Synthesis and Characterization of Novel 1,3-Oxazepines Derived from Diamic Acid : N,N¯-Bis-(4-methyl phenyl) pyromellitamic Diacid

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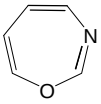
Abstract

The symmetrical N,N¯-Bis-(4-methyl phenyl) pyromellitamic diacid (I) was synthesized from the reaction of toludine with pyromellitic dianhydride in dry acetone. Esterification of amic acid (I) with dimethyl sulphate in basic medium using acetone as a solvent give symmetrical N,N¯-bis-(4- methyl phenyl) pyromellitam diacetate (II). The condensation of new ester with hydrazine hydrate in ethanol leads to the formation symmetrical N,N¯-bis- **(**4-methyl phenyl) pyromellitamic hydrazide (III). New symmetrical 1,3-oxazepine derivatives $(V)_{a-e}$ can be synthesized from the reaction of the new synthesized Schiff bases $(III)_{a-e}$ (which are synthesized from the reaction new hydrazide (II) with different aromatic aldehyde) with naphthalic anhydride in dry benzene . The synthesized compounds have been characterized by their melting points and by their spectral data, FTIR and ^{1}HNMR spectroscopy of compound $(V)_c$.

Key words: 1,3-Oxazepines, Schiff bases, hydrazides, Easters

Introduction

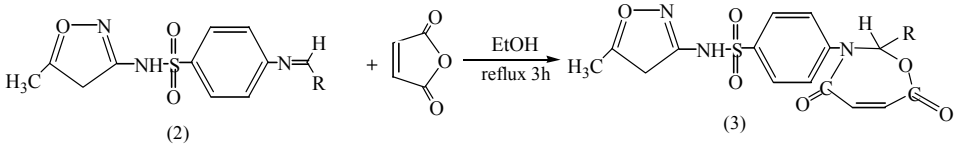
1,3 –oxazepine (1) is a seven member ring compound with two hetero atoms, oxygen atom at position (1) and nitrogen atom at position (3).



(1)

Oxazepine derivatives showed various biological activities [1,2] Also, oxazepine derivatives are used in another applied fields [3] .

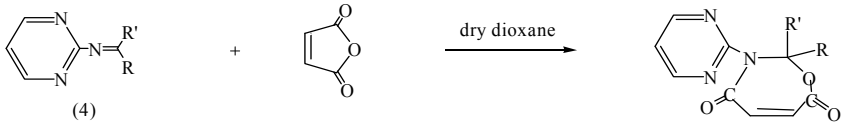
1,3 oxazepines (3) synthesized from the reaction of compound (2) with maleic anhydride in EtOH as a solvent [4] .



(2) (3)

R=HCOH , -CH=CH-CH3 , Ph , -Ph-Br ,4-(CH3)2-Ph or -H

In addition , 2-disubstituted -3 - (pyrimidine -2-yl)-1,3-dihydro-1,3-oxazepine -4,7diones (5) were synthesized from condensation of compound (4) with malice anhydride in dry dioxane as a solvent [5] .

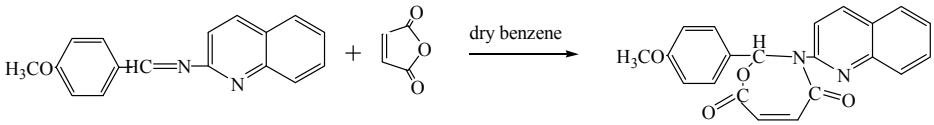


(4) (5)

R= , , or

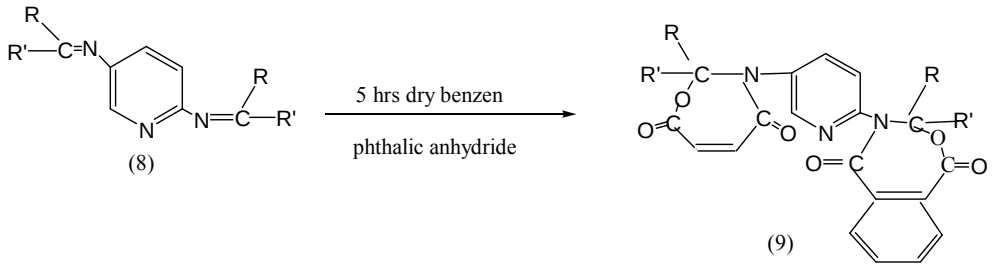
R'= , or H

Recently, Al-Jamali et. al [6] synthesized 2-(p- methoxy phenyl) -2,3-(quinolone) -[1,3]-oxazpine -4,7 dione (7) from reflux of Schiff base (6) with malice anhydride in dry benzene .



(6) (7)

More recently S. Al- Zobaydi et .al [7] synthesized a new oxazepines (9) from reaction of Schiff bases (8) with phthalic anhydride in dry benzene.



(8) (9)

According to above facts , we decided to synthesize a new symmetrical Schiff bases and thier novel 1,3-oxazepine derivatives.

Experimental

Materials

All the chemicals were supplied from Merck , GCC and Aldrich Chemicals Co. and used as received .

Techniques

FTIR spectra were recorded using potassium bromide discs on a FTIR spectrophotometer , Shimadzo (Ir prestige-21) . ^{1}HNMR spectrum was carried out by company : Bruker , model: ultra shield 300 MHz , origin : Switzerland and are reported in ppm(δ), DMSO was used as a solvent with TMS as an internal standard . Measurements were made at Chemistry Department, Al-albyat University , Uncorrected melting points were determined by using Hot-Stage, Gallen Kamp melting point apparatus.

General procedure

Compounds $(IV)_{a-e}$ and $(V)_{a-e}$were synthesized according to Scheme 1.

Synthesis of symmetrical diamic acid N,N⁻-Bis-(4-methyl phenyl) pyromellitamic diacid (I) .

To a solution of pyromellitic dianhydride (0.218g, 0.001mole) in (15mL) acetone , a solution of 4-toludine (0.214g, 0.002 mole) in (15mL) acetone was added dropwise during one hour, the mixture was then left at room temperature with continuous stirring for 24 hrs [8], the pale yellow product was then filtered off and recrystallized from acetone to give the a corresponding pyromellitamic diacid (I) . yield 76% , mp > 300^{o} C.

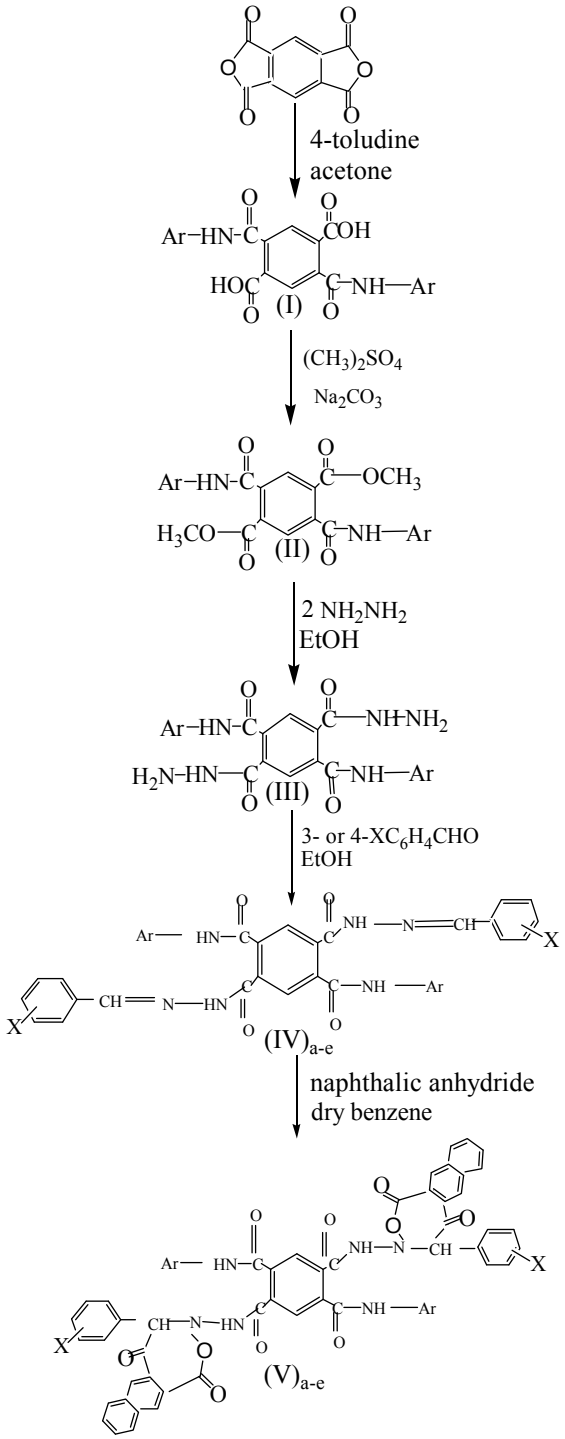
Synthesis of symmetrical N,N⁻-bis-(4-methyl phenyl) pyromellitam diacetate (II).

A mixture of compound $(I)_{a-c}$ (4.3 g, 0.01mole) and anhydrous sodium carbonate (1.8g, 0.02 mole) was dissolved in 20mL of acetone , to this solution (0.02 mole) of dimethyl sulphate was added . After 20 min , the resulting mixture was heated under reflux for 4 hrs. The reaction mixture was allowed to cool down to room temperature, extraction with chloroform[9]. The yellow oily product was collected by evaporating the chloroform to give compound (II) . yield 65% , mp = 180-181^{o} C.

Synthesis of symmetrical N,N⁻-bis-(4-methyl phenyl) pyromellitamic hydrazide (III)

A solution of ester compounds (II) (4.6g, 0.01 mole) and hydrazine hydrate (15mL) in 25 mL of ethanol was heated under reflex for 2 hrs , the mixture was then cooled to room

temperature, and the obtained solid was filtered and recrystallized from ethanol[10] .The physical properties data of new yellow hydrazide compound (III) , yield 80% , mp =228-230 ^{o} C.



Ar= 4-MeC_6H_4- ; X= 3-NO_2, 4-Cl , 4-Br, 4-OH or 4-OCH_3

Scheme 1

Synthesis of symmetrical new Schiff bases. $(IV)_{a-e}$.

A mixture of new acid hydrazide (III) (0.46g, 0.001 mole) , different aromatic aldehyde (0.002 mole) , ethanol absolute (3 mL) was heated to reflux for 4hrs[6] . Then the mixture was cooled to room temperature , and the solid obtained was filtered and recrystallized from ethanol .The physical data of new Schiff bases are listed in Table (1).

Synthesis of symmetrical novel 1,3-oxazepine derivatives $(V)_{a-e}$.

A mixture of synthesized Schiff bases (0.001mole) and naphthalic anhydride (0.296g ,0.002 mole) in dry benzene 5mL was refluxed for 6 hrs. The solvent was removed and the resulting colored crystalline solid was recrystallized from 1,4-dioxane to obtain new 1,3-oxazipenes . The physical data for all synthesized 1,3-oxazepines are given in Table (2) .

Results and Discussion

N,N¯-Bis-(4-methyl phenyl) pyromellitamic diacid (I) was synthesized by the reaction of one mole of pyromellitic dianhydride with two moles of toluedine in acetone as a solvent.

The structure of amic acid was studied by it′s melting point and FTIR spectroscopy . FTIR spectrum showed the disappearance of absorption bands of NH_2 group and other peaks characterized of cyclic anhydride of the starting materials together with the appearance of new absorption stretching bands due to O-H of carboxylic moiety in the region (3292-2546) cm^{-1}, a stretching band of carboxylic acid (C=O) appeared 1701 cm^{-1} , a stretching band of N-H group appeared at 3257 cm^{-1} . While a stretching band which is appeared at 1653cm^{-1} could be attributed to amid group(C=O) . Also the FTIR spectrum exhibited new absorption bands in the region 2922-2868 cm^{-1} due to C-H aliphatic group[11] .

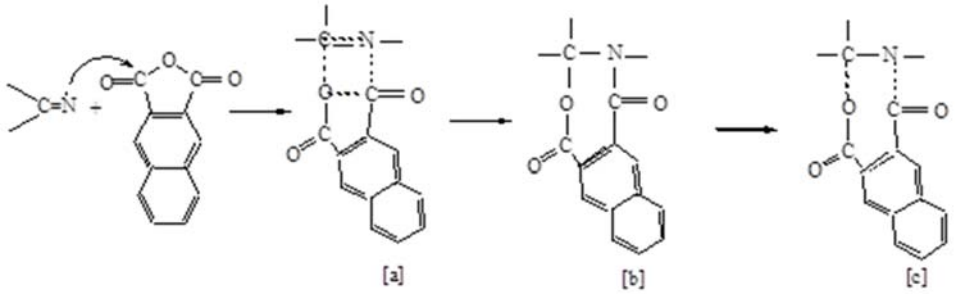
The esterification of N,N¯-Bis-(4-methylphenyl) pyromellitamic diacid using dimethyl sulphate in presence of anhydrous sodium carbonate in dry acetone to get the corresponding esters. The ester compound (II) was charecteized by their melting point and FTIR sprcetroscopy . The FTIR spectrum showed a new absorption band at 1728 cm^{-1} due to stretching vibration of the (C=O) for ester , also the appearance of a new band at 1199 cm^{-1} due to (C-O) of ester , besides to the disappearance of two bands of O-H and C=O of carboxylic moiety [12].

The acid hydrazide (III) was synthesized by the reaction of compounds [II]with hydrazine hydrate in ethanol . This compound was characterized by its melting point and FTIR spectrum which was showed new absorption bands in the region (3327- 3217) cm^{-1} due to the (NH and NH_2) groups and new stretching vibration band due to (C=O) of amide group at 1631 cm^{-1} for hydrazide moiety .

The new Schiff bases $(IV)_{a-e}$ were synthesized by condensation of one mole of acid hydrazide (III) with two moles of different aromatic aldehyde in ethanol . These compounds were identified by their melting points , FTIR and ^{1}HNMR spectrum of compound $(IV)_c$. FTIR absorption-spectra which showed the disappearance of absorption bands due to NH_2 group together with appearance of new absorption band in the region (1645-1608) cm^{-1} which is assigned to imine group (C=N) stretching. The other FTIR data of functional groups which are characteristic of these compounds are given in Table 3.

The new 1,3-oxazepine derivatives $(V)_{a-e}$ were synthesized by refluxing one mole of compounds (IV) with two moles of naphthalic anhydride in dry benzene.

The mechanism involves the addition of one σ bond of C-O group to π-bond (N=C) to give 4-membered cyclic ring and 5-membered cyclic ring of naphthalic anhydride in the same transition state $[T.S]_a$, which opens into phthalic anhydride to give 7-membered cyclic ring (C). The mechanism of this reaction [13] may be outlined as follows in Scheme (2).



Scheme 2

The characteristic FTIR absorption bands of these compounds were confirmed from the disappearance of stretching band due to C=N of Schiff bases and other peaks characterized of cyclic anhydride of the starting materials with appearance of two bands characteristic of two carbonyl groups of oxazepine ring. The FTIR spectral data of new oxazepine compounds are listed in Table 4. The ^{1}HNMR spectrum of compound $(V)_c$, Figure 1 showed aromatic protons , C-H protons of oxazepine rings[14] and protons of N-H group of CONHAr moiety appear as triplet ,doublet and singlet signals in the region δ(7.13 – 8.99) ppm and the NH protons of CONH-Hetrocyclic moiety appear at δ 3.09ppm [15]. A good sharp singlet signal at δ 1.05ppm due to protons of two CH_3 groups .

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Table No.(1): The physical properties of new Schiff bases[IV]

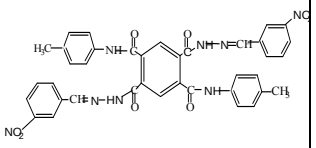
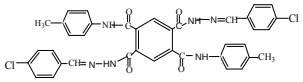
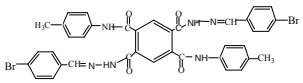
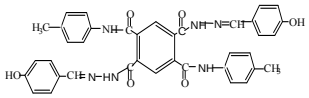
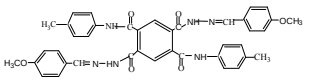
Comp. No.	Nomenclature	Structural formula	Molecuar formula	M. P ^0C	Yield %	Color
[IV]a	Bis[N,N′-(4-methyl phenyl)-2,2′-(3″-nitrophenyl) benzylidene amino]pyromellit diamid		C_{38} H_{30} N_8O_8	192-194	86	Glow yellow
[IV]b	Bis[N,N′-(4-chlorol phenyl)-2,2′-(4″-nitrophenyl) benzylidene amino]pyromellit diamid		$C_{38}H_{30}$ $N_6O_4Cl_2$	>290	83	Pale yellow
[IV]c	Bis[N,N′-(4-bromo phenyl)-2,2′-(4″-nitrophenyl) benzylidene amino]pyromellit diamid		$C_{38}H_{30}N_6$ O_4 Br_2	218-220	87	Yellow
[IV]d	Bis[N,N′-(4-hydr- oxy phenyl)-2,2′-(4″-nitrophenyl) benzylidene amino]pyromellit diamid		$C_{38}H_{32}$ N_6 O_6	250-252	78	Orange yellow
[IV]e	Bis[N,N′-(4-meth- oxy phenyl)-2,2′-(4″-nitrophenyl) benzylidene amino]pyromellit diamid		C_{40} H_{36} N_6 O_6	160-162	81	yellow

Table No.(2): The physical properties of new 1,3-oxazepines [V].

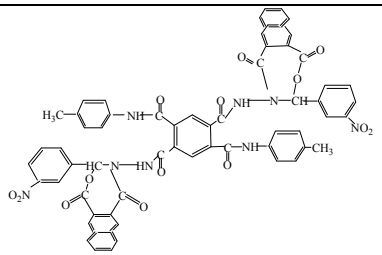
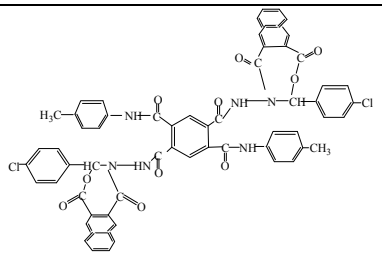
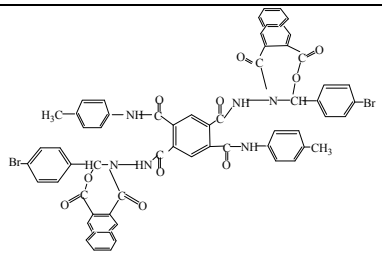
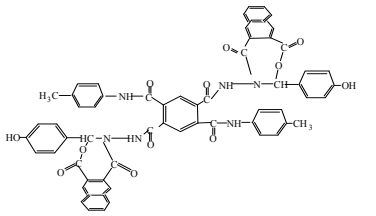
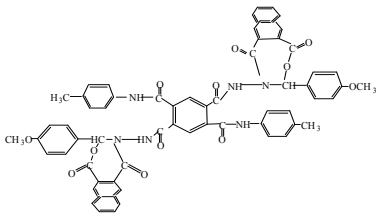
Comp. No.	Nomenclature	Structural formula	Molecuar formula	M. P ^{0}C	Yield %	Color
$[V]_a$	Bis [N,N′- [(4-methylphenyl)-2,2′-(3″-methoxy phenyl)(2,3-dihydro-naphth[1,2e]1,3-oxazepin -4,7-diones-3-yl)] pyromellit diamide		C_{62} H $_{42}$ N_8 O_{14}	184-185	79	Dark yellow
$[V]_b$	Bis [N,N′- [(4-methyl phenyl)-2,2′-(4″-chloro phenyl)-(2,3-dihydro-naphth[1,2e]1,3-oxazepin -4,7-diones-3-yl)] pyromellit diamide		C $_{62}$ H_{42} N_6 O_{10} Cl_2	207-208	78	Dark yellow
$[V]_c$	Bis [N,N′- [(4-methyl phenyl)-2,2′-(4″-bromo phenyl)-(2,3-dihydro-naphth[1,2e]1,3-oxazepin -4,7-diones-3-yl)] pyromellit diamide		C_{62} H_{42} N_6 O_{10} Br_2	207-208	81	Dark yellow
$[V]_d$	Bis [N,N′- [(4-methyl phenyl)-2,2′-(4″-hydroxy phenyl)-(2,3-dihydro-naphth[1,2e]1,3-oxazepin -4,7-diones-3-yl)] pyromellit diamide		$C_{62}H_{44}$ N_6 O_{12}	234-235	80	Pale orange
$[V]_e$	Bis [N,N′- [(4-methyl phenyl)-2,2′-(4″-methoxy phenyl)-(2,3-dihydro-naphth[1,2e]1,3-oxazepin -4,7-diones-3-yl)] pyromellit diamide		$C_{64}H_{48}$ N_6 O_{12}	165-166	83	Dark yellow

Table No.(3):Characteristic FTIR absorption bands of new schiff bases compounds[IV]$_{ae}$.

Comp. No.	Characteristic bands FTIR spectra(cm^{-1})				
	υ (NH)	υ (C-H)aliph.	υ (C=O) Lacton, lactam	υ (C=O) amide	υ (C=C)
[V]$_a$	3464	2924-2852	1770,1735	1660,1625	1589
[V]$_b$	3203	2910-2860	1770,1741	1654,1640	1586
[V]$_c$	3421	2939-2852	1770,1734	1668,1625	1583
[V]$_d$	3468	2899-2829	1772,1736	1654,1645	1600
[V]$_e$	3446	2944-2850	1772,1735	1645,1622	1602

Table No.(4): Characteristic FTIR absorption bands of 1,3 oxazepine[V].

Comp. No.	Characteristic bands FTIR spectra(cm^{-1})					
	υ (NH)	υ (C-H) arom.	υ (C=O) amide	υ (C=N)	υ (C=C)	other
[IV]$_a$	3450-3423	3005	1660,1625	1645	1585	NO2:1527,1307
[IV]$_b$	3286-3215	3014	1654,1635	1609	1600	C-Cl: 940
[IV]$_c$	3442-3430	3059	1668,1653	1640	1583	C-Br: 619
[IV]$_d$	3485-3470	3030	1654,1630	1608	1597	O-H: 3305
[IV]$_e$	3462-3420	3020	1645,1628	1620	1602	C-O: 1251

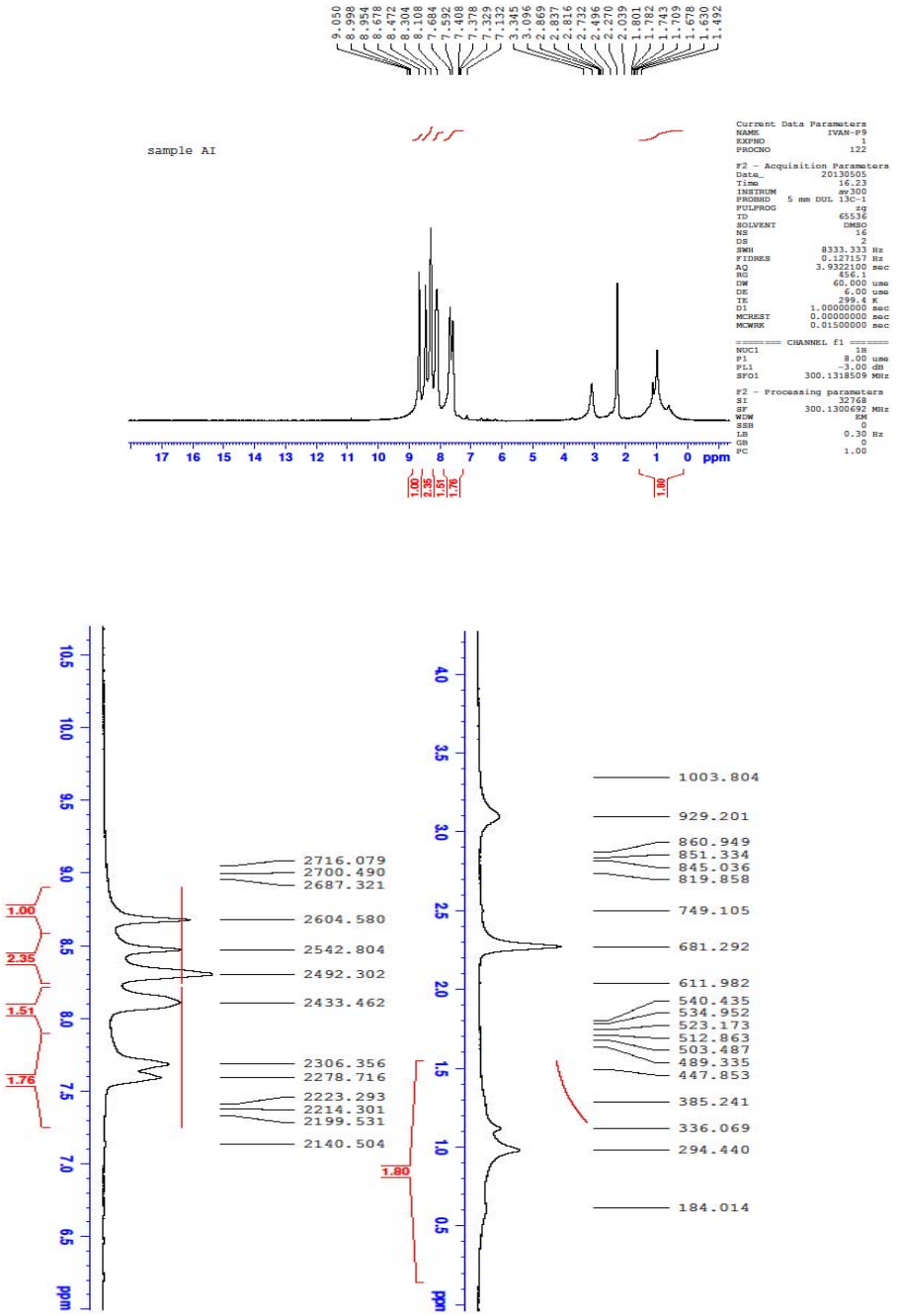


Figure No.(1): 1H-NMR spectra of compound [V]c

تحضير وتشخيص مركبات 3,1-اوكسازبين جديدة مشتقة من حامض ثنائي الاميك : بس-(4- مثيل فنيل)بايرومالتاميك ثنائي الحامض

شيماء عبد سعود حميد
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استلم البحث في: 3 اذار 2014 ,قبل البحث في:22 حزيران2014

الخلاصة

N,N′- بس-(4- مثيل فنيل)بايرومالتاميك ثنائي الحامض [I] حضر من تفاعل 4-توليدين مع بايرومالتيك ثنائي الانهيدرايد في الاسيتون الجاف. تمت استرة حامض الاميك مع داي مثيل سلفيت و كاربونات الصوديوم اللامائية في الاسيتون بوصفه مذيبا للحصول على المركبN,N′-بس-(4-مثيل فنيل)بايرومالتام ثنائي اسيتيت[II] . ومن تكاثف هذا الاستر مع الهيدرازين المائي في الايثانول ينتج المركب الجديد -N,N′-بس-(4-مثيل فنيل)بايرومالتاميك هيدرازايد**[III]** .حضرت مركبات جديدة من 3,1-اوكسازبين [V]a-e من تفاعل مركبات الشف الجديدة [VIII] a-e (التي حضرت من تفاعل الهيدرازايد[III] مع الالديهايدات الاروماتية المتنوعة) مع فثاللك انهيدرايد في البنزين الجاف . شخصت جميع المركبات المحضرة اعلاه ودرست من خلال قياس درجة الانصهار لها واطياف الاشعة تحت الحمراء وطيف الرنين النووي المغناطيسي للبعض منها .

الكلمات المفتاحية: 3,1-اوكسازبين , قواعد شف , هيدرازيد , استرات.