The comparative study of the bioactivity of polyquinone and corresponding derivatives

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Abstract

Quinone and corresponding compounds available in literature shows remarkable bioactivity against various microbes which include bacteria, fungi and the most prominently viruses. The bioactivity of any biomolecule is rest on on various parameters like compound itself, target system, surrounding excreta. This paper has enlightened on bioactivity of quinone based polymers and structural effects how they emphasize, work effectivity against microbes. During the experimental condition different prepared polyquiones and their derivatives are used to check the bioactivity against various pathogenic cultures of bacteria, viruses and fungi. For the few targeted pathogenic cultures extremely, good results are obtained which also justifies the QSAR of the molecule.

Keywords

Quinone, quinonic derivatives, bioactivity, structural effect, pathogenic activity

Introduction

Quinones are the class of compounds which responds against wide range of pathogens. Along with quinones amines are also showing bioactivities against special range of pathogens. [5] The polymers prepared with the help of these compounds were tested for bioactivity against various reaction conditions. [8] For the checking of bioactivity different methods are available like disk diffusion method, microdilution technique, borth method and agar method [10]. Among all listed methods for the experiment Agar dilution and microdilution method is used. For the checking of bioactivity during the experimental condition we have used three different types of fungi namely Asperillus flavus, Candida albicans [2] and Aspergillus niger and three bacteria which include two-gram positive bacteria and one-gram negative bacteria. The gram-positive bacteria include staphylococcus aureus and Bacillus subtilis. The gram negative strain of Escherichia coli .

Experimental

During the experimental condition synthesized desire compounds were subjected for testing of invitro antimicrobial activity. As per described in introduction, the antifungal activity was evaluated against three fungi stains A. flavus [NCIM-539], C.albicans [NICM-3471] and A. niger [NICM-1196]. The two gram positive bacterial strains of S.aureus[NICM-2901], B.subtilus [NICM-2063] and gram negative bacteria e. coil [NICM-2256]. For studying antimicrobial properties of compounds, Minimum Inhibitory Concentration (MIC, µg/mL), Minimum Bacterial Concentration (MBC) and Minimum Fungicidal Concentration (MFC) were studied by modified microdilution technique. For Fungal strains agar dilution technique, on Potato Dextrose Agar (PDA) Medium were used for MIC determination. The MBC and MFC of compounds were determined by serial sub cultivation after inoculated for 72 h with tested compounds dissolved in saline containing 5% DMSO. The lowest concentration with no visible growth was defined as MBC/MFC indicating 99.5% killing of the original inoculums. [6] All the experiments performed in triplicates and mean reading is taken as final reading. 5% DMSO was used as a negative control along with Fluconazole and Miconazole as the standard antifungal drugs and Ciprofloxacin as the standard antibacterial drugs For bacterial strains MIC determination were done by a serial of microdilution technique using 96-well microtiter plate reader. Compounds are prepared in saline (0.8% NaCl) solution containing 5% Dimethyl sulfoxide (DMSO) for dissolution. All microbial strains were incubated with different concentration of each compound in 96-well microtiter plate for 20 h at 37 oC on Rotary shaker (160 rpm). After incubation the lowest concentration value without growth were defined as MICs.

The compounds used for the analysis has structure like

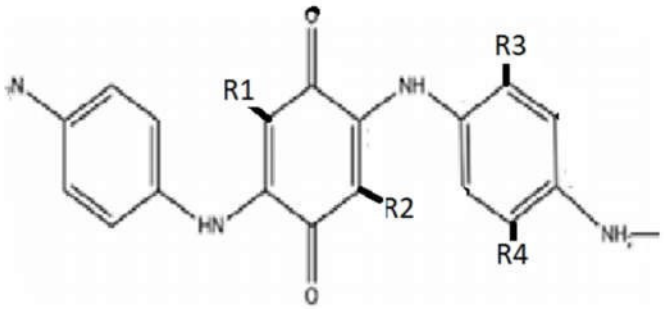


Table 1: Details about compound substituents

Compound	R1	R2	R3	R4
1	H	H	H	H
2	Cl	H	H	H
3	Cl	Cl	H	H
4	H	H	Cl	H
5	H	H	Cl	Cl

The polyquinone prepared with the help of quninone and phenylene diamine along with mono chloro, dichloro derivatives are used to check the bioactivity. All above polymeric species vary with polar group substituents therefor they show variation in bioactivity as their mode of interaction varies. Polarity of the compounds influences more for binding of compounds with pathogens and therefore various results are observed.

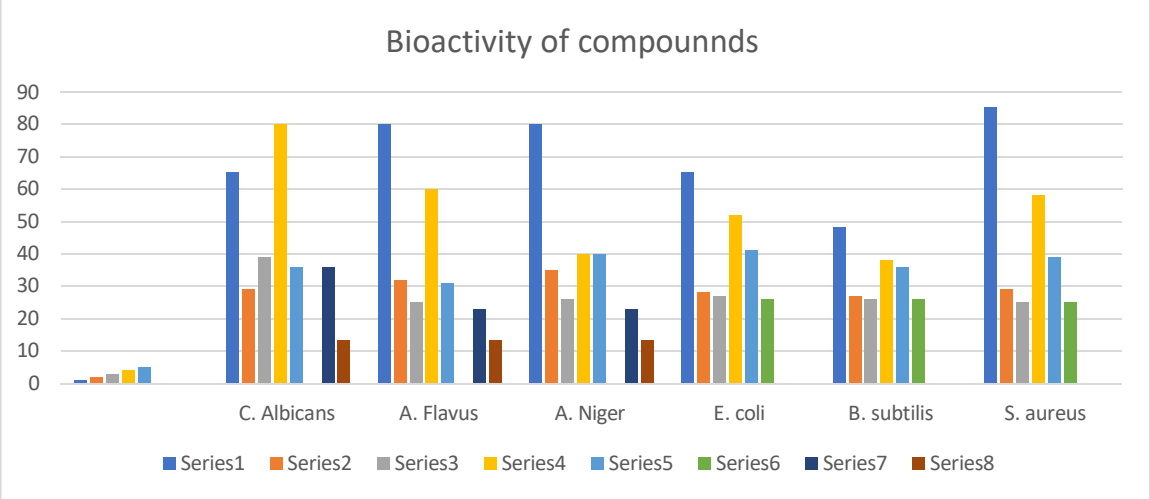
Observations

Table 2: Observations for antipathogenic activity

Compounds	MIC values[a] (µg/ml)					
	C. Albicans	*A. Flavus*	*A. Niger*	*E. coli*	*B. subtilis*	*S. aureus*
1	65	80	80	65	48	85
2	29	32	35	28	27	29
3	39	25	26	27	26	25
4	80	60	40	52	38	58
5	36	31	40	41	36	39
Ciprofloxacin	-	-	-	26	26	25
Fluconazole	36	23	23	-	-	-
Miconazole	13.5	13.5	13.5	-	-	-
All the values are taken as average of three readings.						

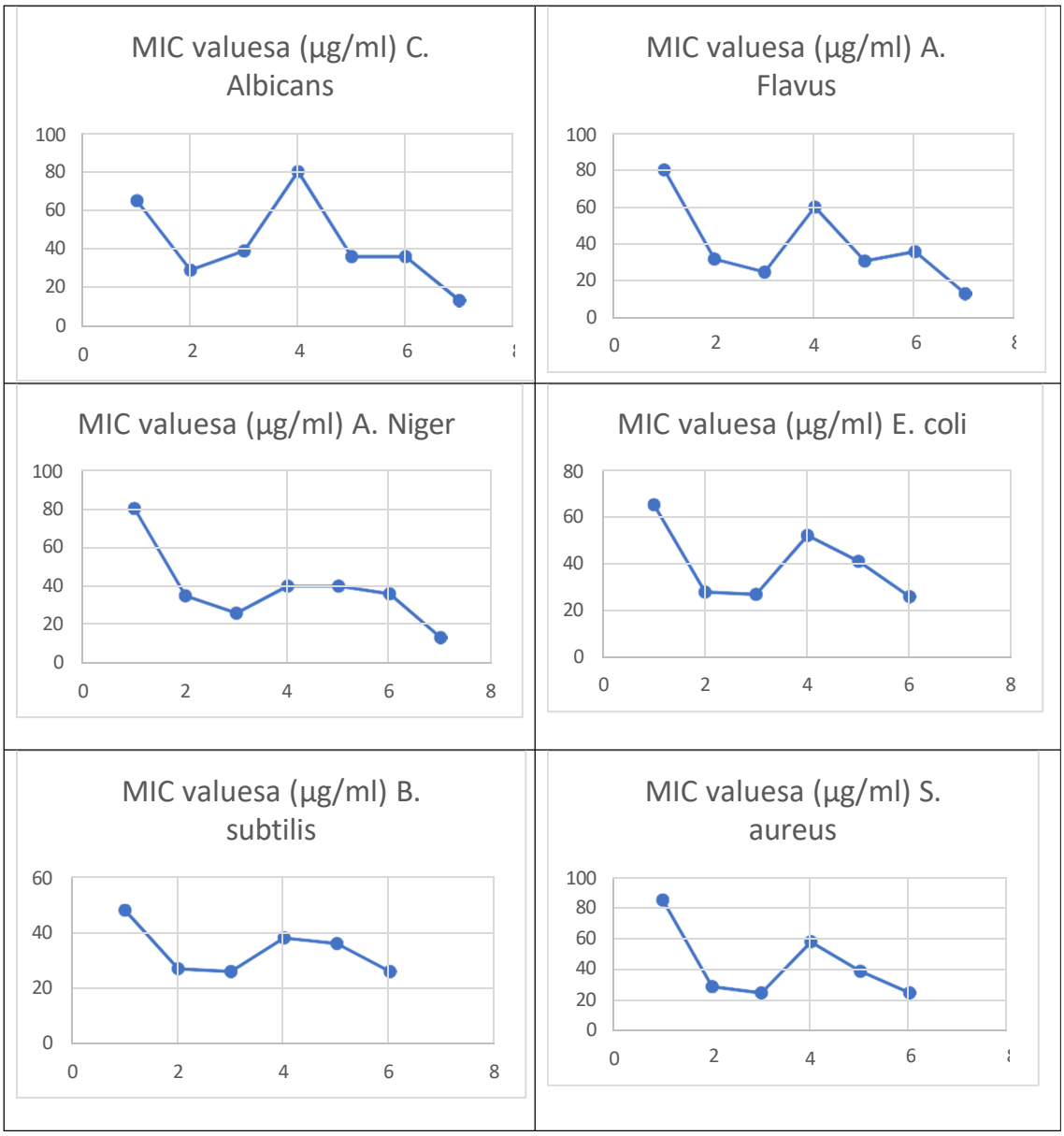
Graph

Graph1: Bioactivity observed for polyquinones



Result and discussion

Table 3 : Individual graphs for interaction of various compounds against pathogens



During the experimental conditional it has been observed that all the polymeric compounds are bioactive in nature but vary or interact differently to show minimum inhibitory concentration [MIC], minimum bacterial concentration [MBC], minimum fungal concentration [MFC]. All the compounds differ with results due to the variation in structures, substitution effect, polarity of compound, interaction of compound with media and binding with pathogen. QSAR plays important roll. [7]. Along with this nature of pathogen, size of pathogen and its activity all together impacted on MIC values [3]. The concentration of pathogen has impact on MIC value [4] Base polymeric compound is less polar in nature and shows least bioactivity as compared to all reaming treated polyquinonic compounds whereas compounds 2 and 3 has showed highest bioactivity and both are chloro-substituted compounds. As compared compound 2, compound 3 has shown more pathogenic activity with minimum MIC as it the dichloro-derivative and more polar as compared to compound 1 and 2. Again among compound 4 and 5, dichloro-derivative has shown more bio activity as

compared to monochloro-derivative. The second polymer shows highest bioactivity against C. Albicans whereas Fourth polymer shows least bioactivity as compared to fluconazole. For A. Flavus polyquione three shows good inhibitory activity followed by second and fifth polymers has showed comparable bioactivity and for A. Flavus first polymer has showed least inhibitory activity. For the fungi A. Niger strain compound three is most effective followed by surprisingly polymer four and five has shown same interaction. In case of gram negative Bacterial E.coil , it has been observed compound three shows comparable bioactivity with Ciprofloxacin but remaining all compounds were less effective. For remaining two-gram positive bacteria B. subtilis and B. subtilis compound three has showed comparable inhibitory activity. S. Aureus has showed least pathogenic activity as compared to standard antibiotic.

Conclusion

After performing experiment and testing bioactivities for synthesized polymeric compounds it has been observed that all polymeric compounds show bioactivities and vary with MIC due to structural effects along with this polarity influences the pathogenic activity. Among all developed compounds Compound three has showed satisfactory bioactivity as compared to all remain compounds.

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