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SYNTHESIS, CHARACTERIZATION AND APPLICATION OF SOME MONOAZO REACTIVE DYES BASED FROM QUINAZOLINONE ON COTTON FABRIC

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ABSTRACT

Various mono azo reactive dyes with quinazolinone moiety were synthesized starting with the preparation of 6,7-dimethoxy-2-phenyl-4H-benzo[d][1,3]oxazin-4-one from 2-amino-4,5-dimethoxybenzoic acid and fusing with different di-amino compounds to give dye intermediates C, 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3H)-one, which were diazotized, followed by azo coupling with various cyanurated coupling components such as H-acid, gamma acid and J-acid. All the reactive dyes were characterized for their percentage yield, and UV-Vis spectroscopy from 400-700 nm. The UV-visible spectrophotometric investigation of the synthesized dyes was carried out in different solvents to obtain the absorption maxima, molar coefficients and solvatochromic effects of the dyes while the infra-red (IR) spectroscopy was investigated. Dyeing performance on cotton fabric was assessed. The synthesized reactive dyes were applied on cotton and the percentage exhaustion and fixation of the dyes were evaluated and usage properties of the dyes also examined. The yield ranged from 89-92% while the IR shows absorption at 3048 and 2924 cm^{-1} which is responsible for C-H stretch for aromatics and aliphatics. The signals at 1743 cm^{-1}, 1496 cm^{-1}, and 3425 cm^{-1} are due to C=O, -N=N- and O-H stretch respectively. The percentage of dye bath exhaustion on the fibre is reasonably good and acceptable. The dyeing performance of all dyes on cotton fabric gave moderate to good light fastness, good to very good wash fastness and fair to very good fastness to perspiration – acid and alkaline. The dyes gave colour ranges from purple to red to pink shade. It has become necessary to explore new areas in a bid to commencing the production of these vital chemicals.

Key words: Reactive dyes, diazotization, percentage exhaustion, fastness properties,, spectroscopy

INTRODUCTION

Dyes that are based on heterocyclic ring systems are known to possess high tinctorial power with outstanding fastness properties. Some azo dyes have been obtained from amino heterocyclic compounds while azo dyes prepared by using selected quinazoline derivatives as coupling components have also been described [1]. The structural development of new reactive dyes has been a subject of interest and many novel structures are useful in commercial application to wool, silk and cotton as well as their blends with other fibers has been discovered [1]. Reactive dyes have an efficient utilization and also a facile ease of washing out of the non-fixed portions which is the requirement of dyeing. They should have a high reactivity, good yield and produce high degrees of fixing in particular dyeing [2].

In the dye stuff research, reactive dyes are the newest addition and is the center of attention [3, 4]. Hot brand reactive dyes are commercially important in reactive dyeing [5]. Due to their higher fixation yields on various fibres, they have been extensively recognized [6]. The popularity of reactive dyes is increased due to the ease of dyeing cellulosic fibres. The structural improvement of reactive chromogens, number and selection of reactive groups led to an increment in their use [7]. The chemicals containing s-triazine nucleus have been widely applied in different fields viz, dyes, explosives, polymers, pesticides and trade good chemicals [8]. As a result, experimental and theoretical research on these types of compounds have been widely carried out [9-11].

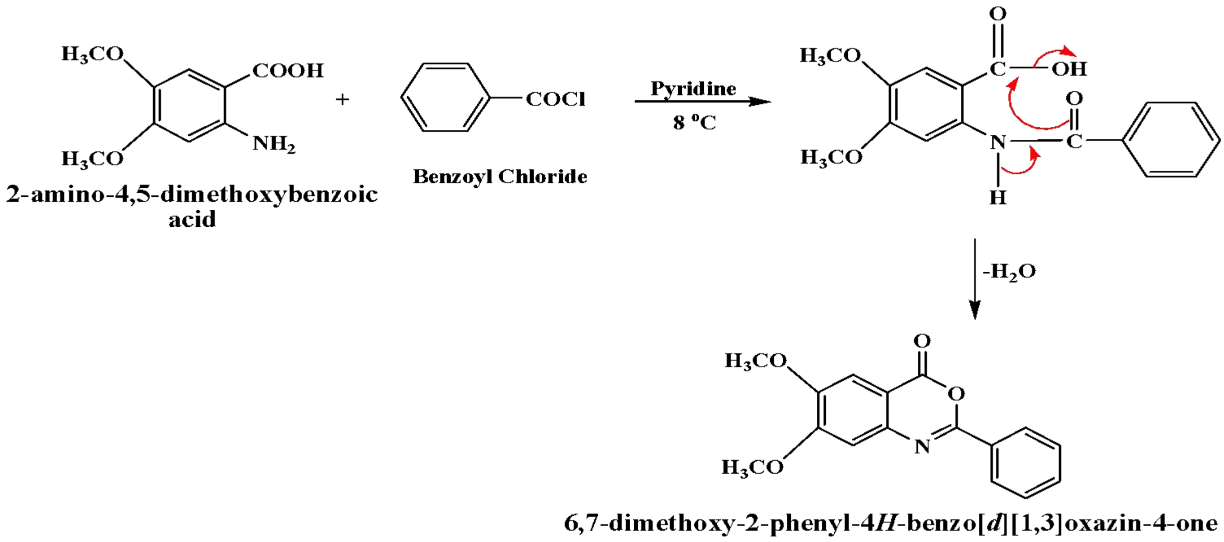
Various mono azo reactive dyes with quinazolinone moiety were synthesized starting with the preparation of 6,7-dimethoxy-2-phenyl-4H-benzo[d][1,3]oxazin-4-one from 2-amino-4,5-dimethoxybenzoic acid and fusing with different di-amino compounds to give dye intermediate. The aim of this research is to synthesize and characterize some quinazolinone-based derivatives of monoazo reactive dyes and to assess them on cotton fabric. The objectives are: Synthesis of 6,7-dimethoxy-2-phenyl-4H-benzo[d][1,3]oxazin-4-one from 2-amino-4,5-dimethoxybenzoic acid; Synthesis of dye intermediate with quinazolinone ring from prepared 6,7-dimethoxy-2-phenyl-4H-benzo[d][1,3]oxazin-4-one; Diazotization and coupling of dye intermediate with several cyanurated coupling components to yield mono reactive dyes containing quinazolinone ring; Characterization of the synthesized dyes and intermediate using UV-Visible Spectrophotometer and FTIR; and Application of the synthesised dyes on cotton fabric and test the fastness to wash, light and perspiration of the dye on the fabric

MATERIALS AND METHODS

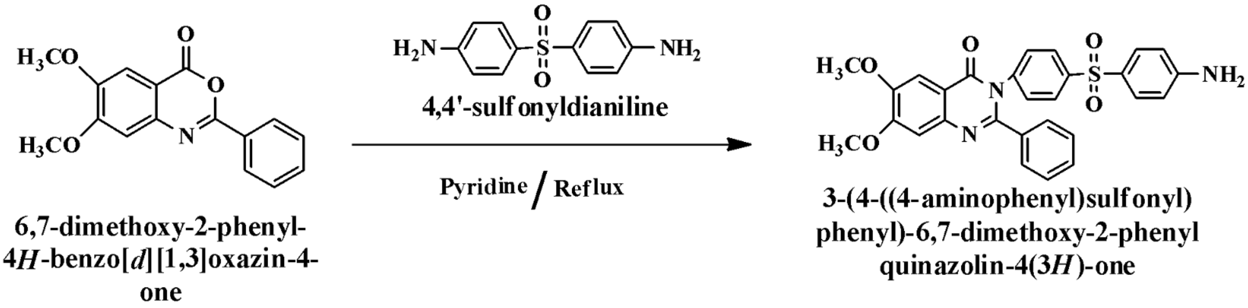
All commercial products such as benzoyl chloride, 2-amino-4,5-dimethoxybenzoic acid, 4,4'-diamino-[1,1'-biphenyl]-2,2'-disulfonic acid, 4,4'-sulfonyldianiline, pyridine, sodium bicarbonate and sodium chloride were purchased from Sigma-Aldrich. Melting points were determined by the open capillary method using the Gallenkamp melting apparatus. The visible absorption spectra were measured using Agilent CARY 300 UV/Vis spectrophotometer; IR was measured and recorded in KBr pellets using the Agilent CARY 630 Fourier Transform Infra-red spectrometer.

Synthesis of 6,7-dimethoxy-2-phenyl-4H-benzo[d][1,3]oxazin-4-one [8]

An acid, 2-amino-4,5-dimethoxybenzoic acid (39.41 g, 0.2 mol), was dissolved in pyridine (100 ml) and stirred. Thereafter, benzoyl chloride (23.22 ml, 0.2 mol) was added dropwise with constant stirring to the solution, maintaining the temperature near 0-5°C for one hour. The reaction mixture was stirred for another one hour at room temperature until a solid product was obtained. At the end of the reaction, the solid mass obtained was filtered, washed successively with saturated sodium bicarbonate solution, to remove unreacted acid, and finally washed with water, dried and recrystallized from pure ethanol. The percentage yield was calculated and the melting point determined.



Scheme 1: Synthesis of quinazolinone ring



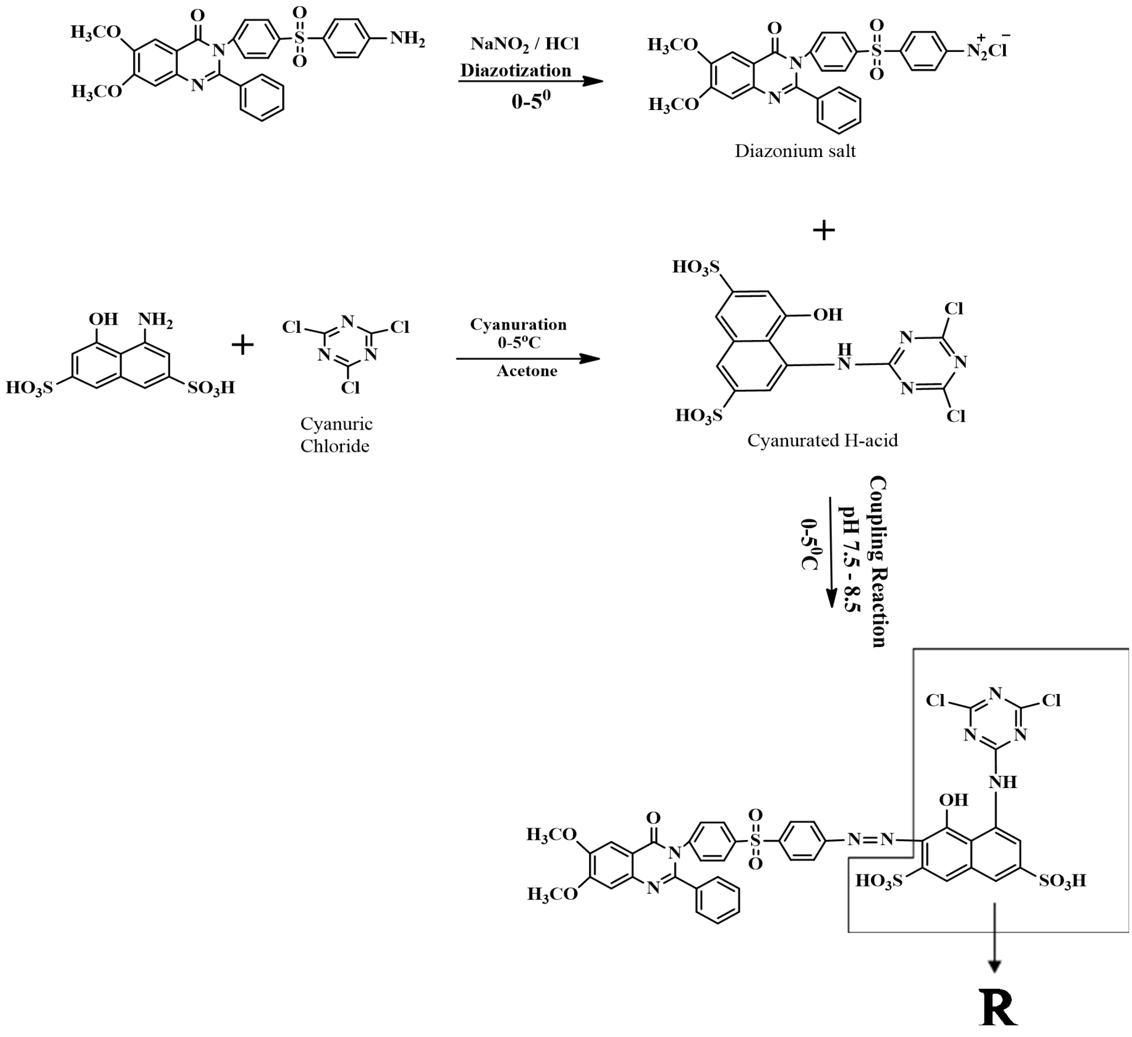
Scheme 2: Synthesis of the dye intermediate (C) 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3H)-one

A ketone, 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3*H*)-one (Intermediate C) (1.026 g, 0.002 mol) was dissolved in water (60 ml), and hydrochloric acid (10 ml, 0.008 mol) was added dropwise to the suspension formed and stirred. Thereafter it was gradually heated up to form a clear solution and 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 added for 5 min with stirring. The stirring was continued for an hour, maintaining the same temperature, for diazotization to occur. A clear diazo solution of 'C' at 0– 5 °C was obtained and used for the coupling reaction.

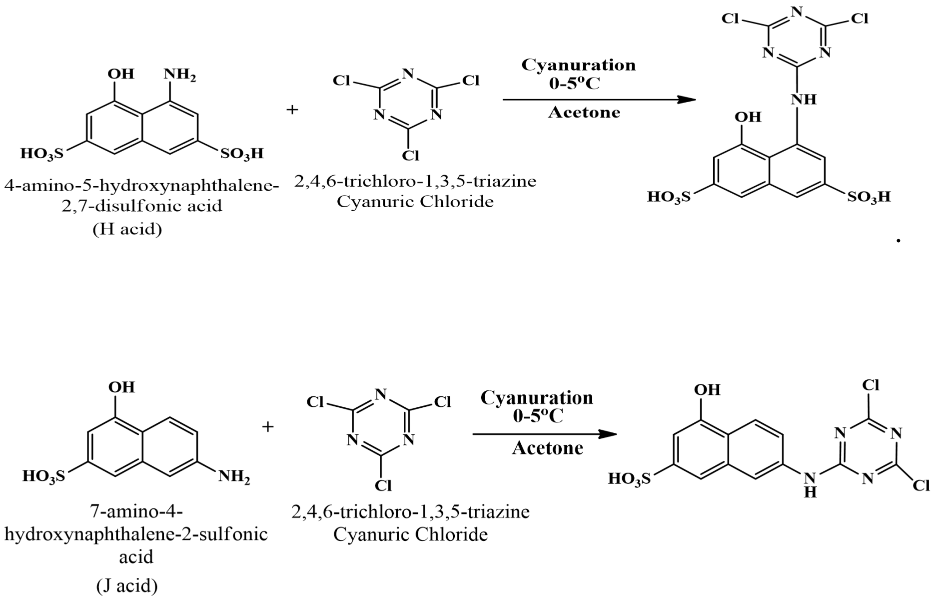
Preparation of coupling components [9]

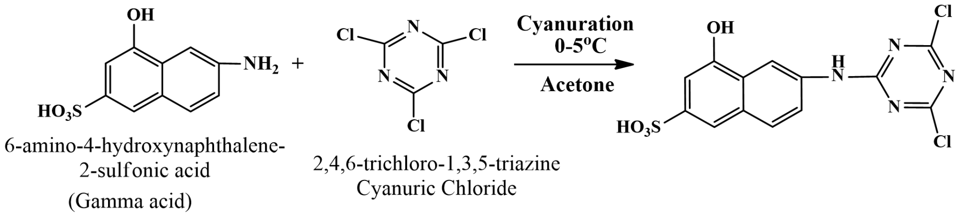
H-acid (3.19 g, 0.01 mol) was dissolved in water (15 ml) at pH 7.5, using 20 % (w/v) Na_2CO_3. A solution of cyanuric chloride (1.85 g, 0.01 mol) was stirred in acetone (25 ml) at a temperature of 0-5 °C and was added dropwise to the stirred H-acid solution at 0-5 °C. After 10 min, the solution was adjusted to a neutral pH by adding 20 % (w/v) Na_2CO_3, and the reaction was continued for about 4 hours at 0-5 °C to obtain a clear solution. The cyanurated H-acid solution thus obtained was used for coupling

Similar procedures and conditions were used for other coupling components; J-acid and Gamma acid.



Scheme 3: Synthesis of coupling components …





Scheme 4: Various synthesized coupling components

Purification of the dyes

The dyes were purified through the same process of recrystallization as highlighted in the Scheme for the intermediates. Some of the dyes required the mixed solvent of ethanol, methanol /DMF (9/1 solvent mixture) according to a procedure suggested by Maradiya and Patel [12]. The purity of each synthesized dyes were confirmed by melting point.

Percentage yield of dyes and intermediates [16]

The percentage yield of the synthesized dyes and intermediates were determined using the formula shown in equation 1 [13].

$$\%Yield = MPMMP \div MRMMR \times 100 \qquad (1)$$

where;

MP is the mass of the product

MMP is the molar mass of the product

MR is the mass of the reactant

MMR is the molar mass of the reactant

Melting point of the dyes

The melting point of each dye was determined using gallenkamp melting apparatus. 0.002 g of each dye was filled into a capillary tube each placed in to the apparatus, the melting point of each dye was obtained by consistently focusing on the apparatus as the apparatus gradually heat the dye in the tube where the melting point is obtained.

Dyeing of cotton fabric

The fabric was introduced into the dye bath at 30 °C and the temperature was raised to 70 °C, over 30 min. at 2 °C/min, as soda ash (Na_2CO_3) solution (10% v/v) was added to bring about fixation and the dyeing continued for 50 min at the same temperature. The material was then removed, rinsed with cold water and dried.[10]

Application of dye solution

A solution was prepared by dissolving about 1 g of dried dye powder in 100 ml of distilled water. To determine the qualities required for the experiment the following equation (2) was utilized.

$$\text{Number of ml of stock solution required} = \frac{W \times P}{C} \qquad (2)$$

Where W = weight (in grams) of sample to be dyed

P = percentage of dye to be used

C = concentration (%) of stock solution [12].

Determination of dye bath exhaustion

Dye uptake was determined by measuring the absorbance of diluted dye bath samples at the wavelength of the maximum absorption. The bath was sampled before and after dyeing. A 1 ml aliquot was taken from the bath and diluted in 20 ml of distilled water. This is to ensure that the absorbance falls within the readable range of 1.5. The percentage dye bath exhaustion (%E) for each substrate was calculated using the equation 3 [13].

$$\% E = \frac{A_o - A_1}{A_o} \times 100 \qquad (3)$$

Where A_o and A_1 are the absorbance at λ_{max} of the dye bath prior to dyeing and after dyeing respectively.

Determination of dyed fixation and fixation efficiency

The term, fixation ratio, refers to the radio of the amount of dye absorbed (which is covalently bonded to the fibre) to the hydrolyzed dye on the surface of the surface.

$$\text{Percentage fixation} = \frac{OD_1 - OD_2 - OD_3}{OD_{1-OD_2}} \times 100 \qquad (4)$$

Where OD_1 = optical density of the dye before dyeing

OD_2 = optical density of the dye after dyeing

OD_3 = optical density after stripped

Each dyed fabric was stripped in a 25% (w/w) pyridine in water solution (100 ° C IR 10:1) for 30 minutes and the part of the solution was taken to the spectrophotometer to give $OD_{3;}$ the optical density after stripping.

Optical overall fixation efficiency value (T) is related to the original amount of dye applied. A simple relationship exist between % T % F, and % E (dye bath exhaustion) given by Yusuf *et al* [14]

$$\%T = \frac{\% F \times \% E}{100} \qquad (5)$$

Light fastness of dyed cotton fabric (fastness to sunlight) SLT 401 (IUF 40)

The test is carried out on the dyed samples under daylight facing south sloping at an angle 45° from the horizontal. The procedures involved aligning both the eight dyed wool standards together with a. 2 cm x 2cm cut pieces of the dyed samples on a card and covering one third of the setup with opaque cover.

Exposure is carried with regular inspection noting when the non-exposed part and exposed part of each dyed sample had contrast equivalent to grade 4 of ISO grey scale after which and opaque cover was placed covering part of the exposed sample part, exposure was continued till the blue standard 7 faded. The rating of the dyed samples is taken to be those equivalents to- that of standard dyed blue wool samples, which faded to the same extent as the specimen at the same time.

Wash fastness of the dyed substrates

This is to assess the leather resistance to prolong action of water. 2 x 2 cm of the dyed leather was dipped into solution made by 5 g (0.5%) of detergent powder into 200 cm^3 of distilled water. This was placed in water bath and the temperature allowed to rise to 40 ^oC while vigorously stirred for about 30 min and the leather was transferred to 100 cm^3 distilled water for washing before rinsing was done five times and then drying. The change in colour was assessed by the blue wool scale .

Fastness to perspiration

This test measures the resistance of the colour of textile fabrics of all kinds to perspiration in all forms. Perspiration was carried out under acidic and alkaline solutions.

Acidic solution: Sodium chloride (NaCl 5g/l), disodium hydrogen orthophosphate dehydrate ($Na_2HPO_4.2H_2O$ 2.5 g/L), histidine monohydrochloride monohydrate ($C_6H_9O_2N_3HCl.H_2O$ 0.5g/L), brought to pH 5.5 with 0.1N sodium hydroxide (NaOH) in a liquor ratio of 20:1.

Alkaline solution: Sodium chloride (NaCl 5g/l), disodium hydrogen orthophosphate dehydrate ($Na_2HPO_4.2H_2O$ 2.5 g/L), histidine monohydrochloride monohydrate ($C_6H_9O_2N_3HCl.H_2O$ 0.5 g/L), brought to pH 8 with 0.1N sodium hydroxide (NaOH) in a liquor ratio of 20:1

Procedure

A composite sample was made by sand witching the dyed sample measuring (5x5) cm between two pieces of un-dyed bleached cotton fabric measuring (5x5) cm. The composite specimen was thoroughly wetted in this solution (acidic and alkaline) at room temperature for 30 min. At the end of 30 min, the composite specimen was removed from the solution and the composite sample placed between two glasses plates measuring about 7.5x6.5cm under a force of about 4.5 kg. The apparatus containing the treated composites was then placed in a perpirometer at 37 + 2°C for 4 hours. After 4 hours, the specimens were removed from the perspirometer and dried at room temperature. The change in colour of the specimen and the staining of the white cloth were assessed using greyscale.Give reference for this procedure

RESULTS AND DISCUSSION

The Physical properties of intermediates are presented in Table 1.1.

Table 1.1: Physical properties of intermediates

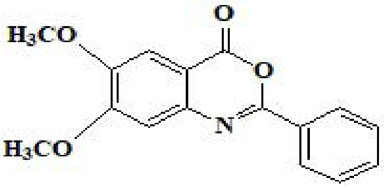
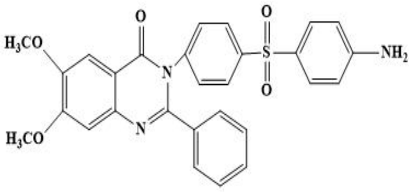
Intermediate	Structures	Molecular Formulae	Molecular Weight (g/mol)	Melting Point °C	Yield %
3[H]		$C_{16}H_{13}NO_4$	283	225-227	78
C		$C_{28}H_{23}N_3SO_5$	513	227-229	65

Table 1.2: FT-IR spectra of the intermediates

Intermediate	FT-IR (KBr) : $v\ (cm^{-1})$
3[H]	1751 (C=O), 1612 (C=N), (C-O-C), 3071 (C-H), 1273 (C-O)
C	1743 (C=O), 1620 (C=N), 1373 (S=O), 3456 (N-H), 3171 (C-H), 1280 (C-O)

The various dyes 1C, 2C and 3C, were successfully synthesized using diazotization and coupling reaction and the structures and properties are shown in Table 1.3

Table 1.3: Structures of the dyes

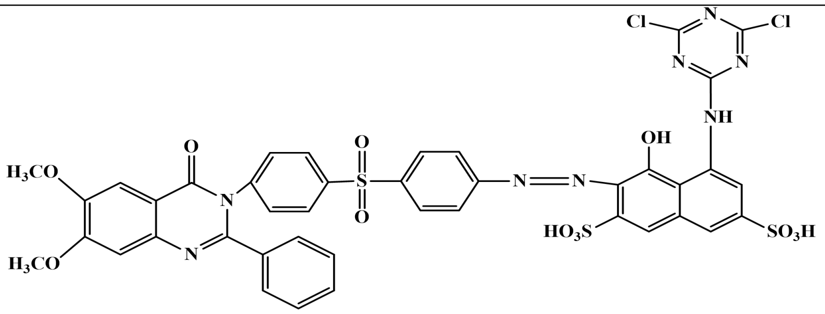
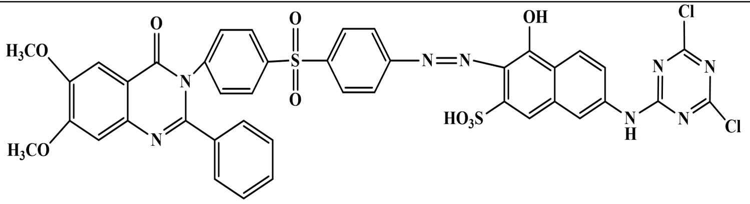
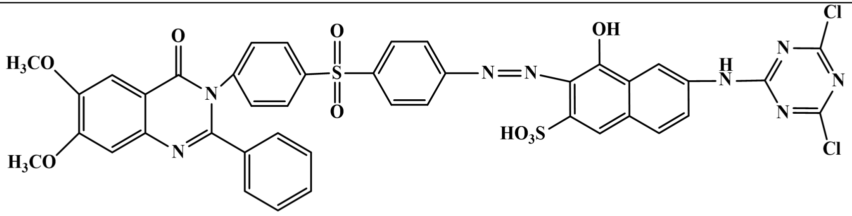
1C	
2C	
3C	

Table 1.4: Physical properties of synthesize dyes

Dyes	Molecular Formulae	Molecular Weight (g/mol)	Melting Point °C	Yield %	Physical Appearance (Colour)
1C	$C_{41}H_{28}N_8S_3Cl_2O_{12}$	991	310-312	89	Light pink
2C	$C_{41}H_{28}N_8S_2Cl_2O_9$	959	303-306	92	Yellowish pink
3C	$C_{41}H_{28}N_8S_2Cl_2O_9$	959	280-283	90	Yellowish pink

FT-IR spectra of the dyes

The spectra are shown in the Figures A1 to A3

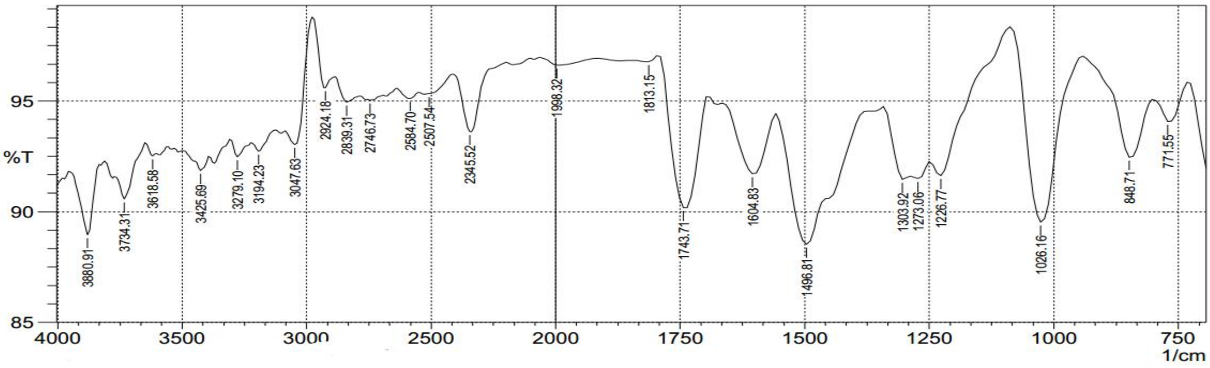


Figure A1: FTIR –spectrum of DYE 1C

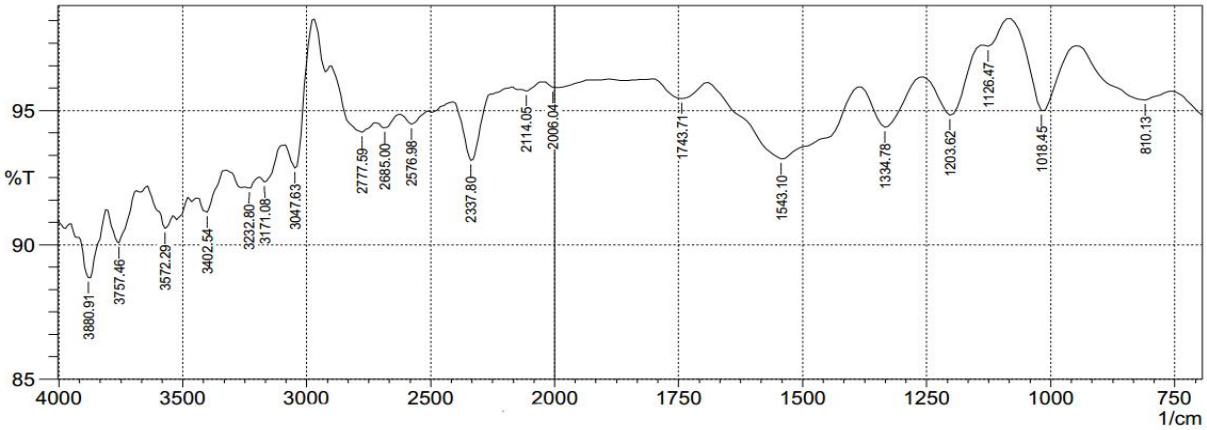


Figure A2: FTIR –spectrum of DYE 2C

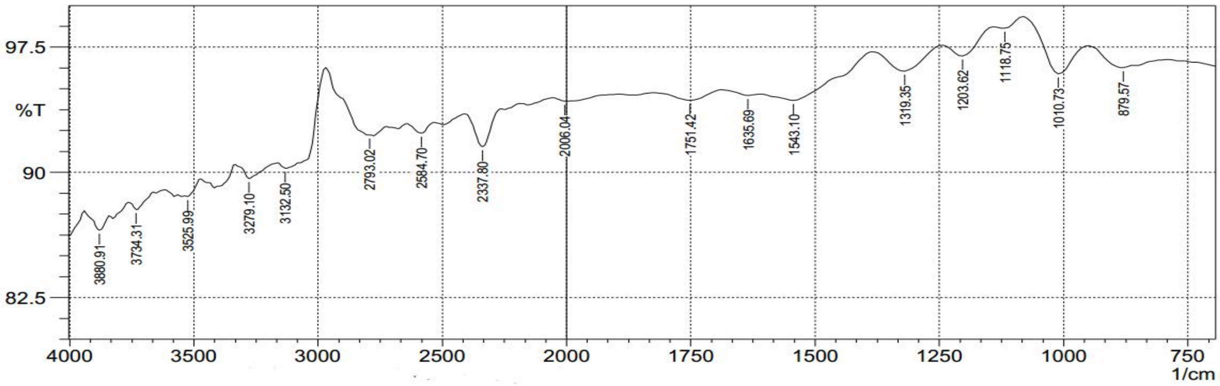


Figure A3: FTIR –spectrum of DYE 3C

Table 1.5: Interpretation of the FT-IR spectra of the dyes

Dye No.	FT-IR (KBr): $\boldsymbol{v}\ (\boldsymbol{cm^{-1}})$
1C	1743 (C=O), 1496 (-N=N-), 3425 (O-H), 1227 (C-N), 3279 (N-H), 1304, 1026 (S=O), 3048, 2924 (C-H aromatic, aliphatic), 849 (C-Cl)
2C	1743 (C=O), 1543 (-N=N-), 3402 (O-H), 1204 (C-N), 3233 (N-H), 1335, 1126 (S=O), 3048, 2778 (C-H aromatic, aliphatic), 810 (C-Cl)
3C	1751 (C=O), 1543 (-N=N-), 3525 (O-H), 1204 (C-N), 3279 (N-H), 1319, 1119 (S=O), 3133, 2793(C-H aromatic, aliphatic), 880(C-Cl)

Table 1.6: The wavelength of maximum absorption and molar extinction coefficient of the dyes

Dye No.	$\varepsilon_{max}\ in\ DMF$ $\times 10^4 lmol^{-1}cm^{-1}$	H_2O λ_{max}(nm)	DMF λ_{max}(nm)	Methanol λ_{max}(nm) a	Methanol + HCl λ_{max}(nm) b	Change in $\boldsymbol{\lambda_{max}}$(nm) (b-a)
1C	0.33	525	526	504	535	+31
2C	0.78	480	461	488	503	+15
3C	1.15	512	509	509	514	+5

Table 1.7: Exhaustion and fixation of reactive dyes on cotton

Dyes	Colour	Exhaustion (%)	Fixation (%)
1C	Light pink	90	72
2C	Yellowish pink	91	78
3C	Yellowish pink	82	66

Table 1.8: Fastness properties of the synthesized dyes

Dyes	Washing Fastness		Light Fastness	Fastness to Perspiration	
	Colour change	Staining		[Acid]	[Alkaline]
1C	3-4	4	3	4	3
2C	4	4	4	3	4
3C	3-4	4	3	3	4

Synthesis of 6,7-dimethoxy-2-phenyl-4*H*-benzo[*d*][1,3]oxaxin-4-one

A ketone, 6,7-dimethoxy-2-phenyl-4*H*-benzo[*d*][1,3]oxaxin-4-one, was synthesized to give a white crystal solid after recrystallization from ethanol as showed in the reaction scheme 4.1 (All the schemes should be clearly identified. None has been marked as scheme 4.1) . the percentage yield and melting point was found to be 78 % and 225-227 °C respectively as shown in Table 1.1.

Synthesis of Intermediates C,

The 6,7-dimethoxy-2-phenyl-4*H*-benzo[*d*][1,3]oxaxin-4-one was refluxed with Benzene-1,4-diamine to obtain intermediate C in the presence of pyridine, as shown in the reaction scheme 4.2 below???missing. The melting point and other physical properties are shown in Table 1.1

Synthesis of dye 1C

The 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3H)-one was diazotized and coupled with cyanurated H-acid to give light pink dye **1C**. The yield and melting point was 89% and 310-312 °C

The infra-red (IR vmax cm-1 Figure A1 This is missing) spectrum shows absorption at 3048 and 2924 cm^{-1} which is responsible for C-H stretch for aromatic and aliphatic. The signal at 1743 unit shows C=O stretch. The signal at 1496 cm^{-1} indicates -N=N- stretch. The signal at 3425 cm^{-1} is due to the O-H stretch. The signal at 1227 cm^{-1}is attributed to the C-N stretch. The signal at 3279 cm^{-1} indicates the N-H stretch. The signals 1304 and 1026 cm^{-1}show absorption for S=O stretch. The signal at 849 cm^{-1} is due to the C-Cl stretch.

Synthesis of dye 2C

The 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3H)-one was diazotized and coupled with cyanurated J-acid to give dye **2C**. The yield and melting point was 92 % and 303-306 °C

The infra-red (IR vmax cm-1 Figure A2) spectrum shows absorption at 1743 cm^{-1} is due to C=O stretch. The signal at 1543 cm^{-1} indicates -N=N- stretch. The signal 3402 cm^{-1} is responsible for the O-H stretch. The signal at 1204 cm^{-1} is due to the C-N stretch. The signal at 3233 cm^{-1} shows absorption for the N-H stretch. The signal at 1335 and 1126 cm^{-1} indicate S=O stretch. The signal 3048 and 2778 cm^{-1} is attributed to C-H stretch for aromatic and aliphatic. The signal at 810 cm^{-1} is due to the C-Cl stretch.

Synthesis of dye 3C

The 3-(4-((4-aminophenyl)sulfonyl)phenyl)-6,7-dimethoxy-2-phenylquinazolin-4(3H)-one was diazotized and coupled with cyanurated Gamma-acid to give dye **3C**. The yield and melting point was 90 % and 280-283 °C. The infra-red (IR vmax cm-1) (Figure A3) spectrum shows absorption at 1751 cm^{-1} is due to C=O stretch. The signal 1543 cm^{-1} indicate -N=N- stretch. The signal 3525 is responsible for the O-H stretch. The signal at 1204 cm^{-1} is attributed to the C-N stretch. The signal at 3279 cm^{-1} is due to the N-H stretch. The signal at 1319 and 1119 shows S=O stretch. The signal at 3133 cm^{-1} and 2793 cm^{-1} is attributed to the C-H stretch for aromatics and aliphatics. The signal 880 cm^{-1} is due to C-Cl stretching vibration.

Visible absorption spectra and molar extinction coefficient of the dyes

Absorbance is the measure of the amount of light absorbed. The visible absorption properties were measured in water, dimethylformamide (DMF) methanol and methanol+HCl. The result is summarized in Table 1.6. The colour of the reactive monoazo dyes depends on the nature of both the diazo and coupling component. The wavelength of the maximum absorption of the quinazolinone based dyes ranges from 470 – 540 in water, 460 – 550 in DMF, 470 – 540 in Methanol and 490 – 540 in Methanol+HCl.

The molar extinction coefficient (ε) of the dyes was calculated based on the concentration in dimethylformamide (DMF) as a solvent and are also listed in Table 1.6

The λ_{max} shifts in solvents are brought about by the solvatochromic effect resulting from changes in the dielectric constant of the solvent. The measurement of λ_{max} in methanol, water and DMF showed that the λ_{max} of the intramolecular charge transfer bonds exhibits a marked redshift on transfer from non-polar to polar solvent. This behaviour indicates that the polar excited states of the synthesised dyes are stabilized by polarization interaction forces as the polarizability of the solvent is increased.

Solvent effect on the UV-Vis spectra (Solvatochromism)

Solvatochromism is due to various solute-solvent interactions in both the ground state and the excited states. Effect of solvent polarity on the maximum absorption wavelength of dyes i.e. the ability of a chemical substance to change colour due to change in solvent polarity was studied. With the increasing polarity of the solvent, the absorption maximum is shifted to a longer wavelength [11]The bathochromic shift observed on changing to a more polar solvent suggests that the dye molecule has a more polar excited state than the ground state and this will lower the energy of the transition. The energy difference between the ground and the excited states is reduced leading to a bathochromic shift of the visible band. On the other hand, those dyes with hypsochromic shift (negative solvatochromism) mean that the dyes molecules have a more polar ground state than the excited state. And when 0.1 M HCl was added to the dye solution in methanol, dye 1A showed a bathochromic shift (positive halochromism). This showed that these dyes exist in the cationic form in an acidic methanolic solution. Dyes 2A and 3A show negative halochromisn on the effects of acids in the dye solution in methanol, this may be due to an electron-withdrawing strength of the substituent, if the electron-withdrawing strength of the substituent is sufficiently high, negative halochromism can be observed.

Wash fastness properties

Coloured fabric must withstand condition which it may encounter during processing following colouration and their subsequent daily use. If the dye is not covalently bonded to the fabric, it may be lost during washing. Wash fastness properties of the synthesized dyes were generally moderate to very good for all dyes, as all the dyes fall between 3-5 as shown in Table 1.8. This is because the dyes containing reactive groups are compatible with the fibre and were covalently bonded with the reactive sites in the fibre. The fastness rating of 4, 4-5 shows that the binding forces between the dye and the fibre are secure. This means the formation of a covalent bond between the reactive sites in the dye and the fibre is relatively strong as there is little or no staining on the adjacent fabric. However, some exhibited good to moderate values of 3, 3-4 an adjacent fabric due to poor uptake of the dye into the fibre.[14]

Fastness to light

Light fastness is the resistance of dyes to the effect of sun, heat and light energy. The light fastness was fair, moderate to fairly good, as value ranges from 3-5 for all the dyes applied on cotton as seen in Table 1.8. The poor light fastness of 3 may be due to the poor planarity of the dyes. Many factors can affect light fastness, some of them are depth of shade, the presence of foreign substances and inherent photo-stability of the dye chromophore and how this stability is affected by the chemical nature of the fabric.Generally, reactive dyes have moderate resistance to light. Also, darker depths of shades show good resistance to light whereas brighter/lighter shades of dyes show poor resistance to light. The electron mobility of brighter shades dyes is high and so the electrons can easily move to the excited state causing breakage in the chromophore system of the dye which results in fading. Generally, factors that affect the colour fastness of textiles are internal and external. Internal factors may include the dye and the fibre type while external factors are products imposed by external forces or conditions [12].

Fastness to perspiration

The perspiration produced by the human body is a chemical fluid that can have adverse effects on a coloured fabric in regular contact with it. All perspiration contains common salt which can affect some dyes but can vary in acidity or alkalinity according to a particular individual [reference number]. Two chemical solutions which approximate human perspiration was used, one being slightly acidic and the other being slightly alkaline [15]. The fastness to perspiration carried out in both acidic and alkaline solutions of histidine is summarized in Table 1.8.All the dyes had a very good fastness to perspiration of values between 3-5.This result shows that the dyed cotton samples had good fastness to perspiration in alkaline than in acid medium.

CONCLUSION

The diazotization of the synthesized quinazolinone intermediates followed by coupling with various cyanurated acid coupling components gave corresponding monoazo reactive dyes. These dyes gave a wide range of fast shades like purple, orange and pink shade on cotton fabric. This type of dye synthesis is generally convenient and economical for use. The dyeing performance of all dyes on cotton fabric gave moderate to good light fastness, good to excellent wash fastness and moderate to good fastness to perspiration – acid and alkaline.The presence of the triazine group of the dye molecule improves the exhaustion, fixation and fastness properties. Thus, the exhaustion and fixation of these dyes are very good; this indicates that the dyes have good affinity and solubility with the fabric. The remarkable degree of levelness and brightness after washing indicates the good penetration and affinity of these dyes to the fabric. The colour difference may be attributed to both the nature and position of the substituent. The dyes gave a satisfactory performance for percentage exhaustion and fixation on cotton fabric. The fastness properties to washing, fastness properties to light and fastness properties to perspiration – acid and alkaline of the dyes on cotton showed good to excellent performance. The remarkable degree of levelness after washing indicates the good penetration and affinity of these dyes to the various fabrics. From this research, new reactive dyes from quinazolinone derivatives were successfully synthesized with a very good yield of up to 90 %.The ease of the synthesis of these dyes makes commercial production highly feasible.The dyes were successfully applied on cotton fabric with an exhaustion rate of up to 78% with good colouristic properties. ^{1}HNMR and ^{13}CNMR should be carried out to further confirm the structures of the synthesized intermediates and dyes

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