

# Studies on Antibacterial Activity of Monoazo Disperse Dyes Based on 4-Hydroxy-6-methoxy-2-phenyl Quinoline

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**ABSTRACT:** Infinite number of quinoline derivatives possesses a wide range of therapeutic activity. Realizing this fact, the study of azo compounds and quinoline derivatives was undertaken in the current research. Disperse dyes synthesized by coupling of diazotized components with 4-Hydroxy-6-methoxy-2-phenyl Quinoline were tested for their antibacterial activity using Disc Diffusion Technique. The organisms used in the study were *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhimurium*, and *Staphylococcus aureus*. Different coupling components exhibited varying degrees of antibacterial activity.

**KEYWORDS:** Antibacterial activity, Disperse dyes, Quinoline derivatives, 4-Hydroxy-6-methoxy-2-phenyl Quinoline.

## I. INTRODUCTION

In the last few decades microbial infections have been associated and attributed to the increased rates of morbidity and mortality amongst all types of life on planet earth. Infections caused by microbial species are common in immune compromised patients and have significant treatment costs and mortality. The increasing rate of bacterial resistance, better known as 'Host resistance', to clinical antimicrobial agents and its impact on the treatment of infectious diseases, have begun to present a unique problem throughout the world. Drug Resistant, Multiple Drug Resistant (MDR), and Extensively Drug Resistant (XDR) infectious bacterial pathogens put a greater risk on the population at large due to them causing pandemic illness. The complications are further increased by the capability of many antibacterial agents in inducing mutations and resistance, often by different mechanisms. Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant *Enterococcus* (VRE) are the most important infections caused by bacteria which have been found in hospitals worldwide [1, 2]. The emerging resistance of some microbial species to some synthetic antimicrobial agents makes it necessary to continue the search for new antimicrobial agents. Quinoline moiety is an important class of nitrogen containing heterocycles used as a key building for medical agents. It exhibits a wide spectrum of pharmacophores and they possess bactericidal, antiviral, anti malarial and anticancer activities. In view of the reported antimicrobial activity of various phenyl quinolines, the importance of the C-6/7 substituents is that they exhibit potent antimicrobial activities due to their broad spectrum and excellent oral bioavailability [3].

Bacteriology is the science which deals with the study of bacteria belonging to the microbial world. The bacteriologists and clinical microbiologists have overlooked the possibility that the bacteriostatic chemical compounds can inhibit the reproduction of pathogenic bacteria in the human and animal anatomy. These static compounds enable the leucocytes and other defense mechanism of the host to cope up with few static invaders [4]. The current investigative work has been focused on assessment of the antibacterial activity of some disperse dyes by the standard Disc Diffusion Technique, which is also known as Kirby-Bauer Technique, as has been propagated by Kirby and Bauer [5]. The bacteria under study are *Bacillus subtilis* (NCIM 2063), *Escherichia coli* (NCIM 5051), *Salmonella typhimurium* (NCIM 2501) and *Staphylococcus aureus* (NCIM 2127). The dyeing procedure for polyester using Disperse dyes is very simple and gives outstanding results [6, 7]. As disperse dyes generally have a heterocyclic ring system, they

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possess a high tinctorial value with better all-round fastness properties. Heterocyclic azo disperse dyes ranging from red to yellow are produced from heterocyclic coupling components. The production and application of such azo dyes derived from quinoline as well as quinazoline systems have been studied earlier [8].

## II. METHODOLOGY

### Bacterial Cultures:

Standard bacterial cultures were procured from “National Collection of Industrial Microorganisms (NCIM), Pune”.

The organisms under study are:

Sr.	Organism	NCIM Code
01	<i>Bacillus subtilis</i>	NCIM 2063
02	<i>Escherichia coli</i>	NCIM 5051
03	<i>Salmonella typhimurium</i>	NCIM 2501
04	<i>Staphylococcus aureus</i>	NCIM 2127

The cultures were allowed to grow on their respective selective media to check and ensure their purity and optimum growth before subjected to further tests.

### Preparation of Antibacterial Solution [9]:

All the compounds were dissolved in Dimethylformamide (DMF). 4-Hydroxy-6-methoxy-2-phenyl Quinoline and their coupling components were taken in a concentration of 50 µg/ml for assessment of their antibacterial activity.

### Preparation of Inoculums:

The inoculums were standardized at  $1.5 \times 10^8$  CFU/ml by comparing it with turbidity standards of 0.5 Mac Farland scale.

### Assay Medium:

Mueller-Hinton agar medium (Hi Media) is selected to check the potency of the drug against different bacteria under study. Kirby-Bauer technique was employed to assess the antibacterial potential of the quinoline compounds.

### Antimicrobial Activity:

Antimicrobial activity test was conducted by Agar well diffusion method according to the following steps:

- 20 ml of sterile Mueller-Hinton agar was poured in sterile petri dishes.
- The plates were allowed to solidify before use.
- The organisms (0.2 ml) were uniformly spread onto the agar plate using a spreader.
- 8 mm bores were made, each at an equal distance from one another on the medium with a sterile cup borer.
- 20 µl of different chemical samples were added to respective bores.
- The plates were incubated at 37 °C for 24 hours, and then the zone of inhibition was measured.
- The results were recorded in a tabular form.

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### III. EXPERIMENTAL RESULTS

**Table 1: Antibacterial activity of 4-Hydroxy-6-methoxy-2-phenylquinoline derivatives**

Dye Sr. #	Coupling Component	Chemical Formula	Zone of Inhibition, in mm			
			<i>Bacillus subtilis</i>	<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>	<i>Salmonella Typhimurium</i>
	<b>DMF Solvent (Control)</b>		--	--	--	--
01	2-Amino-5,6-dichlorobenzothiazole	C <sub>23</sub> H <sub>14</sub> O <sub>2</sub> N <sub>4</sub> Cl <sub>2</sub> S	21	13	--	--
02	2-Amino-6-nitrobenzothiazole	C <sub>23</sub> H <sub>15</sub> O <sub>4</sub> N <sub>5</sub> S	09	11	12	--
03	3-Chloro-4-fluoroaniline	C <sub>22</sub> H <sub>15</sub> O <sub>2</sub> N <sub>3</sub> ClF	09	13	--	--
04	4-Amino-acetanilide	C <sub>24</sub> H <sub>20</sub> O <sub>3</sub> N <sub>4</sub>	10	15	--	--
05	4-Nitroaniline	C <sub>22</sub> H <sub>16</sub> O <sub>4</sub> N <sub>4</sub>	09	17	--	--
06	p-Toluidine	C <sub>23</sub> H <sub>19</sub> O <sub>2</sub> N <sub>3</sub>	--	15	--	--
07	4-Chloroaniline	C <sub>22</sub> H <sub>16</sub> O <sub>2</sub> N <sub>3</sub> Cl	10	--	--	--
08	3-Aminoacetanilide	C <sub>24</sub> H <sub>20</sub> O <sub>3</sub> N <sub>4</sub>	--	--	--	--
09	4-Chloro-2-nitroaniline	C <sub>22</sub> H <sub>15</sub> O <sub>4</sub> N <sub>4</sub> Cl	09	11	10	--
10	2,6-Dibromo-p-toluidine	C <sub>23</sub> H <sub>17</sub> O <sub>2</sub> N <sub>3</sub> Br <sub>2</sub>	18	10	--	13
11	6-Chloro-2,4-dinitroaniline	C <sub>22</sub> H <sub>14</sub> O <sub>6</sub> N <sub>5</sub> Cl	12	09	--	--
12	6-Bromo-2-Cyano-4-nitroaniline	C <sub>23</sub> H <sub>14</sub> O <sub>4</sub> N <sub>5</sub> Br	09	--	--	--
13	4-Acetylamino-2-aminoanisole	C <sub>25</sub> H <sub>22</sub> O <sub>4</sub> N <sub>4</sub>	--	--	--	--
14	2-Cyano-4-nitroaniline	C <sub>23</sub> H <sub>15</sub> O <sub>4</sub> N <sub>5</sub>	13	13	16	--
15	2,6-dibromo-4-nitroaniline	C <sub>22</sub> H <sub>14</sub> O <sub>4</sub> N <sub>4</sub> Br <sub>2</sub>	08	12	--	09
16	3-Amino-O-sulphophenylphenol	C <sub>28</sub> H <sub>21</sub> O <sub>5</sub> N <sub>3</sub> S	13	--	--	--
17	5-Nitro-2-methoxyaniline	C <sub>23</sub> H <sub>18</sub> O <sub>5</sub> N <sub>4</sub>	12	13	17	10

Each compound synthesized had its specific maximum and minimum bacteriostatic potential depending upon the specific species. Similar results as those obtained were also found in the compound 4-Hydroxy-6-methoxy-2-phenylquinoline. The antibacterial effect was equivalent to the current study. The quinoline moiety with a methoxy substituent at position 6 was found to be the most effective.

The results of the antibacterial activity of different compounds are summarized as follows:

Gram negative bacteria like *Escherichia coli* and *Salmonella typhimurium* were very less resistant to the quinoline compounds used in the study, they hardly exhibited some antibacterial activity whereas, Gram positive organisms like *Bacillus subtilis* and *Staphylococcus aureus* were highly resistant to this quinoline derivatives and showed a marked inhibitory action.

From the above results it can be deduced that 4-hydroxy-6-methoxy-2-phenyl quinoline (Sr.# 3), if coupled with other coupling components, would exhibit better antibacterial properties than the rest of the compounds synthesized.

This implies that each compound acts differently over specific species of bacteria as far as its bacteriostatic potential and effect is concerned. These compounds can be subjected to evaluate their free radical scavenging activity by DPPH model in another study [10, 11]. These compounds need to be checked for their Anti-HIV properties, Analgesic activity, Anti-rheumatoid and Antitubercle activity [12, 13, 14].

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## IV. CONCLUSION

It can be safely concluded that a choice for a most effective specific compound for a particular species is always limited. Physical conditions such as rate of diffusion of the compound, layer of culture media, effect of pH and size of inoculum may differ. The azo bearing ligands have enhanced therapeutic effect when they were combined with transition metallic ions thus exhibiting good therapeutic potential. The only disadvantage of these compounds is that they are carcinogenic and can cause mutation in the cell. So they should be used judiciously after due medical trials.

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