Study and Determination of Antimicrobial role of Polymeric Schiff based Resins

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Abstract—

Background: Schiff based polymers possess strong antimicrobial, anti inflammatory, antihypertensive, analgesics, antitumor, antituberculous, anticonvulsants, antihelminthic, antioxidant and antiviral activities and seek attention in pharmacodynamics and other related fields.

Methodology & Results: The classical synthesis of different diamino compounds like 1,2-diaminopropane, 1,3-diaminopropane, ethylenediamine, and urea were treated with methylene bis napthaldehyde in an inert atmosphere to form Schiff base polymers. The dialdehyde and its synthesized Schiff based polymers were thoroughly characterized spectroscopically, thermo-analytically. The intrinsic viscosity of all compounds was also examined for their antimicrobial activities.

Conclusion: This experimental study revealed significant outcome against the antibacterial and antifungal properties of four synthesized Schiff base polymers.

Index Terms— Antimicrobial, Biomedical, Characterization, Intrinsic Viscosity, Pharmacodynamics, Schiff base Polymers

1 Introduction

Schiff bases were discovered by German Chemist, Hugo Schiff in 1864. These are condensed products of Carbonyl compounds and primary amines [2]. Azomethine group is the common structural feature of Schiff base polymers with general formula of RHC=N–R_1, where R and R_1 are Alkyl, Aryl, Cycloalkyl, or Heterocyclic groups. Azomethine is a Nitrogen analogue of a Ketone or Aldehyde group [29]. This Nitrogen analogue may be responsible for interruption in normal cell function and formation of Hydrogen bond with active cell constituents [2]. Schiff base polymers achieved attention of worldwide scientists due to their multifaceted applications in pharmacodynamics and in related diverse fields [29]. In Bio-Sciences and Bio-Medical Engineering, Schiff bases exhibited strong antimicrobial, anti inflammatory, antihypertensive, analgesics, antitumor, antituberculous, anticonvulsants, antihelminthic, antioxidant and antiviral activities [2]. Numerous studies highlighted that introduction of different metal complexes in polymeric chain displayed greater biological activities than free organic compounds [23]. Because of the involved catalyst, Schiff base polymers exhibit inspiring features such as thermal constancy, and photo-luminescence possessions [1], [3], [4], [5], [6], [7], [8], [9], [12], [20], [21], [22], [25], [27], [28].

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2 Antimicrobial Properties

The rising burden of worldwide mortality is due to the infectious diseases which have a direct link to multiple resistances to antibiotics against bacteria. To overcome this burden the development of inventive antimicrobial drugs is substantial and an urgent medical need [14]. Schiff base polymers revealed antibacterial and antifungal expression contrary to Escherichia Coli (E. Coli), Staphylococcus Aureus (S. Aureus), Bacillus Cirroflgellosus (B. Cirroflgellosus), Shigella Flexneri (S. Flexneri), Micrococcus Flavus (M. Flavus), Aspergillus Flavus (A. Flavus), Candida Albicans (C. Albicans) and Aspergillus Niger (A. Niger) [10], [11]. Schiff bases on coordination present carcinostatic and bacteriostatic properties [13], [15], [26].

3 Methodology

The aim of the study was to evaluate the antimicrobial i.e. antibacterial and antifungal activity of newly synthesized Schiff based polymers. In this experimental study, the strains of different diamino compounds explicitly bis napthaldehyde, poly[6,6-methylenebis(1-napthaldehyde)1,2propylenediamine] (PMBNPn), poly[6, 6-methylene bis (1-napthaldehyde) 1, 3-propylenediamine] (PMBNPR), poly[6, 6-methylene bis (1-napthaldehyde) ethylenediamine] (PMBNen) and poly[6,6-methylene bis(1-napthaldehyde) Urea (PMBNU) were treated with methylene bisnapthaldehyde in an inert atmosphere to form Schiff base polymers. The experiment was conducted using Agar-Well diffusion method. The wells measuring 24 mm in diameter were dug in the culture plates. The 1 mg per mL in (dimethylformamide) concentration was suggested for making sample solutions and was filled in the well with a

TABLE-1
ANTIMICROBIAL (ANTIBACTERIAL& ANTIFUNGAL) ACTIVITY OF SCHIFF BASE POLYMERS
ZONE OF INHIBITION (mm) 50µg/mL

Compound	ANTIBACTERIAL					ANTIFUNGAL		
	M. Flavus	S. Aureus	B. Cirroflgellosus	S. Flexneri	E. Coli	C. Albicans	A. Flavus	A. Niger
Dialdehyde	+ +	+ +	+	–	+	+	+	–
PMBNPn	+ +	+	+ +	+ + +	+ + +	+ +	+ +	+
PMBNPR	+	+ + +	+ + +	+ + + +	+ + + +	+ +	+ + + +	+ + + +
PMBNen	+ + +	+ + + +	+ + +	–	–	+ +	+ + +	–
PMBNU	–	+ + +	+ + + +	+ +	+ + +	+ +	+ + +	+
Tetracycline[a]	+	+	–	+	+	…	…	…
Miconazole[b]	–	+	–	++	+	–	+ + +	+ +

[a] Standard Drug: +ve control, Antibacterial Activity
[b] Standard Drug: –ve control, Antifungal Activity

–	INACTIVE	5 mm
+	WEAKLY ACTIVE	8-10 mm
+ +	MODERATELY ACTIVE	11-15 mm
+ + +	HIGHLY ACTIVE	16-20 mm
+ + + +	MOST ACTIVE	21-24 mm

micropipette. Inoculation of the culture samples was accomplished before pouring into the petri plates. Incubation of petri plates was carried out at 37°C for 24 hours, and zones of inhibition formed on the medium were measured with a scale in millimeters, presenting comprehensive inhibition. An antibacterial tetracycline and an antifungal miconazole were used to regulate the positive and negative controls.

4 RESULTS AND DISCUSSION

The synthesized Schiff base polymers from Methylene bis napthaldehyde were evaluated for their antibacterial and antifungal activity against micro-organisms like Escherichia Coli, Staphylococcus Aureus, Bacillus Cirroflgellosus, Shigella Flexneri, Micrococcus Flavus, Aspergillus Flavus, Candida Albicans and Aspergillus Niger. The results revealed that methylene bis napthaldehyde present low inhibitory effects as compared to its Schiff base polymers. The dialdehyde present (15, 15, 10, 5, 10 mm) inhibitory effects against the bacteria M. Flavus, S. Aureus, B. Cirraflgellosus, S. Flexneri, and E. Coli, whereas the Schiff base polymers PMBNPn, PMBNPR, PMBNen and PMBNU present (15, 10, 15, 20, 20 mm), (10, 20, 20, 24, 24 mm), (20, 24, 20, 5, 5 mm) and (5, 20, 24, 15, 20 mm) zones of inhibition against the examined bacteria. The polymers indicated higher values of inhibition as compared to their dialdehyde.

The antifungal studies of the Schiff base polymers displayed significant results. The dialdehyde presented lower inhibitory effects than the corresponding Schiff base polymers. The dialdehyde presented (10, 10, 5 mm) zones of inhibition whereas the polymers PMBNPn, PMBNPR, PMBNen and PMBNU presented enhancement in effects as (15, 15, 10 mm), (15, 24, 24 mm), (15, 20, 5 mm) and (15, 20, 10 mm) zones of inhibition against stated fungi. Among these polymers, the polymer PMBNPR displayed the highest antifungal activity against the fungi C. Albicans, A. Flavus, and A. Niger.

The values for Antimicrobial i.e. Antibacterial and Antifungal activity of Schiff base polymers are recorded in Table-1 [16], [17], [18], [19], [24], [30].

5 CONCLUSIONS

Four synthesized Schiff base polymers PMBNPn, PMBNPR, PMBNen and PMBNU were screened against various bacteria i.e. M. Flavus, S. Aureus, B. Cirraflgellosus, S. Flexneri, and E. Coli; and fungi i.e. C. Albicans, A. Flavus, and A. Niger. All the compounds revealed antimicrobial properties, and the Schiff base polymers were found to be more active in bacterial as well as fungal studies than their parent dialdehyde.

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