Cholinesterase, α-glucosidase, tyrosinase and urease inhibitory activities of compounds from fruits of *Rinorea oblongifolia* C.H. Wright (Violaceae)

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Abstract
From *Rinorea oblongifolia* fruits, 3-Nor-4β-friedelan-24-ol (**1**) and 3-decyl-6,7,8-trimethoxy-2H,5H-furo[4,3,2-de]isochromene-2,5-dione (**4**), new derivatives alongside, 28-hydroxyfriedelan-3-one (**2**), friedelin (**3**), 3,3',4,4',5'-pentamethylcoruleoellagic acid (**5**), hexamethylcoruleoellagic acid (**6**), 3',4,4',5,5'-pentamethylcoruleoellagic acid (**7**), and fatty compounds **8-11** were isolated and characterized using HRESIMS, EIMS, 1D and 2D NMR. *In vitro* enzyme inhibition of compounds **1, 2, 4, 5, 6** and **7** were evaluated on acetylcholinesterase (AChE), butyrylcholinesterase (BChE), α-glucosidase, urease and tyrosinase. Against AChE and BChE, the phenolic compounds **4, 5, 6,** and **7** had good activity probably due to the phenolic nature and methoxy substituents. Compounds **4, 5, 6** and **7** exhibited good α-glucosidase inhibition especially compound **4** whose IC_{50} = 42.45±0.46 µg/mL was close that of acarbose (IC_{50} = 20.52±0.84 µg/mL) standard drug. Urease and tyrosinase were appreciably inhibited by the compounds. Overall results of enzyme inhibitory assays indicate *Rinorea oblongifolia,* fruits and its constituents as potential remedy for enzymatic disorders.
Keywords *Rinorea oblongifolia,* triterpenoids, coruleoellagic acid derivatives, enzyme inhibition, anticholinesterase, α-glucosidase inhibition

Supplementary material

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Table S1. The NMR spectral data of compound **1**
Table S2. The NMR spectral data of compound **4**

Table S3. Cholinesterase, α-glucosidase, urease and tyrosinase inhibitory activities of the isolated compounds

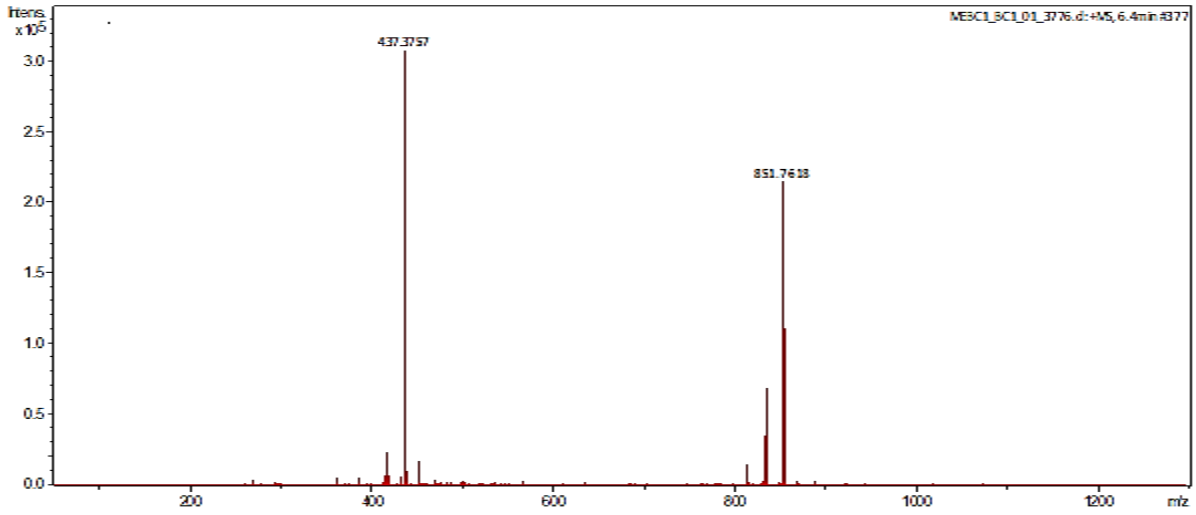

Figure S1: HRESI Mass Spectrum of compound **1**

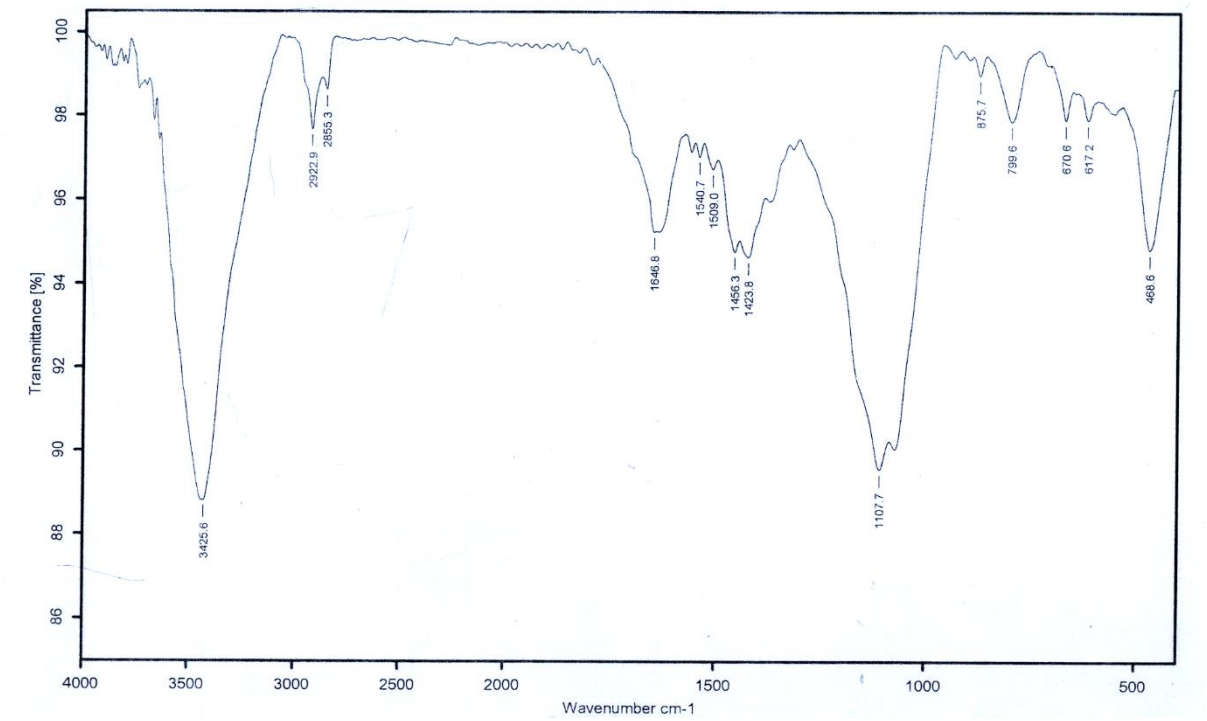

Figure S2: IR spectrum of compound **1**

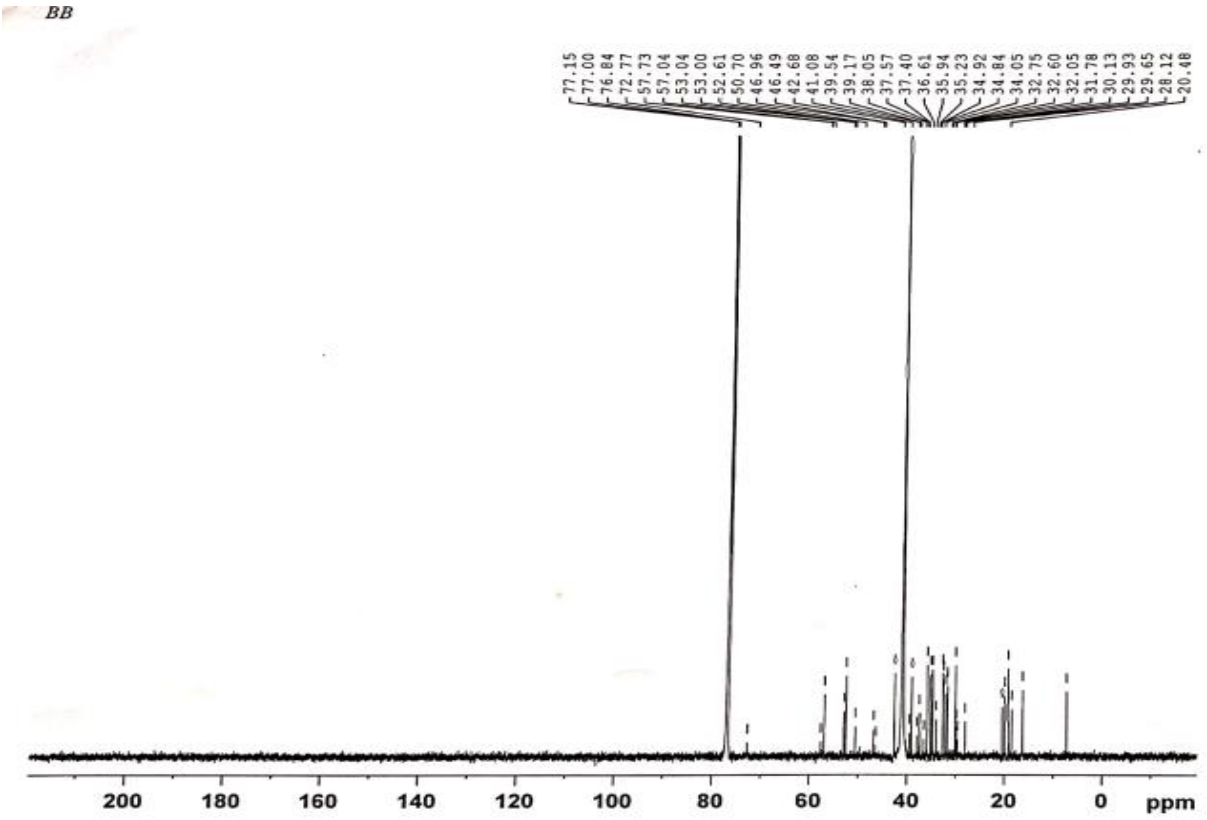

Figure S3: ^{13}C NMR spectrum (($CDCl_3$, 200 MHz) of compound **1**

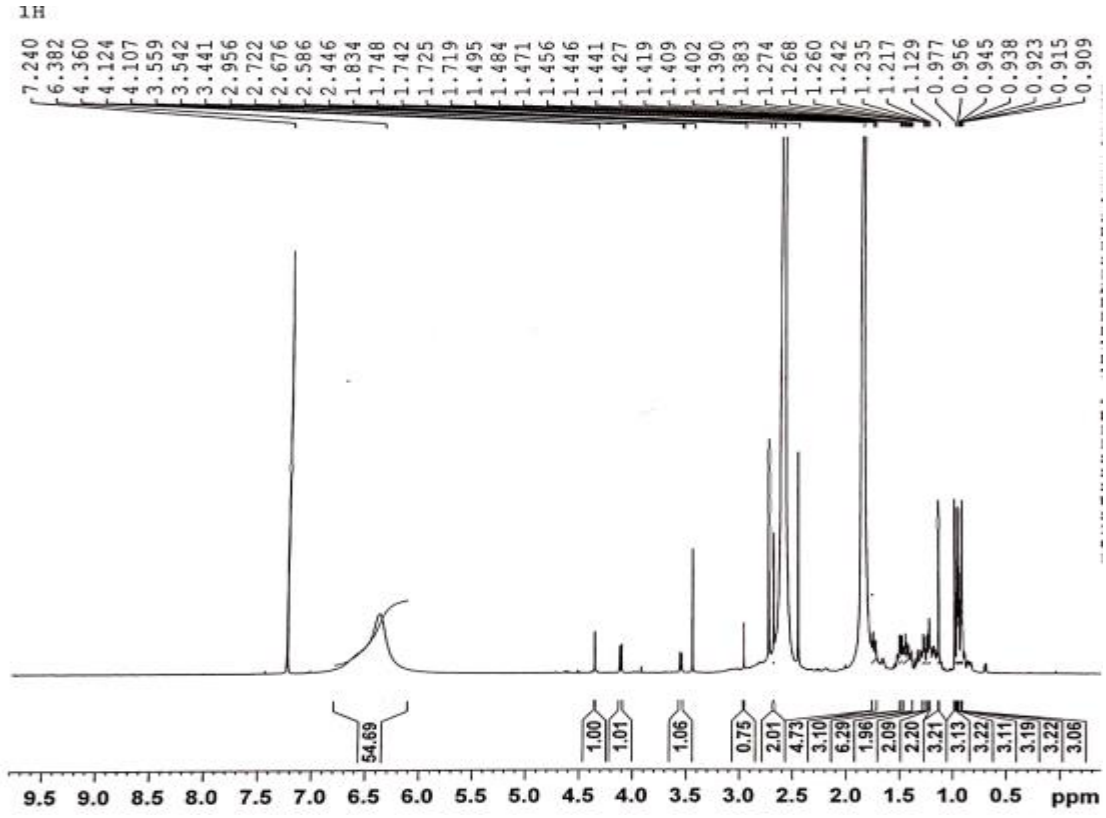

Figure S4-1: ^{1}H NMR spectrum ($CDCl_3$, 800 MHz) of compound **1**

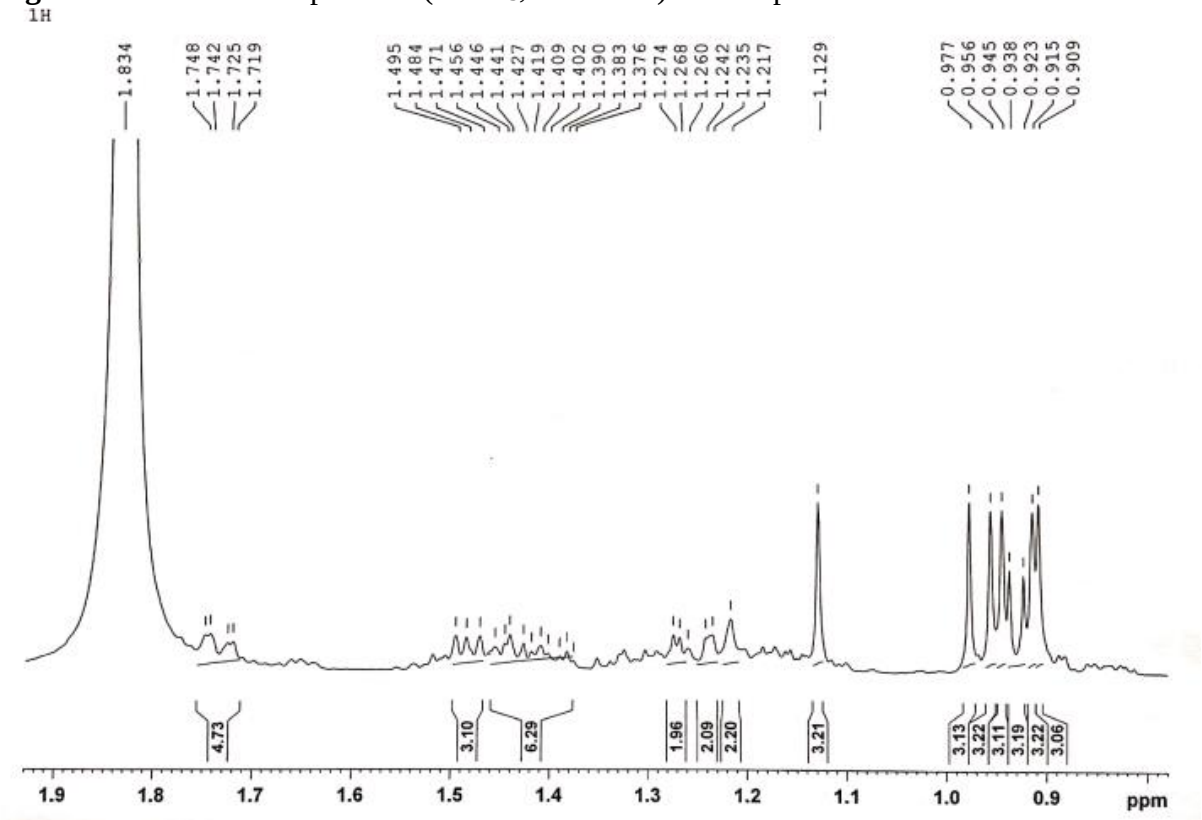

Figure S4-2: ^{1}H NMR spectrum ($CDCl_3$, 800 MHz) of compound **1**

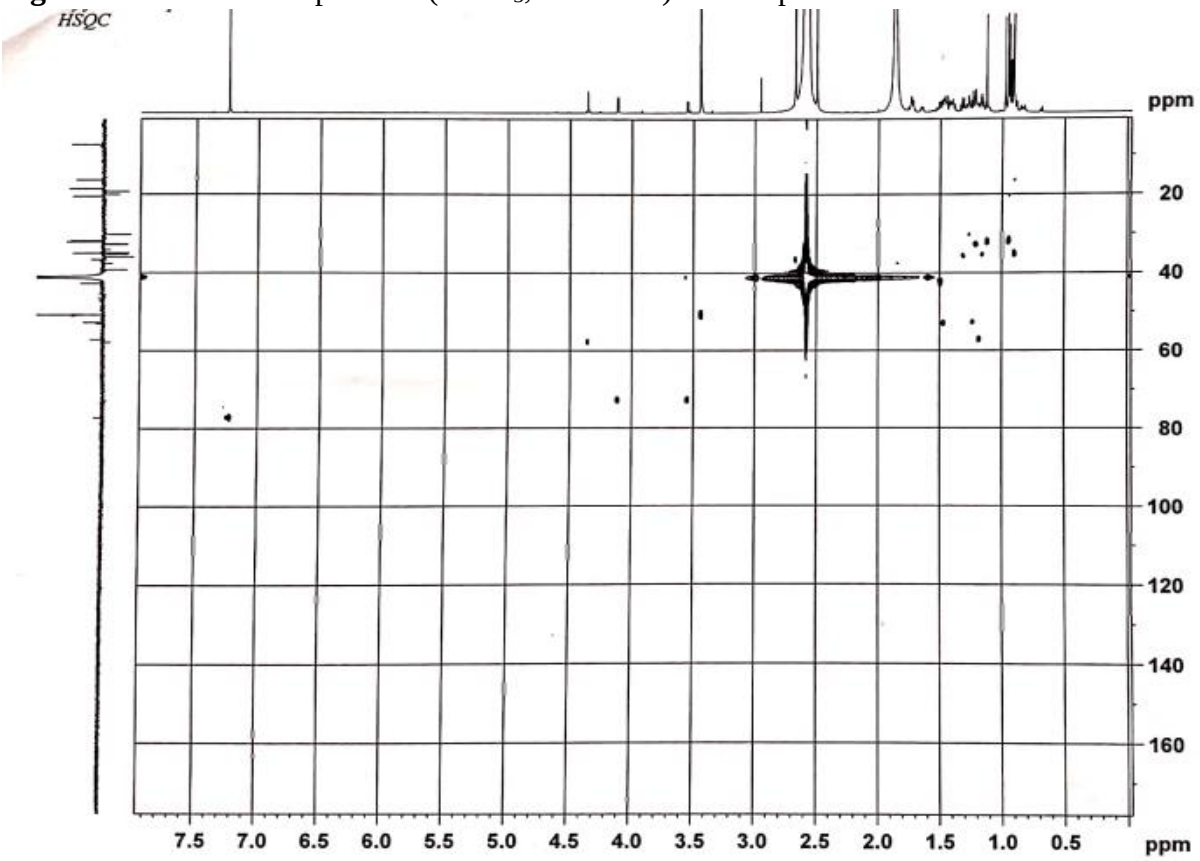

Figure S5: DEPT- HSQC spectrum ($CDCl_3$, 800 MHz) of compound **1**

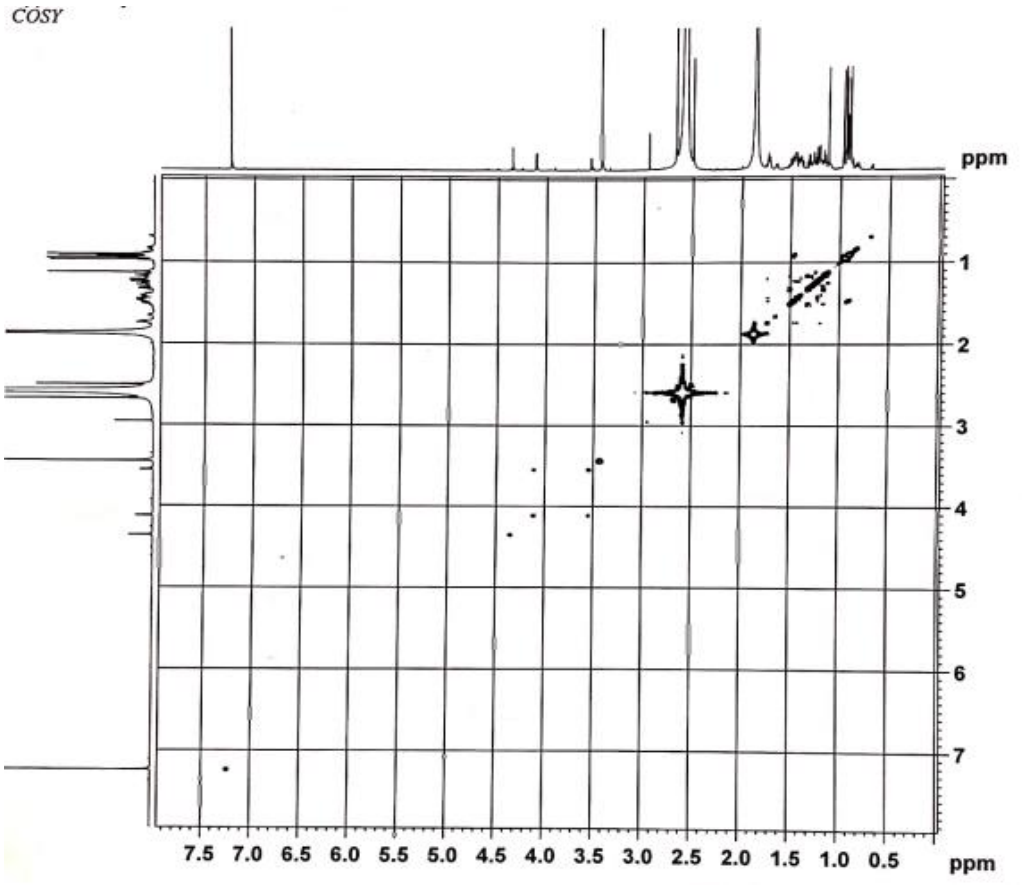

Figure S6: COSY spectrum ($CDCl_3$, 800 MHz) of compound **1**

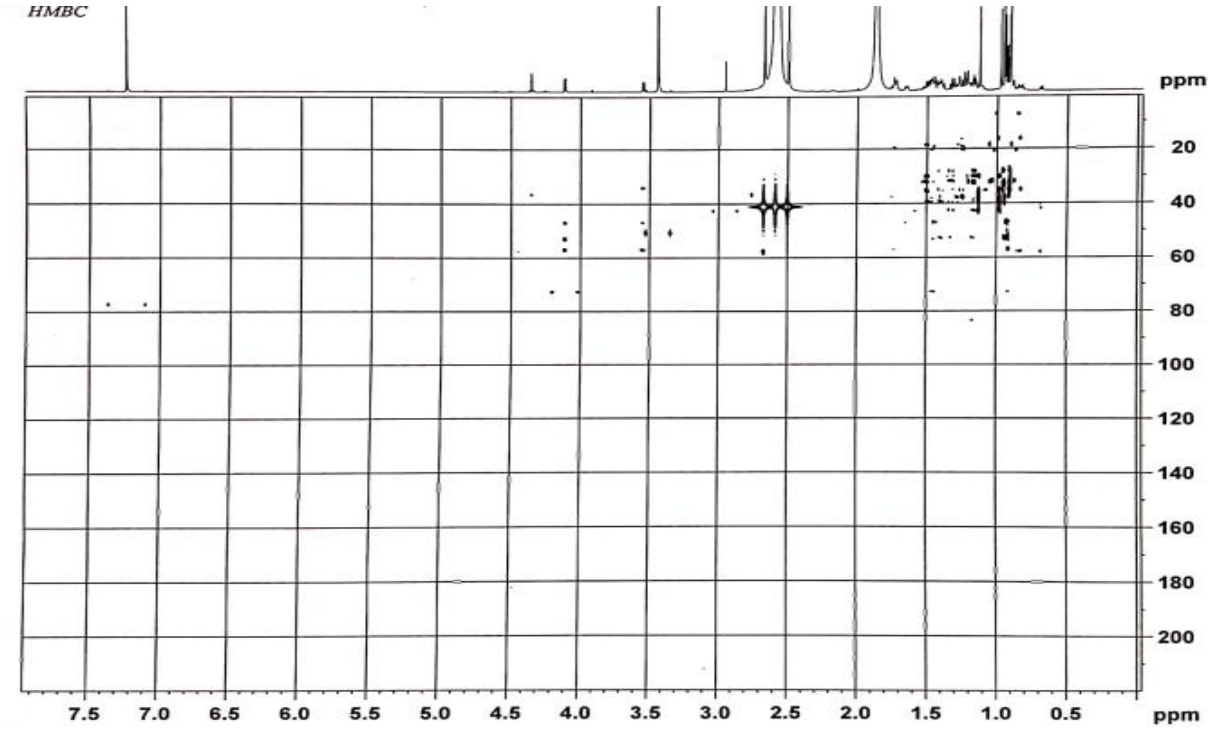

Figure S7-1: HMBC spectrum ($CDCl_3$, 800 MHz) of compound **1**

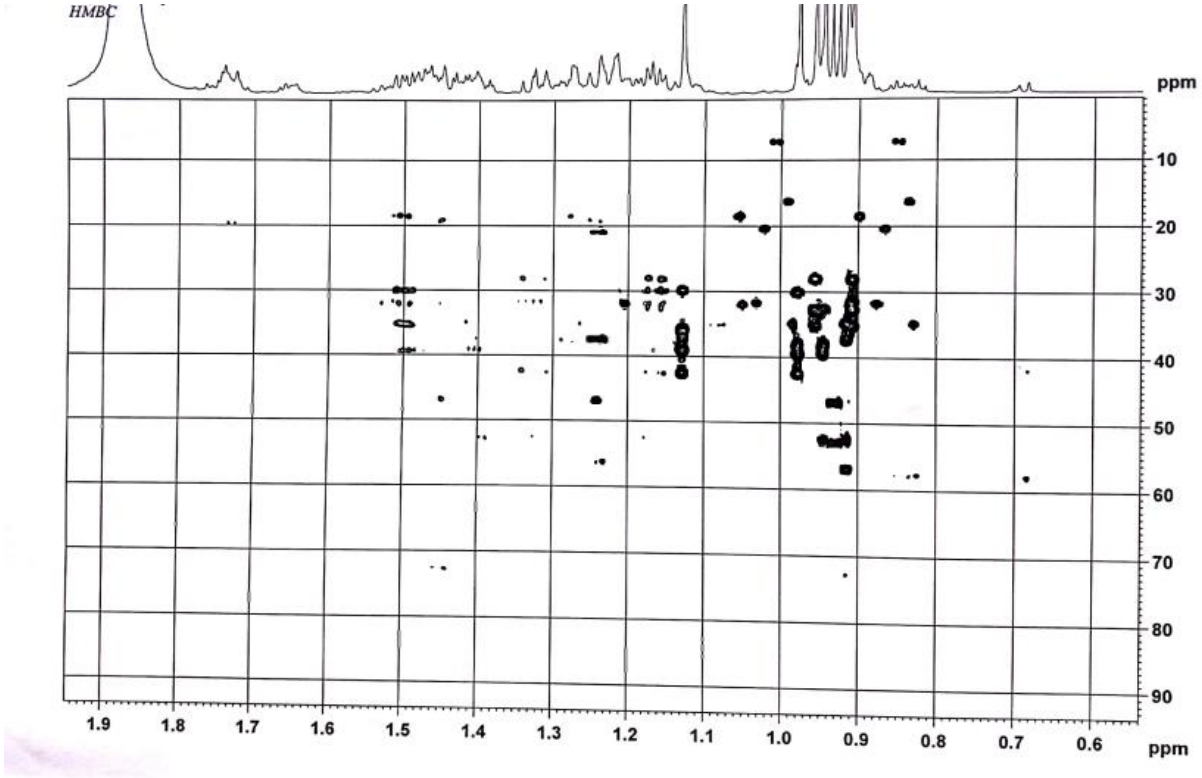

Figure S7-2: HMBC spectrum ($CDCl_3$, 800 MHz) of compound **1**

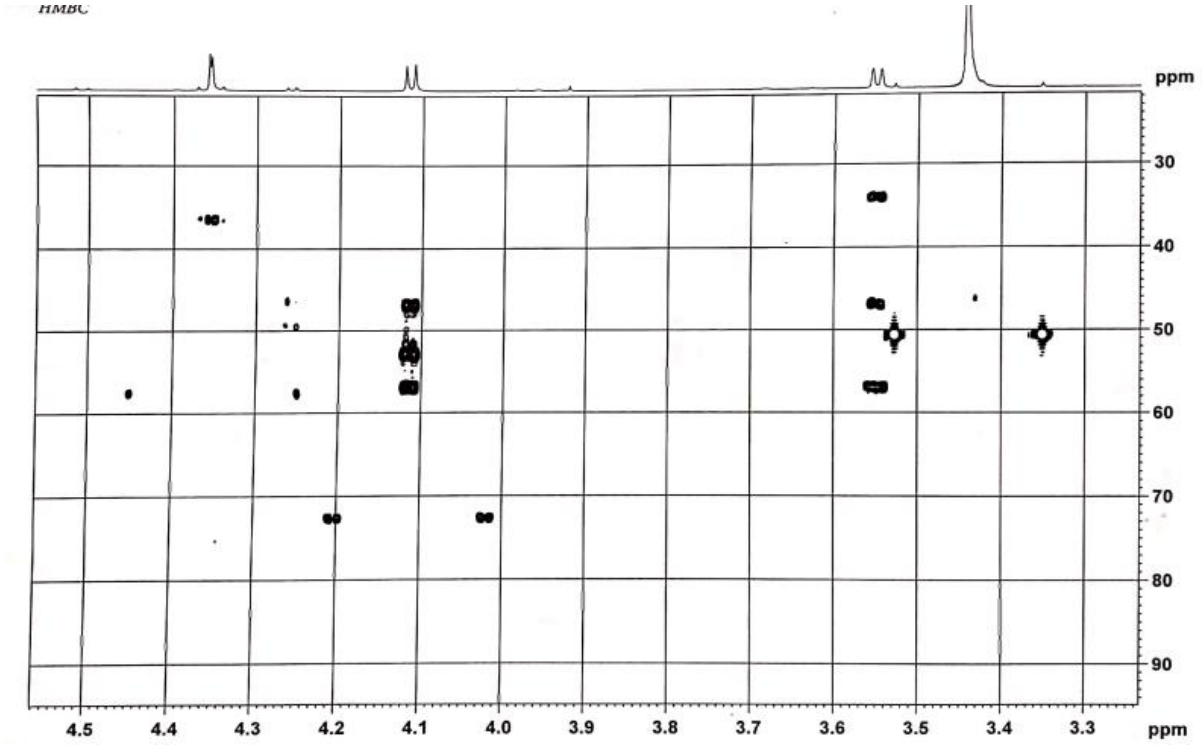

Figure S7-3: HMBC spectrum ($CDCl_3$, 800 MHz) of compound **1**

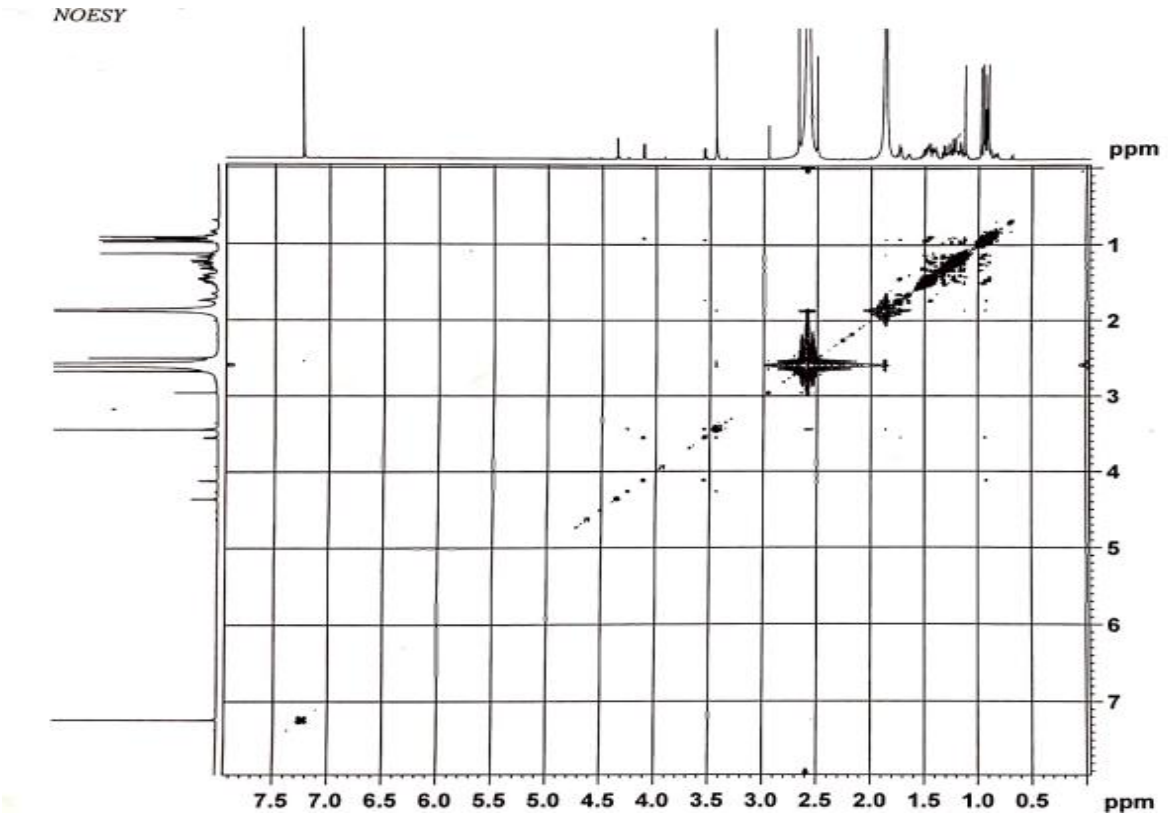

Figure S8-1: NOESY spectrum ($CDCl_3$, 800 MHz) of compound **1**

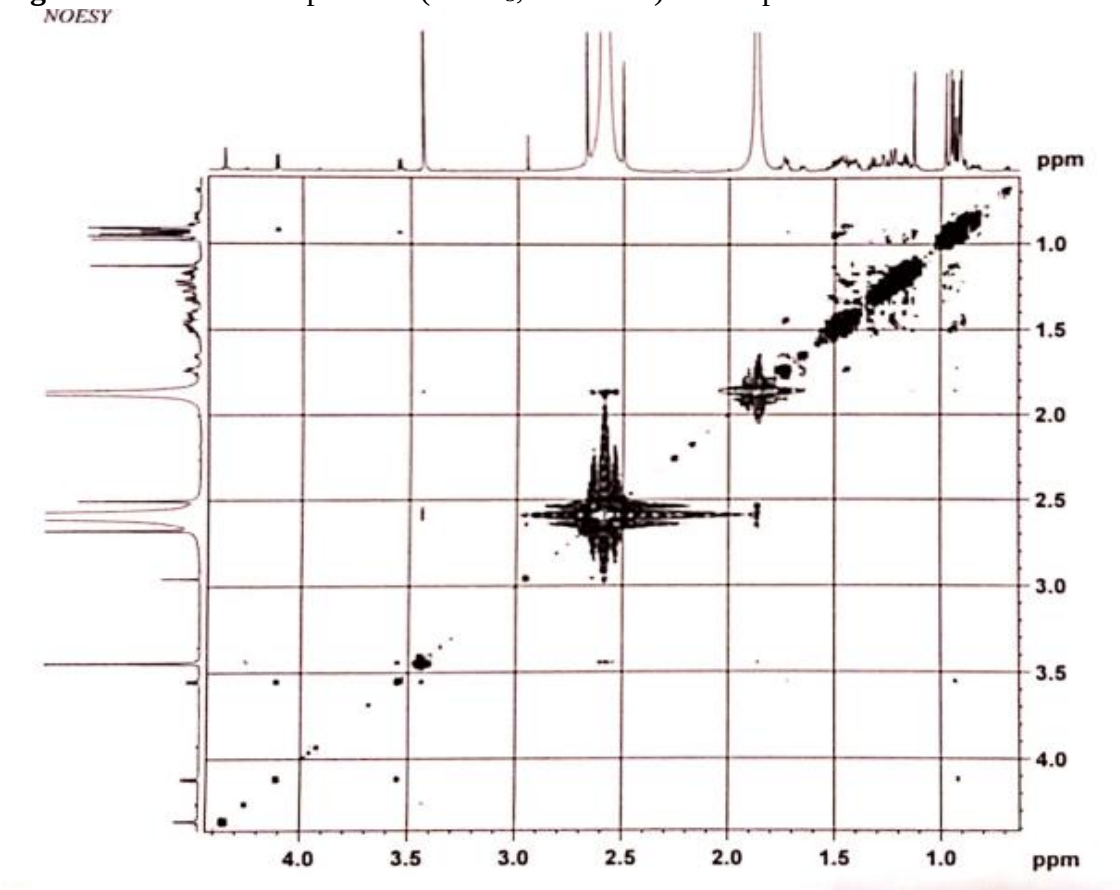

Figure S8-2: NOESY spectrum ($CDCl_3$, 800 MHz) of compound **1**

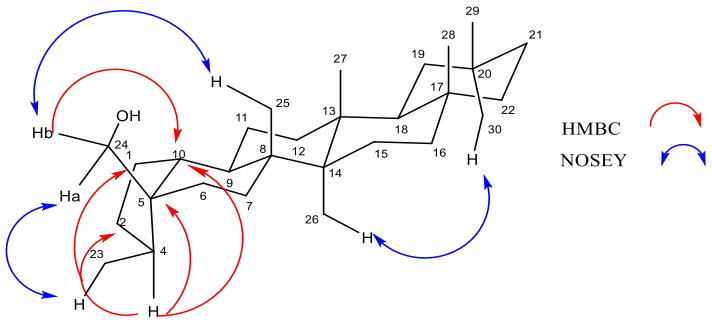

Figure S9: HMBC and NOESY correlation of compound **1**

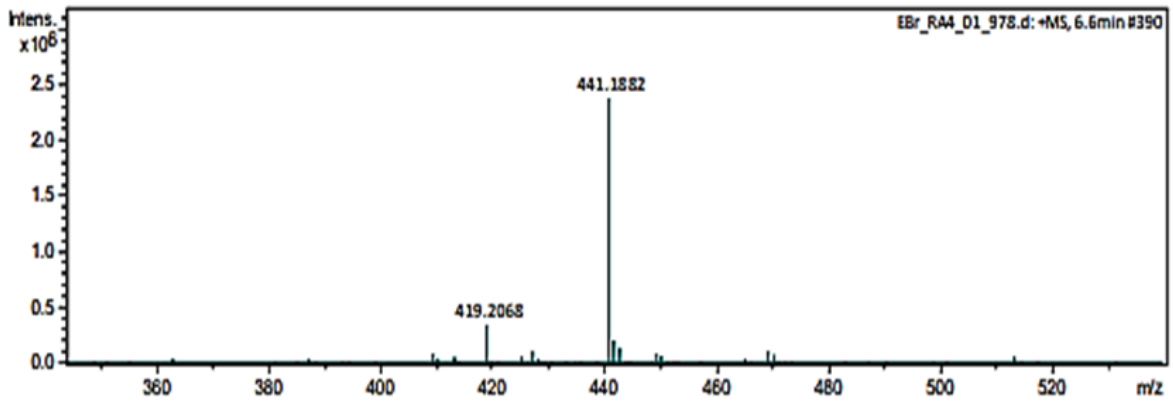

Figure S10-1: HR ESI Mass Spectrum of compound **4**

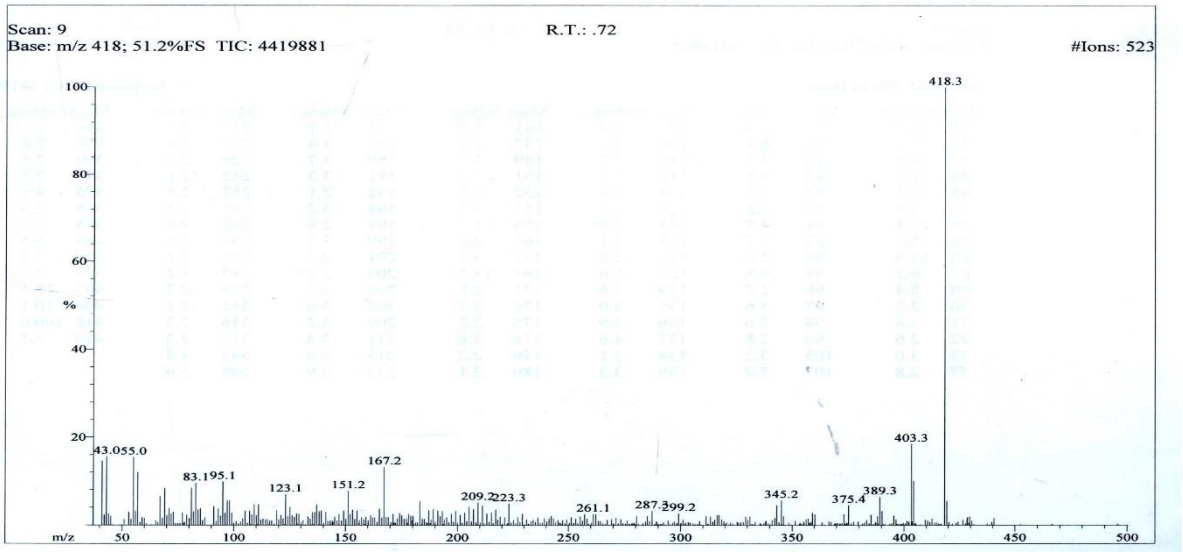

Figure S10-2: LREI Mass Spectrum of compound **4**

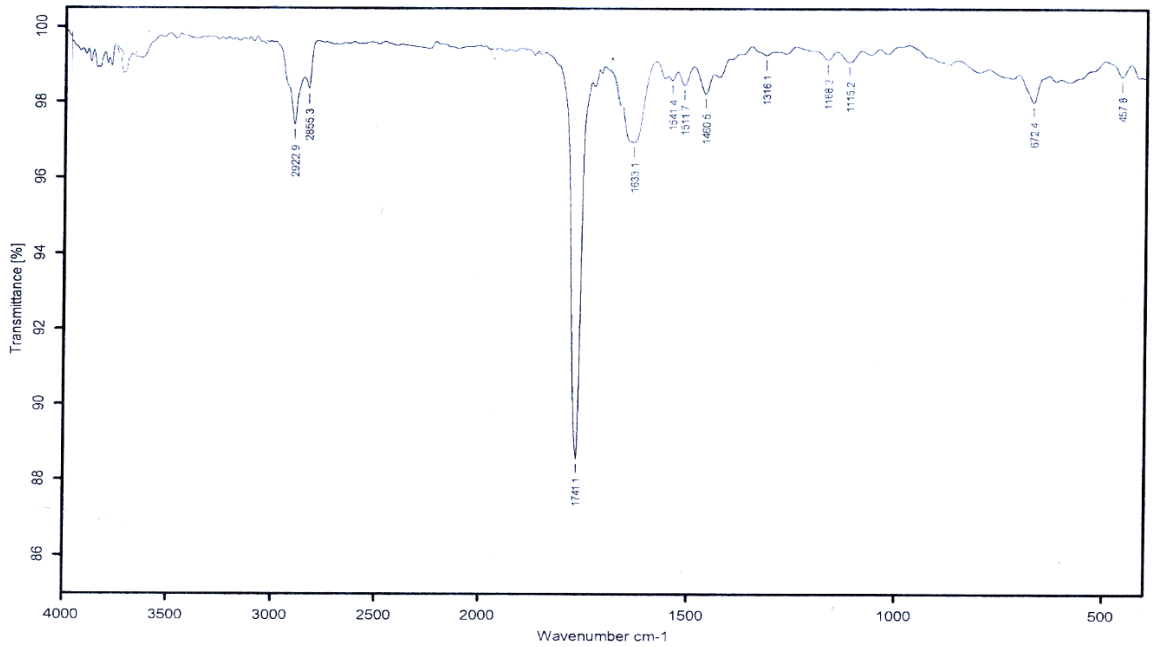

Figure S11: IR spectrum of compound **4**

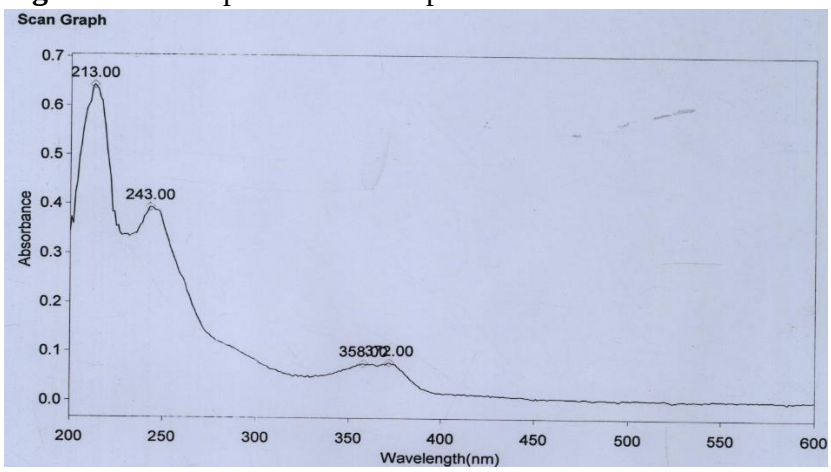

Figure S12: UV spectrum of compound **4**

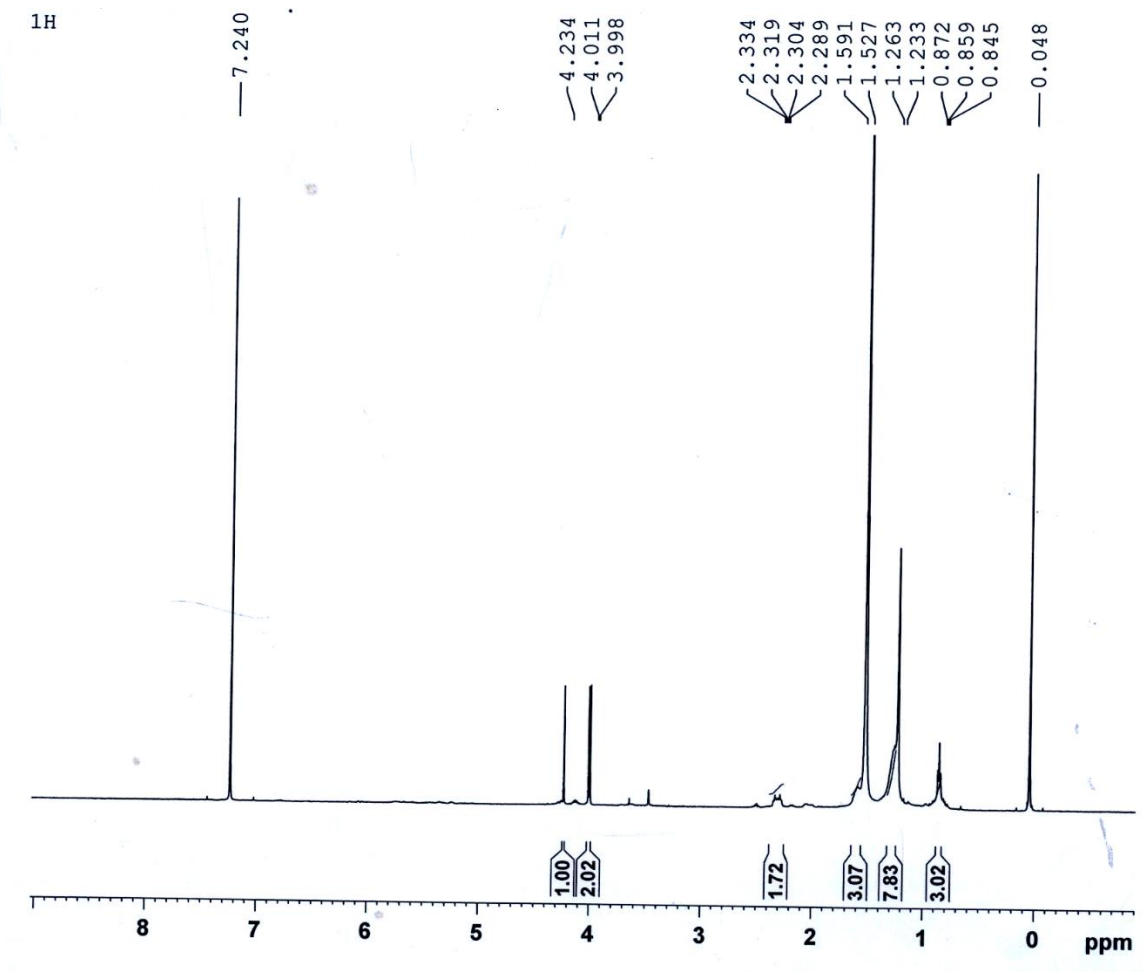

Figure S13-1: ^{1}H NMR spectrum ($CDCl_3$, 500 MHz) of compound of compound **4**

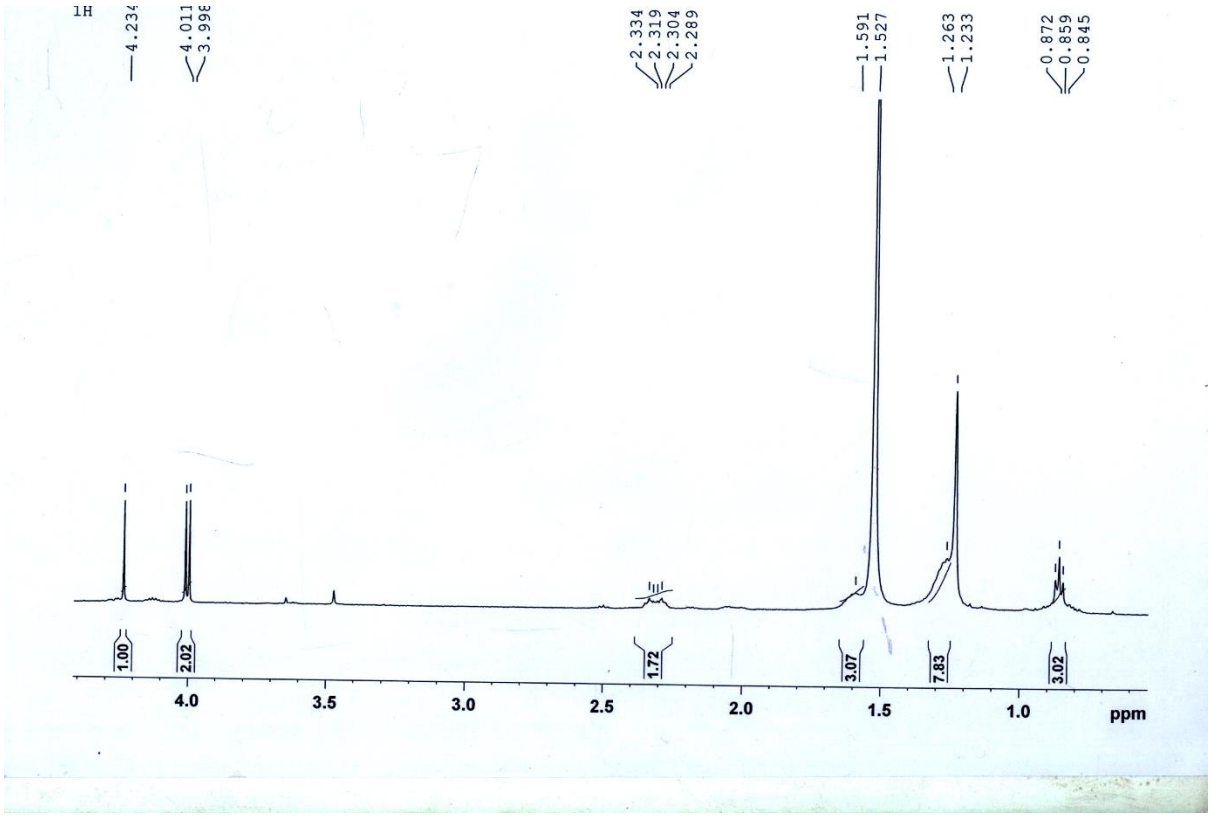

Figure S13-2: ^{1}H NMR spectrum ($CDCl_3$, 500 MHz) of compound of compound **4**

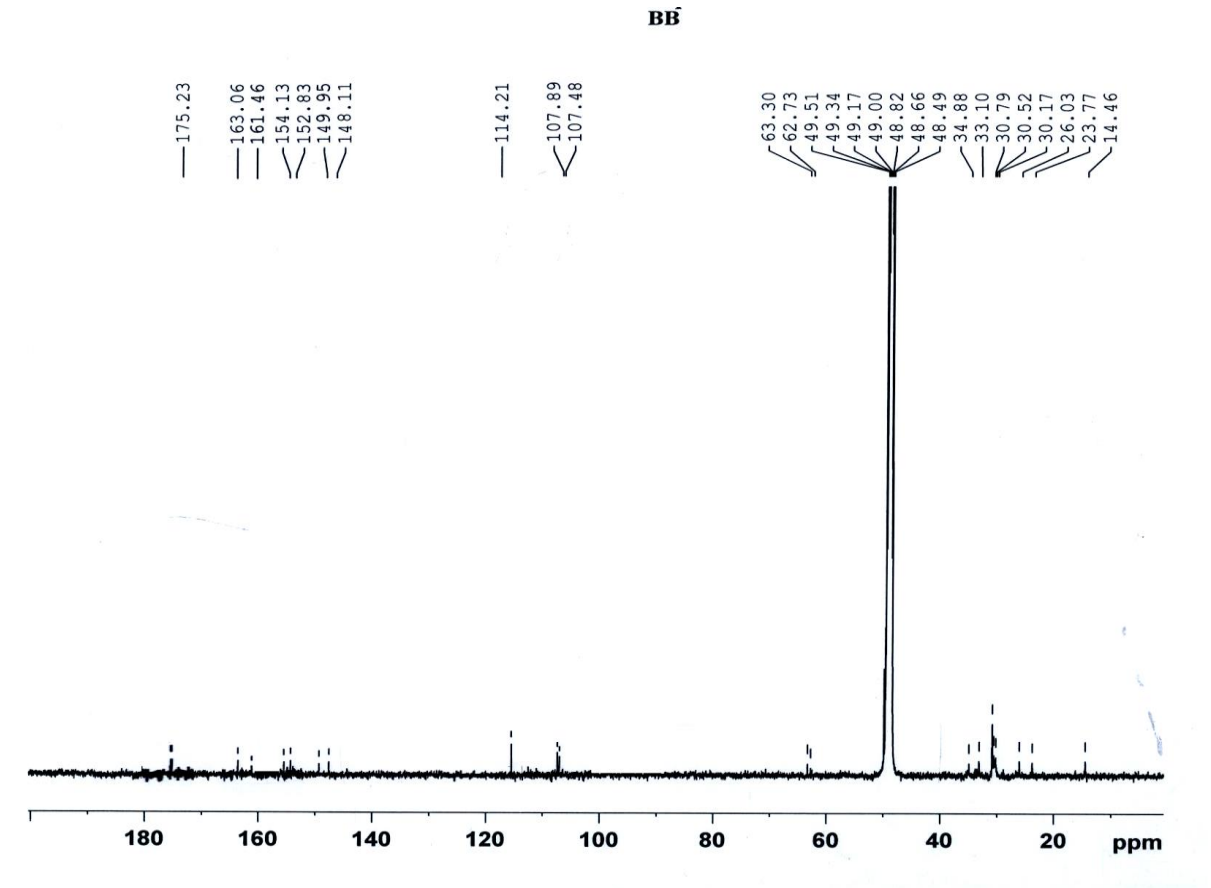

Figure S14: ^{13}C NMR spectrum ($CDCl_3$, 125 MHz) of compound **4**

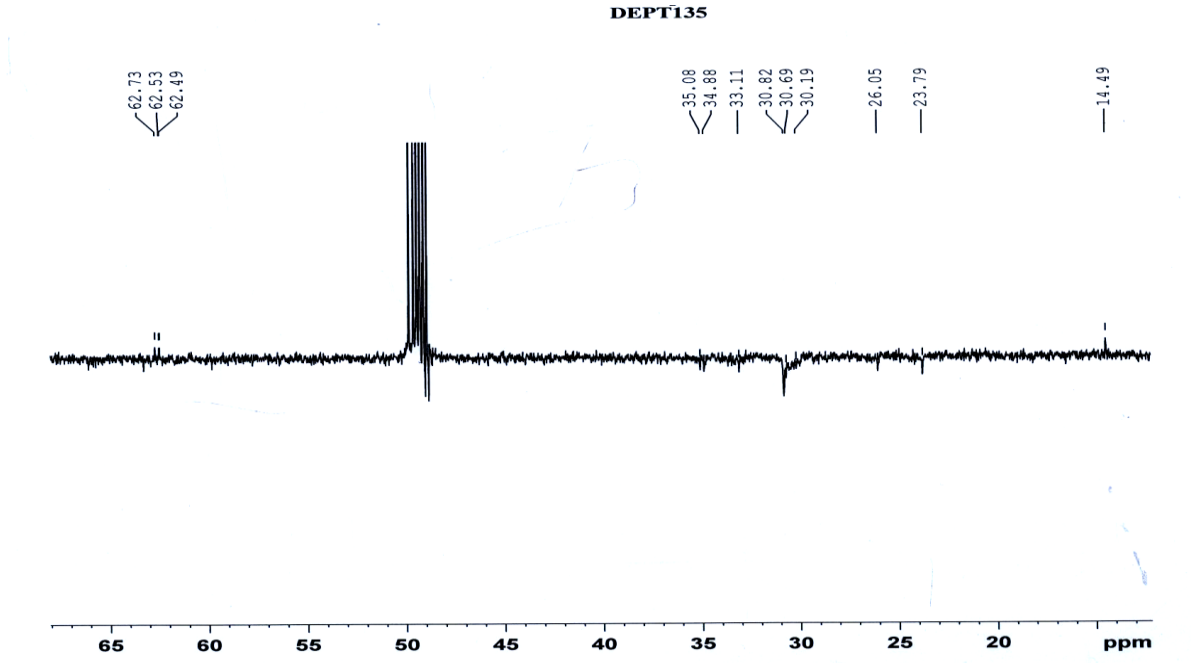

Figure S15: DEPT spectrum ($CDCl_3$, 125 MHz) of compound **4**

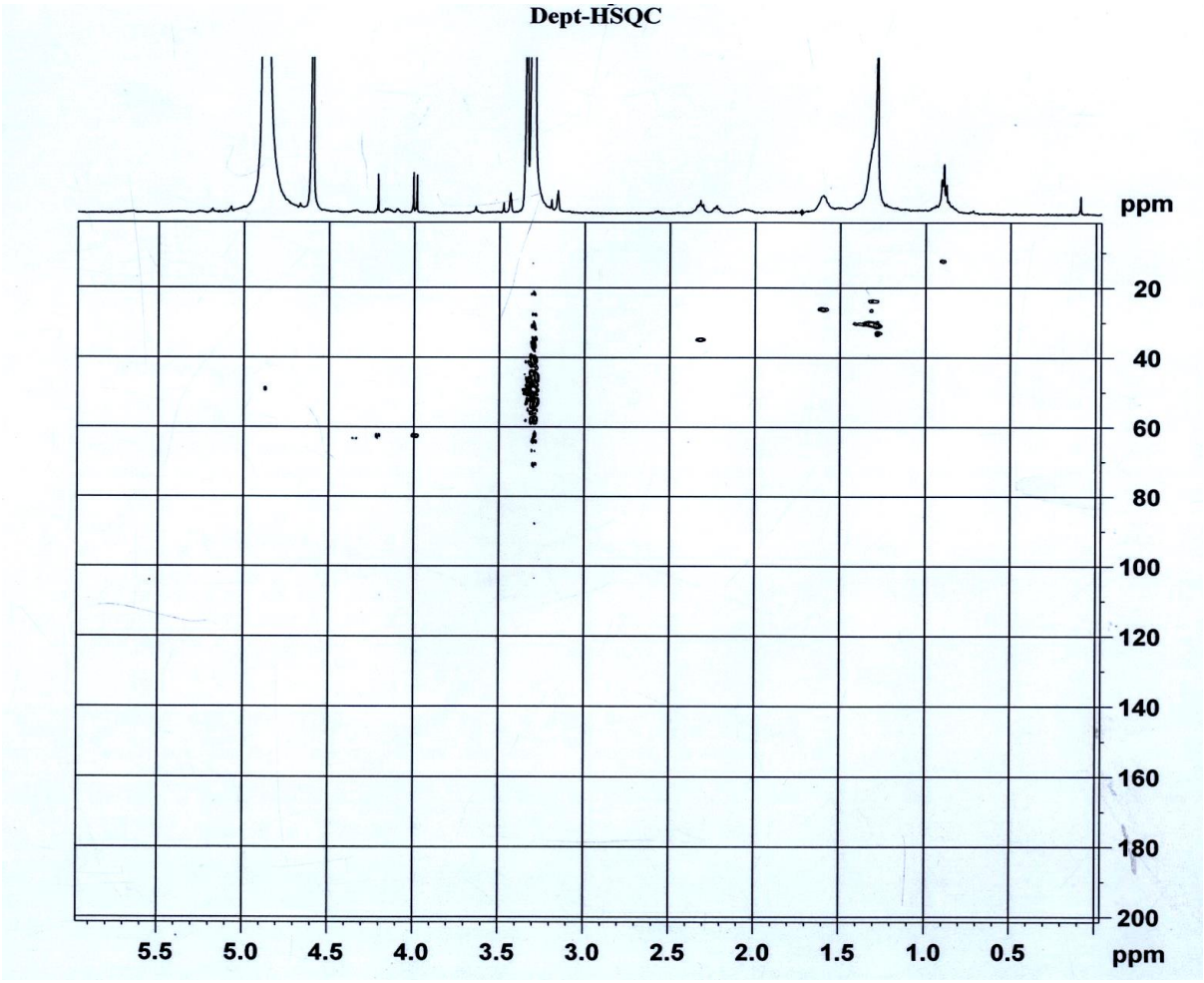

Figure S16: DEPT- HSQC spectrum ($CDCl_3$, 500 MHz) of compound **4**

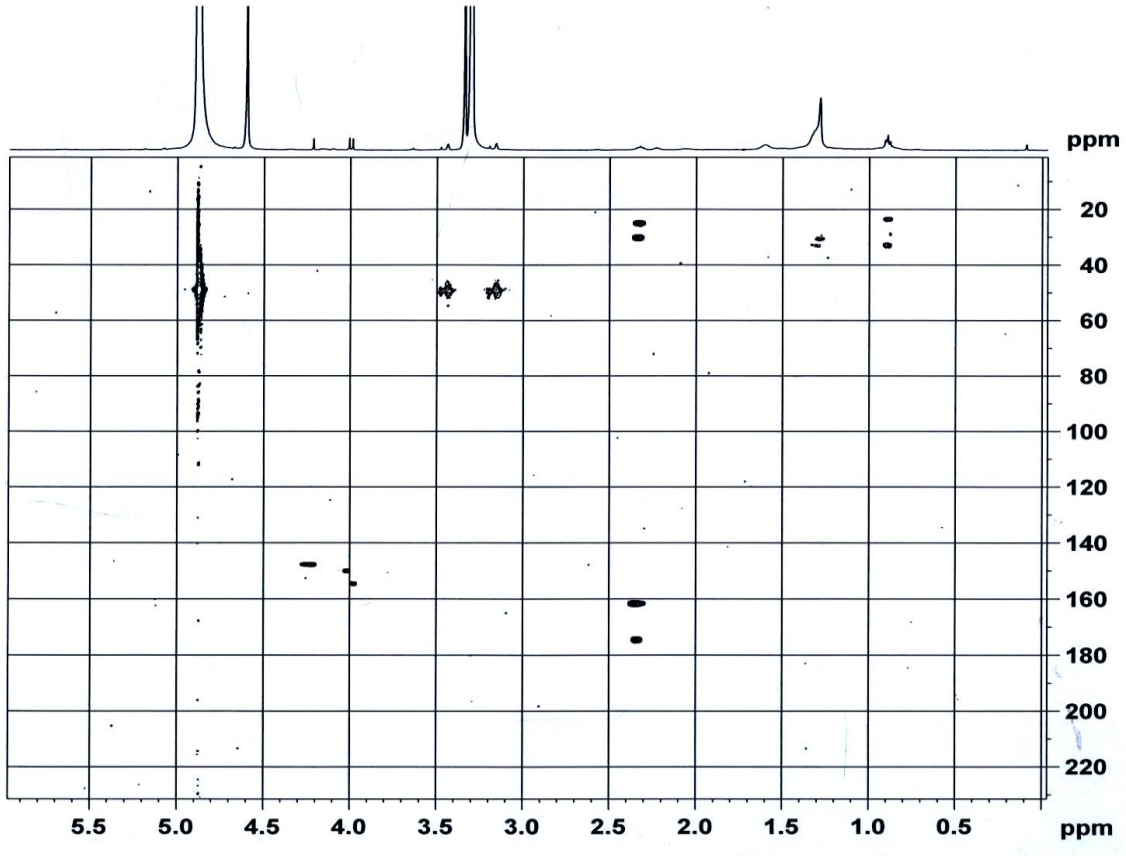

Figure S17-1: HMBC spectrum ($CDCl_3$, 500 MHz) of compound **4**

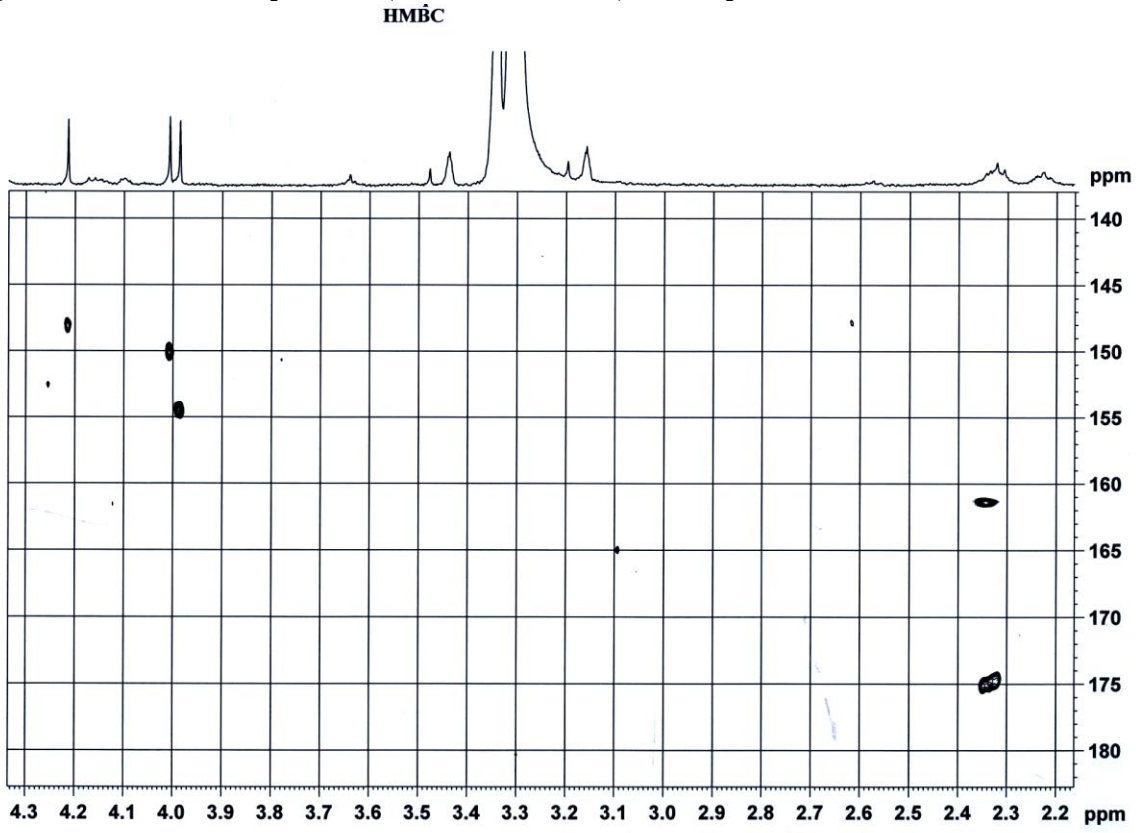

Figure S17-2: HMBC spectrum ($CDCl_3$, 500 MHz) of compound **4**

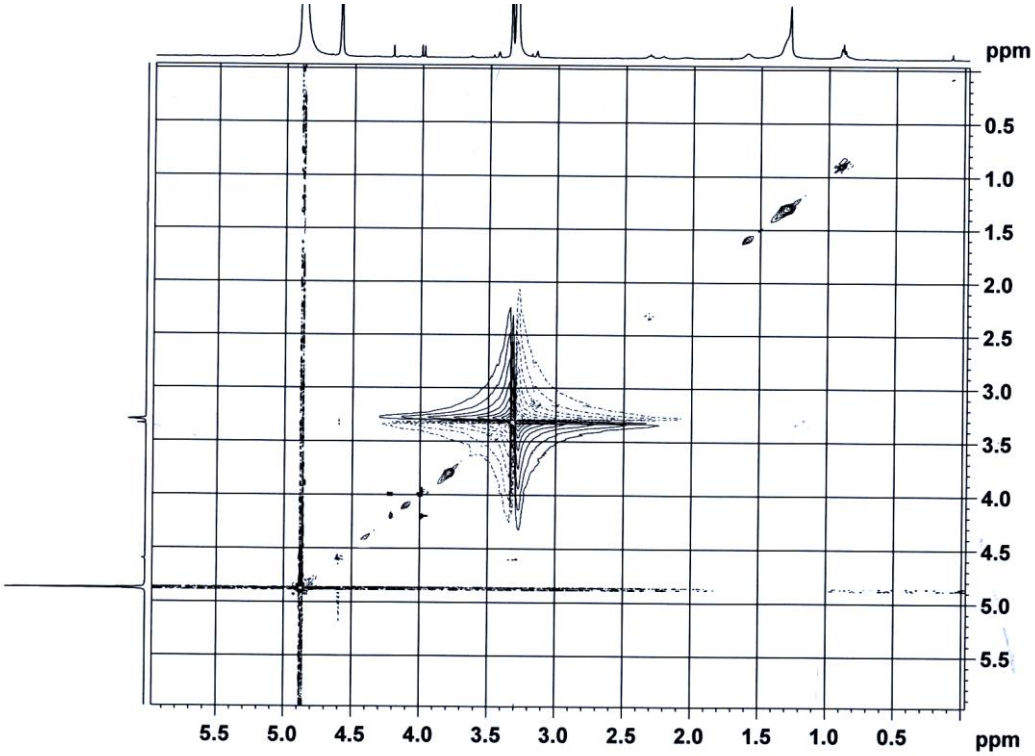

Figure S18: NOESY spectrum ($CHCl_3$, 500 MHz) of compound **4**

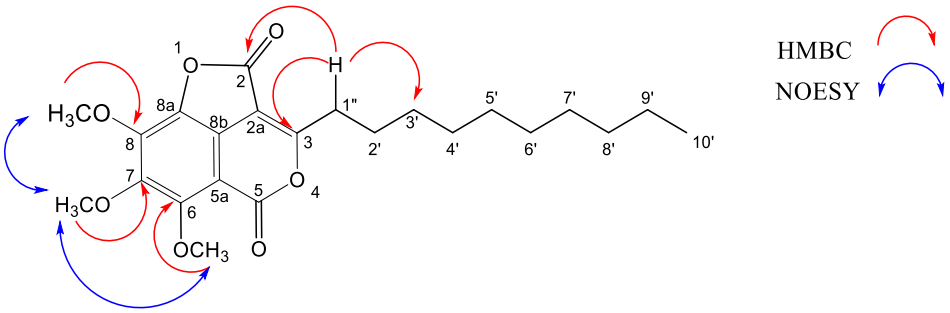

Figure S19: HMBC and NOESY correlation of compound **1**

Table S1: The NMR spectral data of compound 1

position	δc (ppm)	δH (ppm)
1	20.0	
2	39.1	
3	-	
4	53.0	1,22 ; m
5	50.7	
6	35.2	
7	19.2	
8	52.6	1,47 ; m
9	37,6	
10	57.0	1, 18 ; m
11	35.9	
12	30.1	
13	39.2	
14	38.1	
15	32.8	
16	36.6	
17	30.1	
18	42.7	1.48; m
19	34.8	
20	28.1	
21	34.1	
22	39.5	
23	8.6	*0.93 (3H, d, 7.5 Hz)*
24	72.8	3.55 ; H24a ; d, *J*= 8.5 Hz
		4.11 ; H24b ; d, *J*= 8.5 Hz
25	16.4	0.92 (3H, s)
26	20.4	0.95 (3H, s)
27	18.6	0.98 (3H, s)
28	32.1	0.96 (3H, s)
29	35.2	0.91 (3H, s)
30	31.8	1.13 (3H, s)

Table S2. The NMR spectral data of compound 2

position	δH (ppm)	δc (ppm)
1	-	-
2		175.2
2a	-	114.2
3	-	161.5
4	-	-
5	-	163.1
5a		107.5
6		154.1
7		148.1
8		150.0
8a		152.8
8b		107.9
1’	2.39	35.8
2’	1.60	26.1
3’-9’	1.23-1.26	23.6-34.8
10’	0.86	14.5
6-OCH_3	3.99	62.7
7- OCH_3	4.23	62.4
8- OCH_3	4.01	62.5

Table S3. Cholinesterase, α-glucosidase, urease and tyrosinase inhibitory activities of the isolated compounds

	Cholinesterase inhibitory activity									
	AChE inhibition		**BChE inhibition**		**α-glucosidase inhibition**		**Urease inhibition**		**Tyrosinase inhibition**	
Test samples	**Inh. (%) (at 100 µg/mL)**	**IC_{50} (µg/mL)**	**Inhibition (%) (at 100 µg/mL)**	**IC_{50} (µg/mL)**	**Inh. (%) (at 100 µg/mL)**	**IC_{50} (µg/mL)**	**Inh. (%) (at 100 µg/mL)**	**IC_{50} (µg/mL)**	**Inh. (%) (at 100 µg/mL)**	**IC_{50} (µg/mL)**
1	28.00±0.74	>100	46.61±0.33	>100	46.15±0.22	>100	51.83±0.66	96.43±0.75	46.98±0.34	>100
2	24.00±0.22	>100	33.40±0.63	>100	43.56±0.45	>100	52.27±0.70	94.85±0.76	25.51±0.33	>100
4	48.72±0.45	>100	60.47±1.25	70.87±0.95	73.91±1.20	42.45±0.46	58.63±0.44	75.17±0.63	35.21±0.46	>100
5	35.90±0.26	>100	57.43±0.53	76.41±0.79	66.30±0.62	60.51±0.67	58.33±0.25	75.48±0.58	75.90±0.85	36.24±0.86
6	37.30±0.16	>100	59.62±0.77	71.24±0.56	64.78±1.10	68.79±1.25	61.20±0.56	66.45±0.38	76.51±0.77	35.72±0.55
7	32.63±0.54	>100	50.42±0.21	98.86±0.90	65.39±1.05	66.80±1.30	46.30±0.20	>100	55.25±0.80	81.34±0.48
Galantamine	85.50±0.70	5.50±0.25	74.65±0.20	42.10±0.45	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*
Thiourea	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	83.75±0.60	8.20±0.35	*NT*	*NT*
Kojic acid	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	*NT*	79.50±0.32	23.75±0.20
Acarbose	*NT*	*NT*	*NT*	*NT*	82.40±0.70	20.52±0.84	*NT*	*NT*	*NT*	*NT*

Values represent the means ± SEM of three parallel sample measurements ($p < 0.05$).
NT: not tested.