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ORIGINAL ARTICLE

Synthesis and characterization of reactive dyes based on 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-sulphonic acid

Divyesh R. Patel, Keshav C. Patel *

New Synthetic Organic Chemistry Research Laboratory, Department of Chemistry, Veer Narmad South Gujarat University, Surat, Gujarat 395 007, India

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KEYWORDS
2-Phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-sulphonic acid;
Synthesis;
Exhaustion;
Fixation;
Dyeing properties

Abstract A series of new quinazolinone based mono azo reactive dyes (**$D_{1–10}$**) have been prepared by subsequent diazotization of 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-sulphonic acid (**C**) and coupling with various 4-chloro anilino cyanurated coupling components. These dyes give purple, red, orange and yellow color shades. All the reactive dyes were characterized by their percentage yield, UV–Vis spectroscopy, elemental analysis, IR spectroscopy, ^{1}H NMR spectroscopy and dyeing performance on silk, wool and cotton fibres. The percentage dye bath exhaustion on different fibres has been found to be reasonably good and acceptable. The dyed fibres show moderate to very good light fastness and good to excellent washing and rubbing fastness.

1. Introduction

Many dyes based on heterocyclic ring system are known to possess high tintorial power and outstanding fastness properties. A number of azo dyes have been prepared from amino heterocycles (Chemical Co. Ltd, 1969; Levy and Stephen, 1956) and azo dyes prepared by using selected quinazoline derivative as coupling components have been described (Chemical Co. Ltd, 1971). Dyes based on quinazoline ring system have also been reported as being useful on natural and synthetic fibres (Arcoria et al., 1971) and 4-oxo quinazoline have been used in the synthesis of azo dyes and reactive dyes (Desai et al., 1985a,b). Improvement in the structure of reactive dye by selection of chromogens and variety of reactive group has led to an increased use of reactive dyes (Renfrew and Taylor, 1990; Abeta et al., 1984; Hahnke, 1986). A number of yellow, orange and red azo dyes from 3H-2-(1′,4′-bis-styryl-4″-amino)-4-quinazoline (Naik and Desai, 1990) and mono azo dyes from 2-styryl-6-amino-4-oxoquinazoline (Patel and Patel, 1999) have also been reported. Synthesis of heterocyclic mono azo dyes derived from 4-oxoquinazoline have been reported (Patel et al., 1998, 2009).

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* Corresponding author. Tel.: +0261 2258384; fax: +0261 2256012.
E-mail address: divyeshpatel_905@yahoo.com (K.C. Patel).

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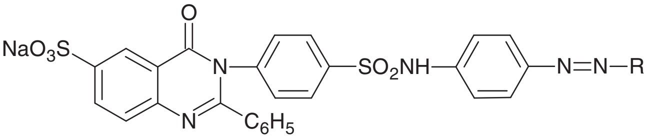
In the present investigation we wish to report a new series of reactive dyes from 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-sulphonic acid (**C**) and various cyanurated coupling components (**H**), then the coupling components tested as a reactive dyes against various fabrics. In addition to the characterization of the dyes, an evaluation of their technical properties and a colour assessment were performed. The general structure of the dyes ($\mathbf{D_{1-10}}$) is shown below.



where R = Various 4-chloroanilino cyanurated coupling components = H-acid, Gamma acid, J-acid, N-methyl-J-acid, N-Phenyl-J-acid, Chicago acid, Laurant acid, Bronner acid, Tobias acid and K-acid.

2. Materials and methods

2.1. General

All the melting points (m.p.) were determine in open capillaries and are uncorrected and expressed in °C. The purity of all the dyes has been checked by TLC (Fried and Sharma, 1982). The IR spectra were recorded in KBr on a Perkin Elmer Model-881 spectrophotometer and ^{1}H NMR spectra were recorded on a Brucker DRX-300 (300 MHz FTNMR) instrument using TMS as internal standard and DMSO as solvent, where the chemical shift δ are given in ppm. Absorption spectra were recorded on a Beckman DB-GT Grating spectrophotometer. The light fastness was assessed in accordance with BS: 1006–1978 (Test Method, 1006). The rubbing fastness test was carried out with a Crockmeter (Atlas) in accordance with AATCC (1961) and the wash fastness test in accordance with ISO: 765–1979 (Indian standard, 1979).

2.2. Preparation of 2-phenyl-4-oxo-3,1-benzoxazine-6-suphonic acid (A) Trivedi et al., 2004

Benzoyl chloride (140.5 g, 1 mol) was added drop wise to a solution of 5-sulfo anthranilic acid (217 g, 1 mol) in pyridine (60 ml), with constant stirring at 8 °C over the period of one hour. After the completion of addition, the reaction mixture was stirred for half an hour at room temperature. At the end of the reaction solid mass was obtained, it was filtered, washed successively with sodium bicarbonate solution (to remove unreacted acid). Finally washed with water, dried and recrystallize from rectified spirit (Scheme 1).

Yield 85%, m.p. 107 °C, IR (KBr): $\nu_{\max}$ (cm^{-1}) 1750 (C=O), 1380 (C–N), 1042 (S=O). Elemental analysis: Found C-55.38%; H-2.94%; N-4.55%; $C_{14}H_9O_5NS$ (Calculated C-55.44%; H-2.99%; N-4.62%).

2.3. Preparation of 4′,4″-diaminodiphenylsulphonamide-(DADPSA) (B)

The title compound was prepared according to the literature procedure (Zhang et al., 1999) (Scheme 2).

2.4. Preparation of 2-phenyl-3-[4′-(4”-aminophenylsulphonamido)]-phenyl-4(3H)-quinazolinone-6-sulphonic acid (C) Pandey et al., 2007

A mixture of 2-phenyl-4-oxo-3,1-benzoxazine-6-sulphonic acid **(A)** (0.05 mol) and 4,4′ diaminodiphenyl sulfonamide **(B)** (0.05 mol) in dry pyridine (50 ml) was refluxed for 6 h under anhydrous reaction conditions. The resulting mixture was then cooled to room temperature. The reaction mixture was treated with 10% dil. HCl and stirred. A solid separate out which was filtered off and washed with water to remove any adhered pyridine. The crude quinazoline thus obtained was dried under vacuum and recrystallize from 95% ethanol (Scheme 3).

Yield 75%, m.p. 130 °C. IR (KBr): $\nu_{\max}$ (cm^{-1}) 3510 (NH_2 Primary), 2925, 2850 (C–H), 1665 (C=O), 1390 (C–N), 1045 (S=O for $-SO_3H$), 1350, 1164 (S=O for $-SO_2NH$). **^{1}H NMR** (DMSO-d_6) (chemical shift δ in ppm) 5.75 (2H, s, $-NH_2$), 8.85 (1H, s, $-SO_2NH$), 11.4 (1H, s, $-SO_3H$), 6.70–8.10 (16H, m, Ar-H).

Elemental analysis: Found C-56.86%; H-3.62%; N-10.15%; $C_{26}H_{20}O_6N_4S_2$ (Calculated C-56.92%; H-3.67%; N-10.21%).

2.5. Diazotisation of 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3H)-quinazolinone-6-sulphonic acid (*D*)

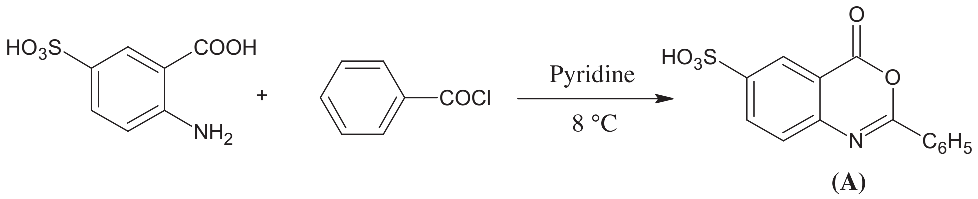
Hydrochloric acid (20 ml, 0.015 mol) was added drop wise to the stirred suspension of **(C)** (2.58 g, 0.005 mol) in water (60 ml) this well stirred suspension. The mixture was gradually heated up to 70 °C, till clear solution obtained then the solution was cooled to 0–5 °C in an ice bath. A solution of $NaNO_2$ (0.6 g) in water (4 ml) previously cooled to 0 °C, was then added over a period of 5 min with stirring. The stirring was continuous for an hour, maintaining the same temperature, with positive test for nitrous acid on starch iodide paper. After just destroying excess of nitrous acid with required amount of a solution of sulphamic acid. The clear diazo solution **(D)** at 0–5 °C was used for subsequent coupling reaction (Scheme 3).

2.6. Preparation of cyanuration of H-acid (*G*)

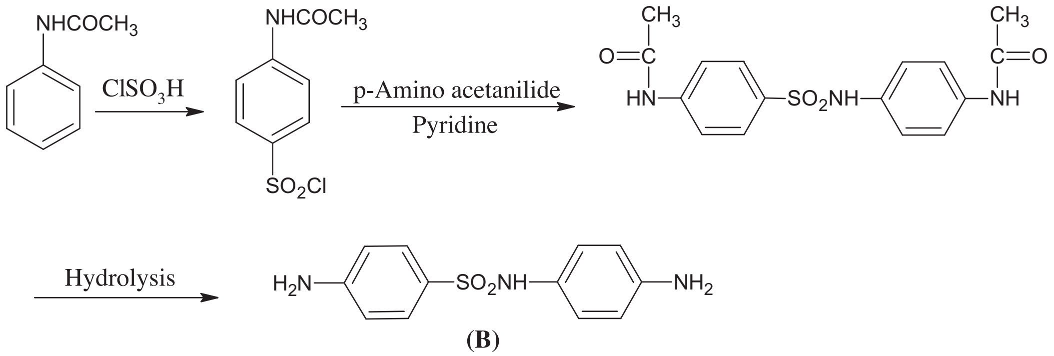
Cyanuric chloride (**E**) (1.85 g, 0.01 mol) was stirred in acetone (25 ml) at a temperature below 5 °C for a period of an hour. To the above stirred solution, a neutral solution of H acid (**F**) (3.19 g, 0.01 mol) in aqueous sodium carbonate solution (10% w/v) was then added in small portions for one hour. The pH was maintained neutral by simultaneous addition of sodium carbonate solution (1% w/v). The reaction mass was stirred continuously at 0–5 °C for four hours until clear solution was obtained (Scheme 4). The resultant solution was used for the next step without further purification.

2.7. Preparation of 4-chloro anilino cyanurated H-acid (*H*)

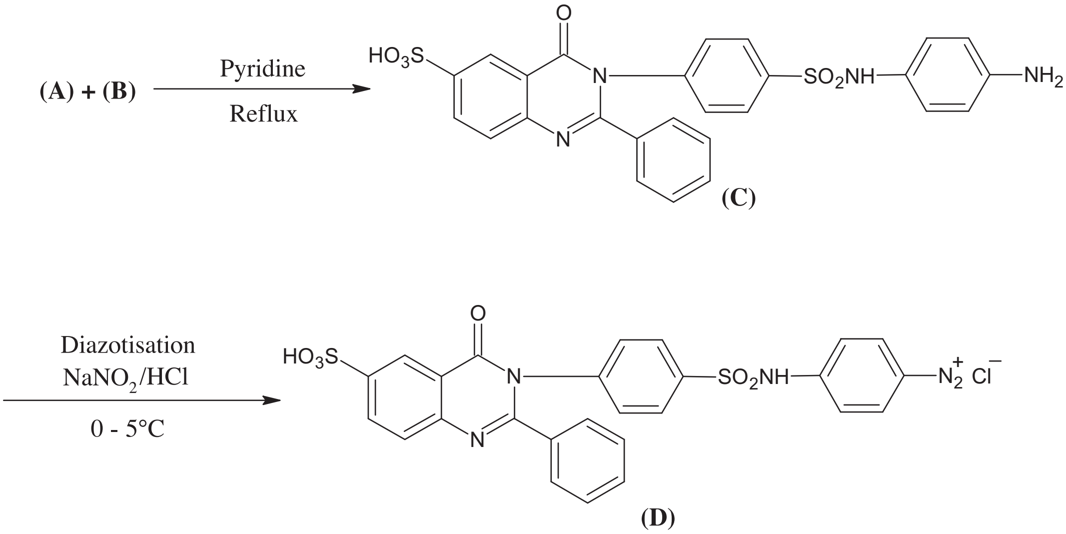
The solution of cyanurated H acid **(G)** (4.67 g, 0.01 mol) was stirred at 30–35 °C for half an hour. To this well stirred solution, 4-chloro aniline (1.28 g, 0.01 mol) was added drop wise during a period of half an hour, maintaining the pH neutral by simultaneous addition of sodium bicarbonate (15 w/v). After addition, the stirring was continued for further 3 h.



Scheme 1 The route of the synthesis of the 2-phenyl-4-oxo-3,1-benzoxazine-6-sulphonic acid **(A)**.



Scheme 2 The route of the synthesis of the 4′,4″-diaminodiphenylsulphonamide (DADPSA) **(B)**.



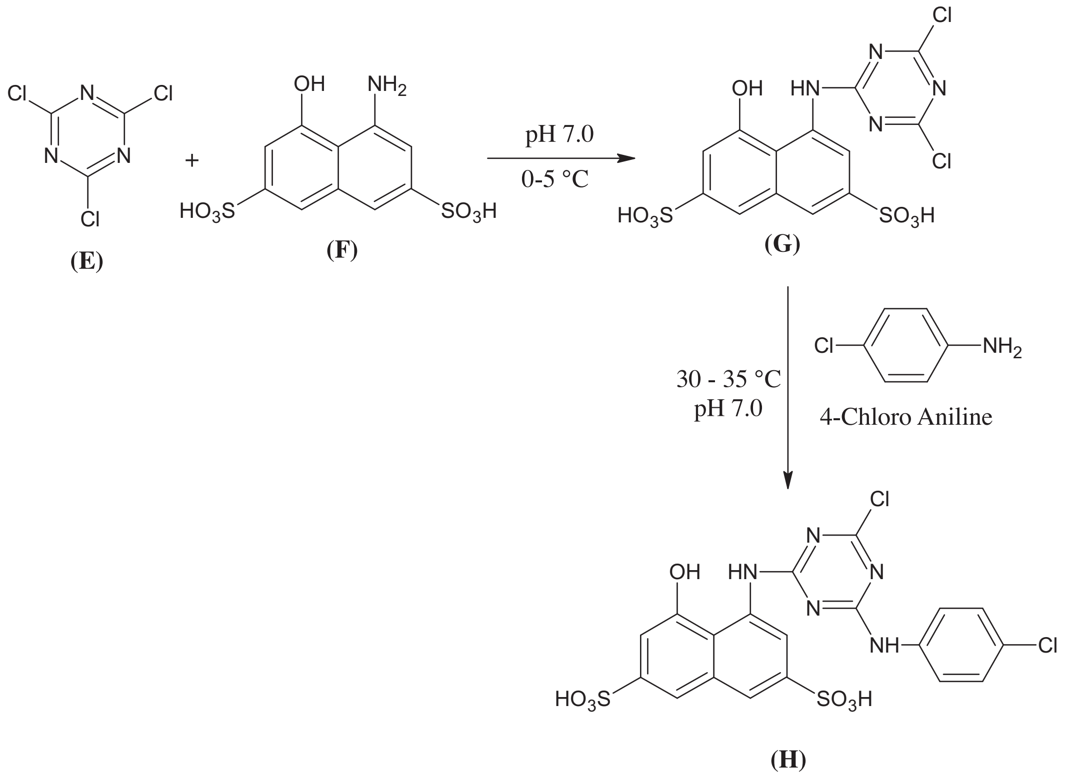
Scheme 3 The route of the synthesis of the 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)] phenyl-4(3*H*)-quinazolinone-6-sulphonic acid **(C)** and its diazonium salt **(D)**.

The resultant solution **(H)** thus obtained was used for further coupling reaction (Scheme 4).

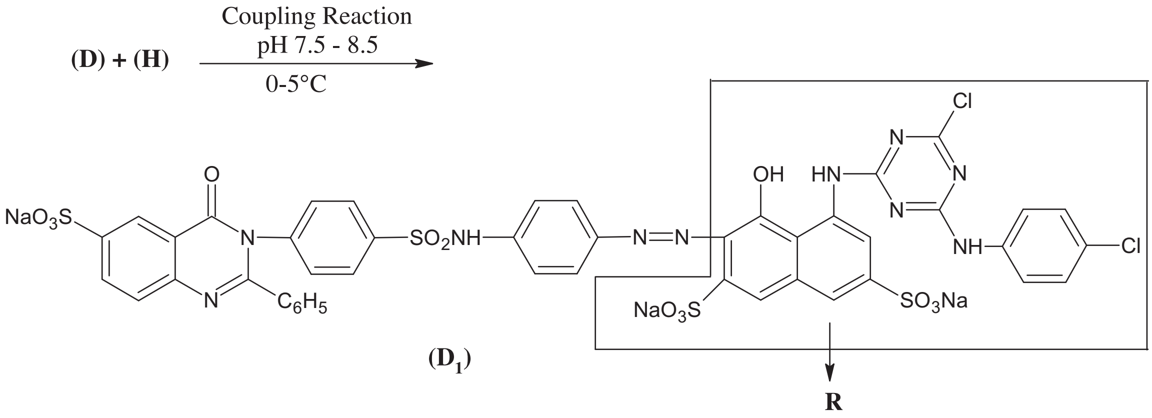
2.8. Formation of the dye D_1

To an ice cold and stirred solution of 4-chloro anilino cyanurated H-acid **(H)** (5.58 g, 0.01 mol), a freshly prepared diazo solution **(D)** (2.98 g, 0.005 mol) was added drop wise over a period of 10–15 min. The pH was maintained at 7.5–8.5 by simultaneous addition of sodium carbonate solution (10% w/v). During coupling the purple solution was formed. The stirring was continued for 3–4 h, maintaining the temperature below 5 °C. The reaction mixture was heated up to 60 °C and sodium chloride added until the colouring material was precipitated. It was stirred for an hour, filtered and washed with a small amount of sodium chloride solution (5% w/v). The solid was dried at 80–90 °C and extracted with DMF. The dye was precipitated by diluting the DMF-extract with excess of chloroform. A purple dye was then filtered, washed with chloroform and dried at 60 °C. Yield 85% (Scheme 5).

According to the above procedure; other reactive dyes $\mathbf{D_{2\text{–}10}}$ were synthesized using 4-chloro anilino cyanurated coupling components such as Gamma acid, J-acid, N-methyl J-acid, N-phenyl J-acid, Chicago acid, Laurant acid, Bronner acid, Tobias acid and K-acid. All the synthesized dyes were recorded in Table 1.



Scheme 4 The route of the synthesis of the cyanurated H-acid **(G)** and 4-chloro anilino cyanurated H-acid **(H)**.



Where **R**=Different p-chloro anilino cyanurated coupling components (**Table 1**)

Scheme 5 The route of the synthesis of the dye **(D_1)**.

3. Results and discussion

A series of quinazoline based reactive dyes (**$D_{1–10}$**) were prepared by cross-coupling reaction of 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-sulphonic acid diazonium salt with various couplers, as listed in Table 1. Diazotization was carried out according to the literature procedure using sodium nitrite and hydrochloric acid.

The principle advantage here for using quinazoline based moiety **(C)** is that the yield is high, short reaction time and reaction procedure is done in few steps, the work up is convenient and thus the starting material can be easily prepared.

3.1. Spectral data

The visible absorption spectroscopic properties of dyes were recorded in water and are shown in Table 5. From the data reported in Table 5, it is apparent that the value of λ_{max} depends on the nature and position of coupling component used. The colour change observed for each dye is due to the oscillation of electrons and the presence of additional substituents. In **D_1** there is more place for the oscillation of electrons and also the presence of both –OH and –NH– groups, thus λ_{max} = 540 nm (purple hue). In other dyes like **D_2**, **D_3**, **D_4** and **D_5** oscillation of electron is very fast due to the lesser

Table 1 Characterization data of reactive dyes (D_{1-10}).

Dyes	Various 4-chloro anilino cyanurated coupling components	Molecular formula	Mol. weight (gm/mol)	Yield (%)	% C		% H		% N		R_f[a] Value
					Found	Req.	Found	Req.	Found	Req.	
D_1	H-acid	$C_{45}H_{27}O_{13}N_{10}Cl_2S_4Na_3$	1184	85	45.60	45.65	2.22	2.30	11.77	11.83	0.43
D_2	Gamma acid	$C_{45}H_{28}O_{10}N_{10}Cl_2S_3Na_2$	1082	82	49.91	49.96	2.55	2.61	12.90	12.95	0.45
D_3	J-acid	$C_{45}H_{28}O_{10}N_{10}Cl_2S_3Na_2$	1082	78	49.92	49.96	2.52	2.61	12.88	12.95	0.38
D_4	N-methyl-J-acid	$C_{46}H_{30}O_{10}N_{10}Cl_2S_3Na_2$	1096	80	50.35	50.42	2.70	2.76	12.71	12.78	0.36
D_5	N-phenyl-J-acid	$C_{51}H_{32}O_{10}N_{10}Cl_2S_3Na_2$	1158	82	52.84	52.90	2.71	2.79	12.02	12.10	0.45
D_6	Chicago acid	$C_{45}H_{27}O_{13}N_{10}Cl_2S_4Na_3$	1184	83	45.58	45.65	2.23	2.30	11.75	11.83	0.41
D_7	Laurant acid	$C_{45}H_{28}O_9N_{10}Cl_2S_3Na_2$	1066	77	50.63	50.71	2.59	2.65	13.06	13.14	0.40
D_8	Bronner acid	$C_{45}H_{28}O_9N_{10}Cl_2S_3Na_2$	1066	78	50.64	50.71	2.57	2.65	13.08	13.14	0.42
D_9	Tobias acid	$C_{45}H_{28}O_6N_{10}Cl_2S_2Na$	0964	80	56.01	56.08	2.95	3.03	14.47	14.53	0.45
D_{10}	K-acid	$C_{45}H_{27}O_{13}N_{10}Cl_2S_4Na_3$	1184	78	45.57	45.65	2.21	2.30	11.78	11.83	0.40

[a] Determined by TLC using benzyl alcohol + DMF + Water (30:20:20/Volume ratio) eluent system on Silica gel-G F_{254} TLC plate.

Table 2 IR Spectra of reactive dyes (D_{1-10}).

Dyes	IR (cm^{-1})
D_1	3510–3630 (–OH & –NH), 1655 (–C=O), 1432 (–N=N–), 1380 (C–N), 1320, 1166, 1045 (–S=O), 1514 (–NH bend.), 1315 (–OH bend.), 762 (C–Cl).
D_2	3520–3642 (–OH & –NH), 1660 (–C=O), 1440 (–N=N–), 1385 (C–N), 1325, 1160, 1042 (–S=O), 1510 (–NH bend.), 1310 (–OH bend.), 765 (C–Cl).
D_3	3500–3650 (–OH & –NH), 1653 (–C=O), 1430 (–N=N–), 1382 (C–N), 1345, 1164, 1042 (–S=O), 1512 (–NH bend.), 1311 (–OH bend.), 760 (C–Cl).
D_4	3530–3620 (–OH & –NH), 1665 (–C=O), 1420 (–N=N–), 1390 (C–N), 1340, 1155, 1050 (–S=O), 1520 (–NH bend.), 1320 (–OH bend.), 766 (C–Cl).
D_5	3540–3650 (–OH & –NH), 1650 (–C=O), 1425 (–N=N–), 1395 (C–N), 1342, 1162, 1040 (–S=O), 1510 (–NH bend.), 1325 (–OH bend.), 770 (C–Cl).
D_6	3530–3675 (–OH & –NH), 1655 (–C=O), 1422 (–N=N–), 1386 (C–N), 1330, 1170, 1050 (–S=O), 1515 (–NH bend.), 1320 (–OH bend.), 765 (C–Cl).
D_7	3525–3665 (–OH & –NH), 1662 (–C=O), 1425 (–N=N–), 1382 (C–N), 1335, 1175, 1052 (–S=O), 1511 (–NH bend.), 766 (C–Cl).
D_8	3545–3650 (–OH & –NH), 1670 (–C=O), 1415 (–N=N–), 1385 (C–N), 1323, 1168, 1045 (–S=O), 1512 (–NH bend.), 762 (C–Cl).
D_9	3505–3642 (–OH & –NH), 1653 (–C=O), 1422 (–N=N–), 1388 (C–N), 1342, 1180, 1060 (–S=O), 1518 (–NH bend.), 760 (C–Cl).
D_{10}	3500–3660 (–OH & –NH), 1655 (–C=O), 1430 (–N=N–), 1382 (C–N), 1330, 1165, 1092 (–S=O), 1506 (–NH bend.), 1310 (–OH bend.), 763 (C–Cl).

Table 3 ^1H NMR spectra of reactive dyes (**D_{1-10}**).

Dyes	^1H NMR (δ ppm)
D_1	–OH (1H, s, 3.35), –2NH (2H, s, 4.14), –SO_2NH (1H, s, 8.82), Ar-H (23H, m, 6.72–8.23)
D_2	–OH (1H, s, 3.32), –2NH (2H, s, 4.12), –SO_2NH (1H, s, 8.84), Ar-H (24H, m, 6.71–8.25)
D_3	–OH (1H, s, 3.38), –2NH (2H, s, 4.18), –SO_2NH (1H, s, 8.86), Ar-H (24H, m, 6.75–8.26)
D_4	–OH (1H, s, 3.30), –N–CH_3 (3H, s, 2.58), –NH (1H, s, 4.12), –SO_2NH (1H, s, 8.80), Ar-H (24H, m, 6.78–8.19)
D_5	–OH (1H, s, 3.32), –NH (1H, s, 4.15), –SO_2NH (1H, s, 8.78), Ar-H (29H, m, 6.72–8.30)
D_6	–OH (1H, s, 3.30), –2NH (2H, s, 4.12), –SO_2NH (1H, s, 8.85), Ar-H (23H, m, 6.72–8.32)
D_7	–2NH (2H, s, 4.20), –SO_2NH (1H, s, 8.80), Ar-H (25H, m, 6.80–8.26)
D_8	–2NH (2H, s, 4.27), –SO_2NH (1H, s, 8.88), Ar-H (25H, m, 6.82–8.38)
D_9	–2NH (2H, s, 4.13), –SO_2NH (1H, s, 8.85), Ar-H (26H, m, 6.76–8.18)
D_{10}	–OH (1H, s, 3.32), –2NH (2H, s, 4.16), –SO_2NH (1H, s, 8.84), Ar-H (23H, m, 6.71–8.28)

Abbreviations: s, singlet; d, doublet; t, triplet; m, multiplet.

Table 4 Dye-bath containing materials.

Materials	Silk	Wool	Cotton
Fabric (g)	2.0	2.0	2.0
Amount of dye (mg)	40	40	40
Glauber's salt (20% w/v) (ml)	1.0	1.5	1.0
Soda ash (10% w/v) (ml)	–	–	1.0
Acetic acid (10% w/v) (ml)	1.0	–	–
Formic acid (10% w/v) (ml)	–	1.5	–
pH	3	3	8
MLR	1:40	1:40	1:40
Dyeing time (min)	40	60	90
Dyeing temp. (°C)	60–80	60–80	60–80
Total volume (ml)	80	80	80

number of electrons and hence these dyes possess lower λ_{max} value compared with **D_1**. The same effect is also revealed for the dyes **D_7**, **D_8** and **D_9**. While for dyes **D_6** and **D_{10}** the substituent are same as in **D_1** but the oscillation of electron is fast due to the locality of $-NH_2$ and $-SO_3Na$ group. Thus; in both dyes neutralization of electron takes place rapidly, hence both dyes have lower λ_{max} compared with **D_1**.

The extent of this shift is probably accounted for the steric effects of the coupler substituents.

3.2. IR spectra

In general, the IR Spectra (Colthup et al., 1991; Bassler et al., 1991) of all the dyes, showed the characteristic band in the range 3500–3675 cm^{-1} indicates the presence of O–H and N–H stretching vibration, in addition to absorption band at 1506–1520 cm^{-1} is due to the N–H bending vibration. The band appeared at 1415–1440 cm^{-1} is due to the stretching vibration of azo group. A strong band at 1650–1670 cm^{-1} is due to the stretching vibration of the C=O group of the quinazoline moiety, and absorption band at 1380–1395 cm^{-1} is due to the C–N stretching vibration. The band at 1040–1345 cm^{-1} is due to the stretching vibration of S=O group, while the band at 1310–1325 cm^{-1} is due to the bending vibration of O–H group and the C–Cl stretching vibration is appeared at 760–770 cm^{-1} (Table 2).

3.3. ^1H NMR spectra

^1H NMR spectral data (Dean, 1968) (300 MHz, DMSO) of representative dye (**D_1**) Showed signal at 3.35 δ (1H, s, –OH), 4.14 δ (2H, s, –2NH), 8.82 δ (1H, s, $-SO_2NH$), 6.72 δ – 8.23 δ (23H, m, Ar-H) (Table 3).

3.4. Dyeing of fibres

All the **D_{1-10}** were applied on silk, wool and cotton fabrics in 2% shade according to the literature procedure (Shenai, 1973) in the dye-bath containing the materials listed in Table 4. These dyes are gave reddish brown to orange hues with brighter and deeper shades with high tinctorial strength and excellent levelness on the fabric. The variation in the hues of the dyed fabric results from the alternation in the coupling components. The remarkable degree of levelness and brightness after washing indicates good penetration and excellent affinity of these dyes to the fabric.

3.5. Exhaustion and fixation study

The percentage exhaustion of 2% dyeing on silk ranges from 67–76%, wool range from 63–72% and cotton ranges from 65–74%. The percentage fixation of 2% dyeing on silk range from 84–92%, wool range from 84–93% and cotton ranges from 84–91%. The data percentage exhaustion on the various fabrics was calculated by known method (Erik, 1977) (Table 5).The higher exhaustion may be expected due to relatively open structure.

Dye uptake by the fiber was measured by sampling the dye bath before and after dyeing. The absorbance of the diluted dye solution was measured at λ_{max} of the dye. Percentage dye bath exhaustion was calculated using the following relationship.

$$\%\text{Exhaustion} = \frac{\text{Initial O.D.} - \text{Final O.D.}}{\text{Initial O.D.}} \times 100$$

3.6. Fastness properties

The light fastness of all the dyes rating 3–6 for silk, wool and cotton which shows light fastness is moderate to very good. The wash fastness of all the dyes rating 3–5 for silk, wool

Table 5 Result of Exhaustion and Fixation study of reactive dyes (**D_{1-10}**) on wool, silk and cotton.

Dyes	Colour	λ_{max}[a] (nm)	% Exhaustion			% Fixation		
			S	W	C	S	W	C
D_1	Purple	540	75.30	70.90	71.55	91.63	93.08	91.54
D_2	Yellow	460	73.50	68.82	67.65	88.43	89.35	84.99
D_3	Light yellow	455	70.60	70.47	68.72	85.69	91.52	86.57
D_4	Dark yellow	465	69.55	65.55	74.72	89.14	87.71	88.99
D_5	Orange	480	67.97	66.12	69.45	91.94	85.44	88.55
D_6	Light purple	505	72.60	71.10	69.57	84.02	88.60	87.67
D_7	Yellowish green	430	69.35	68.00	71.82	85.80	84.55	90.49
D_8	Light yellow	442	75.45	65.27	70.52	90.12	91.91	85.78
D_9	Yellowish green	435	69.65	68.40	65.17	89.73	86.94	84.38
D_{10}	Light red	495	67.55	65.82	68.04	92.52	91.91	88.85

[a] Determined in water at 28 °C at 2×10^{-3} M dye concentration.

Table 6 Fastness properties of reactive dyes ($\mathbf{D}_{1-10}$) on wool, silk and cotton.

Dyes	Light fastness			Wash fastness			Rubbing fastness					
	S	W	C	S	W	C	Dry			Wet		
							S	W	C	S	W	C
$\mathbf{D}_1$	4	6	3	4	5	4	4–5	3	4	3–4	3	4
$\mathbf{D}_2$	5	5	6	4	4	4	4	3	3	4	5	4
$\mathbf{D}_3$	4–5	5	3–4	4–5	3	3	4	4	5	3	6	3
$\mathbf{D}_4$	3	4–5	5	4–5	4	3–4	4	3	3	4	5	4
$\mathbf{D}_5$	5	3	3–4	3–4	3	5	3	5	3	3	4–5	4
$\mathbf{D}_6$	5	4	4–5	5	4	4	4	3	4–5	3–4	5	3
$\mathbf{D}_7$	6	5	3	3	3–4	3–4	4–5	3	4–3	3	3	3–4
$\mathbf{D}_8$	4–5	3	4	3	5	3	3	4	3	4	4	5
$\mathbf{D}_9$	4	5	4–5	4	4–5	3–4	3	3	4	5	3	4–5
$\mathbf{D}_{10}$	5–6	4–5	4	4	3–4	4	4	4	3–4	4	3	4

S = silk, W = wool, C = cotton.
Light fastness: 1-poor, 2-slight, 3-moderate, 4-fair, 5-good, 6-very good.
Wash and rubbing fastness: 1-poor, 2-fair, 3-good, 4-very good, 5-excellent.

and cotton which shows wash fastness is good to excellent. The rubbing (dry and wet) fastness of all the dyes rating 3–5 for silk, wool and cotton which shows rubbing fastness is good to excellent (Table 6).

4. Conclusion

The diazo component 2-phenyl-3-[4′-(4″-aminophenylsulphonamido)]phenyl-4(3*H*)-quinazolinone-6-Sulphonic acid acquired suitable basicity for the successful condition of diazotization. It was observed that nitrous acid which is formed by the reaction between sodium nitrite and hydrochloric acid was needed for satisfactory diazotization. A series of reactive dyes containing quinazoline moiety have been synthesized by conventional method and their different properties examined in solution and applied to silk, wool and cotton fabrics. The dyes gave wide range of fast shade like purple, red, orange and yellow having very good fastness properties. This type of dye synthesis is generally convenient and economical for use.

Exhaustion and fixation of these dyes are very good. This indicate that the dyes have excellent attraction and solubility with the fabric. The dye molecule possess bridging group like –SO_2NH– which increase the substantivity due to the formation of hydrogen bond.

Furthermore these dyes showed an incredible degree of levelness after washing indicates the good diffusion and excellent affinity of these dyes to the fabric due to the accumulation of polar group.

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