INTERNATIONAL JOURNAL OF PHARMACEUTICAL, CHEMICAL AND BIOLOGICAL SCIENCES

Available online at www.ijpcbs.com

Research Article

SYNTHESIS AND CHARACTERIZATION OF SOME 3-(2-(5-PHENYL-1*H*-1,2,3-TRIAZOL-1-YL)ACETYL)-2*H*-CHROMEN-2-ONES, USING CLICK REACTION

Jayendra Kanzariya, Prachi Trivedi, Sanjay Hadiyal, Ashish Dhamshaniya, Shahrukhkhan Safi and Jatin Upadhyay*

Matushri Virbaima Mahila Science & Home Science College, Rajkot-36005, India.

ABSTRACT

Novel 1,2,3-triazoles were synthesised using the one-pot reaction of, 3-(2-azidoacetyl)-2H-chromen-2-one and terminal alkynes in the presence of water: t-BuOH: DMF(1:1:1) using the click approach, The new therapeutically active 1,2,3, triazole compounds have been synthesised bearing coumarin moiety The structures of compounds have been confirmed by various spectroscopic methods.

Keywords: Coumarin, 1,2,3-triazoles, Click chemistry.

INTRODUCTION

Triazole is an important moiety for the wide array of drug families such as, anti-depressant anti-tubercular, anti-diabetic, analgesic anti-inflammatory, anti-viral, anti-neoplastic, anti-parkinsons, etc. Potent pharmacological activity of triazoles and their derivatives have substantiated them as very important scaffolds.[1] The triazole products are more than just passive linkers; they readily associate with biological targets, through hydrogen bonding and dipole interactions.[2] Moreover, coumarin bearing derivatives of triazoles exhibits good cytotoxic and anti-malarial activity.[1a]

The structural diversity found in coumarin family of compounds led to the division into different categories, from simple coumarins to polycyclic coumarins like furocoumarins and pyranocoumarins. Simple coumarins and analogues are a large variety of compounds that have fascinated their interest for a long time due to their biological activities: they have shown to be useful as antitumoural, anti-HIV agents and as CNS-active compounds.[1b]

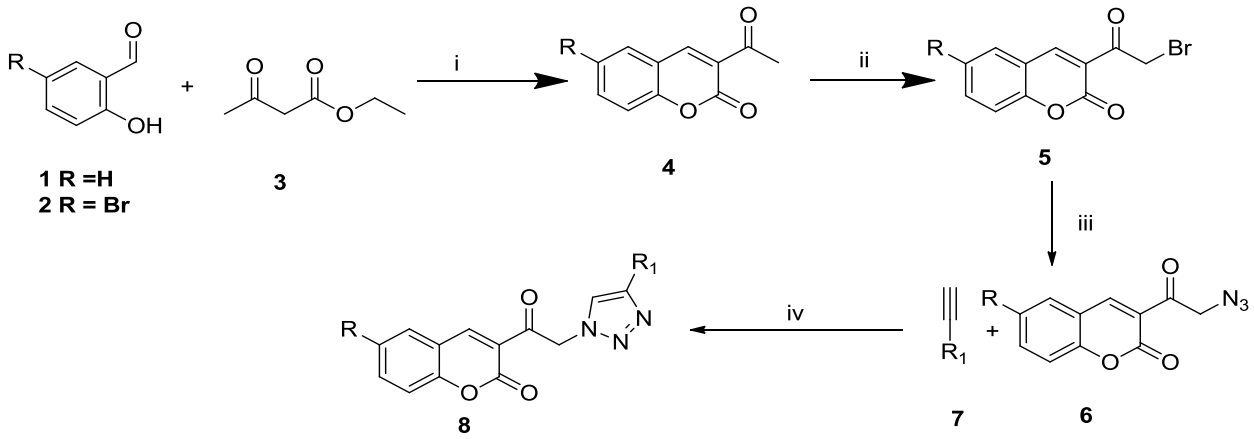
Click chemistry come forth as a powerful and rapid technique in recent years for synthesis of novel compounds where triazole acts as a linkage of two pharmacologically potent scaffolds. Amongst variety of 'click reactions', a catalytic version of the Huisgen 1,3-dipolar cycloaddition which is also known as Copper (I) catalyzed Azide Alkyne Cycloaddition (CuAAC) has received enormous attention. Most of CuAAC catalytic systems consist of stable Cu(I) salts or stable Cu(I) complexes with N-, P- and C-based ligands or a combination of Cu(II) salts with good reducing agents[3-6]. The reason behind using copper (I) is rate enhancement and improved regioselectivity of the 1,3-dipolar cycloaddition reaction[7,8].

MATERIALS AND METHOD

All the chemicals were purchased from Spectrochem Pvt. Ltd. Melting points were determined in open capillary tubes and are uncorrected. Progress of reaction was checked by TLC on silica gel-G plates of 0.5 mm thickness IR spectra were recorded on SHIMADZU FT-IR-Affinity-1S. Mass spectra were recorded on Shimadzu GC-MS-QP-2010 model using direct inlet probe technique. ^{1}H NMR and ^{13}C NMR was

determined in DMSO-d_6 solution on a Bruker Ac 400 MHz spectrometer. Chemical shifts are expressed in δ ppm downfield from TMS as an internal standard. Elemental analysis of the all the synthesised compounds was carried out on Euro EA 3000 elemental analyser and the results are in agreements with the structures assigned.

Reaction Scheme



(i) Piperidine, Acetonitrile **(ii)** Br_2, $CHCl_3$ **(iii)** NaN_3, DMF **(iv)** $CuSO_4$, Na ascorbate, H_2O: t-BuOH, DMF

Experimental Procedure

Preparation of 3-(2-azidoacetyl)-2H-chromen-2-one 6

Substituted salicylaldehyde **1** and **2** (1.0 mmol), ethyl acetoacetate **3** (1.0 mmol), and catalytic amount of Piperidine in Ethanol was stirred for 30 min at room temperature. The solid separated was filtered and recrystallized from chloroform.

Compound **4** (1.0mmol) further dissolved in dry chloroform for the bromination. Bromine solution was prepared by dissolving Bromine (1.0mmol) in 5 ml chloroform and added drop wise in reaction mixture with continuous stirring at 0-5°C. After addition, reaction mass was refluxed for 6-7 hours. After completion of the reaction, the mixture was concentrated under reduced pressure. Solid obtained was recrystallized from 70:30 $CHCl_3$: EtOH.

Further, Compound **5** (1.0mmol) was dissolved in minimum amount of DMF and Sodium azide (1.1mmol) was added in small proportion at 0°C. Reaction mixture was stirred for 1 hour. Solid (Compound **6**) fall out was poured in ice water and separated and dried by vacuum filtration.

General Procedure for Preparation of 8a-q

3-(2-azidoacetyl)-2*H*-chromen-2-one (1.0 mmol) and various acetylene derivatives (1.0 mmol) were dissolved in DMF: t-butanol: Water (1:1:1, 2ml). Sodium ascorbate (0.2 mmol) and aqueous solution of $CuSO_4$ (0.5 mmol) were added simultaneously. The reaction mixture was allowed to stir at room temperature for 3 hr. After the reaction was complete, as indicated by TLC, the reaction mixture was poured in crushed ice and stirred for 30 min. Solid separated was filter and resulting crude product was recrystallized from acetone.

RESULT AND DISCUSSION

A rapid, simple and efficient method for the synthesis of coumarin based 1,2,3 triazole using 1,4 cycloaddition was optimized using various Cu(I) and Cu(II) catalysts.

Reaction between Compound C and Phenyl acetylene was selected as precursor to investigate the effect of various catalysts on click reaction. As depicted in Table 1, reaction conditions shown in entry 6 gave the maximum yield. All the reactions were performed by using DMF:t-BuOH: H_2O as a solvent, $CuSO_4$ as a catalyst and Na ascorbate as reducing agent. Table 2 shows various substituent of alkynes used as starting material.

Table 1

Entry	Solvent	Catalyst	Time	Yield %
1	DMF:t-BuOH: H_2O	CuBr	3 h	23
2	DMF:t-BuOH: H_2O	CuCl	3 h	10
3	DMF:t-BuOH: H_2O	CuI	3 h	25
4	DMF:t-BuOH: H_2O	$Cu(OAc)_2$	3 h	37
5	DMF:t-BuOH: H_2O	$CuSO_4$/Na ascorbate	1.5 h	70
6	DMF:t-BuOH: H_2O	$CuSO_4$/Na ascorbate	3 h	95

Table 2

Code-No	R_1	R1	Yield %
8a	H	Cyclo Hexane	87%
8b	H	4-F- Ph	91%
8c	H	Cyclo pentane	85%
8d	H	4-ter.But.-Ph	95%
8e	Br	Ph	79%
8f	Br	Cyclo hexane	82%
8g	Br	4-Ethyl-Ph	75%
8h	Br	Cyclo pentane	79%
8i	Br	4-ter. But.-Ph	85%
8j	Br	4-F-Ph	82%
8k	Br	4-CH3-Ph	86%
8l	H	4-CH3-Ph	81%
8m	H	4-Propyl-Ph	92%
8n	H	Cyclopropyl	89%

Spectral data

3-(2-(5-cyclohexyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8a)

Yield.(87%), M.P.252-254, IR (cm-1)3054, 3001, 2951, 1741, 1715, 1702, 1587, 1424, 1053, 1H NMR: δ ppm =1.26-1.30(m, 2H, CH2), 1.44-1.49(m, 6H, CH2), 1.88-1.97(m, 2H, CH2), 2.95- 3.03(m, 1H, CH*), 6.02(s, 2H, CH2), 7.18-7.24(m, 2H, ArH), 7.27(s, 1H, ArH), 7.42-7.46(t, 1H, ArH), 7.61(d, 1H, J=6.4Hz, ArH), 8.2(s, 1H, ArH) 13C NMR: δ ppm =25.1, 25.9, 31.6, 35.2, 48.8, 117.1, 120.6, 122.1, 123.9, 125.0, 129.5, 132.8, 134.2, 136.5, 154.1, 160.9, 180.5. Elemental Analysis: Calculated: C (67.64%), H (5.68%), N (12.46%), Found: C (67.54 %), H (5.56 %), N (12.38 %),

3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8b)

Yield.(91%), M.P.264-266, IR (cm-1)3059, 2929, 1726, 1691, 1606, 1450, 1188.1056
1H NMR: δ ppm =6.08(s, 2H, CH2), 7.29-7.33 (t, 2H, ArH), 7.45-7.49(t, 1H. ArH), 7.54 (d, 1H,J=8.0Hz, ArH), 7.80-7.84 (t, 1H, ArH), 7.90-7.94 (m, 2H, ArH), 8.40 (d,1H, J=7.2Hz, ArH), 8.50(s, 1H, ArH), 8.88(s, 1H, ArH), 13C NMR: δ ppm =58.4, 115.7, 115.9, 116.2, 118.0, 122.1, 122.9, 125.2, 127.1, 127.1, 127.2, 131.2, 135.2, 145.3, 148.6, 154.7, 158.6, 160.5, 162.9, 189.4. Elemental Analysis: Calculated: C (66.33%), H (3.46%), N (12.03%), Found: C (66.18 %), H (3.41 %), N (11.95 %),

3-(2-(5-cyclopentyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8c)

Yield.(85%), M.P.277-279, IR (cm-1)3045, 3020, 2974, 1748,1700, 1480, 1398, 1024,759. 1H NMR: δ ppm =0.73-0.74 (m, 4H, CH2), 0.91-0.93 (m, 4H, CH2), 2.01 (s,1H, CH*), 5.93 (s, 2H,CH2), 7.44-7.48 (t,1H, ArH), 7.53 (d, 1H, J=8.4Hz, ArH), 7.78-7.83 (m, 2H, ArH), 8.04 (d, 1H, j=7.2Hz, ArH) 8.84 (s, 1H, ArH), 13C NMR: δ ppm = 6.5, 7.6, 38.8, 39.0, 39.2, 39.4, 39.6, 39.9, 40.1, 58.1, 116.2, 118.0, 122.2, 122.4, 125.2, 131.1, 135.2, 148.5, 154.6, 158.5, 189.6. Elemental Analysis: Calculated: C (66.86%), H (5.30%), N (13.00%), Found: C (66.78 %), H (5.22 %), N (12.90 %),

3-(2-(5-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)acetyl) -2H-chromen-2-one (8d)

Yield.(95%),M.P.290-292, IR (cm-1)3298, 3021, 2850, 1740, 1680, 1542, 1352, 1074, 1H NMR: δ ppm =1.25(s, 9H, CH3), 6.07 (s, 2H, CH2), 7.45-7.50 (m, 3H, ArH), 7.54(d, 1H, j=7.6Hz, ArH), 7.78-7.82(m, 3H, ArH), 8.46(s, 1H, ArH),8.03(d, j=7.6Hz, ArH), 8.8(s, 1H, ArH), 13C NMR: δ ppm = 31.0,

34.3, 58.3, 116.2, 118.0, 122.1, 122.6, 124.9, 125.2, 125.4, 125.6, 127.9, 131.2, 135.2, 146.1, 148.6, 150.3, 154.7, 158.6, 189.5. Elemental Analysis: Calculated: C (71.30 %), H (5.46 %), N (10.85%), Found: C (71.21 %), H (5.49 %), N (10.78 %),

6-bromo-3-(2-(5-phenyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8e)

Yield.(79%), M.P.264-266, IR (cm-1)3035, 2947, 1737, 1701, 1606,1375, 1053. 1H NMR: δ ppm = 6.07 (s, 2H, CH2), 7.09 (d, 1H, J=7.6Hz, ArH), 7.25-7.29 (t, 1H, ArH), 7.35-7.38 (t, 2H, ArH), 7.57-7.62 (m, 3H, ArH), 7.71 (d, 1H, J=7.6Hz), 7.95 (s, 1H, ArH), 8.31 (s, 1H, ArH).13C NMR: δ ppm = 50.3, 118.9, 120.1, 121.3, 122.4, 124.2, 127.2, 127.3, 127.6, 129.2, 131.1, 132.0, 135.6, 147.7, 154.1, 160.7, 180.3. Elemental Analysis: Calculated: C (55.63 %), H (2.95 %), N (10.24 %), Found: C (55.52 %), H (2.84 %), N (10.15 %),

6-bromo-3-(2-(5-cyclohexyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8f)

Yield.(82%), M.P.252-254, IR (cm-1)3074, 3012, 2856, 1746, 1715, 1702, 1587, 1424, 1053,531. 1H NMR: δ ppm =1.55-1.61(m, 8H, CH2), 2.44-2.49(m, 2H, CH2), 3.34-3.42(m,1H, CH*), 6.04(s, 2H, CH2), 7.09(s,1H, ArH), 7.13(d, 1H, J=8.0Hz, ArH), 7.61(d, 1H, J=6Hz, ArH), 7.78(d, 1H, J=4.8Hz, ArH), 8.35(s, 1H, ArH).13C NMR: δ ppm = 25.1, 25.5, 25.9, 31.6, 31.8, 35.2, 48.8, 118.9, 120.1, 121.3, 122.4, 124.2, 131.1, 134.2, 135.6, 136.5, 154.1, 159.8, 180.5. Elemental Analysis: Calculated: C (54.82 %), H (4.36 %), N (10.09 %), Found: C (54.67 %), H (4.20 %), N (9.94 %),

6-bromo-3-(2-(5-(4-ethylphenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8g)

Yield.(75%), M.P.276-278, IR (cm-1)3304, 3041, 2876, 1736, 1676, 1435, 1357, 1026.545. 1H NMR: δ ppm =1.30-1.33(t, 3H, CH3), 2.60-2.65 (m, 2H, CH2), 6.21 (s, 2H, CH2), 7.12 (d, 1H, J=5.6Hz, ArH), 7.31(d, 2H, J=8.4Hz, ArH), 7.50(s, 1H, ArH), 7.55(d, 2H, J=8.0Hz, ArH), 7.63(d, 1H, J=8.4Hz, ArH), 7.78(s, 1H, ArH), 8.27(s, 1H,ArH) 13C NMR: δ ppm = 13.2, 28.2, 50.3, 118.9, 120.1, 121.3, 122.4, 124.7, 129.3, 129.9, 131.1, 131.4, 132.0, 135.6, 142.8, 147.7, 154.1, 161.9, 180.7. Elemental Analysis: Calculated: C (57.55 %), H (3.68 %), N (9.59 %), Found: C (57.38 %), H (3.51 %), N (9.43 %),

6-bromo-3-(2-(5-cyclopentyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8h)

Yield.(79%), M.P.261-263, IR (cm-1)3055, 3000, 2964, 1746, 1738,1690, 1481, 1398, 1054,759, 597. 1H NMR: δ ppm =1.57-1.67(m, 6H, CH2), 1.94(d, 2H, CH2),2.74- 2.83(m, 1H, CH*), 5.90(d, 2H, CH2), 7.07-7.12(t, 2H, ArH), 7.60-7.62(d, 1H, J=8.8Hz, ArH), 7.71(s, 1H, ArH), 8.06(s, 1H, ArH) 13C NMR: δ ppm = 26.1, 26.2, 34.0, 34.7, 36.7, 48.8, 118.9, 120.1, 121.3, 122.4, 124.2, 131.1, 135.2, 135.6, 136.6, 154.1, 158.9, 185.7. Elemental Analysis: Calculated: C (53.75 %), H (4.01 %), N (10.45 %), Found: C (53.67 %), H (3.89 %), N (10.28 %),

6-bromo-3-(2-(5-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8i)

Yield.(85%),M.P.280-282, IR (cm-1)3290, 3021, 2850, 1740, 1680, 1542, 1352, 1074, 526. 1H NMR: δ ppm =1.12(s, 9H, CH3), 6.05(s, 2H, CH2), 7.09(d,1H, J=7.6Hz, ArH), 7.37(d, 2H, j=8.0Hz, ArH), 7.52(d, 2H, J=6.4Hz, ArH), 7.60(d, 1H, J=7.2Hz, ArH), 7.73(d,1H, J=8.8Hz, ArH), 7.90(s, 1H, ArH), 8.36(s, 1H, ArH)13C NMR: δ ppm = 29.2, 29.5, 29.7, 34.3, 50.3, 118.9, 120.1, 121.3, 122.4, 124.0, 124.2, 125.9, 127.0, 127.6, 131.1, 132.0, 135.6, 147.7, 152.5, 154.1, 160.9, 180.5. Elemental Analysis: Calculated: C (59.24 %), H (4.32 %), N (9.01 %), Found: C (59.17 %), H (4.25 %), N (8.94 %),

6-bromo-3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8j)

Yield.(82%), M.P.261-263, IR (cm-1)3027, 2935, 1729, 1681, 1651, 1429, 1188.1056, 567. 1H NMR: δ ppm =5.92(s, 2H, CH2), 7.09-7.13(t, 3H, ArH), 7.56-7.62(m, 3H, ArH), 7.71(s, 1H, ArH), 7.81(s, 1H, ArH), 8.31sss(s, 1H, ArH), 13C NMR: δ ppm = 50.3, 115.9, 118.9, 120.1, 121.3, 122.4, 124.2, 128.5, 129.8, 131.1, 132.0, 135.6, 147.7, 154.1, 160.9, 162.3, 180.5. Elemental Analysis: Calculated: C (53.29 %), H (2.59 %), N (9.81 %), Found: C (53.11 %), H (5.35 %), N (9.70 %),

6-bromo-3-(2-(5-(p-tolyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8k)

Yield.(86%),M.P.271-273, IR (cm-1)3312, 3042, 2925, 1748, 1675, 1364, 1140, 531. 1H NMR: δ ppm =2.24(s, 3H, CH3), 6.01(s, 2H, CH2), 7.12(s, 1H, ArH), 7.29(d, 2H, J=7.6Hz, ArH), 7.45(s, 1H, ArH), 7.52(d, 2H, J=10.4Hz), 7.62(d, 1H, J=8.4Hz), 7.77(s, 1H, ArH), 8.28(s, 1H, ArH)13C NMR: δ ppm = 21.1, 50.3, 118.9, 120.1, 121.3, 122.4, 124.2, 127.8, 129.0, 129.1, 131.1, 131.5, 132.0,135.6, 135.8, 147.7, 154.1, 160.9, 180.5. Elemental Analysis: Calculated: C (56.62 %), H (3.33 %), N (9.90 %), Found: C (56.48 %), H (3.21 %), N (9.71 %),

3-(2-(5-(p-tolyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one(8l)

Yield.(81%), M.P.276-278, IR (cm-1)3300, 3010, 2866, 1796, 1556, 1395, 1240. 1H NMR: δ ppm =2.31(s, 3H, CH3), 6.07(s, 2H, CH2), 7.26(d, 2H, J=7.6Hz, ArH), 7.45-7.48(t, 1H, ArH), 7.53(d,1H, J=8.4Hz, ArH), 7.75(d, 2H, J=7.6Hz, ArH), 7.80-7.84(t, 1H, ArH), 8.03(d, 1H, J=6.8Hz, ArH), 8.5(s, 1H, ArH), 9.0(s,1H, ArH). 13C NMR: δ ppm = 180.5, 160.9, 154.1, 147.7, 135.8, 132.8, 132.0, 131.5, 129.5, 129.1, 129.1, 127.8, 127.8, 125.0, 123.9, 122.1, 120.6, 117.1, 50.3, 21.1. Elemental Analysis: Calculated: C (69.56 %), H (4.38 %), N (12.17 %), Found: C (69.45 %), H (4.25 %), N (12.01 %)

3-(2-(5-(4-propylphenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8m)

Yield.(81%), M.P.271-273, IR (cm-1) 3321, 3030, 2924, 1735, 1670, 1425, 1342, 1002. 1H NMR: δ ppm = 0.87-0.93(m, 3H, CH3), 1.61-1.63(m, 2H, CH2), 2.57-2.60(m, 2H, CH2), 6.07(s, 2H, CH2), 7.27(d, 2H, J=8.4Hz, ArH), 7.45-7.49(m, 1H, ArH), 7.54(d, 2H, J=8.0Hz, ArH), 7.77-7.84(m, 2H, ArH), 8.03(d, 1H, J=6.4Hz, ArH), 8.45(s, 1H, ArH), 8.88(s, 1H, ArH). 13C NMR: δ ppm = 12.9, 24.4, 38.1, 50.3, 117.1, 120.6, 122.1, 123.9, 125.0, 125.6, 127.5, 129.5, 132.0, 132.3, 132.8, 142.5, 147.7, 154.1, 160.9, 180.5. Elemental Analysis: Calculated: C (70.76 %), H (5.13 %), N (11.25 %), Found: C (70.70 %), H (5.08 %), N (11.17 %)

3-(2-(5-cyclopropyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8n)

Yield.(81%), M.P.252-254, IR (cm-1) 3312, 3020, 2937, 1852, 1738, 1696, 1485, 1398, 1054, 1H NMR: δ ppm =0.57-0.64(m, 2H, CH2), 0.76-0.84(m, 2H, CH2), 1.21-1.31(m, 1H, CH*), 5.69(s, 2H, CH2), 6.80(s, 1H, ArH), 7.17 -7.41(m, 2H, ArH), 7.42-7.46(m, 1H, ArH), 7.58-7.61(m, 1H, ArH), 8.06(s, 1H, ArH). 13C NMR: δ ppm = 7.3, 7.4, 48.8, 117.1, 120.6, 122.1, 123.9, 125.0, 129.5, 132.7, 132.8, 136.0, 154.1, 160.9, 180.5. Elemental Analysis: Calculated: C (65.08 %), H (4.44 %), N (14.23 %), Found: C (65.00 %), H (4.37 %), N (14.18 %),

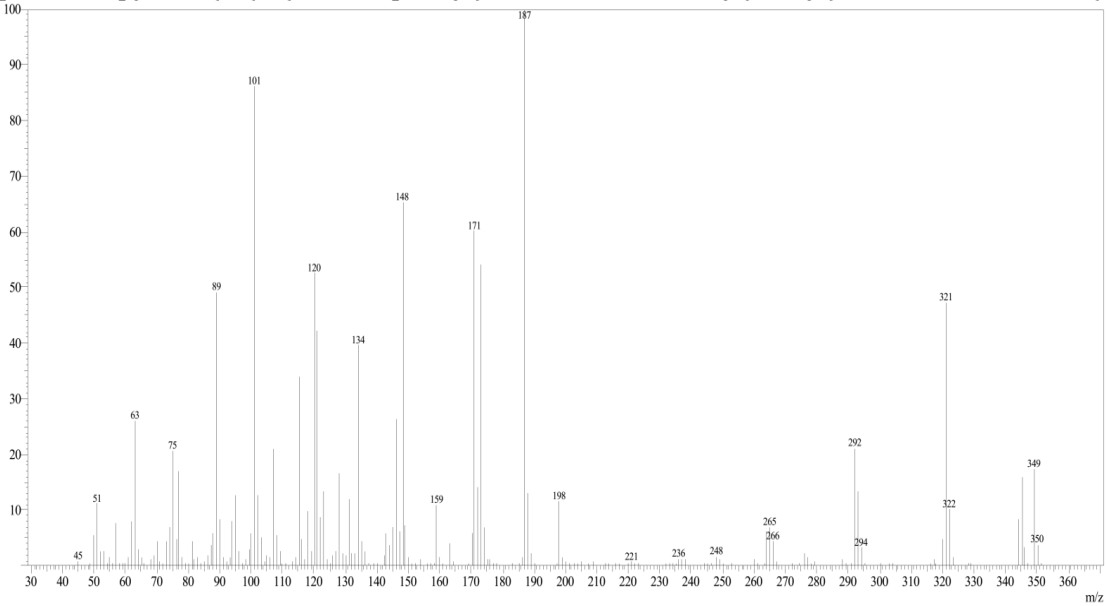
CONCLUSION

In summary, we have synthesized few novel coumarin bearing 1,2,3-Triazole derivatives using substituted phenyl acetylene via CuAAC reactions. It is also worthy to mention here that no any chromatographic purification was needed to obtain desired triazole derivatives **8a-8q.** The structure of all the newly synthesized derivatives was confirmed by ^{1}H, ^{13}C NMR, FTIR and MS spectral data.

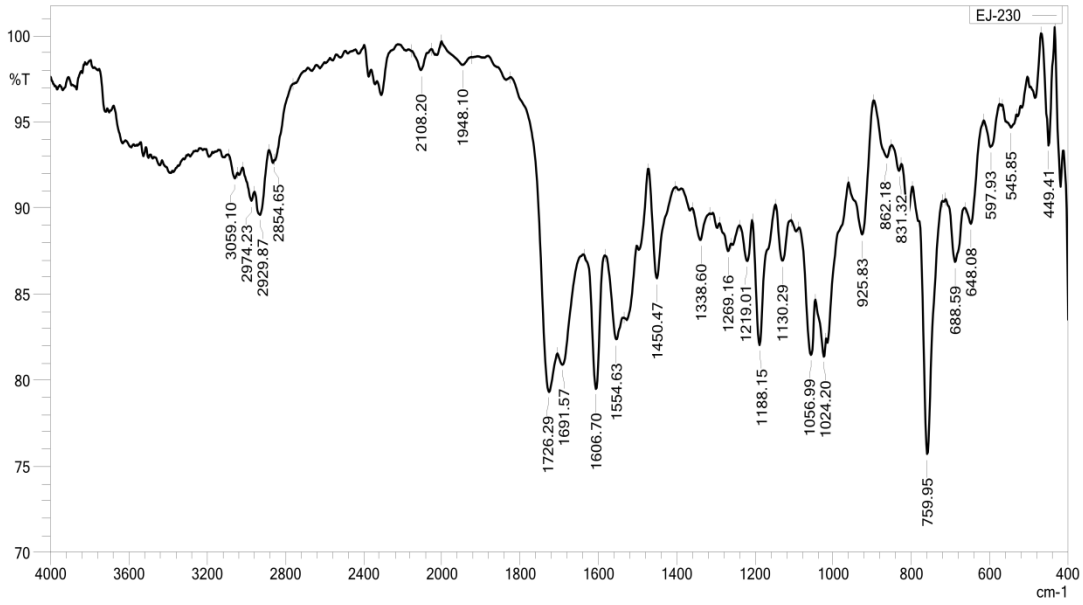
ACKNOWLEDGEMENT

Authors are thankful to Matushri Virbaima Mahila Science & Home Science College, Rajkot, and Center of Excellence (CoE), NFDD Complex, Saurashtra University –Rajkot for providing excellent synthetic facility as well as analytical support.

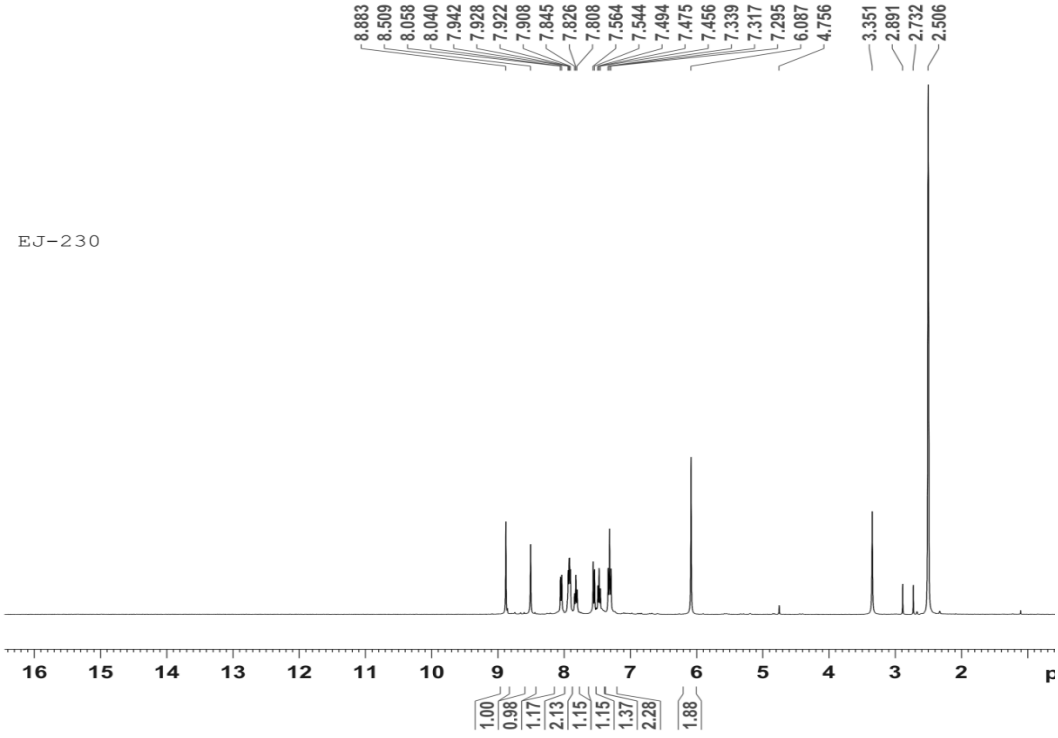
Mass spectroscopy of 3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8b)



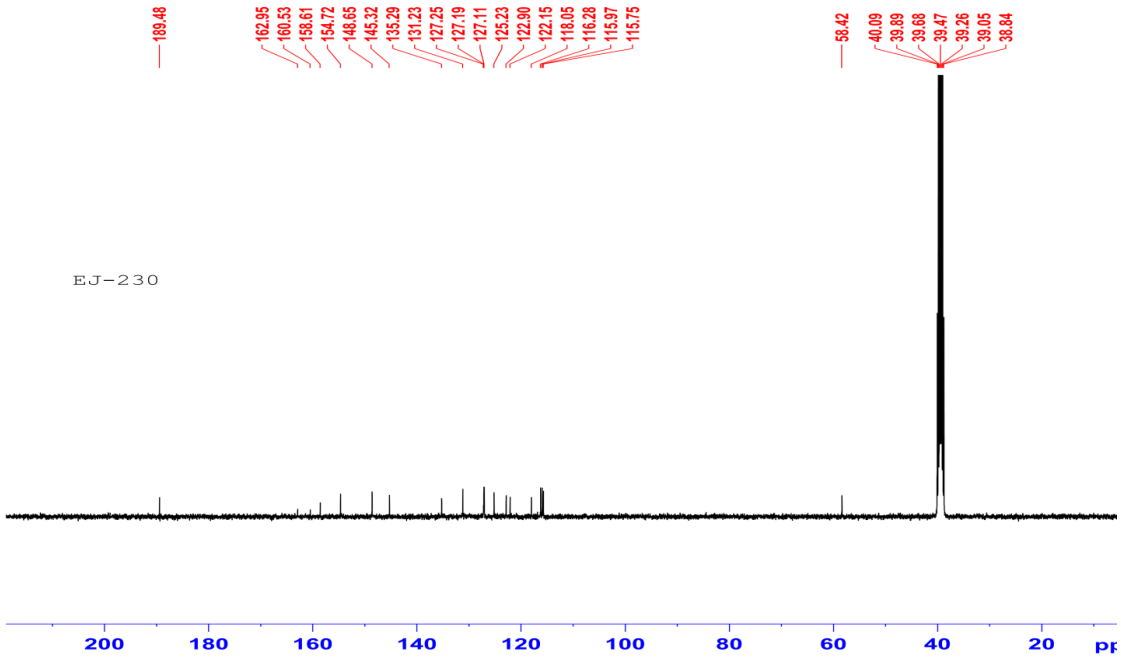
IR spectroscopy of 3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8b)



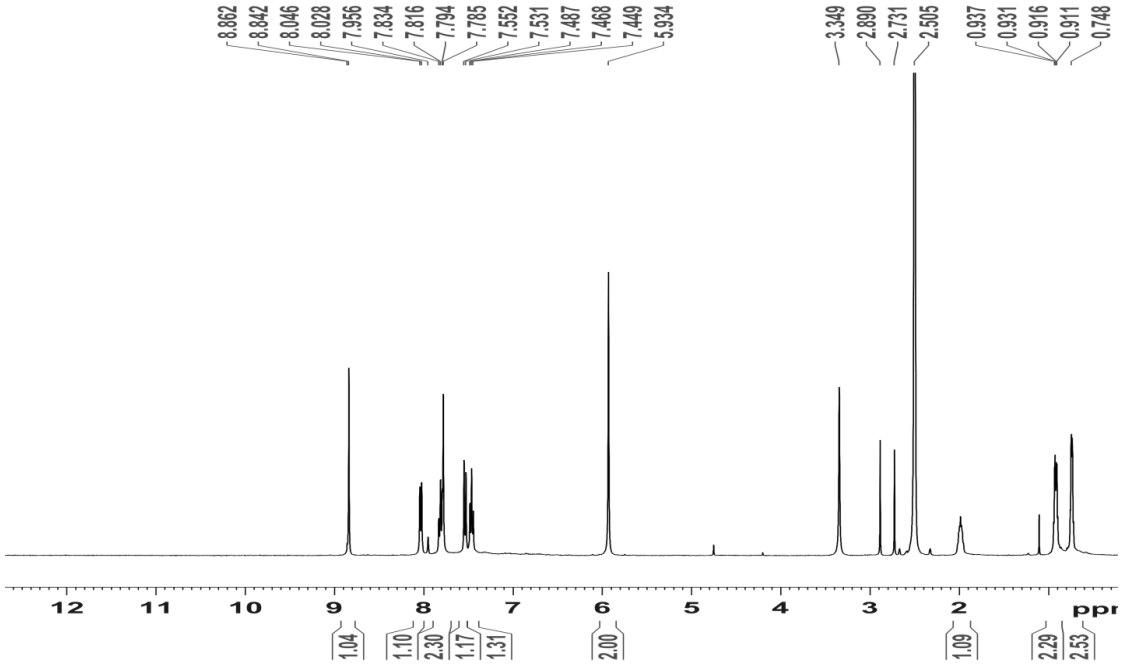
^{1}H NMR spectroscopy of 3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8b)



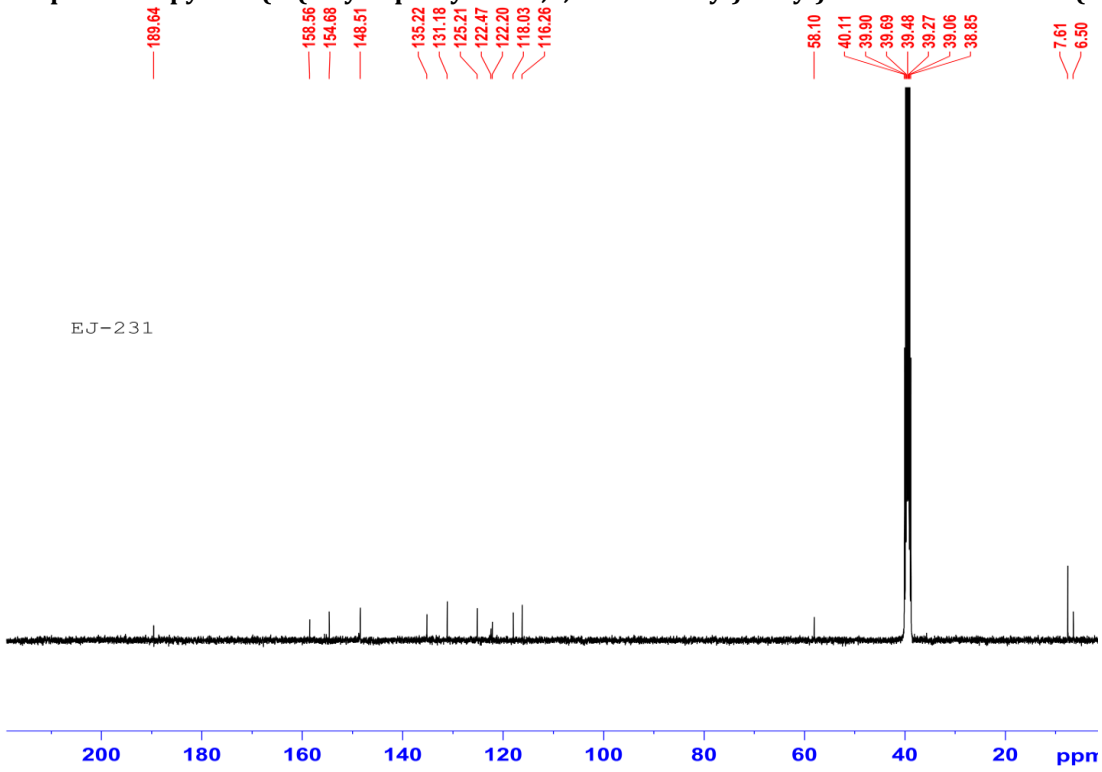
^{13}C NMR spectroscopy of 3-(2-(5-(4-fluorophenyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8b)



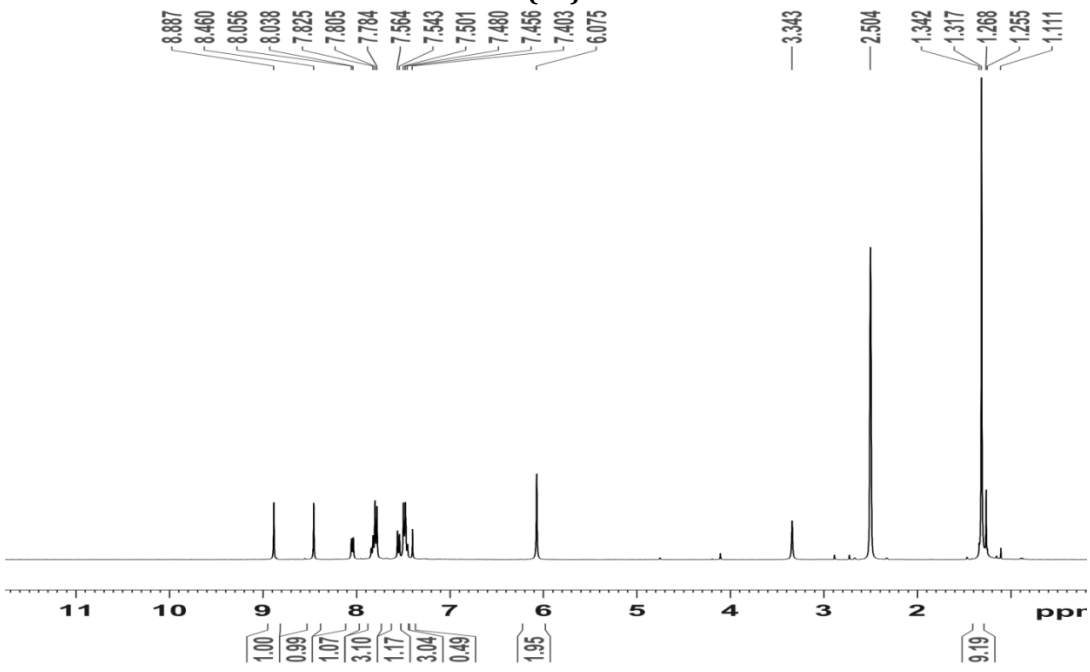
^{1}H NMR spectroscopy of 3-(2-(5-cyclopentyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8c)



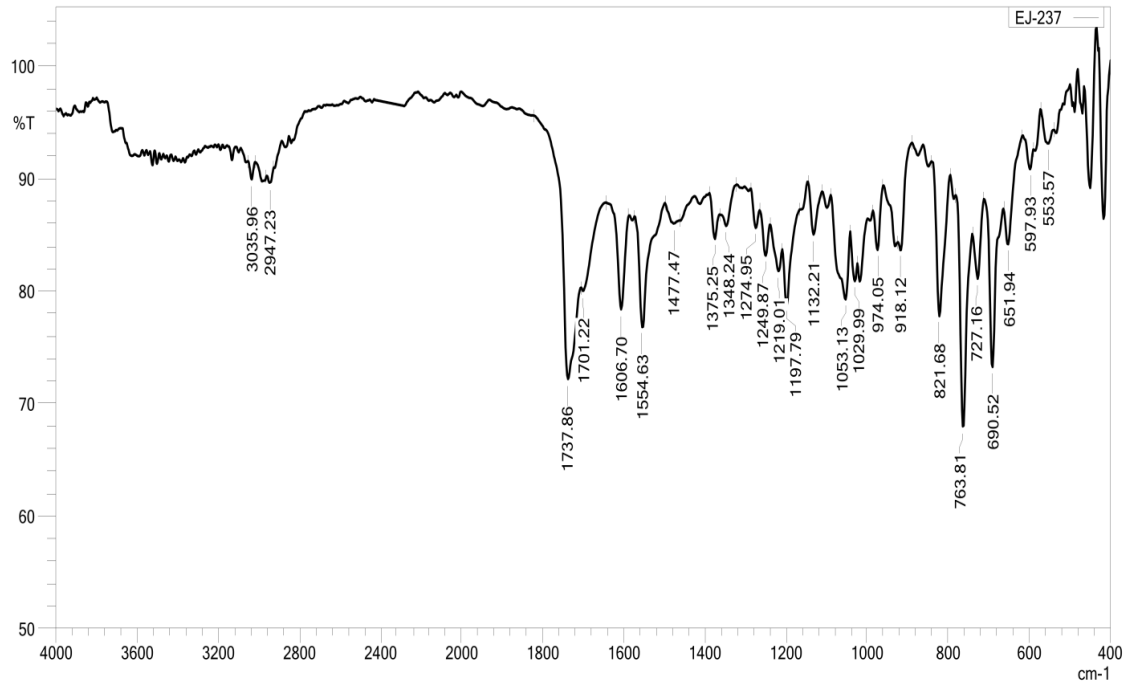
^{13}C NMR spectroscopy of 3-(2-(5-cyclopentyl-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8c)



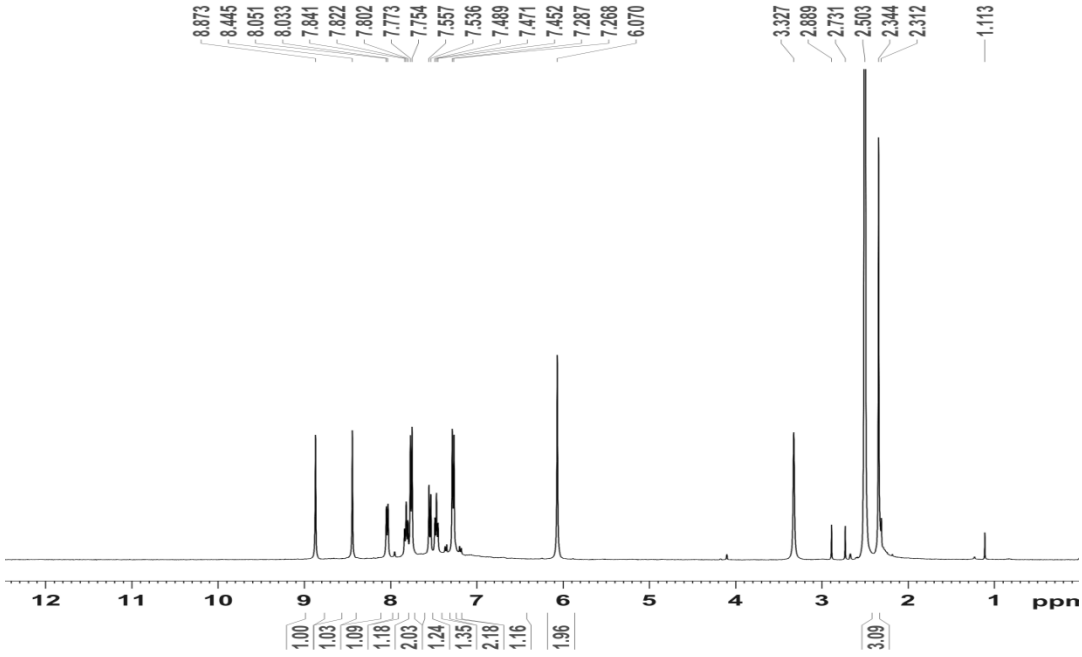
^{1}H NMR spectroscopy of 3-(2-(5-(4-(tert-butyl)phenyl)-1H-1,2,3-triazol-1-yl)acetyl) -2H-chromen-2-one (8d)



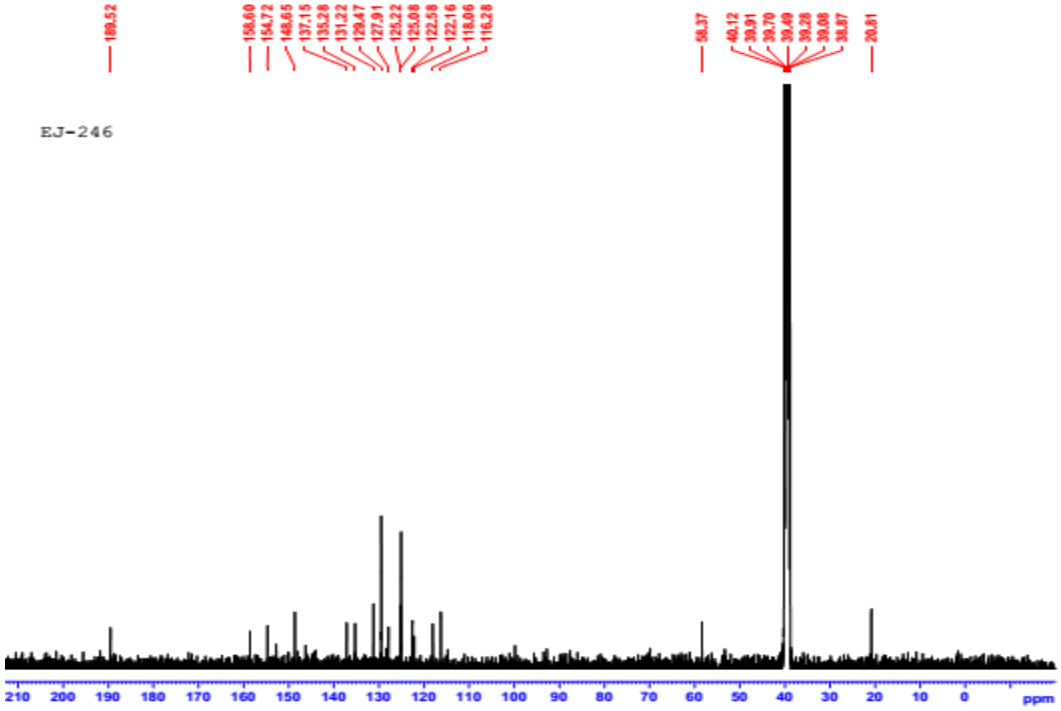
IR spectroscopy of 6-bromo-3-(2-(5-phenyl-1H-1,2,3-triazol-1-yl)acetyl) -2H-chromen-2-one (8e)



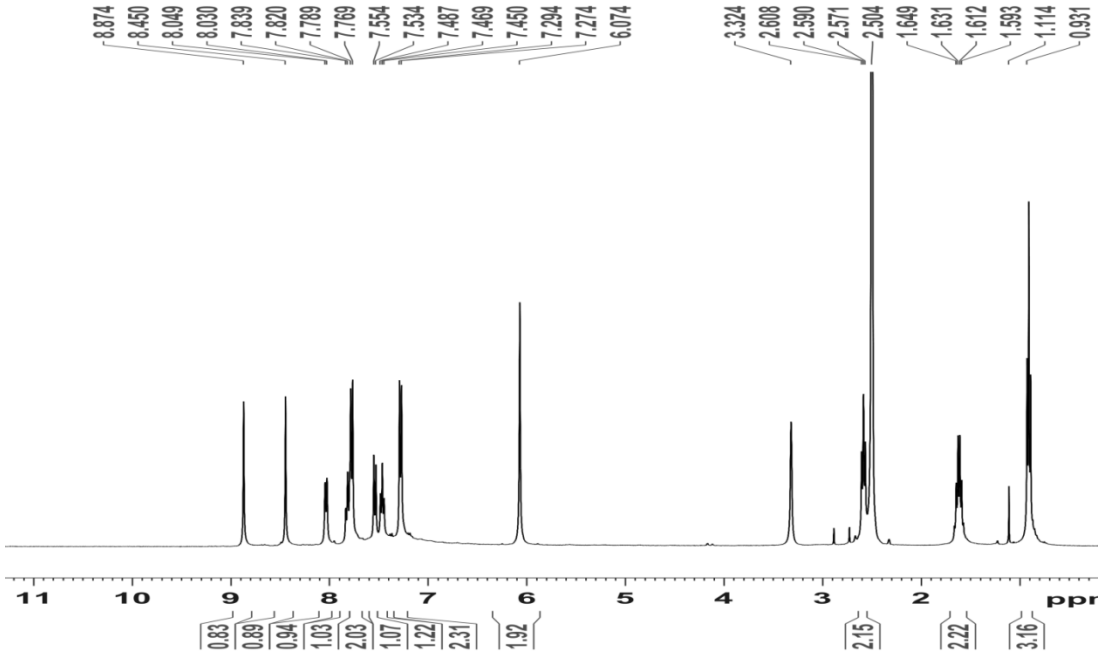
^{1}H NMR Spectroscopy of 3-(2-(5-(p-tolyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8l)



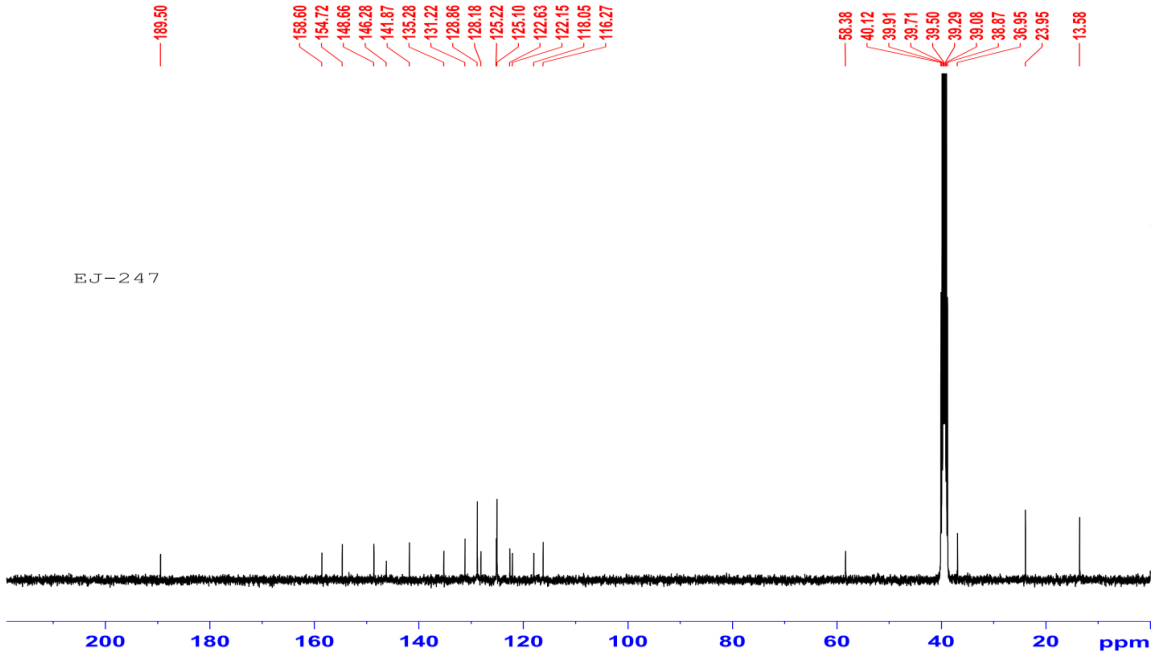
^{13}C NMR Spectroscopy of 3-(2-(5-(p-tolyl)-1H-1,2,3-triazol-1-yl)acetyl)-2H-chromen-2-one (8l)



^{1}H NMR spectroscopy of 3-(2-(5-(4-propylphenyl)-1H-1,2,3-triazol-1-yl)acetyl) -2H-chromen-2-one (8m)



^{13}C NMR spectroscopy of 3-(2-(5-(4-propylphenyl)-1H-1,2,3-triazol-1-yl)acetyl) -2H-chromen-2-one (8m)



REFERENCES

1. Dar, Mukhtar Ahmad, Sarita Shrivastava, and Prince Firdoos Iqbal. "Click Chemistry and Anticancer Properties of 1, 2, 3-Triazoles." ChemInform 46.29 (2015).(1a). Pingaew, Ratchanok, et al. "Synthesis and cytotoxicity of novel 4-(4-(substituted)-1H-1, 2, 3-triazol-1-yl)-N-phenethylbenzenesulfonamides." Medicinal Chemistry Research 23.4 (2014): 1768-1780. (1b). Borges, F., et al. "Simple coumarins and analogues in medicinal chemistry: occurrence, synthesis and biological activity." Current medicinal chemistry 12.8 (2005): 887-916.
2. Kolb, Hartmuth C., and K. Barry Sharpless. "The growing impact of click chemistry on drug discovery." Drug discovery today 8.24 (2003): 1128-1137.
3. Hohloch, Stephan, et al. "Are Cu (I)-mesoionic NHC carbenes associated with nitrogen additives the best Cu-carbene catalysts for the azide–alkyne click reaction in solution? A case study." Tetrahedron Letters 54.14 (2013): 1808-1812.
4. (b) Candelon, Nicolas, et al. "A highly active and reusable copper (I)-tren catalyst for the "click" 1, 3-dipolar cycloaddition of azides and alkynes." Chemical Communications 6 (2008): 741-743.
5. Pérez-Balderas, Francisco, et al. "Multivalent neoglycoconjugates by regiospecific cycloaddition of alkynes and azides using organic-soluble copper catalysts." Organic letters 5.11 (2003): 1951-1954.
6. Lal, Steven, et al. "Novel phosphinite and phosphonite copper (I) complexes: Efficient catalysts for click azide–alkyne cycloaddition reactions." Organometallics 30.22 (2011): 6225-6232.
7. Rostovtsev, Vsevolod V., et al. "A stepwise huisgen cycloaddition process: copper (I)-catalyzed regioselective "ligation" of azides and terminal alkynes." Angewandte Chemie 114.14 (2002): 2708-2711.
8. Tornøe, Christian W., Caspar Christensen, and Morten Meldal. "Peptidotriazoles on solid phase:[1, 2, 3]-triazoles by regiospecific copper (I)-catalyzed 1, 3-dipolar cycloadditions of terminal alkynes to azides." The Journal of organic chemistry 67.9 (2002): 3057-3064.