Oriental Journal of Chemistry Vol. **25**(1), 195-198 (2009)

Convenient synthesis and evaluation of new substituted phenyl Azo-coumarins and Schiff's bases

ALOK K. PAREEK*, P.E. JOSEPH and DAYA S. SETH

School of Chemical Sciences, Chemistry Department St. John's College, Agra - 282 002 (India).

(Received: December 20, 2008; Accepted: February 03, 2009)

ABSTRACT

Various substituted azo-coumarins and schiff's bases bearing methoxy and chloro groups have been synthesized by the condensation of substituted 3-chloro-4-methoxy phenyl azo-salicylaldehyde with different malon-anilic acids by using pyridine as condensing agent. Structure of newly synthesized azo-coumarins and schiff's bases were established on the basis of their analytical and spectral evaluation.

Key words: Substituted phenyl azo-coumarins and Schiff's bases, condensation, spectral studies.

INTRODUCTION

The compounds bearing azo group are known to exhibit bacterostatic[1-2] and anticancereous activity. The biological importance of azo-coumarins and their derivatives is well known for their use as antibiotics[3], antineoplastic[4], anti-diabetics[5], anti-bacterial[6-7] and antifungal[8-9] activities, several antibacterial drugs are modulate on it's structure such as Novobiocin Coumeromycin and Chartusein. Schiff's bases have also possess antiviral[10], anticancer[11], antimicrobial[12] activities.

Schiff's bases have also possess with sulfonamide moiety are endowed with antibacterial activity13. In this laboratory also a number of azo-coumarins and schiff's bases have been prepared[14-21]. In the present study we have synthesized a series of new azo-coumarins and schiff's bases and they having azo group at position 6. The azo-coumarins and schiff's bases have been synthesized by the condensation of substituted azo-salicylaldehyde with N(R)-phenyl malonamic acids in presence of pyridine.

EXPERIMENTAL

Material

Melting points were taken in open capillary tubes and are uncorrected. All the chemicals used in the synthesis were obtained from Sigma-Aldrich Company. All the newly synthesized compounds were recrystallised by absolute ethanol 99.9%. The purity of all the compounds checked by TLC on silica-gel-coated AI plates (Merck), by using 10% benzene/methanol for azo-coumarins and 5% benzene/methanol for schiff's bases. IR spectra (cm^{-1}) were recorded on Perkin-Elmer spectrum RX-1 FT-IR spectrophotometer at St. John's College, Agra by KBr-disc method.

The physical and analytical data, melting point, colour, molecular formula, molecular weight, yield% are recorded in Table-1.

Synthesis of 2-hydroxy-5 (3-chloro- 4-methoxy phenyl azo) benzaldehyde (1)

To the substituted aniline (3-chloro-4-methoxy) 3.940 gm (0.025 mole) was diazotized by adding concentrated HCl (8 ml) in 7 ml water and cooled at 00C in an ice-bath then a cold solution of sodium nitrite in water (8 ml) was slowly added with stirring and maintaining the temperature at 0°C to 2°C till the whole reaction was complete, after that a solution of salicylaldehyde (0.025 mole) in 2N NaOH (20 ml) was added with constant stirring to the above diazotised solution. The brownish yellow solid which separated was filtered, washed with cold water and recrystallised from ethanol, yield 72.06%.

Table 1 : Physical and Analytical data of synthesized compounds

C.No.	Compound Name	Molecular Weight	Molecular Formula	% Analytical data						Colour	M.P. (°C)	Yield %
				C cal.	Found	H cal.	Found	N cal.	Found			
1.	2-OH-5 (3-Cl-4-0CH_3 Phenyl Azo) Benzaldehyde	291.71	$C_{14}H_{12}N_2O_3Cl_1$	57.64	57.67	4.14	4.15	9.60	9.62	Pale Cream	103°	72.06
2	N-(2-Cl-5-F_3 Methyl) Phenyl Malonamic Acid	281.63	$C_{10}H_7O_3N_1Cl_1F_3$	42.64	42.68	2.50	2.51	4.97	4.99	Light Green	132°	43.24
3.	N-(2-OC_2H_5) Phenyl Malonamic Acid	223.23	$C_{11}H_{13}O_4N_1$	59.18	59.21	5.87	5.88	6.27	6.28	Suede	121°	59.90
4.	N-(2,4-DiChloro) Phenyl Malonamic Acid	248.06	$C_9H_7N_1O_3Cl_2$	43.57	43.61	2.84	2.86	5.64	5.66	White	134°	57.92
5.	N-(2-Fluoro) Phenyl Malonamic Acid	197.16	$C_9H_8N_1O_3F_1$	54.82	54.84	4.09	4.10	7.10	7.12	Lemonish White Crystaline	122°	42.25
6.	N-(4-CH_3) Phenyl Malonamic Acid	193.20	$C_{10}H_{11}N_1O_3$	62.16	62.19	5.74	5.76	7.25	7.28	White	142°	53.98
7.	N-(4-Br) Phenyl Malonamic Acid	258.06	$C_9H_8N_1O_3Br_1$	41.88	41.91	3.12	3.13	5.43	5.45	White	138°	57.09
8.	N-(2-OCH_3) Phenyl Malonamic Acid	209.19	$C_{10}H_{11}N_1O_4$	57.41	57.39	5.29	5.28	6.69	6.71	Mangolia	130°	43.86
9.	N-(5-Cl-2CH_3) Phenyl Malonamic Acid	227.65	$C_{10}H_{10}N_1O_3Cl_1$	52.76	52.79	4.42	4.44	6.15	6.18	Off White	148°	42.39
10.	N-(2,4-$(CH_3)_2$) Phenyl Malonamic Acid	207.23	$C_{11}H_{13}N_1O_3$	63.75	63.73	6.32	6.30	6.76	6.79	Yellowish White	134°	48.44
11.	N-(3,5-$(CH_3)_2$) Phenyl Malonamic Acid	207.23	$C_{11}H_{13}N_1O_3$	63.75	63.72	6.32	6.31	6.76	6.78	Creamish White	112°	43.73
12.	6-(2Cl-5 F_3 Methyl Phenyl azo) - coumarin-R^1	537.32	$C_{24}H_{15}N_3O_4Cl_2F_3$	53.64	53.67	2.81	2.83	7.82	7.85	Pale Cream	185°	40.73
13.	6-(2OC_2H_5 Phenyl azo) - coumarin-R^1	478.92	$C_{25}H_{21}N_3O_5Cl_1$	62.69	62.73	4.42	4.45	8.77	8.79	Volcano	222°	50.97
14.	6-(2, 4 DiChloro Phenyl azo) - coumarin-R^1	503.76	$C_{23}H_{15}N_3O_4Cl_3$	54.83	54.87	3.00	3.02	8.34	8.36	Dark Pale Cream	237°	57.97
15.	6-(2-Fluoro Phenyl azo) - coumarin-R^1	452.86	$C_{23}H_{16}N_3O_4Cl_1F_1$	61.00	61.03	3.55	3.59	9.27	9.31	Yellowish Green	211°	45.90
16.	6-(4-CH_3 Phenyl azo) - coumarin-R^1	448.89	$C_{24}H_{19}N_3O_4Cl_1$	64.21	64.25	4.26	4.28	9.36	9.38	Volcano	185°	66.32
17.	6-(4-Br Phenyl azo) - coumarin-R^1	513.77	$C_{23}H_{16}N_3O_4Cl_1Br_1$	53.77	53.81	3.14	3.15	8.18	8.21	Pale Cream	223°	70.49
18.	6-(2-OCH_3 Phenyl azo) - coumarin-R^1	464.89	$C_{24}H_{19}N_3O_5Cl_1$	62.00	62.04	4.12	4.14	9.04	9.07	Volcano	198°	52.60
19.	6-(5-Cl-2CH_3 Phenyl azo) - coumarin-R^1	483.34	$C_{24}H_{18}N_3O_4Cl_2$	59.64	59.67	3.75	3.78	8.69	8.72	Deep Brown	241°	54.24
20.	6-(2,4-Di-Methyl Phenyl azo) - coumarin-R^1	462.92	$C_{25}H_{21}N_3O_4Cl_1$	64.86	64.83	4.57	4.56	9.08	9.11	Jeep Green	231°	46.98
21.	6-(3,5-Di-Methyl Phenyl azo) - coumarin-R^1	462.92	$C_{25}H_{21}N_3O_4Cl_1$	64.86	64.84	4.57	4.55	9.08	9.09	Dark Casablanca	216°	44.57
22.	2-hydroxy-5 (2-Cl-5-F_3 Methyl) benzylidine-R^2	470.30	$C_{21}H_{16}N_3O_2Cl_2F_3$	53.63	53.67	3.43	3.44	8.93	8.95	Coffee Brown	66°	42.11
23.	2-hydroxy-5 (2-OC_2H_5) benzylidine-R^2	411.89	$C_{22}H_{22}N_3O_3Cl_1$	64.15	64.18	5.38	5.40	10.20	10.22	Velvet Red	68°	46.49
24.	2-hydroxy-5 (2,4 DiChloro) benzylidine-R^2	436.74	$C_{20}H_{16}N_3O_2Cl_3$	55.00	55.04	3.69	3.70	9.62	9.65	African Red	76°	55.05
25.	2-hydroxy-5 (2-Fluoro) benzylidine-R^2	385.83	$C_{20}H_{17}N_3O_2Cl_1F_1$	62.26	62.30	4.44	4.42	10.89	10.93	Brick Tone Brown	89°	41.80
26.	2-hydroxy-5 (4-CH_3) benzylidine-R^2	381.87	$C_{21}H_{20}N_3O_2Cl_1$	66.05	66.09	5.28	5.30	11.00	11.04	Light Brown	86°	61.57
27.	2-hydroxy-5 (4-Br) benzylidine-R^2	446.75	$C_{20}H_{17}N_3O_2Cl_1Br_1$	53.77	53.79	3.83	3.87	9.40	9.42	African Brown	84°	66.12
28	2-hydroxy-5 (2-OCH_3) benzylidine-R^2	397.87	$C_{21}H_{20}N_3O_3Cl_1$	63.39	63.40	5.06	5.09	10.56	10.57	Rust	63°	50.20
29.	2-hydroxy-5 (5-Cl-2CH_3) benzylidine-R^2	416.32	$C_{21}H_{19}N_3O_2Cl_2$	60.58	60.57	4.60	4.58	10.09	10.12	Light Coffee	72°	50.96
30	2-hydroxy-5 (2,4-Di-Methyl) benzylidine-R^2	395.89	$C_{22}H_{22}N_3O_2Cl_1$	66.74	66.71	5.60	5.57	10.61	10.59	Coffee Brown	Sticky	43.77
31.	2-hydroxy-5 (3,5-Di-Methyl) benzylidine-R^2	395.89	$C_{22}H_{22}N_3O_2Cl_1$	66.74	66.70	5.60	5.56	10.61	10.62	Dark Brown	Sticky	40.36

R^1=3-Carboxy-(3-Chloro-4-Methoxy) anilide
R^2=(3-Chloro-4-Methoxy) aniline

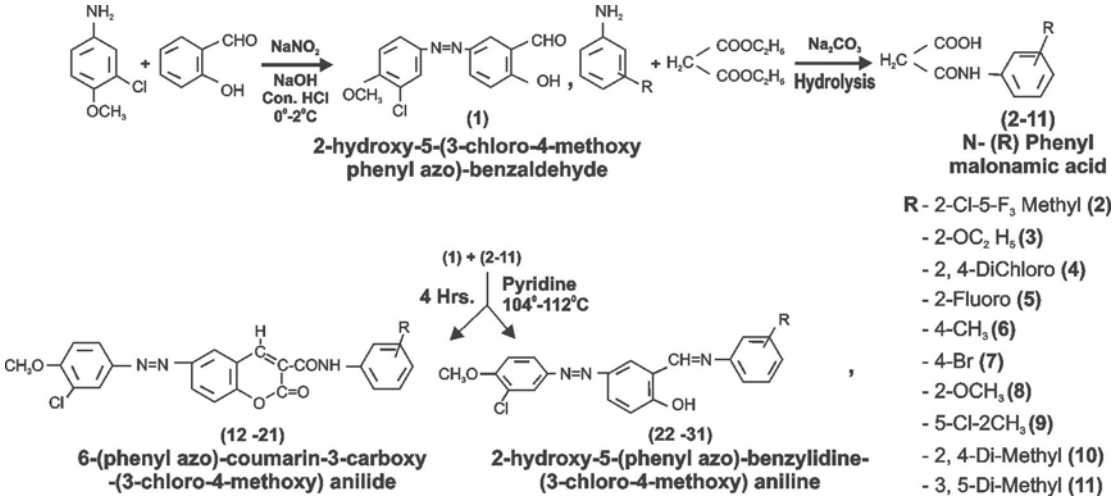

Table 2 : IR Absorption Bands

Compound No.	Ar C=C cm^{-1} Stretching	HC=N cm^{-1} Stretching	-OH cm^{-1} Stretching	N=N cm^{-1} Stretching	CONH cm^{-1} Stretching	Lactone C=O cm^{-1}	C-Cl cm^{-1} Stretching	N-H cm^{-1} Stretching
1.	-	-	3442	1489	-	-	679	-
12.	1564	-	-	1462	1618	1716	618	3415
13.	1544	-	-	1489	1618	1718	617	3415
14.	1563	-	-	1461	1617	1718	619	3414
15.	1555	-	-	1494	1662	1724	669	3442
22.	1590	2361	3441	1488	-	-	670	-
23.	1595	2363	3421	1490	-	-	669	-
24.	1591	2361	3414	1488	-	-	616	-
25.	1593	2361	3379	1488	-	-	669	-

Synthesis of N-(R) phenyl malonamic acid (2-11)

To the primary amine (0.025 mole), diethyl malonate (0.05 mole) was added with dimethyl formamide as a catalyst and refluxed for 45-60 minutes, after cooling, filtered, to the filtrate ethanol (20 ml) and a solution of Na_2CO_3 (20 ml) was added. The reaction mixture was hydrolysed for 30-45 minutes and then filtered, to the filtrate concentrated HCl was added. The solid thus separated was filtered washed with distilled water and recrystallised from saturated solution of $NaHCO_3$ was identified as N-(R) phenyl malonamic acid **(2-11)**.

Synthesis of 6(phenyl azo)-coumarin-3-carboxy-3-chloro-4-methoxy anilide (12-21) and 2-hydroxy-5-(phenyl azo)-benzylidine-3-chloro-4-methoxy aniline (22-31)

A mixture of 2-hydroxy-5(3-chloro-4-methoxy phenyl azo) benzaldehyde (0.001 mole; **1)** and N-(R) phenyl malonamic acid (0.001 mole ; **2-11)** in equimolar quantities (1:1), with a trace of pyridine was added. The reaction mixture was heated for 4 hours in an oil-bath at 104° to 112°C maintained. The mixture first melted to a liquid and soon set to a solid, after cooling it was digested with NaHCO3 solution and washed with water. The schiff's bases was removed by extraction with hot ethanol (10ml) and the residue was recrystallised from absolute ethanol, methanol, schiff's bases was recrystallised from absolute ethanol.

RESULTS AND DISCUSSION

The IR spectra of the synthesized

compounds have been recorded in the frequency region 4000-450 Cm-1, are recorded in Table-2.

The IR (KBr) spectrum of 6(2-chloro-5-trifluoro methyl phenyl azo)-coumarin-3 carboxy- (3-chloro-4-methoxy) anilide12 shows absorption at 1564 cm-1 indicating aromatic-C=C, absorption at 1618 cm-1 show-CONH stretching vibrations while absorption in 3415 cm-1 reveals-NH streching vibrations and absorption at 1719 indicates-C=O stretching vibrations, absorption at 1462 show-N=N stretching vibrations. These characters are support to the structure of compounds No. 12,13-15 and other compounds (16-21).

The IR (KBr) spectrum of-2-hydroxy 5-(2-chloro-5-trifluoro methyl) benzylidine-(3-chloro-4 -methoxy) aniline22, shows absorption at 2361cm-1 indicating-N=CH stretching vibrations, absorption at 3441 cm-1 show free -OH group stretchting vibrations, absorption at 1488cm-1 reveals -N=N stretching vibrations, absorption at 670 cm-1 show -C-Cl linkage stretching vibrations. The above observations are agreed with the assigned structure of compounds No. 22,23-25 and other compounds (26-31).

The IR spectrum of 2-hydroxy-5-(3-chloro-4-methoxy) phenyl azo benzaldehyde1 reveals free -OH group stretching vibrations at 3442 cm-1 , absorption at 1489 cm-1 indicating-N=N stretching vibrations, absorption at 679 cm-1 show -C-Cl stretching vibrations. These observations indicating the presence of azo group and these characters lent support to the structure of compound No. 1.

Thus the IR spectra of all substituted azo-coumarins and schiff's bases indicating the absorption spectrum was in agreement with the assigned structure. The azo-coumarins were found to possess higher melting points as compaired to schiff's bases which melted lower melting points, shows that azo-coumarins have more thermal stability than schiff's bases.

REFERENCES

1. Ostromistensky, J. Amer. *Chem. Soc.,* **56**, 1713, (1934)
2. D.E. Fink and D.L. Vivian, *J. Econ. Entonol.,* **29,** 804 (1936).
3. C G Smith, A Dutz, Wtsotoloski & GM savage, *Antibiot Chemothrapy* **6**:135 (1956).
4. R.G. Child, R.G. Wilkinson and A. Tomcu-Fucik, *U.S. Pat.* 4006234 (1977)., C.A. **87**, 6031 (1977).
5. I.M. Roushid, E.S.A. Ibrahim and H.S. Habib, *Pharmazie,* **31**, 856 (1956).
6. H. Brauninger, R. Plagemann, H.D. Schalicke, K. Peseke, *Naturwissens Chaftlice Reihe* **35**, 34-39 (1986).
7. D. Heber, Arch, *Pharm.,* **320**, 402 - 406 (1987).
8. E. Valencia, A. Patra, A.J. Freyer, M. Shamma, V. Fajardo, *Tetrahedron Lett.*, **25**, 3163 (1984).
9. W.H. Lewis, R.J. Stonard, B. Porras - Reyes, T.A. Mustoe, A. Thomas, US Patent 5756847 (1992); *Chem. Abstr.,* **117**, 245630t (1992).
10. A. Das., MDTrousdale, S Ren and E.J. Lien, *Antiviral Res.*, **44**, 201 (1999).
11. J.D. Modi, S.S. Sabxis and C.V. Delizala., *J. Mol. Chem.*, **13**, 935 (1970).
12. G.S. Godaginamath and R.G. Joshi., *Ind. J. Chem.*, **34** (B), 120-24 (1995).
13. S. Goyal and K. Lal., *J. Indian Chem. Soc.,* **66**(7), 477-9 (1989).
14. O.P. Singhal and P.I. Ittyerah, *J. Ind. Chem. Soc.*, **42**, 616-618 (1965).
15. D.S. Seth and B.C. Banerji, *Agra Uni. J. Res. (Sci.)*, **27**, 107-10 (1978).
16. D.S. Seth and B.C. Banerji and P, I, Ittyerah, *Curr. Sci.*, **48**, 859-60 (1979).
17. M.K. Mukerjee, Ph.D. Thesis. *Agra Univ.*, Agra (1982).
18. M. Kalani, Ph.D. Thesis. *Agra Univ.*, Agra (1989).
19. S. Bhatnagar, Ph.D. Thesis. *Agra Univ.*, Agra (1990).
20. S. Sharma, Ph.D. Thesis. *Agra Univ.*, Agra (1992).
21. G. Saxena, A. Chaudhary, A. Naqvi, S. Khan and D.S. Seth, *Orient. Journal. Chem.,* **Vol. 23** (2), 683-686 (2007).