Colourant Performance and Fastness Assessment of 1, 3-diaryl 1, 2-propen-1-one Compounds on Synthetic Fabrics

Kiran V. Mehta

Department of Chemistry, R. R. Mehta College of Science and C. L. Parikh College of Commerce, Palanpur 385001, Dist. - Banaskantha, State - Gujarat (India).

Correspondence:
Kiran V. Mehta
Department of Chemistry, R. R. Mehta College of Science, and C. L. Parikh College of Commerce,
Palanpur-385001,
Dist. - Banaskantha,
State - Gujarat (India)
Email: kiranvmehta@ymail.com

Abstract

For many years, researchers have been attracted towards 1, 3-diaryl-2-propen-1- one(DPO) compounds. Generally, DPOs have been studied for their versatile biological activities. Heterocyclic compounds have been synthesized from DPOs and their biological activities have been explored in detail. DPOs have wonderful colours. Hence, they may be considered as colourants for various fabrics. For the present study, six DPOs were synthesized, and dyeing was carried out on synthetic fabrics like polyester and nylon. Extent of exhaustion of dye bath and extent of fixation on the fabrics were determined. Their light fastness and wash fastness properties were evaluated. Good colourant properties of DPOs were noticed for synthetic fabrics.

Keywords: Colourant, polyester, wonderful colours, nylon, dyeing, exhaustion, fixation, light fastness and wash fastness.

1. Introduction

By studying the research literature published for the last eight to ten decades, it can be said that 1,3-diaryl-2-propen-1-one(DPO) compounds have been comprehensively studied by organic chemists. Various heterocyclic compounds also have been prepared from DPOs and their applications have been evaluated. In nature, DPOs are intermediates for flavonoids in biosynthetic reactions. Certain phenoxy DPOs are reported for possessing insecticidal activity[1].They have exhibited antiflammatory [2], antiviral [3-5], antibacterial [6], antitubercular [7-8], antimicrobial [9-17], and anticancer[18] properties. Thus, DPOs are versatile for various applications. These compounds possess fascinating colours. So, compounds like isosalipurposides are studied for wool as colourants [19]. Dyes and pigments are important colourants for today's colourful clothes and materials. Hence, to use such compounds as colourants was thought interesting for the present work.

Material and Methods

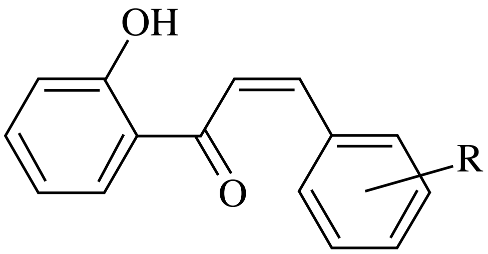

Fig. 1. General structure of DPO compound.

DPO-1: R = 2 -Cl, DPO-2: R = 4 -Br,
DPO-3: R = 2 -OCH3, DPO-4: R = 4 -SCH3, DPO-5: R = 3 -NO2, DPO-6: R = 4 -CH3.

Synthesis of these compounds follows Claisen- Schmidt condensation.

Six DPOs were synthesized according to the method described in the literature[20-22]. A solution of 2-hydroxy acetophenone (0.01 mole) in absolute ethanol (40 ml) was warmed. Aldehyde (0.01 mole) was added to that warm solution and stirred to dissolve the aldehyde. Thus, a clear solution was obtained into which an aqueous solution of sodium hydroxide (10N, 1.5ml) was poured gradually. This mixture was stirred at room temperature by a mechanical stirrer for 6-8 hours to get an orange mass which was decomposed with chilled HCl (50%, 4 ml). Thus, yellow granules were obtained which were filtered. The granules were washed with an aqueous solution of sodium bicarbonate (10%, 2ml). The granules were dried and crystallized from absolute ethanol.

In this way, crystals of the DPOs were obtained. The % of yields is given in Table 1.

The melting points of all the DPOs were determined using open capillary glass tubes and paraffin bath. These melting points are uncorrected and shown in Table 1.

Table 1 DPO Compounds.

Comp.	*Name of DPO*	*M. F.*	*M.P. (°C)*	*% of yield*
DPO-1	3-(2-chlorophenyl)-1-(2-hydroxyphenyl) prop-2-en-1-one	$C_{15}H_{11}O_2Cl$	177	64
DPO-2	3-(4-bromophenyl)-1-(2-hydroxyphenyl) prop-2-en-1-one	$C_{15}H_{11}O_2Br$	145	57
DPO-3	1-(2-hydroxyphenyl)-3-(2-methoxyphenyl) prop-2-en-1-one	$C_{16}H_{14}O_3$	151	68
DPO-4	1-(2-hydroxyphenyl)-[3-(4 methylsulfanyl) phenyl]prop-2-en-1-one	$C_{16}H_{14}O_2S$	89	69
DPO-5	1-(2-hydroxyphenyl)-3-(3-nitrophenyl) prop-2-en-1-one	$C_{15}H_{11}N\ O_4$	180	56
DPO-6	1-(2-hydroxyphenyl)-3-(4-methylphenyl) prop-2-en-1-one	$C_{16}H_{14}O_2$	123	61

Comp.: Compound, M. F.: Molecular Formula, M. P.: Melting Point.

The DPOs which were synthesized used for dyeing on synthetic fabrics (polyester and nylon). The general method that was adopted for dyeing polyester and nylon is as follows: In a conical flask containing distilled water (100 ml), a synthetic fabric pattern (2.0 gm) was introduced. A $^2/_3$ portion of the flask was immersed into a thermostat bath and temperature was maintained at 80 °C for 10 minutes. The fabric pattern was then taken out of the flask, squeezed very well and dried. The pretreated polyester fabric thus prepared was used further in the process of dyeing.

For 2% dyeing, DPO under study (40 mg) was dissolved in a minimum quantity of DMF. The DPO solution was then added with continuous stirring into a dye pot containing the solution of dispersing agent (sodium lauryl sulphate, 100 mg) in distilled water to obtain a fine aqueous dispersion of the DPO. The total volume of the solution in the dye bath was 100 ml. Thus, the MLR was maintained at 1:50. The dye bath was set at 60 °C and the same temperature was maintained for 10 minutes. The temperature was then raised up to 70 °C. The temperature was raised from 70 °C to 130 °C within 1 hour at a rate of 1 °C per minute. Dyeing was carried out at this temperature for 1 hour. After this stage, the dye bath was cooled. The dyed fabric pattern was washed well with water (100 ml). This water was collected in a volumetric flask containing DMF (40 ml) and the residual dye liquor was collected from the dye bath. The total volume of the solution in the flask was made 250 ml by the further dilution with water. This solution (25 ml) was pipetted out and further diluted to 50 ml with water. One ml of this consequent solution was further diluted to 10 ml with DMF. The absorbance of the resultant solution was measured. Thus, the dyed polyester fabric was obtained. It was then rinsed and scoured in a detergent (Lissapol) solution (100 ml, 0.2%) at 50 °C for 20 minutes. The % of exhaustion and fixation were determined according to the known methods [23-25].

For the present study, light fastness and wash fastness tests were performed on dyed synthetic fabrics and fastness values were obtained. For determining light fastness, a general method according to British Standards(BS) 1006-1978 was followed [26-29] and for the grade determination of the wash fastness, a general method according to Indian Standards : IS : 765-1979 was followed [30-31]. All the DPOs under study were rated in the different grades of light and wash fastness. The data thus obtained are given in Tables 2 and 3.

Table 2 Dyeing performance and fastness properties of polyester fabric.

Comp.	*Shade on fabric*	*Exhaustion % from dye bath*	*% of fixation on fabric*	*L.F.*	*W.F.*
DPO-1	Pale Yellow	74.16	52.83	2-3	3
DPO-2	Pale Orange	76.35	58.35	2-3	1-2
DPO-3	Deep Yellow	68.85	59.47	3-4	3
DPO-4	Yellow	73.52	62.86	4	2-3
DPO-5	Pale Orange	80.04	65.03	3-4	3
DPO-6	Bright Yellow	79.95	61.52	2-3	3

Comp. : Compound, L.F. : Light Fastness, W. F. : Wash Fastness

Table 3 Dyeing performance and fastness properties on nylon fabric.

Comp.	*Shade on fabric*	*Exhaustion % of dye bath*	*% of fixation on fabric*	*L.F.*	*W.F.*
DPO-1	Pale Yellow	73.11	64.12	2-3	3
DPO-2	Pale Orange	80	71.05	3	2
DPO-3	Deep Yellow	62.38	58.06	2-3	3
DPO-4	Pale Yellow	75.55	69.74	3-4	2-3
DPO-5	Pale Orange	71.94	56.89	3-4	3
DPO-6	Pale Yellow	60.23	53.77	3	3

Comp. : Compound, L.F. : Light Fastness, W. F.: Wash Fastness

2. Results and discussion

Exhaustion of a dye from the dye bath during dyeing process and fixation of dye on the fabric are basic important characteristics in determining dyeing performance of a colourant material. The DPOs used to colour synthetic fabrics gave yellow or orange shades. The exhaustion of DPO from the dye bath on polyester fabric was in the range of 68.85% to 80.04%. Thus, satisfactory exhaustion of the DPOs was observed for the polyester fabric. The percentage of DPOs fixed on the polyester fabric range from 52.83% to 65.03%. This indicates that fixation characteristics of the DPOs are good.

Similarly, exhaustion extent of nylon fabric was from 60.23% to 80% while fixation extent was from 53.77% to 71.05%. So, DPOs showed good exhaustion and fixation characteristics for polyester and nylon fabrics.

Fastness properties of dyes play a very decisive role in determining their usage in the dye industry. In the present work, stability of dyes on a fabric was studied with respect to light and washings. The light fastness for DPO on the polyester fabric was found from slight fastness to fair fastness while it was from slight fastness to moderately fair fastness for the nylon fabric. The wash fastness for DPOS on polyester was found to be from poor to good while it was found to be from fair to good for nylon fabric.

3. Conclusion

Thus, DPOs show a good penetration and affinity for polyester and nylon fabrics. A remarkable levelness of the colour was observed after washing and drying the fabrics. These all properties indicate that DPOs may be used as a colourant material.

References

[1] Mudaliar V. R., Joshi V., Synthesis and Insecticidal Activity of New Substituted Phenoxy Chalcones, Ind. J. Chem., Vol. 34B, pp. 456-457, 1995.

[2] Felipe H, Luisa F., Amali U., Josem, Domiquez, Synthesis and Antiflammatory Activity of Chalcone Derivatives, Bioorganic and Medicinal Chem. Lett., Vol.-8, pp. 1169-1174, 1998.

[3] Onyilagha C. J., Malhotra B., Elder M., French C.J., Towers Neil G.H., Comparative Studies of Inhibitory Activities of Chalcones on Tomato Ringpost Virus (ToRSV), Canadian J. Plant Pathology, Vol. 19, pp. 133-137, 1997.

[4] Mallikarjun K.G., Antiviral Activity of Substituted Chalcones and Their Respective Cu(II), Ni(II) and Zn(II) Complexes., E. J. Chem., Vol. 2, No. 6, pp. 58 - 61, 2005

[5] Trivedi J.C., Bariwal J.B., Upadhyay K.D., Naliapara Y.T., Joshi S.K., Pannecouque C.C., Clercq E.D., Shah A.K., Improved and Rapid Synthesis of New Coumarinyl Chalcone Derivatives and Their Antiviral Activity. Tetrahedron Lett., Vol. 48, pp 8472-8474, 2007.

[6] S.S.Mokle, S.V.Khansole, R.B.Patil Y.B. Vibhute, Synthesis and Antibacterial Activity of Some New Chalcones and Flavones Having 2-Chloro-8-Methoxyquinolinyl Moiety, Int. J. Pharma. Bio. Sciences, Vol. 1 No. 1, pp. 1-7, 2010.

[7] Shivakumar P.M., Geetha Babu S.M., Mukesh D, QSAR Studies on Chalcones and Flavonoids as Antitubercular Agents Using Genetic Function Approximation(GFA) Method, Chemical Pharma. Bullet., Vol.-55, pp. 44-49, 2009.

[8] Lin, M., Zhou Y., Flavin M.T., Zhou L., Nie W., Chen F., Chalcones and Flavonoids as Anti-Tuberculosis Agents. Bioorg. Med. Chem., Vol. 10, pp 2795-2802, 2002.

[9] Deshpande S. R., K. Pai V., Synthesis and Biological Activities of Certain Mesoionic Sydnone Compounds Containing Chalcone Moiety, J. Basic and Clinical Pharmacy, pp 147-152. Vol. 001, No. 003, 2010.

[10] Rajendraprasad Y., Praveenkumar P., Ravikumar P., Synthesis and Antimicrobial Activity of Some New Chalcones of 2-acetyl pyridine, Eur. J. Chem., Vol. 5, pp. 144-148, 2008.

[11] Desai B., Modi S., Naik H.B., Antimicrobial Studies of Some New Chalcones and 2-aminopyridines, J. Ind. Council. Chem., Vol. 10, No. 1, pp. 11-14, 1994.

[12] Azad M., Munwarali M., Sidiqui H.L., Antimicrobial Activity and Synthesis of Quinoline Based Chalcones, J. Applied Sciences, Vol. 7, No. 17, pp. 2485-2489, 2007.

[13] Paramesh M., Niranjan M. S., Sarfaraj N., Shivaraja S., Rubbani M. S., Synthesis and Antimicrobial Study of Some Chlorine Containing Chalcones, Int. J. Pharmacy and Pharmaceutical Sciences, Vol. 2, No. 2, 2010.

[14] Ngaini Z., Haris-Faizillah S. M., Hussain H., Kamaruddin K., Synthesis and Antimicrobial Studies of (E)-3-(4-alkoxyphenyl)-1-(4- hydroxyphenyl) prop-2-en-1-one and Their Analogues, World J. Chem., Vol. 4, No. 1, pp.09-14, 2009.

[15] Mohite P. B., Pandhare R. B., Khanage S. G., Bhaskar V. H., Synthesis and In-Vitro Antimicrobial Activity of Some Novel Chalcones Containing 5-phenyl tetrazole, Acta Pharmaceutica Sciencia, Vol. 52, pp 504-509, 2010.

[16] Baviskar B.A., Baviskar B., Shiradkar M.R., Deokate U.A., Khandabadi S.S., Synthesis and Antimicrobial Activity of Some Novel Benzimidazolyl Chalcones, E.J. Chem., Vol. 6, No. 1, pp. 196-200, 2009.

[17] Bandgar, B.P., Patil, S.A., Korbad B.L., Nile S.H., Khobragade C.N., Synthesis and Biological Evaluation of β-chloro Vinyl Chalcones as Inhibitors of TNF-α and IL-6 with Antimicrobial Activity, Eur. J. Med. Chem., Vol. 45, pp. 2629-2633, 2010.

[18] Ku B. M., Ryu H.W., Lee Y.K., Ryu J., Jeong J.Y., Choi J., Cho H.J., Park K.H., Kang S.S., 4'-Acetoamido-4-hydroxychalcone, A Chalcone Derivative, Inhibits Glioma Growth and Invasion Through Regulation of the Tropomyosin 1 Gene, Biochem. Biophys. Res. Commun., Epub. 2010, Oct 28, 402(3), pp. 525-30, (Epub. 2010, Oct 28), Nov 19, 2010.

[19] Ghouila H., Meksi N., Haddar W., Mhenni M.F., Jannet H.B., Extraction, Identification and Dyeing Studies of Isosalipurposide, A Natural Chalcone Dye From Acacia Cyanophylla Flowers on Wool, Industrial Crops and Products, Vol. 35, No. 1, pp. 31-36, January 2012.

[20] Mahrous Hamada N.M, Mohamed E.M., Synthesis and Antimicrobial Evaluation of Some Heterocyclic Chalcone Derivatives, Molecules, Vol. 16, pp. 2304-2312, 2011.

[21] Gurubasvaraja Swamy P.M., Agasimundin Y.S., Synthesis and Antimicrobial Activity of Some Novel Chalcones Containing 3-hydroxy benzofuran, Acta Pharmaceutical Sciencia, Vol. 50, pp. 197-202, 2008.

[22] Gurubasavaraja Swamy P.M., Y.S. Agasimundin, Synthesis and Antimicrobial Screening of Certain Substituted Chalcones and Isoxazolines Bearing Hydroxy Benzofuran , Rasayan J. Chem., Vol. 1, No. 2, pp. 421-428, 2008.

[23] Shah K. M., Handbook of Synthetic Dyes and Pigments, Vol. 1: Synthetic Dyes, 2nd edition, Multitech Publishing Company, Mumbai (India), pp 271-273, 1998.

[24] Dixit B.C., Patel H.M., Desai D.J., Synthesis and Application of New Mordent and Disperse Azo Dyes Based on 2-4 Dihydroxy Benzophenone, J. Serb. Chem. Soc., Vol. 72, No. 2, pp. 121, 127, 2007.

[25] NIIR Board of Consultants & Engineers, The Complete Technology Book on Dyes and Dye Intermediates, National Institute of Industrial Research, Delhi (India), pp. 78, 448, 484-485, 2004.

[26] Desai V.A., Desai K.R., Synthesis of Monochlorotriazinyl Reactive Dyes Containing Heterocyclic Diazo Component, J. Ind. Council Chemists, Vol. 10, No.1, pp. 26-28, 1994.

[27] Troatman E. R., Dyeing and Chemical Technology of Textile Fibres, 4th edition, Griffin, London (U.K.), pp. 589-590, 596-597,1970.

[28] NIIR Board of Consultants & Engineers, The Complete Technology Book on Dyes and Dye Intermediates, National Institute of Industrial Research, Delhi (India), pp. 529-530, 2004.

[29] Miranda P.C., Rodrigues L.M., Conclaves M.S.T., Costa S.P.G., Hrdina R., Oliveira-Campos A.M.F., Synthesis, Wash and Light Fastness of Azo Dyes Derived From N,N-dimethylanilines, Advances in Colour Science and Technol., Vol. 4, No. 1, pp. 21-27, 2001.

[30] Shah K. M., Handbook of Synthetic Dyes and Pigments, Vol. 1: Synthetic Dyes, 2nd edition, Multitech Publishing Company, Mumbai (India), pp. 134, 1998.

[31] NIIR Board of Consultants & Engineers, The Complete Technology Book on Dyes and Dye Intermediates, National Institute of Industrial Research, Delhi (India), pp. 533-535, 2004.