Asian Journal of Chemistry Vol. 15, Nos. 3 & 4 (2003), 1867–1870

NOTE

Synthesis and Characterization of Some New Phthalides

V. KUKRETI* and R.P. CHAMOLI
Department of Chemistry
Government Post-graduate College, Kotdwara-246 149, India

A series of some new phthalides has been synthesized by condensing a γ-oxoacid, 2-(2,5-dichlorobenzoyl)benzoic acid with various mono, di and trihydroxyphenols in presence of concentrated sulphuric acid.

Key Words: Synthesis, γ-Oxoacid, 2-(2,5-Dichlorobenzoyl)-benzoic acid; hydroxy phenols.

The γ-oxoacids and some of their derivatives exhibit the phenomenon of ring-chain tautomerism. It has been observed that, generally, γ-oxoacids exist in keto-acid (chain) and lactol (ring) tautomeric forms[1–3]. Many reactions of these acids have been explained on the basis of their cyclization to lactols[4–7]. Results of our recent work[8–11] on synthesis of some substituted phthalides motivated us to condense a γ-oxoacid, 2-(2,5-dichlorobenzoyl)benzoic acid with some mono, di and trihydroxyphenols to get a new series of phthalides. The results of this investigation are being reported in this paper.

Melting points are uncorrected and purity of the products was checked by TLC. PMR spectra of the γ-oxoacid and its acetyl derivative were recorded in DMSO-d_6 and $CDCl_3$ respectively on a Bruker WH-90 spectrometer and chemical shifts (δ in ppm) are reported relative to TMS as internal standard. IR spectra (KBr) were run on a Perkin-Elmer 137 spectrophotometer (ν_{max} in cm^{-1}).

The preparation of 2-(2,5-dichlorobenzoyl)benzoic acid (**1**) was carried out by literature procedure[12]. The phenols (phenol, resorcinol, catechol, quinol, phloroglucinol and pyrogallol) were taken in slight excess over the acid (**1**), and concentrated sulphuric acid (4–5 drops) was used as condensing agent throughout. The condensation is assumed to have taken place as shown in **Scheme-1.**

3-Acetoxy-3-(2,5-dichlorophenyl)phthalide (3): The acid **1** (1.0 g) was refluxed with acetic anhydride (15 mL) and fused sodium acetate (3.0 g) for *ca.* 4 h. The contents were poured into ice-cold water, stirred well and the residue was filtered. It was washed with water and recrystallized from acetone into a brownish white crystalline compound (0.78 g, 70.9%), m.p. 142–143°C. (Found: C, 57.61; H, 3.12; Cl, 20.31%; $C_{16}H_{10}O_4Cl_2$ requires C, 57.14; H, 2.97; Cl, 20.83%). IR: 1771, 1752, 1600, 1586, 1497, 1455 cm^{-1}. PMR δ (ppm): 7–8.2 (m, aromatic protons); 2.1 (s, protons of acetoxyl group).

Phthalides (5–12): The preparation and purification of phthalides **(5–10)**, diacetyl derivative **(11)** and dibromo derivative **(12)** and KOH fusion of the phthalide **6** were carried out by the procedure reported for similar compounds in our earlier communication[8]. Physical data of the phthalides **(5–12)** are presented in Table-1.

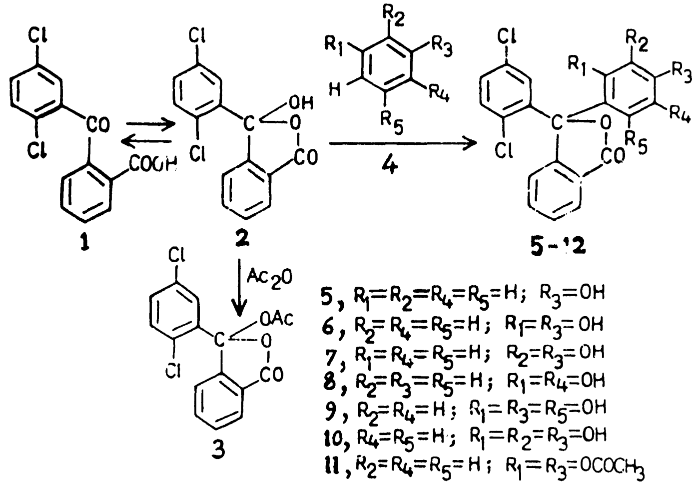
TABLE-1
PHYSICAL DATA OF PHTHALIDES (5–12)

Phthalide	Colour	Yield (%)	m.p. (°C)	m.f.*	ν_{max} (cm^{-1})
5	Pinkish brown	48.6	107–108	$C_{20}H_{12}O_3Cl_2$	3545, 1770, 770, 710
6	Yellowish brown	42.0	195–197	$C_{20}H_{12}O_4Cl_2$	3540, 1780, 770, 710
7	Dark brown	32.6	188–190	$C_{20}H_{12}O_4Cl_2$	3560, 1798, 765, 698
8	Dark grey	39.5	104–105	$C_{20}H_{12}O_4Cl_2$	3520, 1760, 765, 705
9	Brownish red	16.0	116–118	$C_{20}H_{12}O_5Cl_2$	3535, 1770, 765, 705
10	Dark brown	38.5	205–207	$C_{20}H_{12}O_5Cl_2$	3540, 1760, 765, 710
11	Light yellow	85.0	140–142	$C_{20}H_{16}O_6Cl_2$	——, 1776, 765, 700
12	Orange red	90.7	155–157	$C_{20}H_{10}O_4Cl_2Br_2$	3545, 1760, 770, 700

*All the compounds gave satisfactory elemental analysis.

2-(2,5-Dichlorobenzoyl)benzoic acid has been found spectroscopically to exist as a mixture of its keto-acid **(1)** and lactol **(2)** tautomeric forms. It gave a cyclic acetyl derivative **(3)** on refluxing with acetic anhydride in presence of fused sodium acetate. The IR spectrum of the acid (in KBr, ν_{max} in cm^{-1}) showed absorption bands at 1690, 1675 and 1776 (weak) characteristic of carboxyl CO, diaryl ketonic CO and lactonic CO groups, respectively. Peaks at 2656 and 3455 were assigned to carboxylic and lactol OH groups respectively. The acetyl derivative (3) of the oxoacid **(1)** showed sharp peaks at 1771 and 1752, which are attributed to lactonic carbonyl and acetoxyl carbonyl stretching vibrations, respectively. The PMR spectrum (chemical shifts in δ scale) of oxoacid **(1)** showed a multiplet in the region between 7 and 8.2, which is assignable to aromatic protons. A singlet of low intensity at 5.6 could be ascribed to the lactol hydroxy proton. PMR spectrum of acetyl derivative **(3)** did not exhibit any signal at 5.6, present in the spectrum of oxoacid **(1)**; instead, it displayed a new signal at 2.1 which was attributed to the protons of acetoxyl group; on the basis of these spectral studies it was concluded that the acetyl derivative **(3)** possesses a cyclic lactonic structure and its formation takes place through the lactol form **(2)** of γ-oxoacid (1) as shown in **Scheme-1.**

2-(2,5-Dichlorobenzoyl)benzoic acid **(1)** reacted with phenols **(4)** in presence of conc. sulphuric acid to give a new series of unsymmetrically substituted phthalides **(5–10)**, in which the central triphenylmethane carbon is attached to two different phenyl rings. The formation of phthalides **(5–10)** occurs through a condensation reaction *via* the lactol form **(2)** of the acid **(1)** and with excess of phenols **(4)** the acid reacts entirely through the lactol form **(Scheme-1)**. The structures of the synthesised phthalides were derived on the basis of elemental analysis, acetylation, bromination, KOH fusion and IR spectral data. Acetylation and bromination of the phthalide **6** gave diacetyl **(11)** and dibromo **(12)** derivatives. On KOH fusion **6** gave the oxoacid **(1)** and resorcinol.



5, $R_1=R_2=R_4=R_5=H$; $R_3=OH$
6, $R_2=R_4=R_5=H$; $R_1=R_3=OH$
7, $R_1=R_4=R_5=H$; $R_2=R_3=OH$
8, $R_2=R_3=R_5=H$; $R_1=R_4=OH$
9, $R_2=R_4=H$; $R_1=R_3=R_5=OH$
10, $R_4=R_5=H$; $R_1=R_2=R_3=OH$
11, $R_2=R_4=R_5=H$; $R_1=R_3=OCOCH_3$
12, $R_5=H$; $R_2=R_4=Br$; $R_1=R_3=OH$

Scheme-1

IR spectra of the phthalides **(5–10)** and **(12)** displayed a broad and strong absorption band in the region 3560 to 3520 due to OH stretching vibrations. The diacetyl derivative **(11)** exhibited a band at 1776 [ν(C═O) of phenolic acetate]. All the phthalides **(5–12)** showed a sharp and strong band at 1798 to 1760 which is characteristic of lactonic carbonyl group. Presence of this band is a significant evidence in favour of the proposed lactonic structures. Two sharp bands which appeared near 770–760 and 710–698 in the IR spectra of **5** to **12** are characteristic of *o*-disubstituted phthalein ring[13].

ACKNOWLEDGEMENTS

The authors are thankful to Prof. P.C. Gupta for constant encouragement, and Director, CDRI, Lucknow and Head, RSIC, IIT Madras for providing analytical and electronic spectral data.

REFERENCES

1. P.R. Jones, *Chem. Rev.*, **63**, 461 (1963).
2. R.E. Valter, *Russ. Chem. Rev.*, **42**, 464 (1973).
3. R. Escale and J. Verducci, *Bull. Soc. Chem. Fr.*, 1203 (1974).
4. M.V. Bhatt and K.M. Kamath, *J. Chem. Soc. (B)*, 1036 (1968).
5. M.V. Bhatt, K.M. Kamath and M. Ravindranathan, *J. Chem. Soc. (C)*, 3344 (1971).
6. M.V. Bhatt and M. Ravindranathan, *J. Chem. Soc. (C)*, 1160 (1973).
7. M.V. Bhatt, K.S. Rao and G.V. Rao, *J. Org. Chem.*, **42**, 2697 (1977).
8. V. Kukreti and R.P. Chamoli, *Dyes and Pigments*, **32**, 15 (1996).
9. ———, *Asian J. Chem.*, **9**, 66 (1997).
10. ———, *J. Inst. Chemists (India)*, **71**, 14 (1999).
11. ———, *J. Indian Council Chem.*, **17**, 15 (2000).
12. M. Philips, *J. Am. Chem. Soc.*, **48**, 3198 (1926).
13. M.M. Ghoneim, Y.M. Issa and M.S. Ashy, *Indian J. Chem.*, **18A**, 349 (1979).

(*Received*: 27 February 2003; *Accepted:* 12 May 2003) AJC–3129