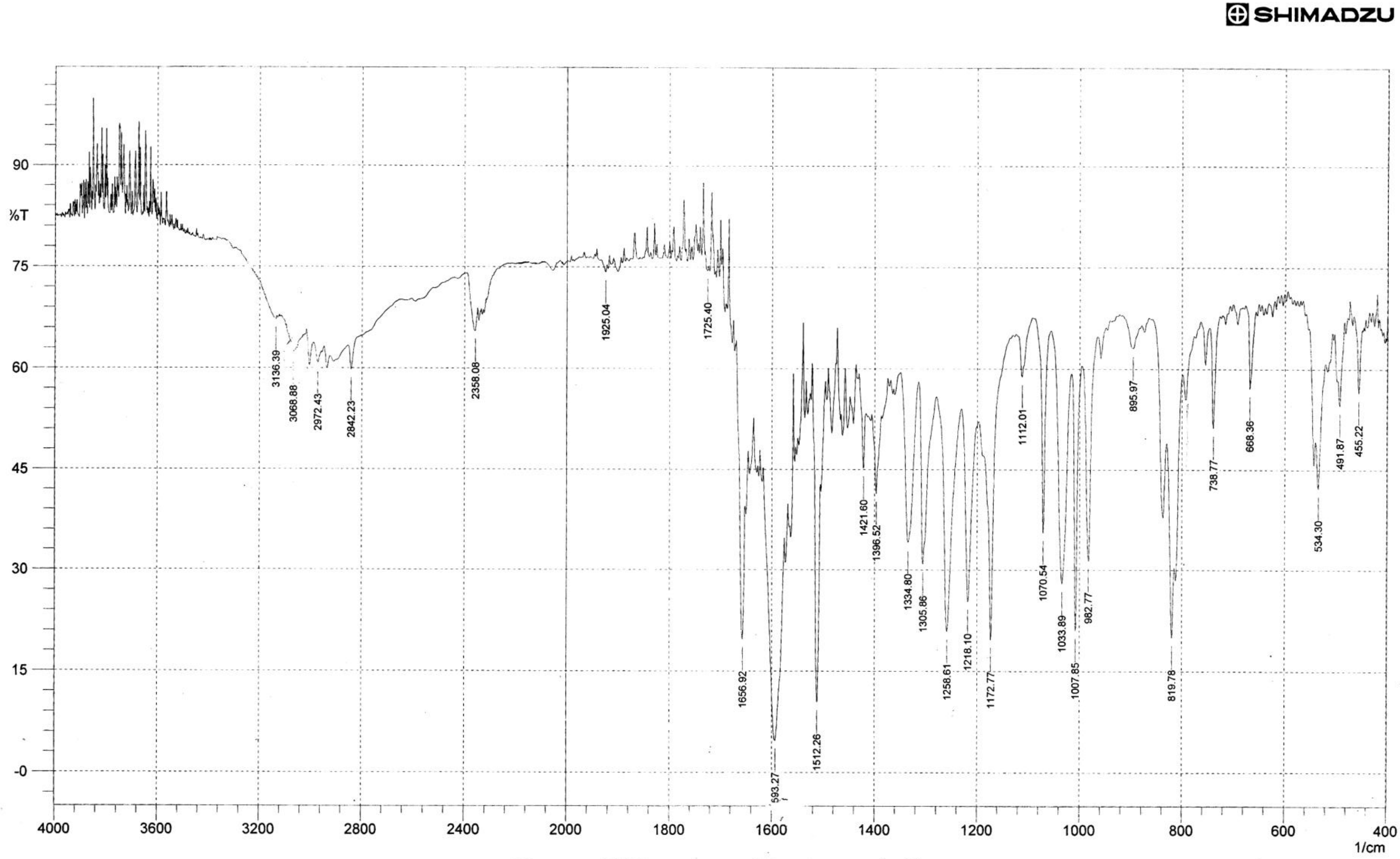
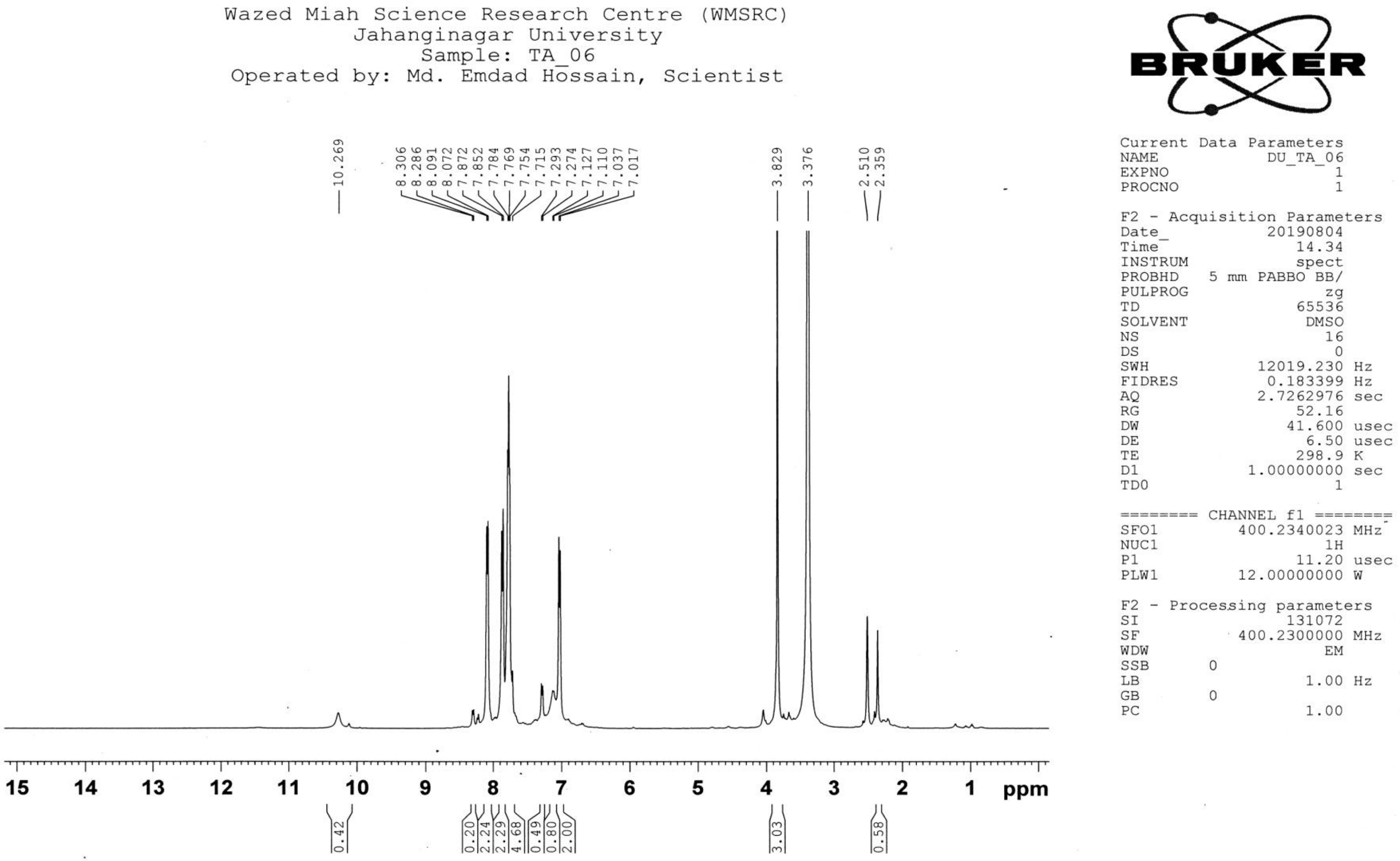


Figure - 34 IR spectrum of the compound 69

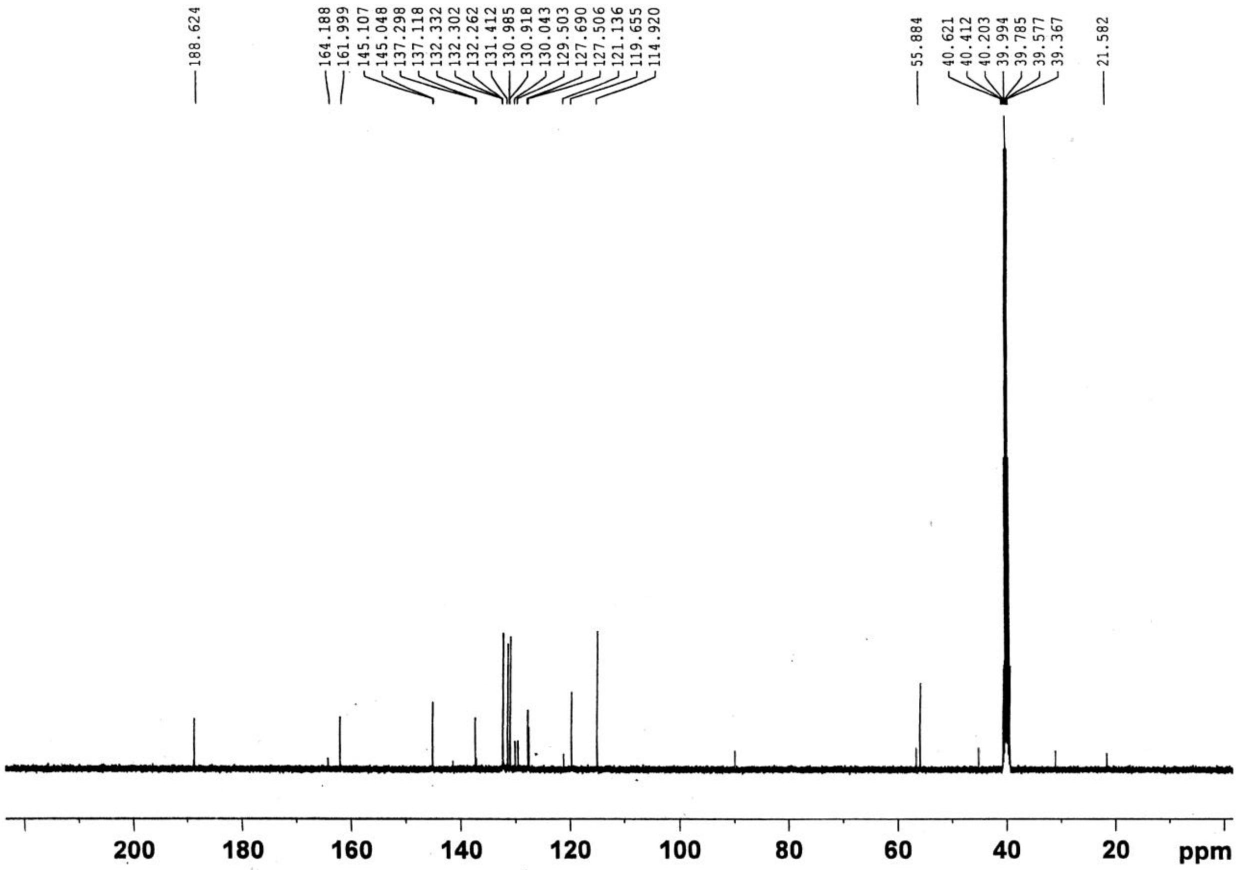


Wazed Miah Science Research Centre (WMSRC)
Jahanginagar University
Sample: TA_06
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME              DU_TA_06
EXPNO                    1
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190804
Time                 14.34
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG                 zg
TD                   65536
SOLVENT               DMSO
NS                      16
DS                       0
SWH              12019.230 Hz
FIDRES            0.183399 Hz
AQ               2.7262976 sec
RG                   52.16
DW                  41.600 usec
DE                    6.50 usec
TE                   298.9 K
D1              1.00000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1           400.2340023 MHz
NUC1                    1H
P1                   11.20 usec
PLW1           12.00000000 W

F2 - Processing parameters
SI                  131072
SF             400.2300000 MHz
WDW                     EM
SSB      0
LB                    1.00 Hz
GB       0
PC                    1.00
```

Figure- 35 The ^{1}H NMR spectrum of the compound 69

Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_06, 13C
Operated by: Md. Emdad Hossain, Scientist

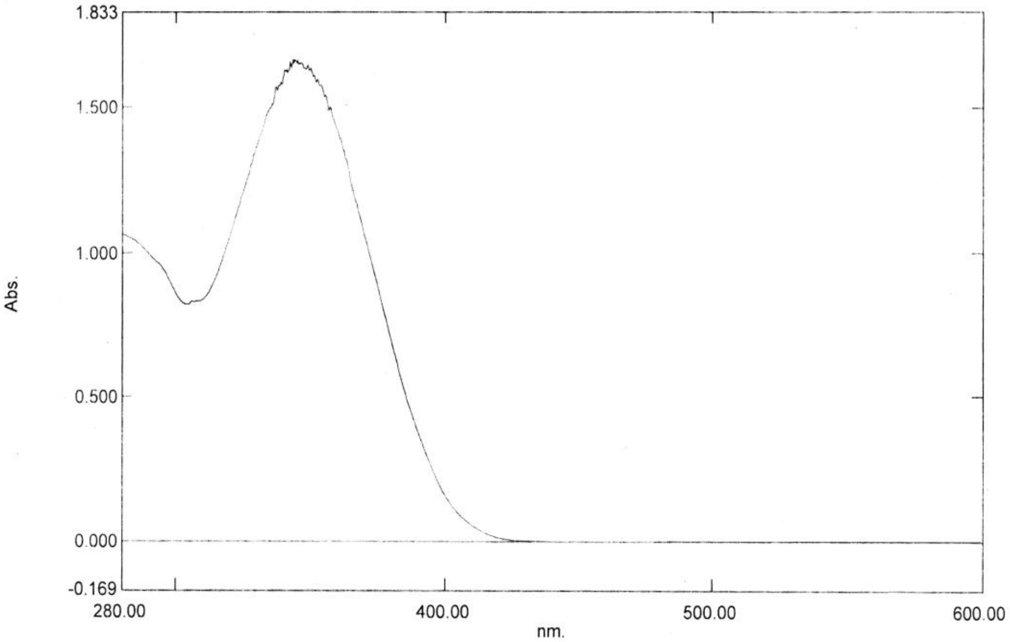


```
Current Data Parameters
NAME              DU_TA_06
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190804
Time_                15.43
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     364
DS                       0
SWH              25252.525 Hz
FIDRES            0.048165 Hz
AQ              10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   300.3 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1           100.6479778 MHz
NUC1                   13C
P1                   10.00 usec
PLW1           49.00000000 W

======== CHANNEL f2 ========
SFO2           400.2320011 MHz
NUC2                    1H
CPDPRG[2           waltz16
PCPD2                90.00 usec
PLW2           12.00000000 W
PLW12           0.18584000 W
PLW13           0.15053000 W

F2 - Processing parameters
SI                 1048576
SF             100.6379135 MHz
WDW                     EM
SSB       0
LB                    0.30 Hz
GB        0
PC                    1.40
```

Figure- 36 The ^{13}C NMR of the compound 69

Spectrum Peak Pick Report

Data Set: File_210128_121001.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	346.10	1.686	
2	↑	304.30	0.830	
3	↓	308.10	0.825	
4	↓	302.00	0.821	

[Measurement Properties]	
Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single

[Instrument Properties]	
Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal

[Attachment Properties]	
Attachment:	None

[Operation]	
Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 37 UV spectrum of the compound 70

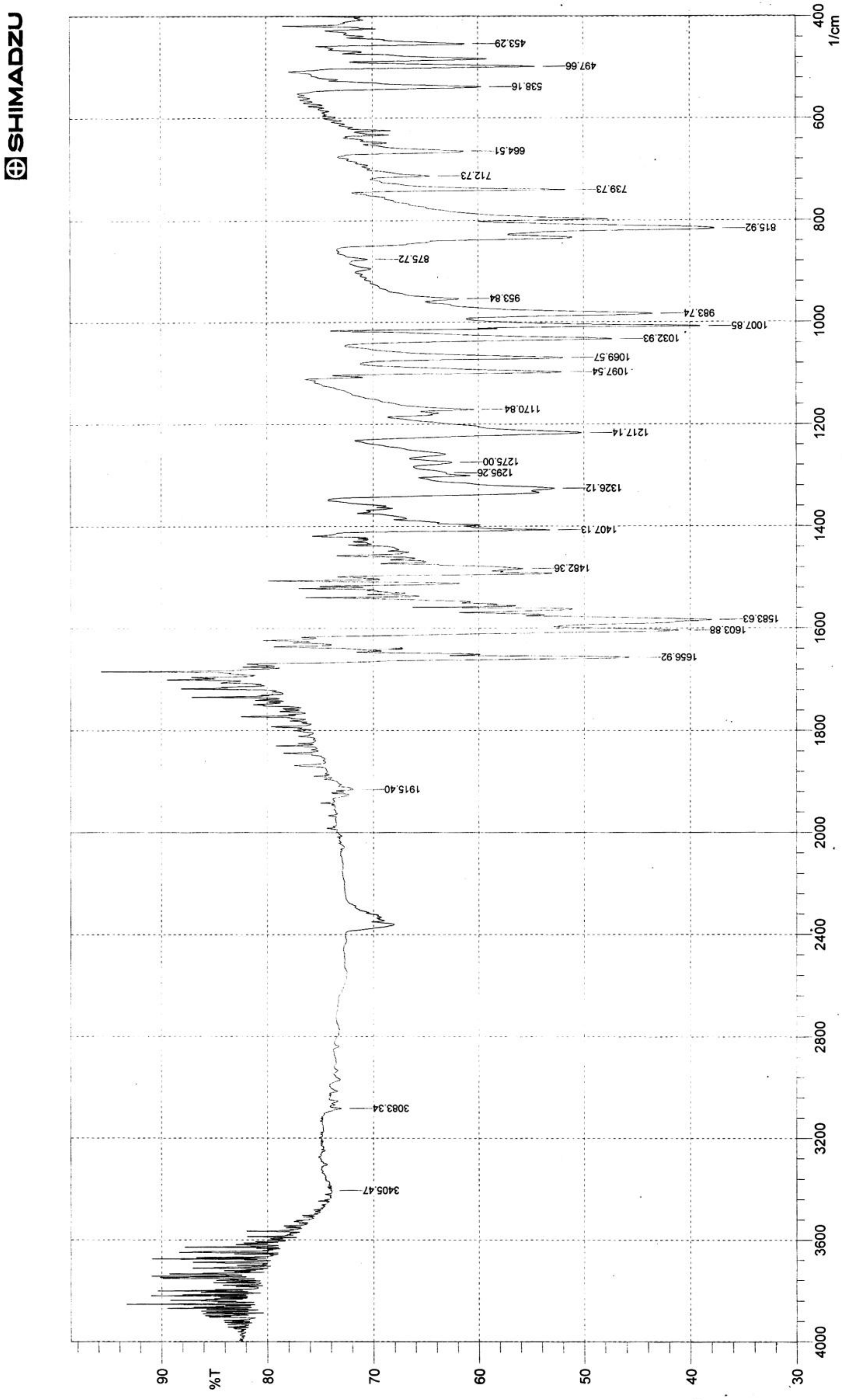
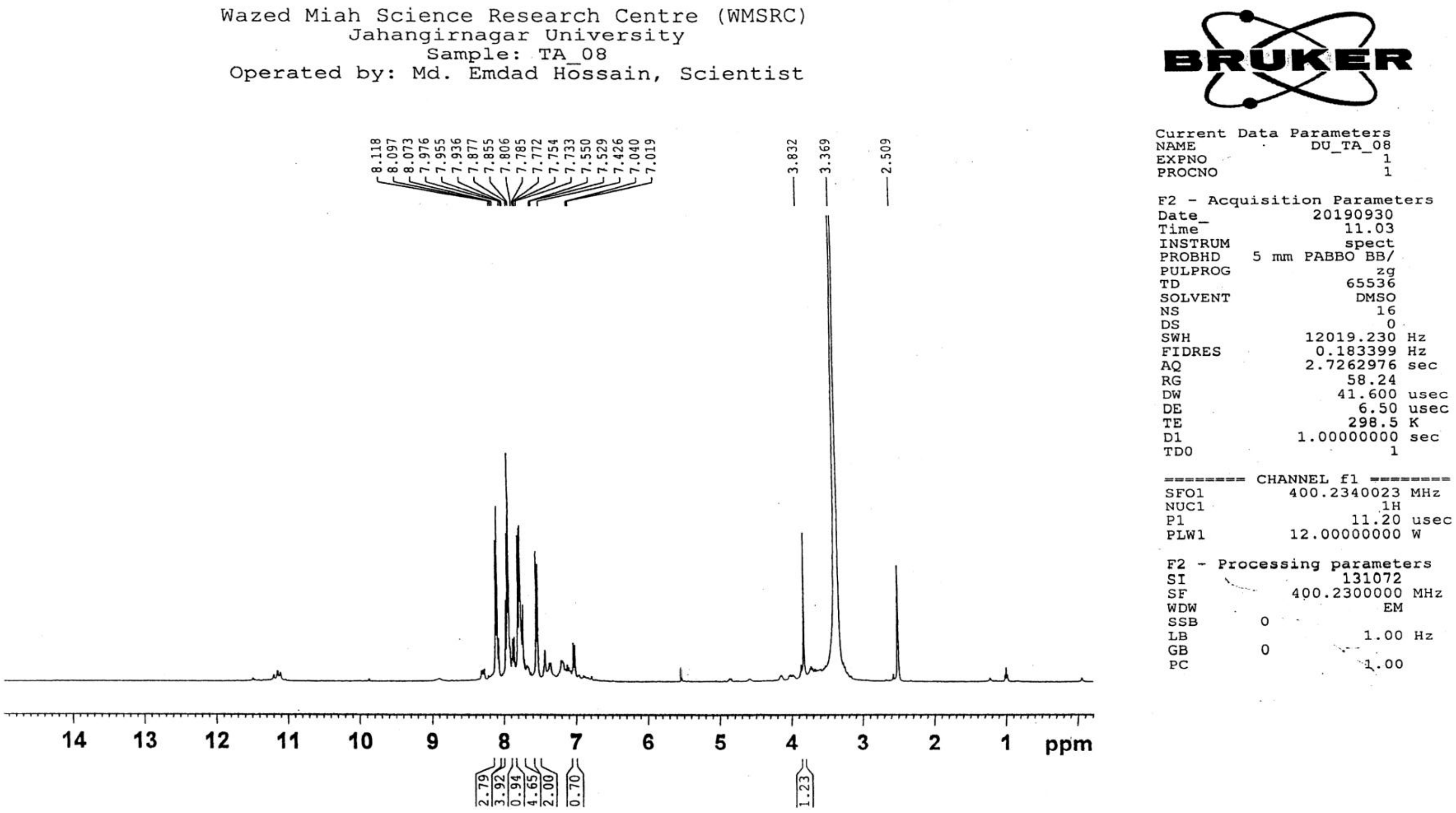


Figure - 38 IR spectrum of the compound 70

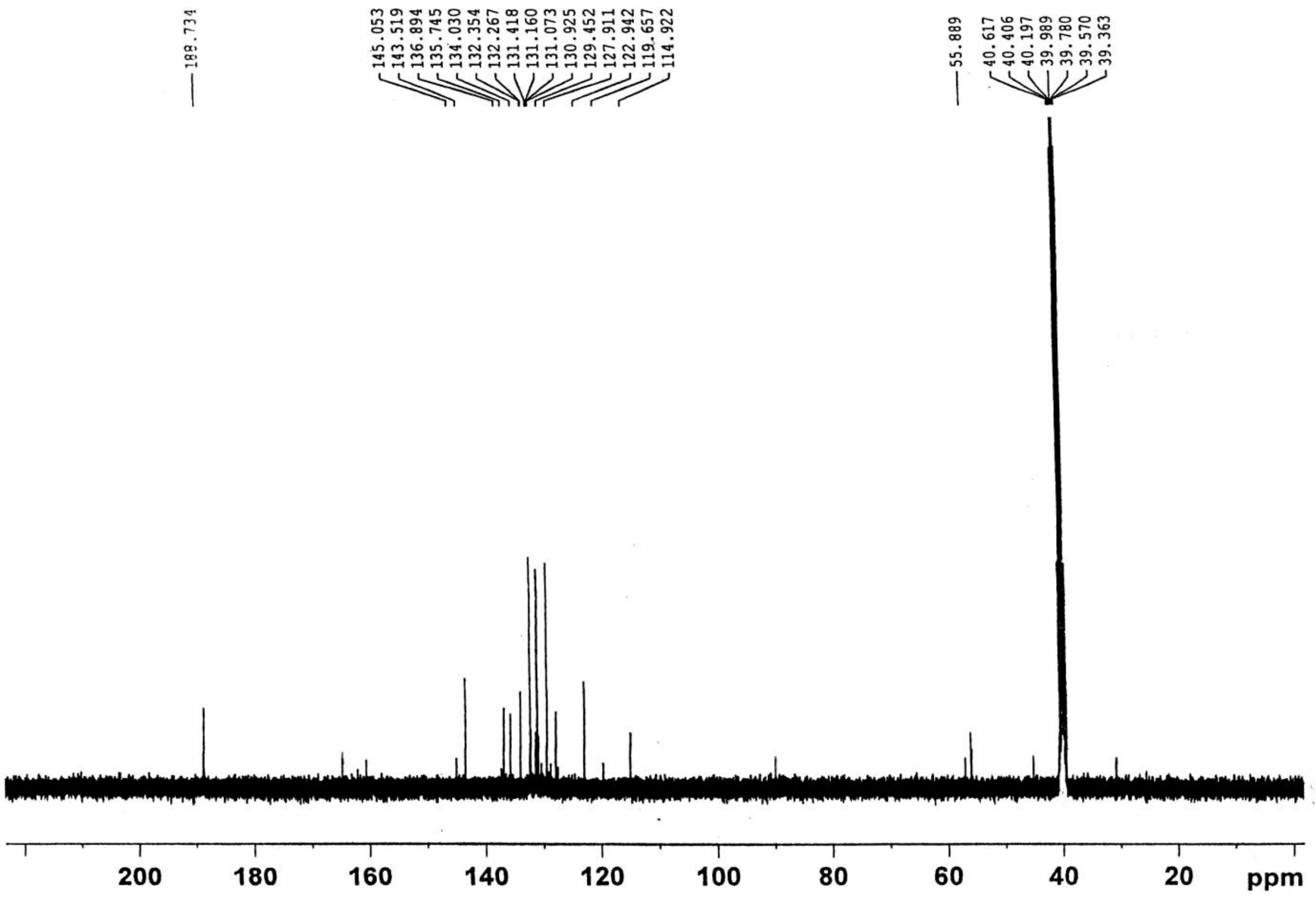


Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_08
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME               DU_TA_08
EXPNO                     1
PROCNO                    1

F2 - Acquisition Parameters
Date_              20190930
Time                  11.03
INSTRUM               spect
PROBHD   5 mm PABBO BB/
PULPROG                  zg
TD                    65536
SOLVENT                DMSO
NS                       16
DS                        0
SWH               12019.230 Hz
FIDRES             0.183399 Hz
AQ                2.7262976 sec
RG                    58.24
DW                   41.600 usec
DE                     6.50 usec
TE                    298.5 K
D1               1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1            400.2340023 MHz
NUC1                     1H
P1                    11.20 usec
PLW1            12.00000000 W

F2 - Processing parameters
SI                   131072
SF              400.2300000 MHz
WDW                      EM
SSB      0
LB                     1.00 Hz
GB       0
PC                     1.00
```

Figure - 39 The ^{1}H NMR spectrum of the compound 70

Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_08, 13C
Operated by: Md. Emdad Hossain, Scientist

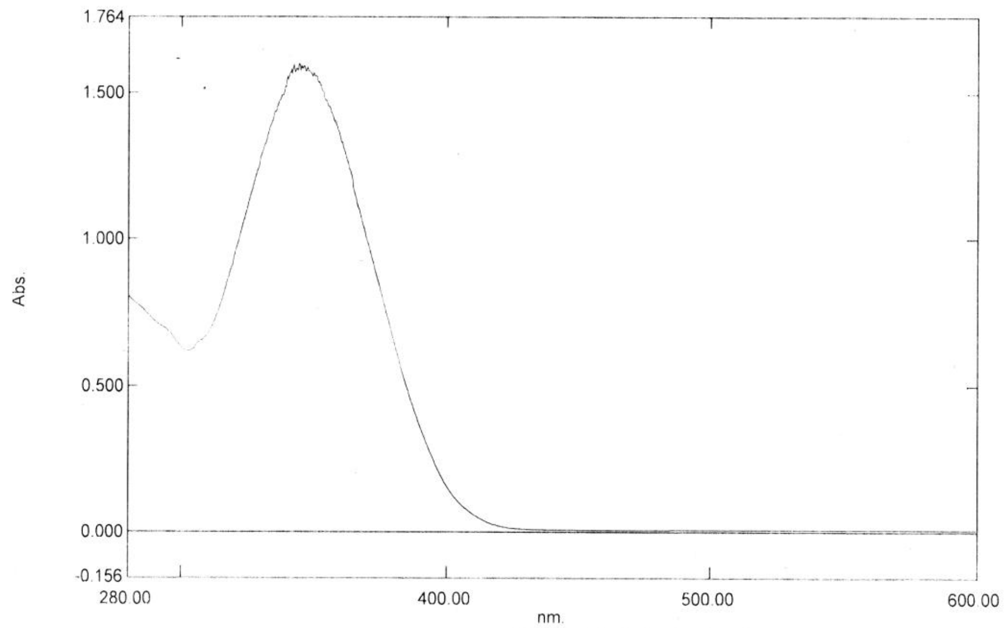


```
Current Data Parameters
NAME              DU_TA_08
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190930
Time                 11.25
INSTRUM              spect
PROBHD   5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     256
DS                       0
SWH             25252.525 Hz
FIDRES           0.048165 Hz
AQ             10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   300.0 K
D1             1.00000000 sec
D11            0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          100.6479778 MHz
NUC1                  13C
P1                  10.00 usec
PLW1          49.00000000 W

======== CHANNEL f2 ========
SFO2          400.2320011 MHz
NUC2                   1H
CPDPRG[2          waltz16
PCPD2               90.00 usec
PLW2          12.00000000 W
PLW12          0.18584000 W
PLW13          0.15053000 W

F2 - Processing parameters
SI                1048576
SF          100.6379135 MHz
WDW                    EM
SSB      0
LB                   0.30 Hz
GB       0
PC                   1.40
```

Figure- 40 The ^{13}C NMR of the compound 70

Spectrum Peak Pick Report

Data Set: File_210128_113722.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	349.70	1.591	
2	↓	301.00	0.617	

[Measurement Properties]
Wavelength Range (nm.): 280.00 to 600.00
Scan Speed: Fast
Sampling Interval: 0.2
Auto Sampling Interval: Enabled
Scan Mode: Single

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]
Attachment: None

[Operation]
Threshold: 0.0010000
Points: 4
InterPolate: Disabled
Average: Disabled

[Sample Preparation Properties]
Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 41 UV spectrum of the compound 71

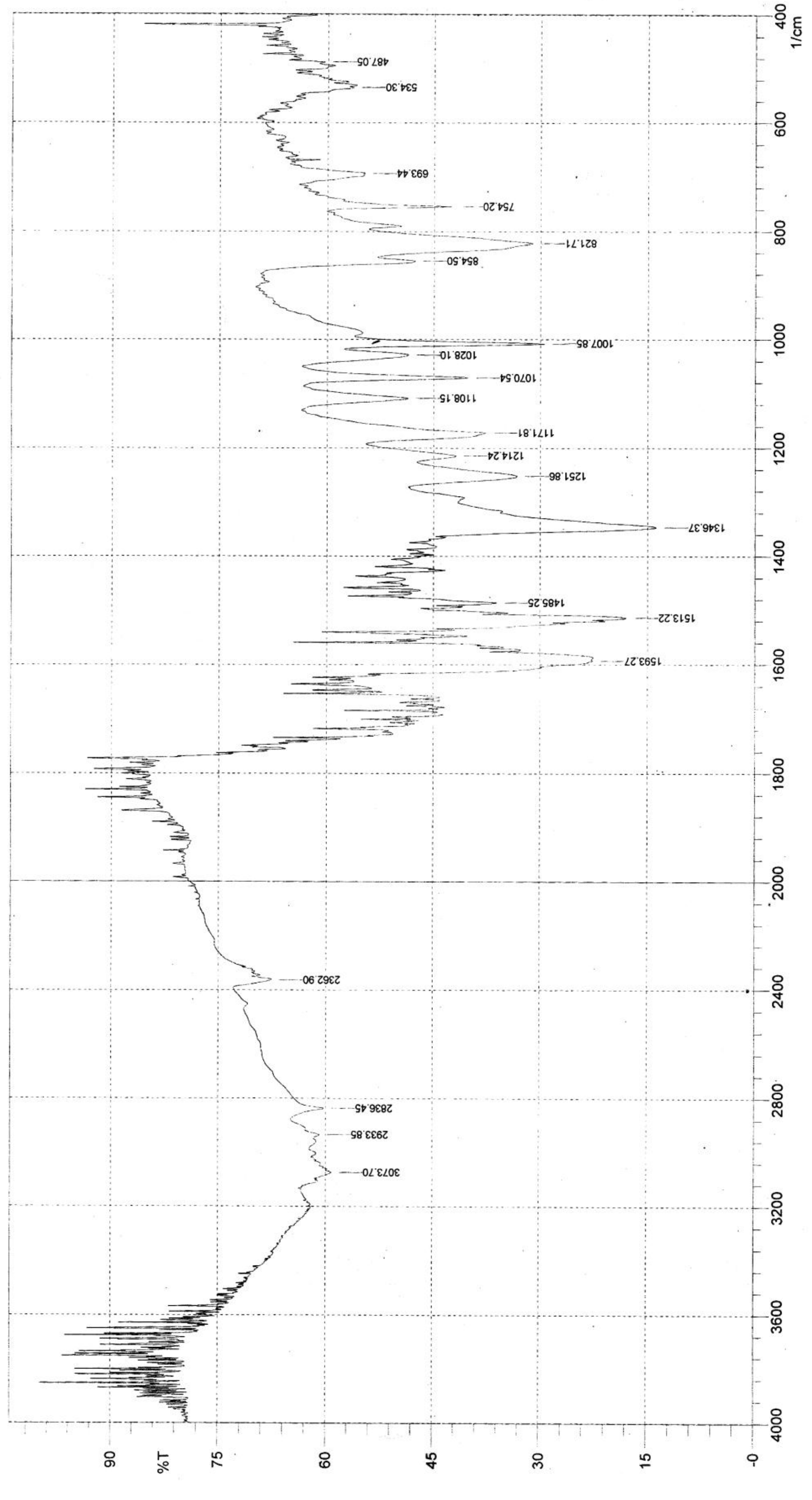
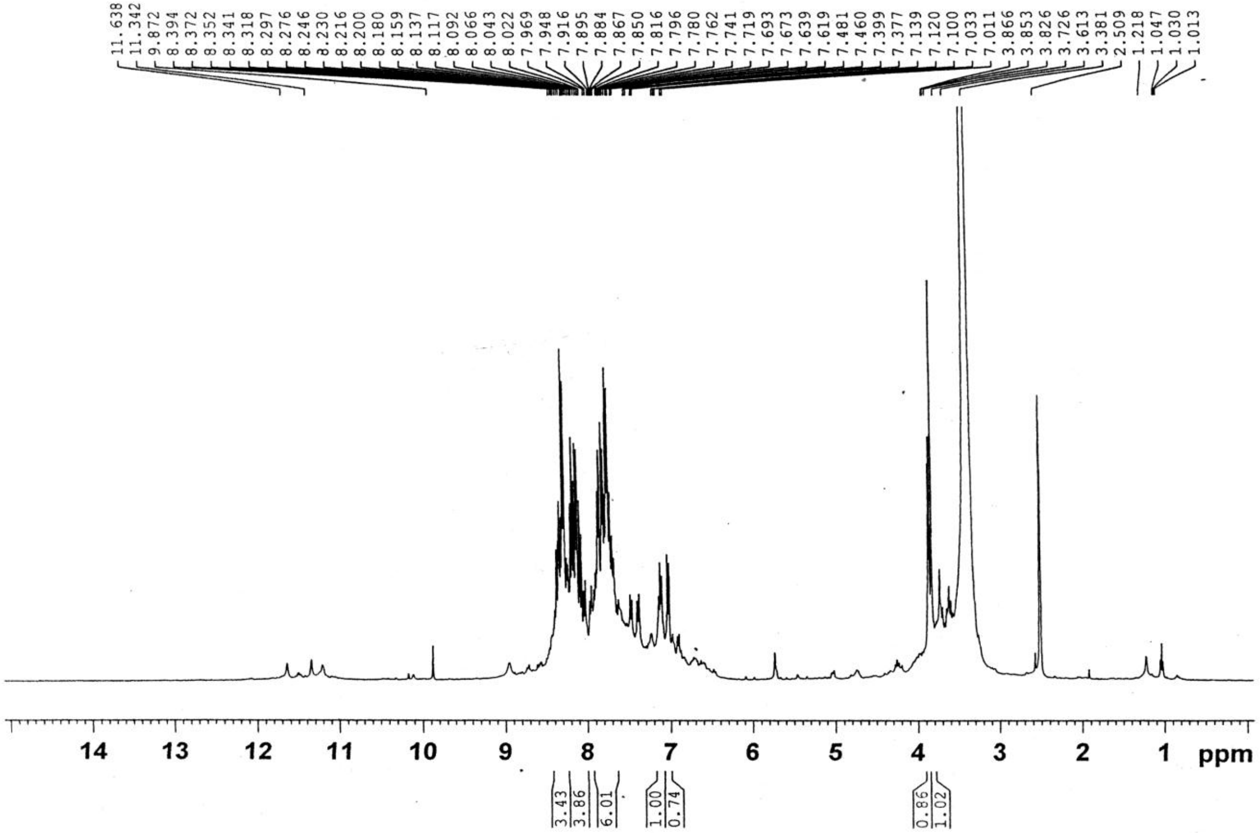


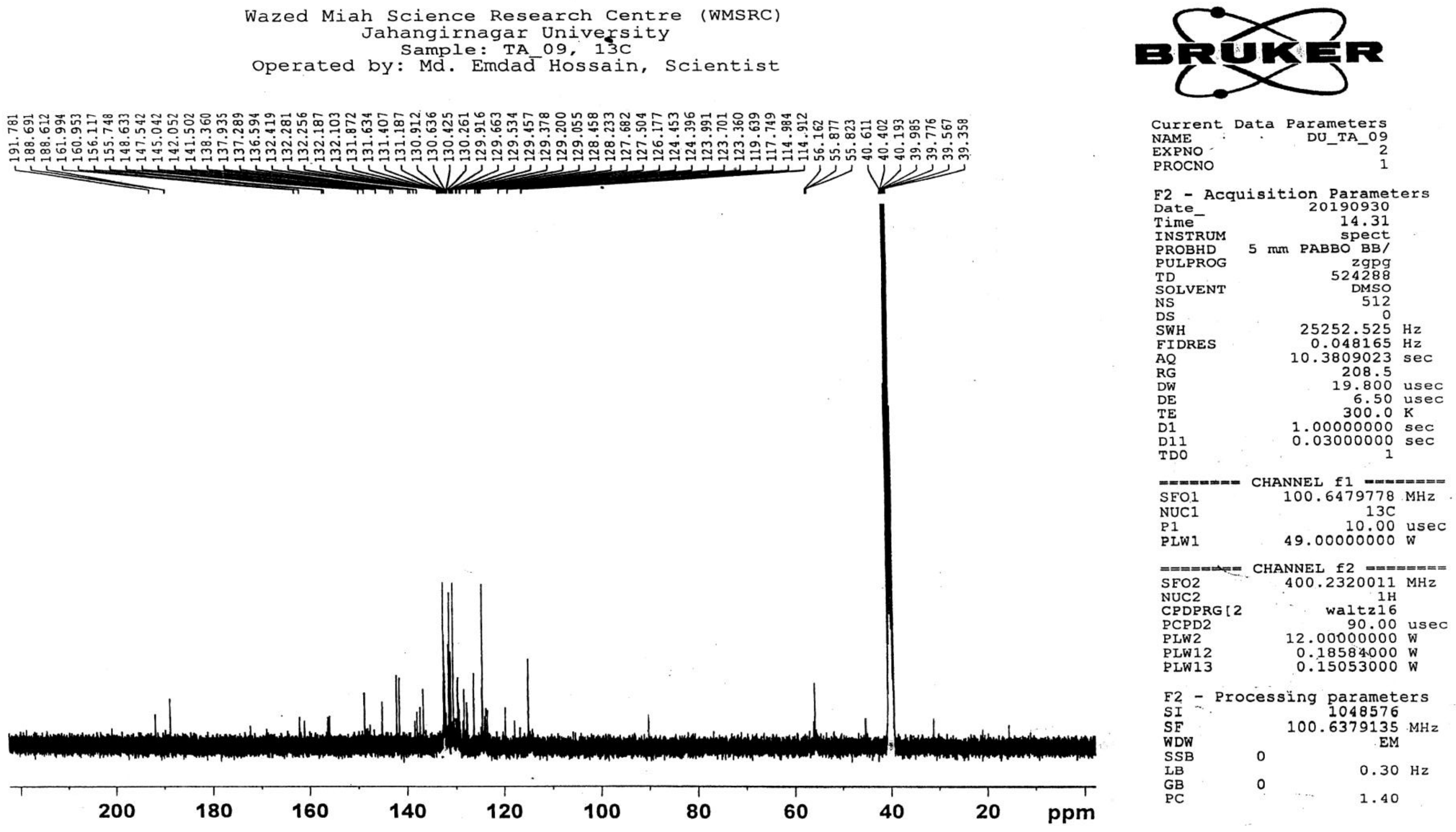
Figure - 42 IR spectrum of the compound 71

Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_09
Operated by: Md. Emdad Hossain, Scientist



```
Current Data Parameters
NAME            DU_TA_09
EXPNO                  1
PROCNO                 1

F2 - Acquisition Parameters
Date_           20190930
Time               12.53
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG               zg
TD                 65536
SOLVENT             DMSO
NS                    16
DS                     0
SWH            12019.230 Hz
FIDRES          0.183399 Hz
AQ             2.7262976 sec
RG                 58.24
DW                41.600 usec
DE                  6.50 usec
TE                 298.5 K
D1            1.00000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         400.2340023 MHz
NUC1                  1H
P1                 11.20 usec
PLW1         12.00000000 W

F2 - Processing parameters
SI                131072
SF           400.2300000 MHz
WDW                   EM
SSB      0
LB                  1.00 Hz
GB       0
PC                  1.00
```

Figure- 43 The ^1H NMR spectrum of the compound 71



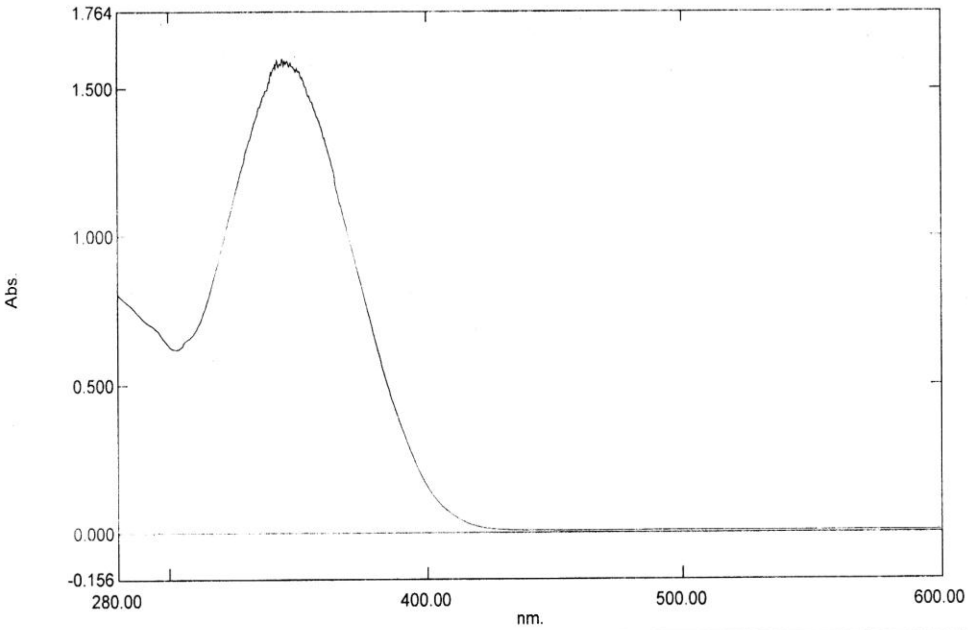
Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_09, 13C
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME              DU_TA_09
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190930
Time                 14.31
INSTRUM              spect
PROBHD    5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     512
DS                       0
SWH             25252.525 Hz
FIDRES           0.048165 Hz
AQ             10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   300.0 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1          100.6479778 MHz
NUC1                   13C
P1                   10.00 usec
PLW1           49.00000000 W

======== CHANNEL f2 ========
SFO2          400.2320011 MHz
NUC2                    1H
CPDPRG[2           waltz16
PCPD2                90.00 usec
PLW2           12.00000000 W
PLW12           0.18584000 W
PLW13           0.15053000 W

F2 - Processing parameters
SI                 1048576
SF            100.6379135 MHz
WDW                     EM
SSB      0
LB                    0.30 Hz
GB       0
PC                    1.40
```

Figure- 44 The ^{13}C NMR of the compound 71

Spectrum Peak Pick Report

Data Set: File_210128_113722.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	340.80	1.591	
2	↓	301.00	0.617	

[Measurement Properties]

Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single

[Instrument Properties]

Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal

[Attachment Properties]

Attachment:	None

[Operation]

Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled

[Sample Preparation Properties]

Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 45 UV spectrum of the compound 72

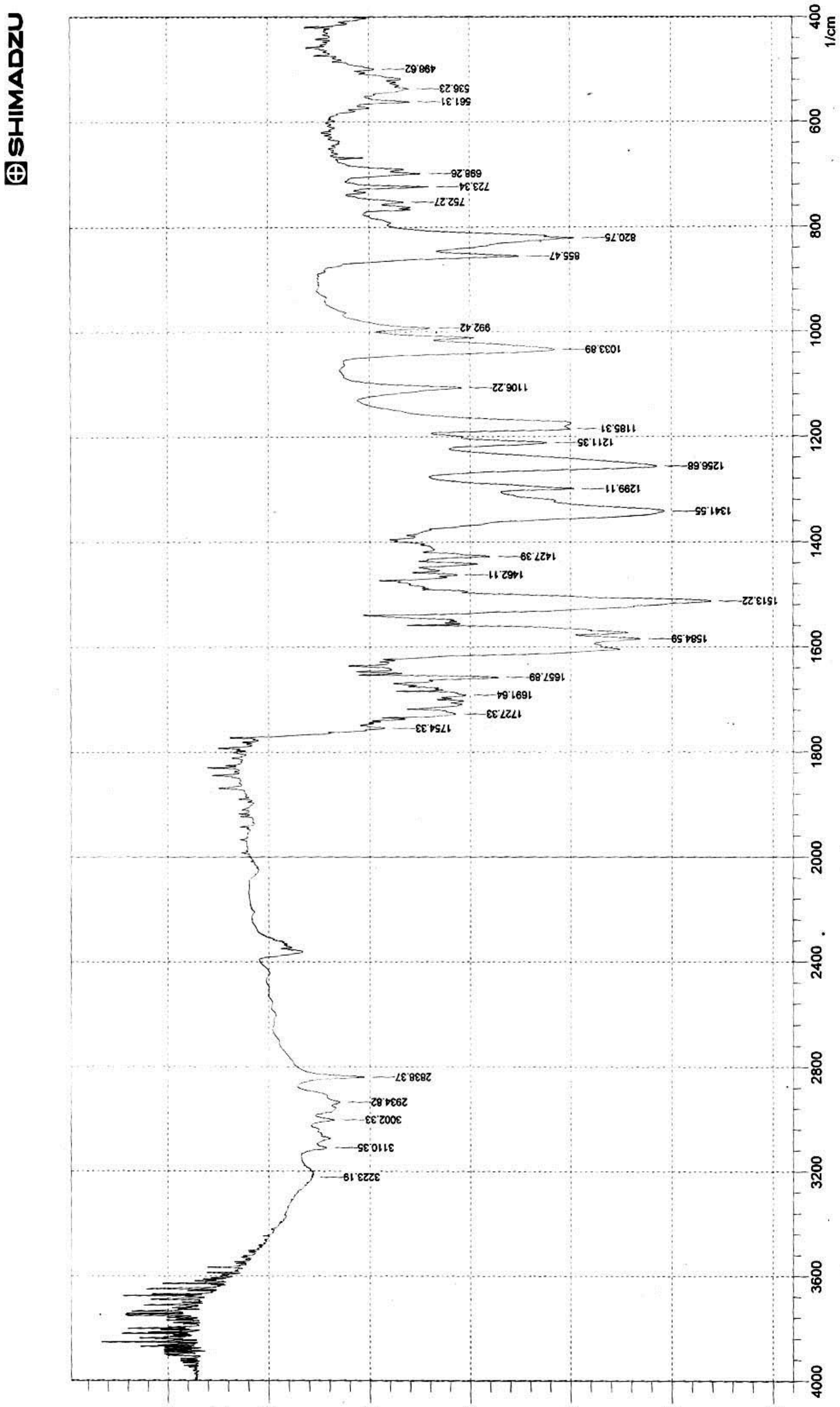
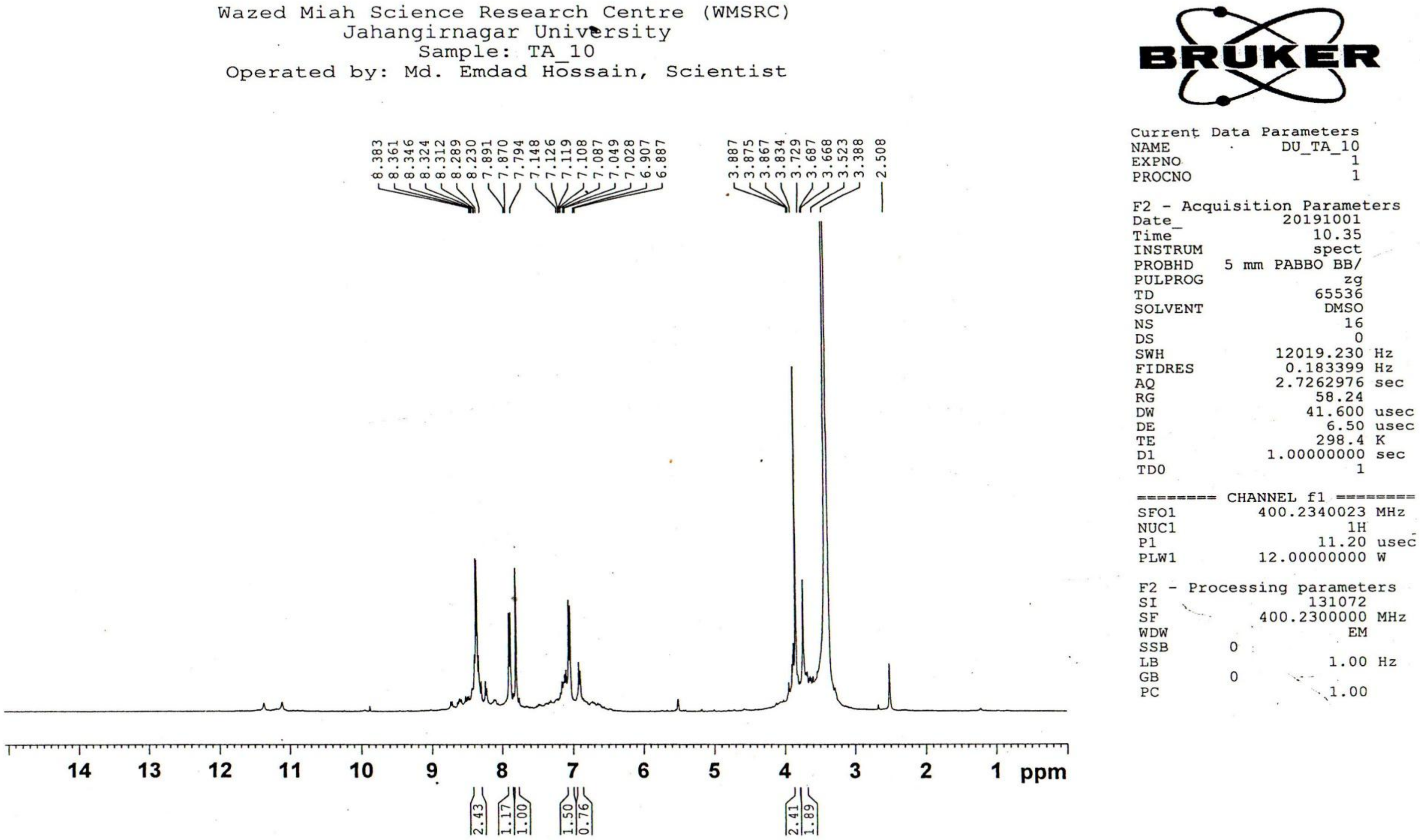


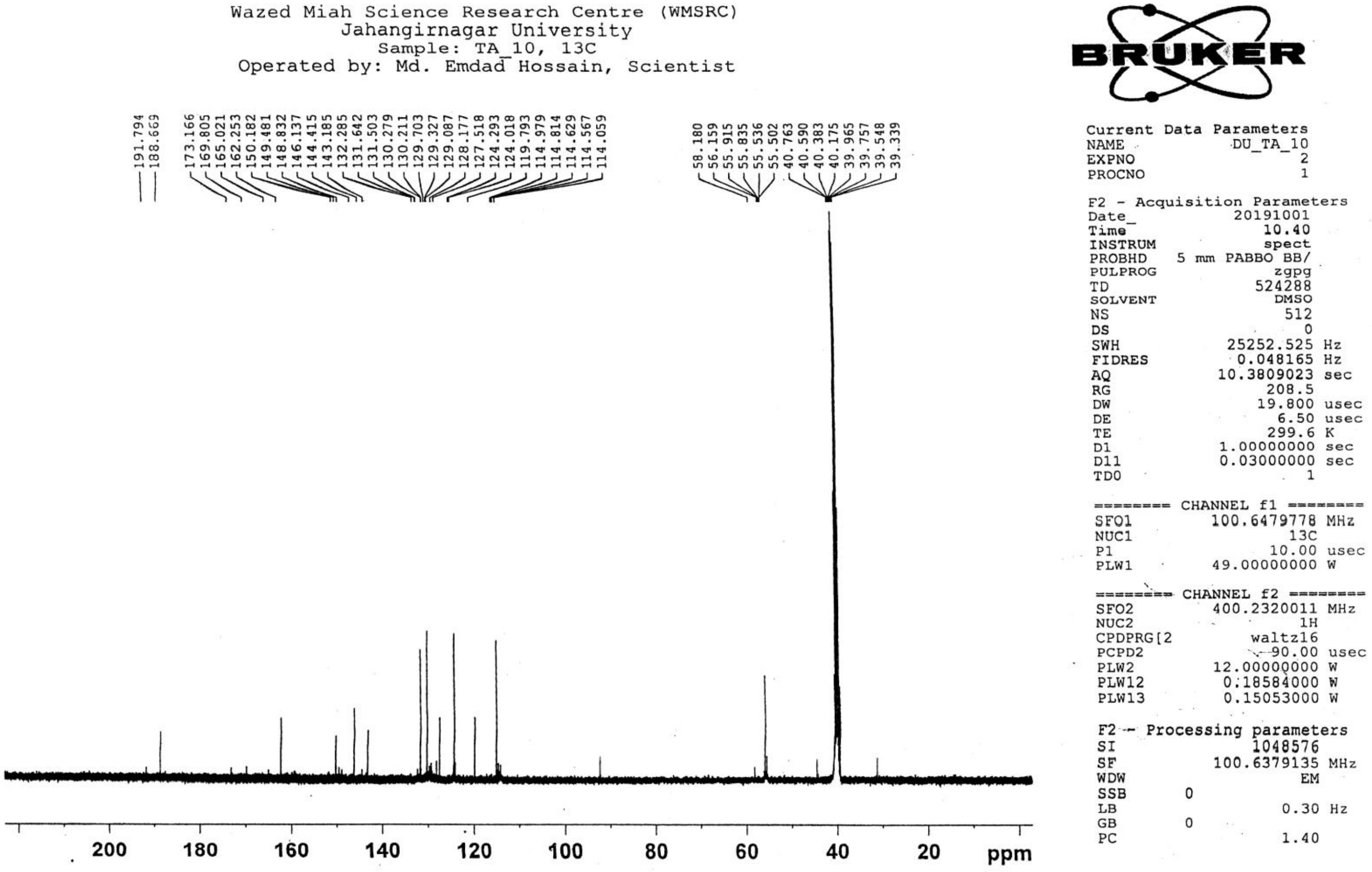
Figure - 46 IR spectrum of the compound 72



Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_10
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME          DU_TA_10
EXPNO                1
PROCNO               1

F2 - Acquisition Parameters
Date_         20191001
Time             10.35
INSTRUM          spect
PROBHD   5 mm PABBO BB/
PULPROG             zg
TD               65536
SOLVENT           DMSO
NS                  16
DS                   0
SWH          12019.230 Hz
FIDRES        0.183399 Hz
AQ           2.7262976 sec
RG               58.24
DW              41.600 usec
DE                6.50 usec
TE               298.4 K
D1          1.00000000 sec
TD0                  1

======== CHANNEL f1 ========
SFO1       400.2340023 MHz
NUC1                1H
P1               11.20 usec
PLW1       12.00000000 W

F2 - Processing parameters
SI              131072
SF         400.2300000 MHz
WDW                 EM
SSB      0
LB                1.00 Hz
GB       0
PC                1.00
```

Figure- 47 The ^{1}H NMR spectrum of the compound 72

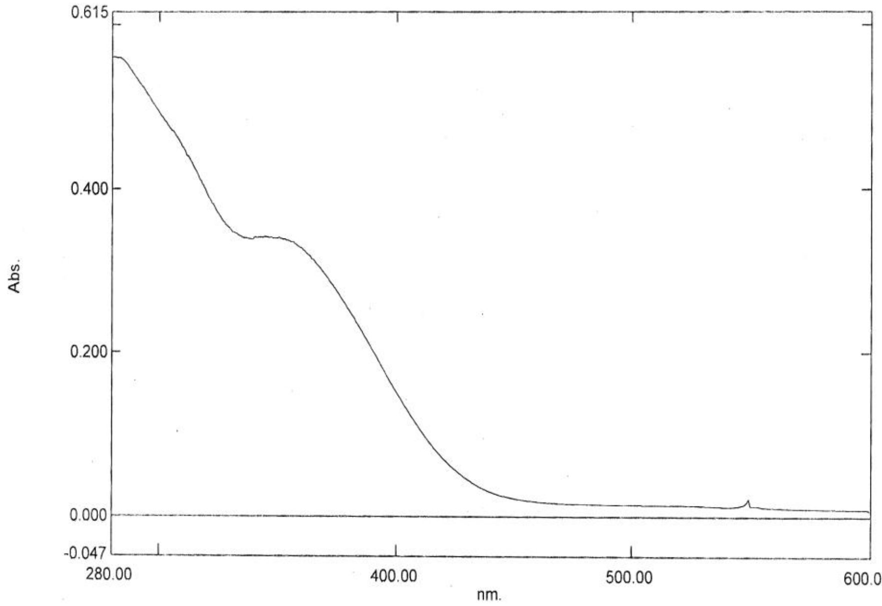


```
Current Data Parameters
NAME            DU_TA_10
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20191001
Time               10.40
INSTRUM            spect
PROBHD   5 mm PABBO BB/
PULPROG             zgpg
TD                524288
SOLVENT             DMSO
NS                   512
DS                     0
SWH            25252.525 Hz
FIDRES          0.048165 Hz
AQ            10.3809023 sec
RG                 208.5
DW                19.800 usec
DE                  6.50 usec
TE                 299.6 K
D1            1.00000000 sec
D11           0.03000000 sec
TD0                    1

======== CHANNEL f1 ========
SFO1         100.6479778 MHz
NUC1                 13C
P1                 10.00 usec
PLW1         49.00000000 W

======== CHANNEL f2 ========
SFO2         400.2320011 MHz
NUC2                  1H
CPDPRG[2         waltz16
PCPD2              90.00 usec
PLW2         12.00000000 W
PLW12         0.18584000 W
PLW13         0.15053000 W

F2 - Processing parameters
SI               1048576
SF           100.6379135 MHz
WDW                   EM
SSB      0
LB                  0.30 Hz
GB       0
PC                  1.40
```

Figure- 48 The ^{13}C NMR of the compound 72

Spectrum Peak Pick Report

Data Set: File_210128_121820.spc - RawData



No.	P/V	Wavelength	Abs.	Description
1	↑	548.80	0.022	
2	↑	345.20	0.342	
3	↓	551.20	0.013	
4	↓	539.80	0.012	
5	↓	339.00	0.338	

[Measurement Properties]

Wavelength Range (nm.):	280.00 to 600.00
Scan Speed:	Fast
Sampling Interval:	0.2
Auto Sampling Interval:	Enabled
Scan Mode:	Single

[Instrument Properties]

Instrument Type:	UV-1800 Series
Measuring Mode:	Absorbance
Slit Width:	1.0 nm
Light Source Change Wavelength:	340.0 nm
S/R Exchange:	Normal

[Attachment Properties]

Attachment:	None

[Operation]

Threshold:	0.0010000
Points:	4
InterPolate:	Disabled
Average:	Disabled

[Sample Preparation Properties]

Weight:
Volume:
Dilution:
Path Length:
Additional Information:

Figure- 49 UV spectrum of the compound 73

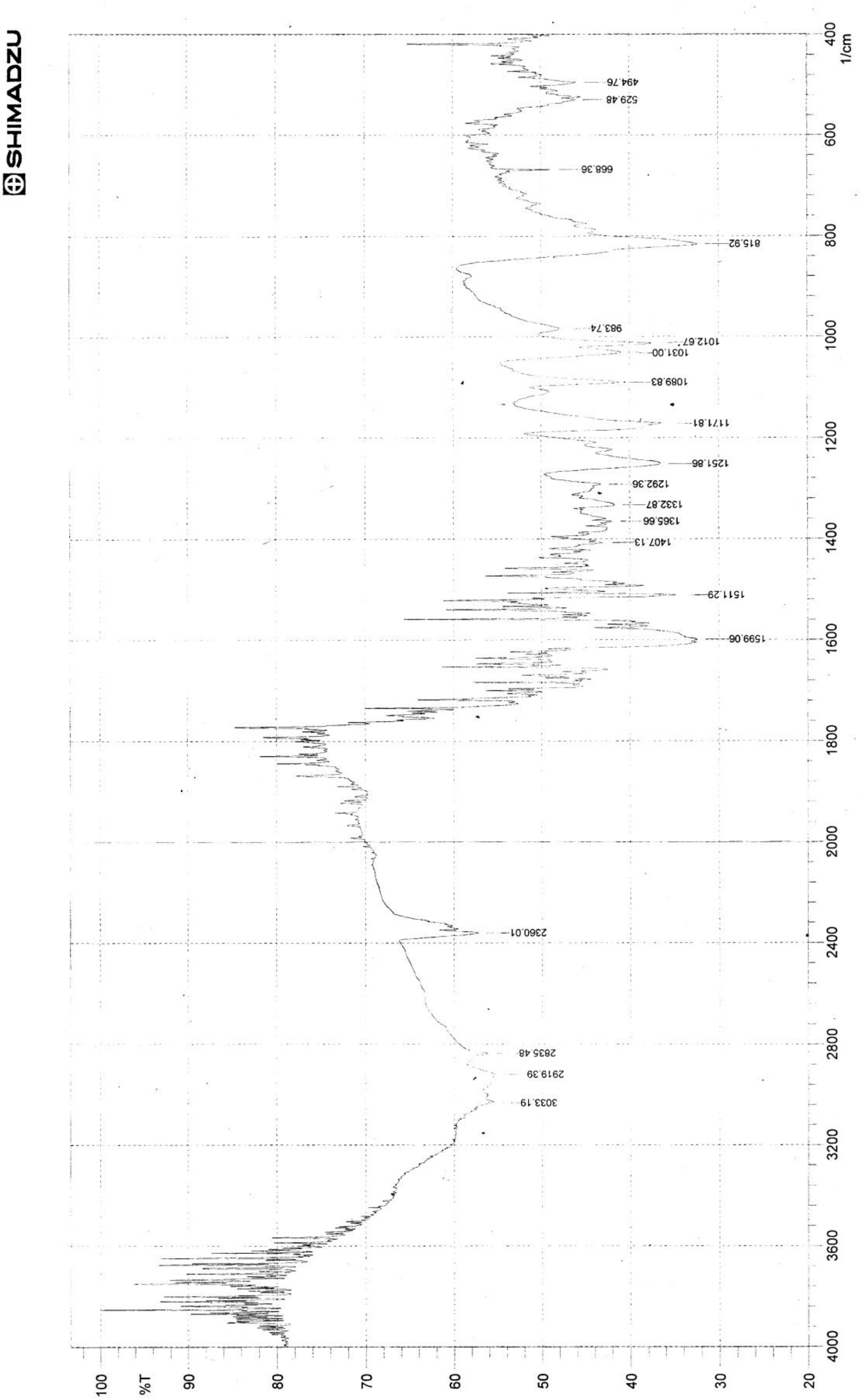
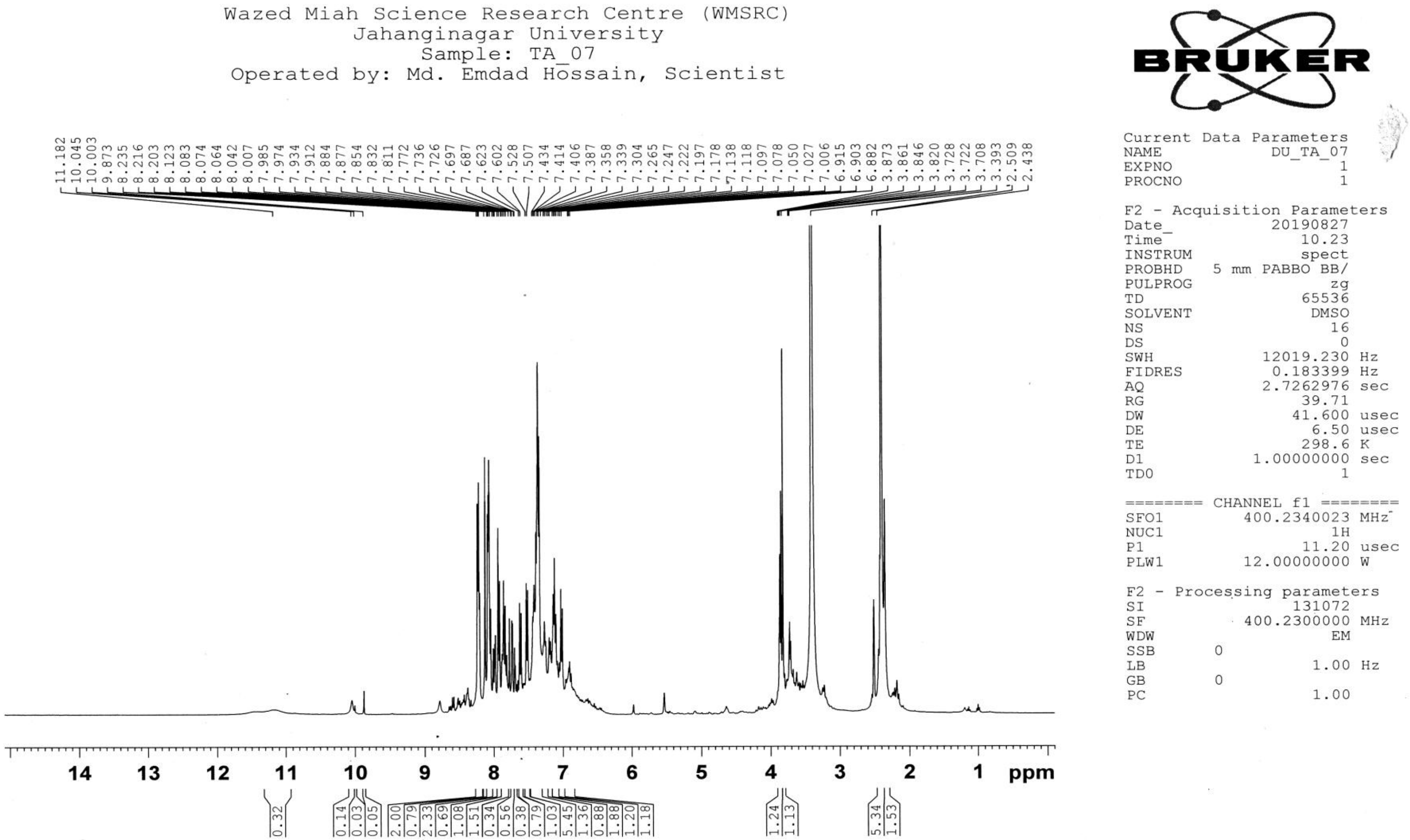


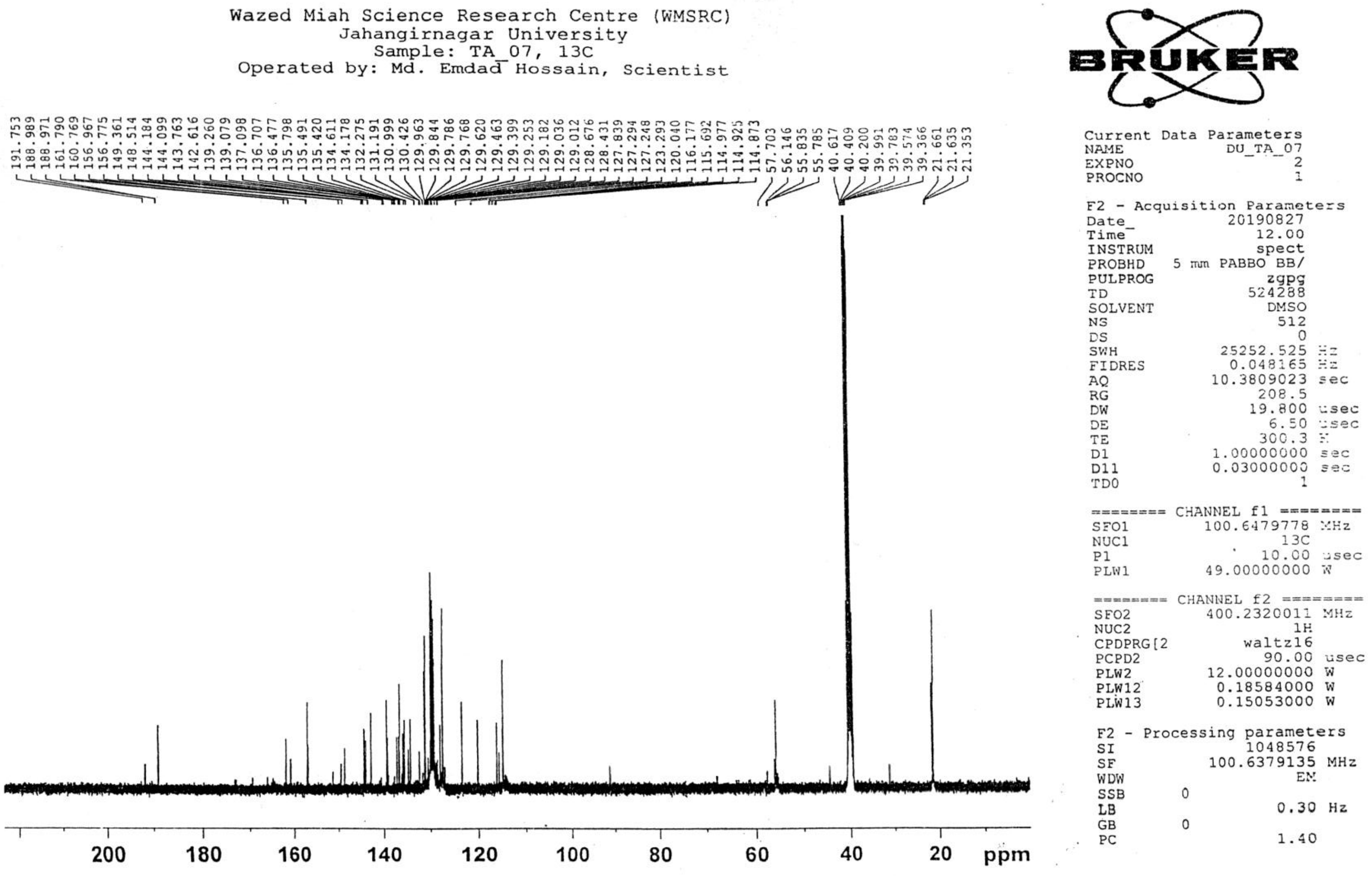
Figure - 50 IR spectrum of the compound 73



Wazed Miah Science Research Centre (WMSRC)
Jahanginagar University
Sample: TA_07
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME               DU_TA_07
EXPNO                     1
PROCNO                    1

F2 - Acquisition Parameters
Date_              20190827
Time                  10.23
INSTRUM               spect
PROBHD     5 mm PABBO BB/
PULPROG                  zg
TD                    65536
SOLVENT                DMSO
NS                       16
DS                        0
SWH               12019.230 Hz
FIDRES             0.183399 Hz
AQ                2.7262976 sec
RG                    39.71
DW                   41.600 usec
DE                     6.50 usec
TE                    298.6 K
D1               1.00000000 sec
TD0                       1

======== CHANNEL f1 ========
SFO1         400.2340023 MHz
NUC1                  1H
P1                 11.20 usec
PLW1         12.00000000 W

F2 - Processing parameters
SI                   131072
SF              400.2300000 MHz
WDW                      EM
SSB      0
LB                     1.00 Hz
GB       0
PC                     1.00
```

Figure- 51 The ^{1}H NMR spectrum of the compound 73

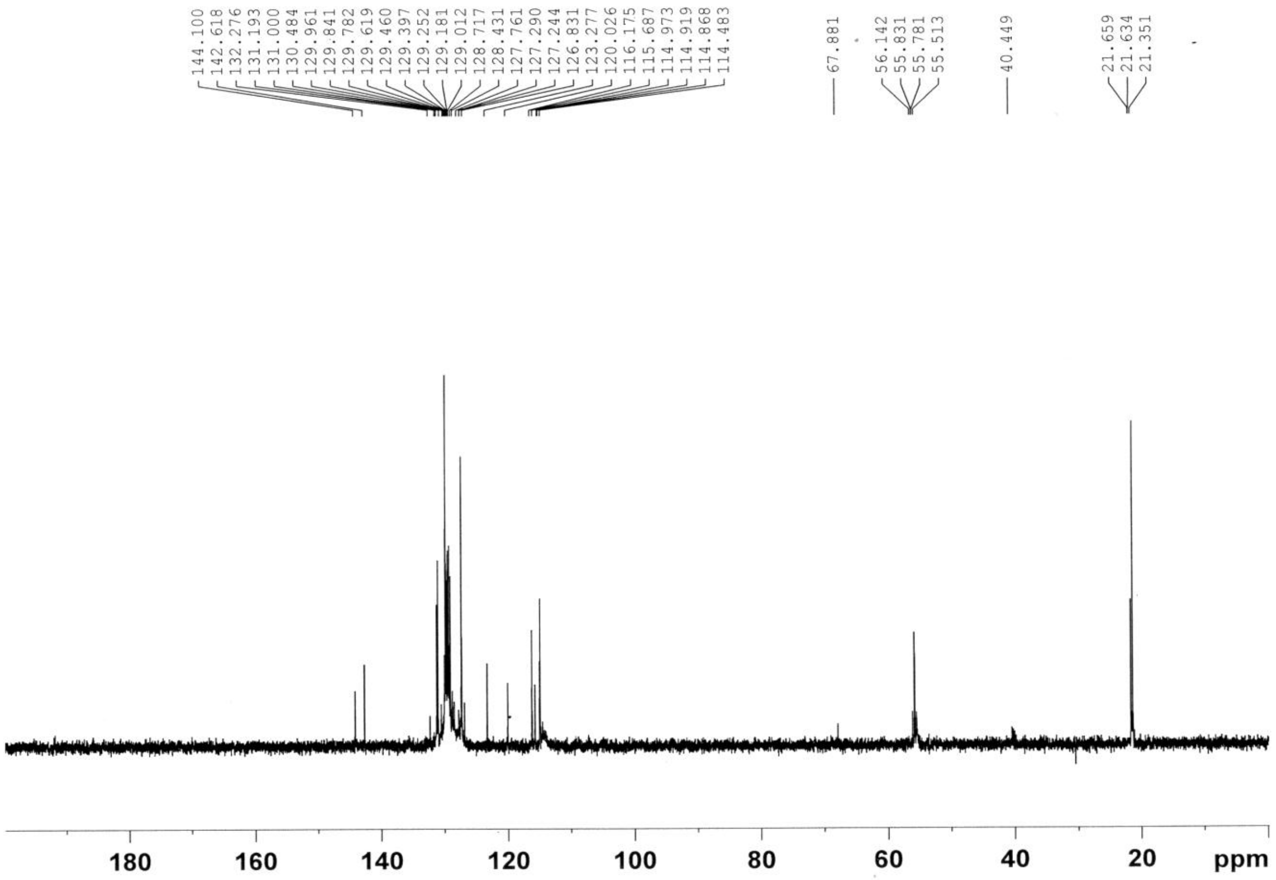


Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_07, 13C
Operated by: Md. Emdad Hossain, Scientist

```
Current Data Parameters
NAME              DU_TA_07
EXPNO                    2
PROCNO                   1

F2 - Acquisition Parameters
Date_             20190827
Time_                12.00
INSTRUM              spect
PROBHD   5 mm PABBO BB/
PULPROG               zgpg
TD                  524288
SOLVENT               DMSO
NS                     512
DS                       0
SWH              25252.525 Hz
FIDRES            0.048165 Hz
AQ              10.3809023 sec
RG                   208.5
DW                  19.800 usec
DE                    6.50 usec
TE                   300.3 K
D1              1.00000000 sec
D11             0.03000000 sec
TD0                      1

======== CHANNEL f1 ========
SFO1           100.6479778 MHz
NUC1                   13C
P1                   10.00 usec
PLW1           49.00000000 W

======== CHANNEL f2 ========
SFO2           400.2320011 MHz
NUC2                    1H
CPDPRG[2           waltz16
PCPD2                90.00 usec
PLW2           12.00000000 W
PLW12           0.18584000 W
PLW13           0.15053000 W

F2 - Processing parameters
SI                 1048576
SF             100.6379135 MHz
WDW                     EM
SSB      0
LB                    0.30 Hz
GB       0
PC                    1.40
```

Figure - 52 The ^{13}C NMR of the compound 73

Wazed Miah Science Research Centre (WMSRC)
Jahangirnagar University
Sample: TA_07, dept-135
Operated by: Md. Emdad Hossain, Scientist



```
Current Data Parameters
NAME             DU_TA_07
EXPNO                   3
PROCNO                  1

F2 - Acquisition Parameters
Date_            20190827
Time                12.21
INSTRUM             spect
PROBHD   5 mm PABBO BB/
PULPROG        deptsp135
TD                  65536
SOLVENT              DMSO
NS                    512
DS                      8
SWH             25252.525 Hz
FIDRES           0.385323 Hz
AQ              1.2976128 sec
RG                  208.5
DW                 19.800 usec
DE                   6.50 usec
TE                  299.6 K
CNST2         145.0000000
D1             1.00000000 sec
D2             0.00344828 sec
D12            0.00002000 sec
TD0                     1

======== CHANNEL f1 ========
SFO1         100.6479773 MHz
NUC1                 13C
P1                 10.00 usec
P13              2000.00 usec
PLW0       0 W
PLW1         49.00000000 W
SPNAM[5]     Crp60comp.4
SPOAL5             0.500
SPOFFS5    0 Hz
SPW5          7.48659992 W

======== CHANNEL f2 ========
SFO2         400.2320011 MHz
NUC2                  1H
CPDPRG[2          waltz16
P3                 11.20 usec
P4                 22.40 usec
PCPD2              90.00 usec
PLW2         12.00000000 W
PLW12         0.18584000 W

F2 - Processing parameters
SI                  32768
SF           100.6379135 MHz
WDW                    EM
SSB        0
LB                   1.00 Hz
GB         0
PC                   1.40
```

Figure- 53 DEPT of the compound 73

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