Open Access
Baghdad Science Journal **Vol.13(1)2016**

DOI: http://dx.doi.org/10.21123/bsj.2016.13.1.0089

Synthesis and Characterization of 3 - Substituted Coumarin

Shatha F. Al- Zobaydi ***Kawther Abdu Al-Hammed***
Ban Dha. Ismael

Department of Chemistry, College of Science for Women, University of Baghdad.

E-mail:shetha_alzubaidy@yahoo.com

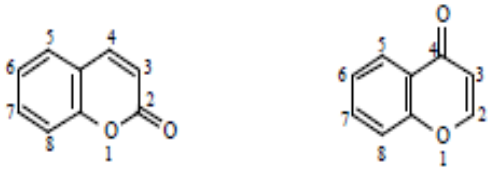
Received 12, November, 2014
Accepted 28, June, 2015

Abstract:

The reaction of(2-oxo-2H-chromen-3-Carbonyl chloride)(k_1) with hydrazine in boiling ethanol gives the hydrazide(K_2).When compound (k_2) reacts with various aromatic aldehydes ,the corres ponding Schiff bases(k_3–k_4) achieve new series of thiazotidines (k_5–k_6) and azetidinones (k_7–k_8) obtained from the reactions of appropriate Schiff bases with mercapto acetic acid and chloro acetyl chloride respectively. All the compounds are characterized by FT-IR,^{1}H-NMR and GC-Ms.

Key words: Schiff bases, Thazotidinone, Azetidinone.

Introduction:



Scheme (1)

Coumarin exists in two figures as seen in scheme[1]. Coumarin is firstly synthesized by the chemist Perkin in 1868 in a reaction known as the perkin reaction .Coumarou is a French term for the tonka bean, one of the sources from which Coumarin was dissociated as a natural product in 1820.It has a junket odor, readily acclaimed as the scent of new-mown thatch, and been used since 1882 . Sweet woodruff , sweet cannabis and sweet-trefoil in particular are named for their sweet smell, which in turn is due to their high Coumarin contextual.When it happen in high concentrations in fodder plants , Coumarin is a somewhat bitter-palate appetite oppressor ,and to be produced by plants as chemical defending to dissuade predation [2].Also was isolated (Hermiain) from the Matricaria plant and in disembodies of justicia pectorlis [3,4].

The Coumarins were found in the enzyme by a gene type that has glucose activities with many trivets including Coumarins[5]. Coumarin has different characteristics in plants may detract the impact of grazing animals. The compound has sweet perfume, it has an astringent savour, which animals birl to avoid it[6], so it should be avoided in alginate food type for animals. Coumarins have shown catalogs of some biological

activities, were recognized for few medical needs as pharmaceuticals. They are used as an anticarcinogenic agent and in treatment of edema and asthma[7] .

Materials and Methods:

Melting points are determined by the capillary tube method.The FT-IR spectra are recorded on FT-IR spectrophotometer, Shimadzu in Ibn Siena Company–Ministry of Industry and Metals, The GC-Ms spectra are recorded on GC-MS spectrophotometer in college of Science \ Al-Mustansaryia University.

Experimental:

1- Synthesis of Coumarin-3-CarboxylicAcid (k)

A mixture of salicylaldehyde (0.001mol) with Malonic acid (0.001mol) in Petroleum ether (25 ml),(4-6) drops of aniline are added, as shown in Scheme (1). The result mixture refluxes for (8 hs.) and (5-7) drops of glacial acetic acid are added. At the end of the reaction, the solid formed, filtered and washed twice by Petroleum ether, then it is re-crystallized from Chloroform[8]. The Physical properties of (k) are listed on Table (1).

2- Synthesis of 2-OXO-2H-Chromen-3-Carbonyl Chlorid (k1)

Thionyl chloride (3ml) was added to the compound (k)(0.01mol) and then dissolved in dry dichloride methane (25ml) then refluxed for (6hs.).The excess of thionyl chloride the evaporates under vacuum and the solid formed is dried and used for the next step[9] as shown in Scheme (3).The Physical properties of (k1) are found in Table (1).

3- Synthesis of 2-OXO-2H-Chromen-3-Carbonyl Hydrazide (K2)

Hydrazine hydrate (2-3 ml) is added to the (0.01mol) of the compound (k1) found in absolute ethanol (10ml), then refluxed for (4hs.). After that the formed solid was cooling and filtered then re-crystallized from (methanol: ethyl acetate) (1:1) [10]. The physical properties of (K2) are listed on Table (1).

4- Synthesis of Schiff Bases (k3-k4)

Equinoxes of compound (K2) (0.001mol) with 4-NO_2 Benzaldehyde (2-OH Benzaldehyde) (0.001mol) was dissolved in (15ml) ethanol absolute to the resultant mixture .Drops (4-5) of glacial acetic acid are added and the mixture was refluxed for (4hs.).The result refluxed for (4hs.). After completing the reaction, the solid formed is filtered[11] and re-crystallized from suitable solvent, as shown in Scheme (3).The physical properties of (k3-k4) compounds are listed on Table (1).

5-Synthesis of β-Lactam Compounds

A- Synthesis of β-Lactam compounds (thazotidinone)(k5-k8)

A Schiff bases mixture (k3-k4) (0.01mol) in (15 ml) of dry benzene and mercapto acetic acid (0.01mol) are dissolved in (10 ml) of dry benzene too, the mixture is refluxed for (10 hs.) in water bath because the reaction is thermoproductive [12].The separated solid is filtered, dried and re-crystallized from the solvent ethyl acetate, as shown in Scheme (4).The physical properties of thazotidinone compounds are listed on Table (1).

B- Synthesis of β-Lactam Compounds (Azetidinone) (k6-k7)

A mixture of Schiff bases (k3-k4) (0.03mol) in (10 ml) of dioxane as a solvent and chloro acetyl chloride (0.006 mol) is dissolved in (10 ml) of

dioxane ,then its refluxed for (20 hs.) in water bath during the first time of refluxing and adding (5-6) drops of triethylamine . The reaction with thionyl chloride may be catalyzed by dichloromethane. In this reaction, the sulfur dioxide (SO2) and (HCl) are generated as gases can leave the reaction container, driving the reaction forward. Excess thionyl chloride (b.p.74.6°C) is easily evaporated as well as shown in Scheme(5). The separated solid is pushed in an ice bath then filtered, washed by water and dried,then re-crystallized by ethyl acetat [13].The Physical properties of azetidinone compounds are found on Table (1).

Results and Discussion:

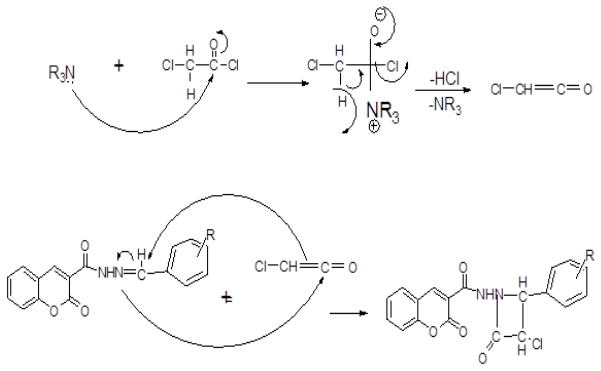
The spectrum FT- IR for the compound (k),as seen in Figure (1) shows characteristics of the absorption bands at (1681) cm1, due to the vibration of carbonyl group (C=O) for the acid and absorption broad band shows at (3390) cm^{-1} which as a signal to hydroxyl group as seen in Table (2).Compound (k1) is prepared from the reacting of compound (k) with thionyl chloride. The spectrum FT-IR of the compound (k1) as seen in Figure (2) has shown the absorption bands at (1774) cm1 due to the (C=O) carbonyle chloride, whereas the vibration due to hydroxyle group (OH) disappeares. Furthermore, the absorption band at(775) cm1 due to the (C-Cl) band, as seen in Table (2).

Compound (k2) is prepared when (k1) reacts with hydrazine 99 %.The spectrum FT-IR of the compound (k2) in Figure (3) shows the absorption bands for symmetric and asymmetric (NH2) at (3394-3448) cm^{-1} with the appearance of the amide group (NH) absorption band at (3167cm^{-1}), as shown on Table(2). The GC-MS spectrum of (K2) in Figure (9) , gives many bands one of them in (204amu)for proposed compound that matches the moleculers weight for (C10H8N2O3) (K2).

Schiff bases (k3-k4) are prepared when the (K2) reacts with two kinds of aromatic aldehyde (P-nitro benzaldehyd) and (o–Hydroxyl benzaldehyd). The FT-IR spectra in Figure (4) for (k3) and Figure (5) for (k4), showed the absorption bands for imine group (-N=C-) at (1627-1624) cm^{-1} with the disappearance of the absorption bands due to symmetric and asymmetric for (NH2) group,as shown in Table (2).

The 1H-NMR spectrum of(k3)in Figure (10) was showed the following signal found on Table(3).The thazotidinone compounds (k5, k8) are synthesized when the compound (k3, k4) reacts with mercapto acetic acid. The FT-IR spectrum of the compounds (K5) and (k8) in Figure (8) showed disappearance of the absorption band to imine group (-N=C-) with occuranate bsorption band to (C-S-C) in (825cm^{-1}) for (k5), absorption bands. (C-S-C) we sew in (771 cm^{-1}) for (k8) than we sew that in Table (2).

The azetidinone compounds (k6 and k7) are synthesized when (k3 and k4) reacts with Color acetic chloride as a triethylamine found as the catalyst, the FT-IR spectrum of the compound (K6) in Figure (7). The absorption bands of (C=O) for imides' we see it in (1624 cm^{-1}) , shows in Figure (6) and the compound (k7) the absorption bands to (C=O) for imides we see it in (1620cm^{-1}) in Table(2). The mechanism of this reaction[14] in Scheme (2):



Scheme (2)

Table (1) Physical Properties and Structures of Compounds

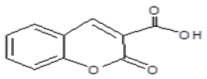
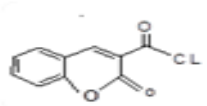
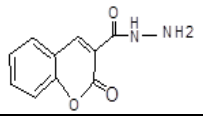
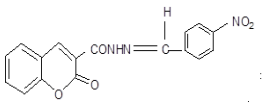
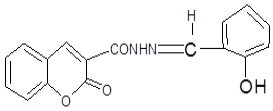
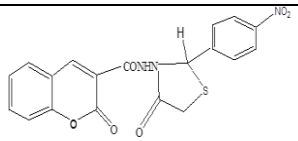
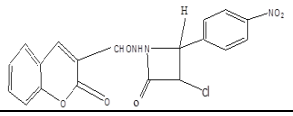
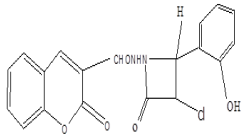
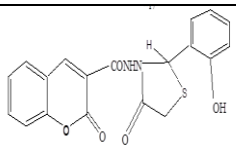
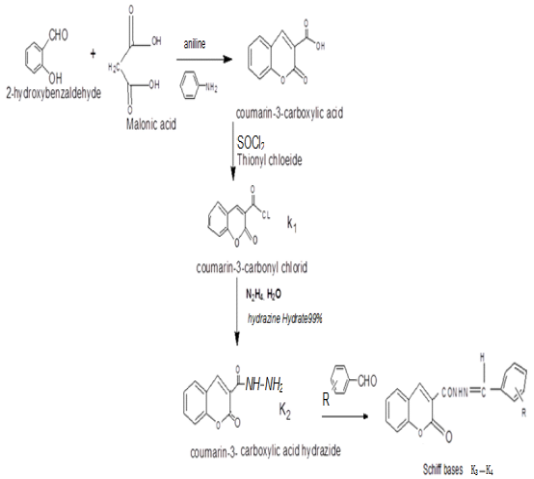
Comp No.	Stractures	m.p^{0}c	Yield %	Color	Recry.solvent.
K		**184-186**	**85**	**White**	**Chloroform**
K_1		**132 -134**	**83**	**Pale brown**	----------
K_2		**204-206**	**88**	**Green yellow**	**Methnol: Ethyl actate) (1:1)**
K_3		**173-174**	**69**	**yellow**	**benzene**
K_4		**125-128**	**87**	**yellow**	**Chloroform : water (1:1)**
K_5		**150-152**	**48**	**Deep yellow**	**Ethyl Actate**
K_6		**112-115**	**63**	**Green yellow**	**-**
K_7		**120-122**	**66**	**Pale brown**	**Ethanol :water (1:1)**
K_8		**110-114**	**63**	**Pale brown**	**-**

Table (2) Spectral FT-IR for Compounds

Com. No.	Comp. Name	Major FTIR Absorption cm^{-1}				
		C = O	C = O	NH	N=C	Others
K	2-OXO-2H-Chromene-3-carboxylic acid	Acid 1681	Lactone 1743			OH 3390 broad
K_1	2-oxo-2H-chromen- 3- carbonyl chloride	Chloride 1774	Lactone 1732			C-O-C 1288
K_2	2-oxo-2H-chromen- 3- carbonyl hydrazine	Amide 1627	Lactone 1701	3167		NH_2))v sym.-a sym. 3394-3448
K_3	N'-(4-nitrobenzylidene)-2-oxo-2H-chromene-3-carbohydrazide	Amide 1672	Lactone 1701	3267	1627	NO_2))v sym. -asym. 1346-1438
K_4	N'-(2-hydroxybenzylidene)-2-oxo-2H-chromene-3-carbohydrazide	Amide 1624	Lactone 1705	3271	1612	(OH)v 3398
K_5	N'-(but-1-en-2-yl)-N'-(1-(4-nitrophenyl)ethyl)-2-oxo-2H-chromene-3-carbohydrazide	Amide 1630	Lactone 1710 Imide 1700	3225		(C-S-C)v 825
K_6	N-(3-chloro-2-(2-hydroxyphenyl)-4-methyleneazetidin-1-yl)-2-oxo-2H-chromene-3-carboxamide	Amide 1612	Lactone 1701 Imide 1624	3398		NO_2))v sym.-asym. 1364-1438 (C-Cl)v 744
K_7	N-(3-chloro-2-methylene-4-(4-nitrophenyl)azetidin-1-yl)-2-oxo-2H-chromene-3-carboxamide	Amide 1600	1735 1620	3271		OH))v 3429 (C-Cl)v 767
K_8	N'-(but-1-en-2-yl)-N'-(1-(2-hydroxyphenyl)ethyl)-2-oxo-2H-chromene-3-carbohydrazideP	Amide 1604	Lactone 1701 Imide 1593	3414		(OH)v 3446 C-S))v 771

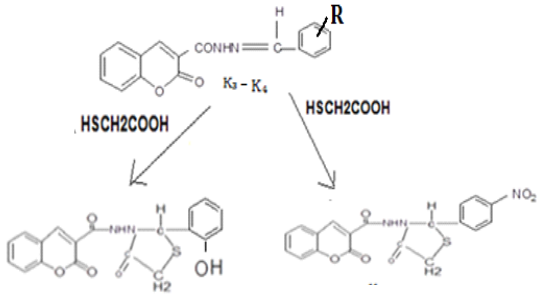
Table (3) Spectral 1H-NMR

Com. No.	OH-^{1}H	NH-^{1}H	=C-H-^{1}H	C-H(ring)-^{1}H
K_3	----	10.9	3.3	7.9-8.6
K_4	9.10	11.17	-----	6.7-8.8



R = p-NO2 , o-OH

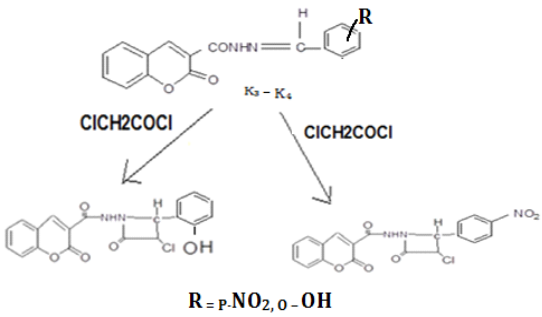
Scheme (3)



$R = p\text{-}NO_2, o\text{-}OH$

K8 K5

Scheme (4)



$R = p\text{-}NO_2, o\text{-}OH$

K6 K7

Scheme (5)

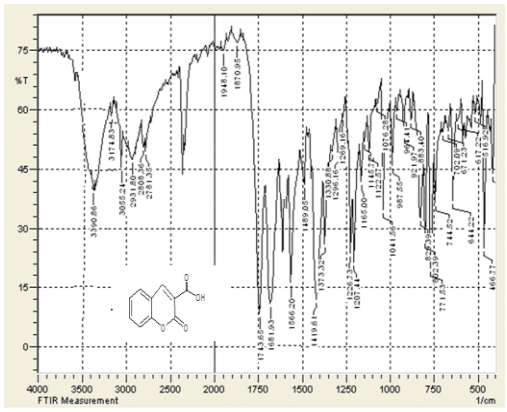


Fig.(1) FT- IR Spectrum for Compound (K)

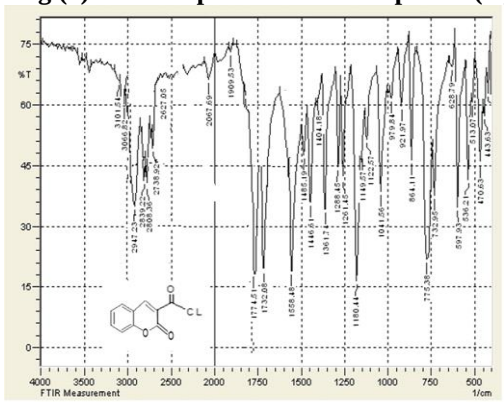


Fig. (2) FT- IR Spectrum for Compound (K1)

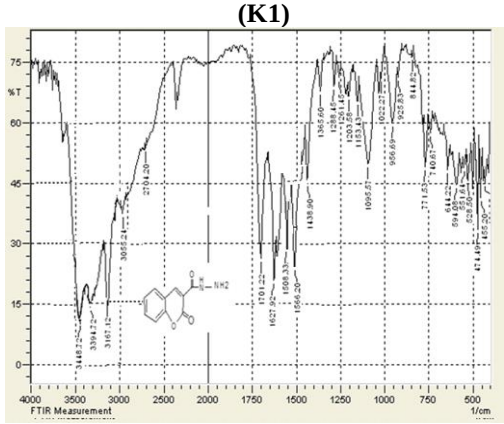


Fig. (3) FT-IR Spectrum for Compound (K2)

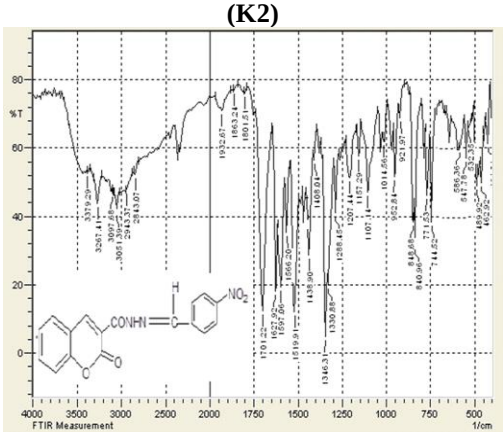


Fig. (4)FT-IR Spectrum for Compound (K3)

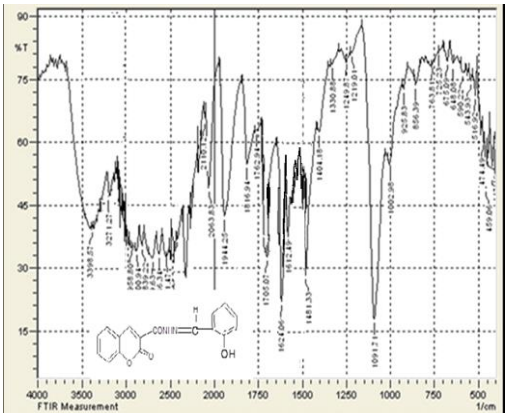


Fig. (5) FT-IR Spectrum for Compound (K4)

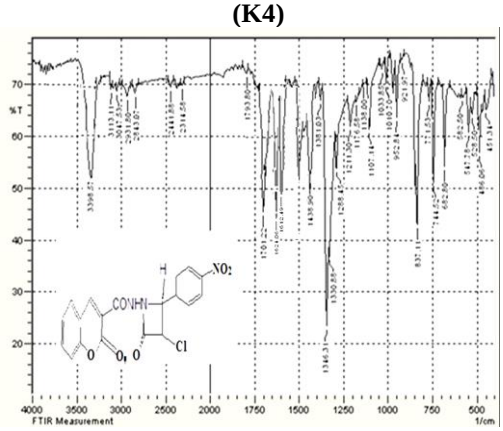


Fig. (6) FT-IR Spectrum for Compound (K6)

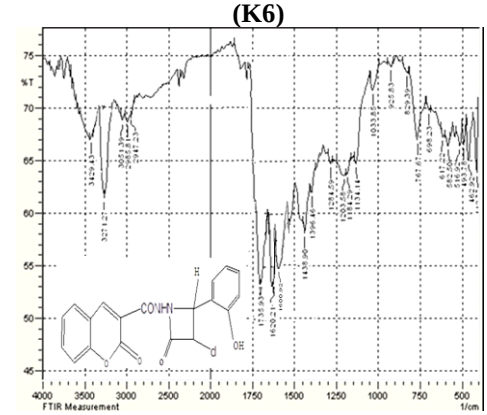


Fig. (7) FT-IR Spectrum for Compound (k7)

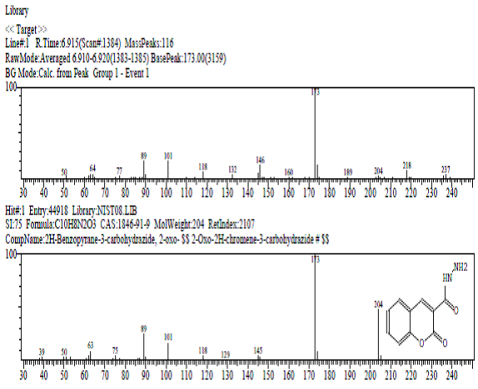


Fig.(8) FT-IR Spectrum for Compound (k8)

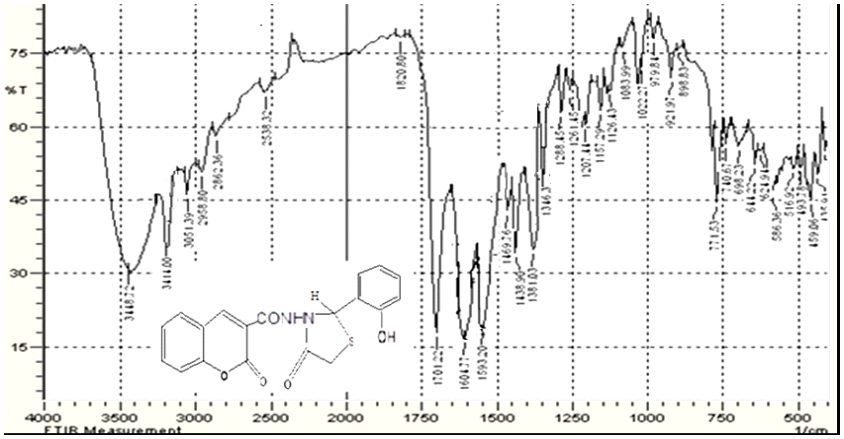


Fig.(9) GC-Ms Spectrum for Compound (K2)

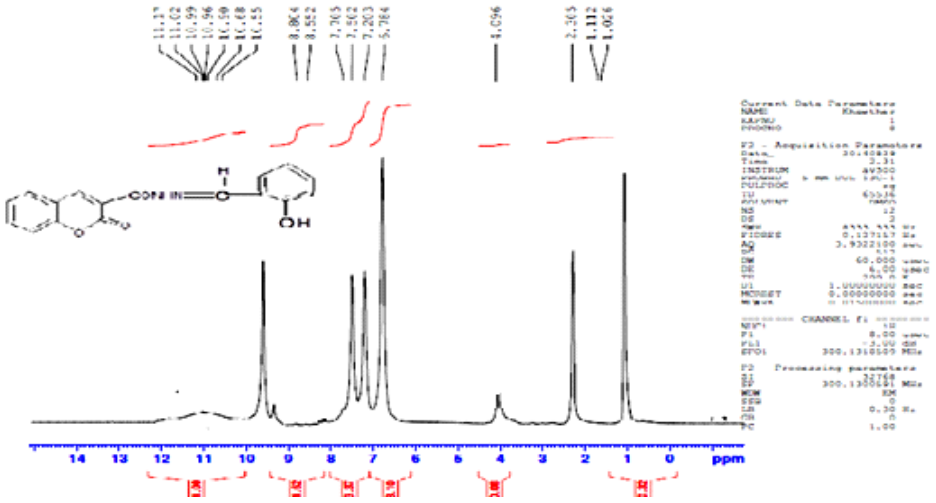


Fig. (10)1-HNMR Spectrum for Compound (k3)

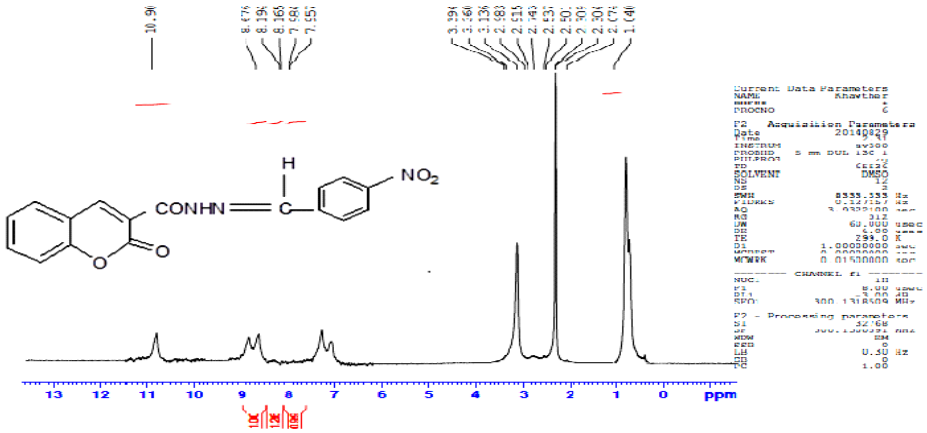


Fig. (11)1-HNMR Spectrum for Compound (k4)

References:

[1]Perkin, W. H. 1868. On the artificial production of coumarin and of its homologues.J.of the Chemical Society 21(6): 53-63.

[2]Leal, L. K. A. M.; Ferreira, A. A. G.; Bezerra G. A.; Matos, G. A. and Viana, G. S. B.2000. Antinociceptive, anti-inflammatory and bronchodilator activities of Brazilian medical plants containing coumarin:a comparative study. Journal of Ethnopharmacology LTWA. 70(2): 151–159.

[3]Lino, C. S.; Taveira, M. L; Viana, G. S. B and Matos, F. J. A. 1997. Analgesic anti-inflammatory activities of justicia pectoralis jacq and its main constituents :coumarin and umbelliferone. Phyto therapy Research 3:211–215.

[4]Ritter, J. K; Wooster, R. 1992. The complex locus UGT1 encodes human bilirubin, phenol and other UDP-glucuronosyl transferase isozymes with the identical carboxyl termini .J. of Biol Chem 267(5): 3257–61.

[5]Link, K. P. 1959.The discovery of dicumarol and its sequels circulation. .JPMID 19(1):97– 107

[6]Liu, H. 2011. Elicitation and isolation of compounds from herbal medicines. In: Willow, J. and H.Liu (Eds.).Traditional herbal medicine research methods. John Wiley and Sons.

[7]Farinola, N.; and Piller, N. 2005. Pharmacogenomics: Its role in re-establishing coumarin as treatment for lymphedema.Lymphati and Bio.3(2):81–86.

[8]Luther, F.; Berhenke, E.; Monoroe, E. and Edgar, C.1941.Preparation of counarin-3-carboxylic acid . Midland,Mich Britton,assignors to the chemical company, a corporation of Michigan Claims.3(6):260-344.

[9]Kidwai, M.; Misra, P. and Bhushan, K. R. 2007. Synth Commun. 30:3031-3040

[10] Burbiel, J. C.; Hockemeyer, J. and Muller, C. E. 2006. Belistein J. Org. Chem. 2 :2012-15.

[11] Elewady,G. Pyrimidine. 2008. Derivatives as corrosion inhibitors for carbon-steel in 2m hydrochloric acid solution Int. J. Electro chem. Sci. 3(1): 1149 – 1161.

[12] Fahmay, H.; Kassem, E. M. M.; Abdon, W. A. M and Mahmoud ,S.A. 1997. Egypt, J. Pharm. 38 (3) 13.

[13] Mohamed, V. 2010 .Synthesis, reactions and antimicrobial activity on some novel phthalazinones derivatives. Der Chemica Sinica, 1(3): 20-31.

[14] Anesid, C. and Perez, C. 1993. Screening of plants use in orgenting folk medicine for antibacterial activity. J ICEP. 3(7):35-47.

تحضير وتشخيص مشتقات بالتعويض على 3 - للكيومارين

شذى فاضل الزبيدي **كوثر عبد الواحد** **بان ذنون اسماعيل**

قسم الكيمياء، كلية العلوم للبنات، جامعة بغداد.

الخلاصة:

تفاعل كلوريد -2 اوكسو -2H- كرومين -3- الكاربونيل (K1) مع الهايدرازين في درجه غليان ايثانوال يعطي الهايدرازايد . (K2) عند معاملة المركب (K2) مع الديهايدات اروماتية مختلفة يتكون قواعد شف المقابل . (k3–k4) تم الحصول على سلاسل جديدة من ثايازوتيدينان (k5–k6) و ازيتيدينولات–k7) (k8من تفاعل قواعد شيف مع حامض مركبتو الخليك وكلورو اسيتايل لكوريد على التوالي . كل المركبات تم تشخيصها بواسطة بعض الطرق الطيفية مثل الاشعة تحت الحمراء و الرنين النووي المغناطيسي وطيف الكتلة و كروماتوغرافيا العمود

الكلمات المفتاحية: قواعد شف ، الثايازوتيدينون ، الازيتيدينون