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ANTIBACTERIAL STUDIES OF SOME NOVEL POLYMERIC PHENOLIC SCHIFF BASES CONTAINING AMINOTHIAZOLE MOIETY

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ABSTRACT

Some novel chelating resins like Salicyldehyde-2-aminothiazole-formaldehyde (SD-HB-AT-HCHO). Salicyladehyde-6-methyl-2-aminobenzothiazole-formaldehyde (SD-MABT-HCHO) and Salicyladehyde-6-chloro-2-aminobenzothiazole-formaldehyde (SD-CABT-HCHO) were prepared by reacting Schiff bases of Salicyldehyde-2-aminothiazole (SD-HB-AT) Salicyladehyde-6-methyl-2-aminobenzothiazole (SD-MABT), Salicyladehyde-6-chloro-2-aminobenzothiazole (SD-CABT) with formaldehyde. These resins are very wide range of application as they contain heterocyclic ring system and multi functional groups. The antibacterial activities of all these resins were studied against pathogenic bacteria *Staphylococcus aureus* and *Escherichia coli*. All these resins are found to be effective against the tested bacterial species and SD-MABT-HCHO resin is found to be most effective among them.

KEYWORDS

Antimicrobial activity, Phenolic Schiff and Aminothiazole Moiety.

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INTRODUCTION

Thiazole, substituted thiazoles and thiadiazole show some fascinating biological activity because of its (i) better *in vivo* stability[1] (i) strong aromaticity of the ring system and (iii) Structural resemblance to the imidazolyl units of the histidyl part present in proteins[2]. Amongst thiazoles especially 2-aminothiazoles are very unique heterocyclic amines. Their odor is similar to pyridine and they are soluble in water, alcohol and ether. 2-aminothiazole is used for preparation of many sulphur containing drugs, chemical reaction accelerator, fungicides and dyes. These are also act as very good ligands and

provide many potential binding sites for complexation of diverse metal ions like Cu (II), Co(II), Ni(II), or Zn(II) among others with well established biological roles[3-9]. Ample evidence is available in literature that amino thiazoles and their Schiff bases shows very good antibacterial, antiviral and anti fungal property and these properties enhanced many fold in metal complexes of Schiff bases of aminothiazoles[10-14]. Schiff-bases of amino thiazoles and their transition metal complexes play a significant role in pharmaceuticals chemistry along with co-ordination chemistry[15-18]. A brief review of literature of antimicrobial activities of different types of thiazole especially aminothiazole is given below.

Antimicrobial activity of methoxy and chloro substituted 2-aminothiazole against bacterial species *Escherichia coli* and *Staphylococcus aureus and* fungal species *Candida albicans* and *Aspergillus niger was studied by* Pattern, *et al*[19]. The results were compared against some known chemotherapeutic agent like norfloxacin, grieseofulvin and DMF and concluded that chemotherapeutic agents are effective against some specific samples where as thiazole derivatives show very effective antimicrobial activity against all the tested samples. Sherman and Dicken[20] have reported a series of 2-amino-4(5-nitro- 2-furyl) thiazole and their chloro, hydroxyl and methoxy derivatives. Pronounced activities are observed against *Escherichia coli*, *Salmonella* and *Staphylococcus aureus*. 2- Aminothiazole. Antimicrobial activity of a series of phenyl-(6*H*-thiazolo) and benzooxazole-2-yl)-amines was studied by R. V. R. Mekala, *et al*[21]. According to their observation the antimicrobial activity of synthesized compounds change with addition or removal of a specific group. The review of antibacterial activities of different thiazoles and their metal complex shows many such observations[22].

Since Schiff bases have multiple coordination sites, so they easily form complex with various transition metal ions[23-25]. Again when these Schiff bases will be present in a polymeric matrix, they are anticipated to show affinity towards certain metal ions at a particular pH. On basis of this simple idea our research group prepared a number of polymeric resins which contain different types of Schiff base and their metal ion uptake capacity was studied[26-31]. It is observed from literature survey that the antibacterial studies of resins containing Schiff bases of amino thiazole are yet to be studied.

Some novel chelating resins like Salicyldehyde-2-aminothiazole-formaldehyde (SD-HB-AT-HCHO). Salicyladehyde-6-methyl-2-aminobenzothiazole-formaldehyde (SD-MABT-HCHO) and Salicyladehyde-6-chloro-2-aminobenzothiazole-formaldehyde (SD-CABT-HCHO) were prepared by reacting Schiff bases of Salicyldehyde-2-aminothiazole (SD-HB-AT) Salicyladehyde-6-methyl-2-aminobenzothiazole (SD-MABT), Salicyladehyde-6-chloro-2-aminobenzothiazole (SD-CABT) with formaldehyde. Thermal and analytical characterization techniques like FTIR, ^{1}HNMR, TGA, and DSC studies were adopted to ascertain the structural features of these resins. The plan of this project is to apply the resin for removal of heavy and toxic metal cations like Fe^{3+}, Ni^{2+}, Cu^{2+} and anions like CrO_4^{2-} or AsO_4^{3-} in drinking water. The synthesis, characterization and metal ion uptake studies and arsenate uptake studies are presented elsewhere. As amino thiazole shows very good antimicrobial activity, so the anti microbial activity of the resin is studied to increase the dimension of applicability of the synthesized resins. Although study of antimicrobial activity of aminothiazole compounds and their Schiff bases has been thoroughly done, but there is no evidence of study of antimicrobial activity of polymeric resins of anminothiazole Schiff bases.

In this paper antibacterial activity of the above three resins against pathogenic bacteria like *Escherichia coli* and *Staphylococcus aureus* is reported.

The study of antibacterial activity of these resins is aiming to increase the dimension of application of these resins in many fold and these resins can be effective in the purification of drinking waters in rural regions which are contaminated with heavy metals and various pathogenic bacteria.

EXPERIMENTAL

MATERIAL

2-amino-6-methyl benozo thiazole, and 2-amino-6-chlorobenzothiazoleWere of Aldrich (USA), where as 2-aminothiazole is of Merck, Germany. Sulphate and nitrate salts of copper, nickel, uranyl and iron and salisaldehyde is of Merck/BDH, India and AnalR grade. These chemicals are used as received. Doubly distilled deionised water was used for the preparation of the solutions. MacConkey agar, Merck, Germany was used for preparation of agar plate for antibacterial study.

RESULTS AND DISCUSSION

Antibacterial studies

These chelating resins SD-HB-AT-HCHO, SD-MABT-HCHO and SD-CABT-HCHO were monitored for the antibacterial activity against the pathogenic bacterial strains of *Escherichia coli* and *Staphylococcus aureus*. The anti bacterial activity study was done by paper disc diffusion method as explained by Chohan and coworkers[10,13,32].

Preparation of the Discs

The paper disc was prepared from blotting paper 5 mm diameter. 30µg of the resin was dissolve in 0.01mL of DMF were applied over the paper disc. Before applied on the bacterial grown agar plate the paper discs were dried in a vacuum incubator at 37^{o}C for 48 hours.

Preparation of Agar Plates

For the preparation of the agar plate for bacterial species, 12g of agar was soaked in 200 ml of distilled water for 15 minutes and then boiled in water bath until the agar was completely dissolved. This was autoclaved for 15 minutes at 120^{o}C, then poured into sterilized Petri dishes, and stored at a temperature of 40^{o}C for inoculation.

Inoculation

Inoculation was done by using platinum ware loop**.** Platinum wire loop was made red hot in a flame, cooled and used for the application of bacterial strains.

Application of the Discs

The paper discs were applied to the inoculated agar plates with the help of sterilized forceps. The measurement of the diameter of the inhibition zone was carried out.

Antibacterial studies

These chelating resins SD-HB-AT-HCHO, SD-MABT-HCHO and SD-CABT-HCHO were tested for antimicrobial activity against the bacterial strains of *Escherichia coli* and *Staphylococcus aureus* (Table No.1a and b). Every chelating resin was individually show varying degree of inhibitory effects on the growth of the bacterial samples. The antibacterial activity of SD-MABT-HCHO is found to be nearly 60-70 % against the tested bacterial species. The order of antibacterial acivity of th above material is SD-MABT-HCHO > SD-HB-AT-HCHO > SD-CABT-HCHO.

Stability and solubility play a great role in the anti bacterial activity of a material. During the condensation with formaldehyde, because of the +I effect of the -CH_3 group in *o*- HB-MABT Schiff bases reduces the cross linking ability. Since SD-MABT-HCHO is less cross linked than other resins, so it is Comparable more soluble. The antibacterial activities are also promoted by accessibility. The accessibility of the resin to the bacteria enhanced when the cross-linking is less. The accessibility, solubility, and conductivity are the major factors which are responsible for the activity of resins against the bacterial species[10].

Table No.1 (a): Antibacterial activity of microbial species *Escherichia coli*

S.No	Resins	% of inhibition	Inhibition zone diameter (mm)
1	*o*-HB-MABT-HCHO	61-70	13.5-15.5
2	*o*-HB-AT-HCHO	59-68	13.0-15.0
3	*o*-HB-CABT-HCHO	52-59	11.5-13.0

Table No.1 (b): Antibacterial activity of microbial species *Staphylococcus aureus*

S.No	Resins	% of inhibition	Inhibition zone diameter (mm)
1	*o*-HB-MABT-HCHO	59-68	13.0-15.0
2	*o*-HB-AT-HCHO	57-64	12.5-14.0
3	*o*-HB-CABT-HCHO	45-57	10.0-12.5

*Percent inhibition values are relative to inhibition zone (22mm) of standard antibacterial (sulfadiazine, sulfathiazole), considered as 100% inhibition, and tested under the same conditions as the new compounds reported here.

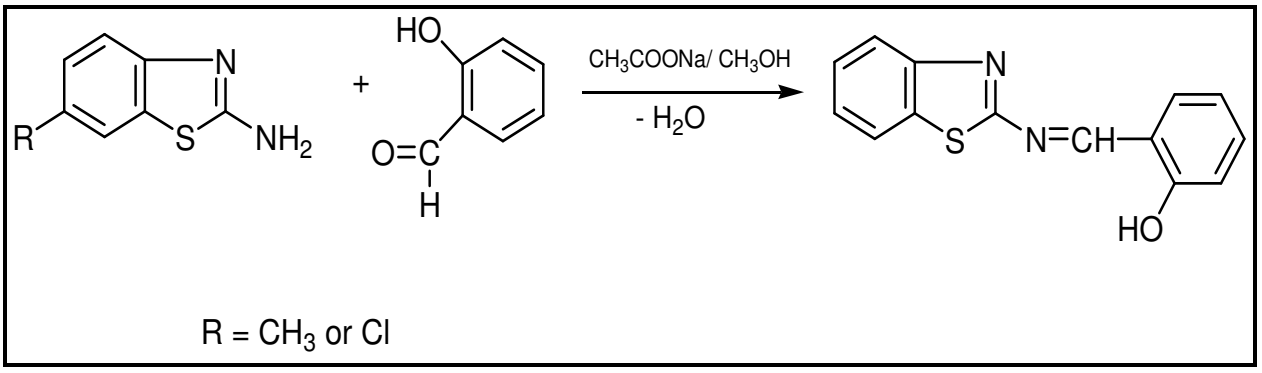

Figure No.1 (a): Reaction scheme for synthesis of Schiff base monomer

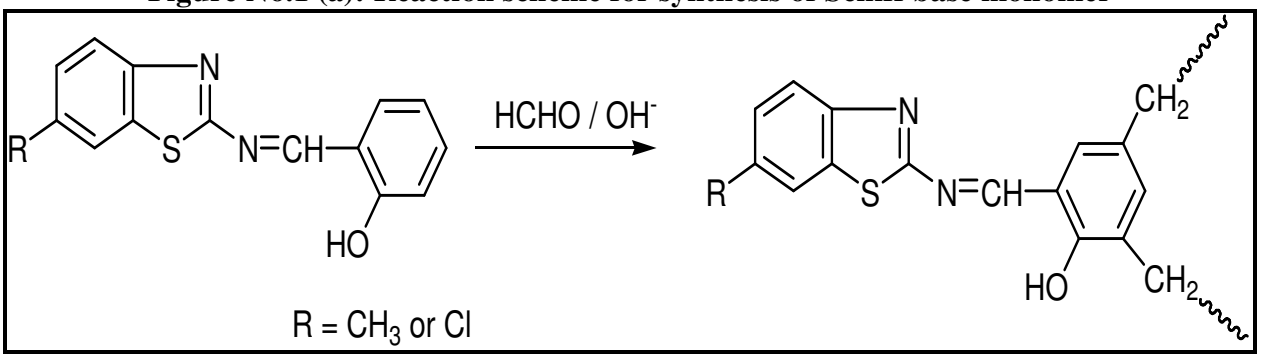

Figure No.1 (b): Reaction scheme for synthesis of resins

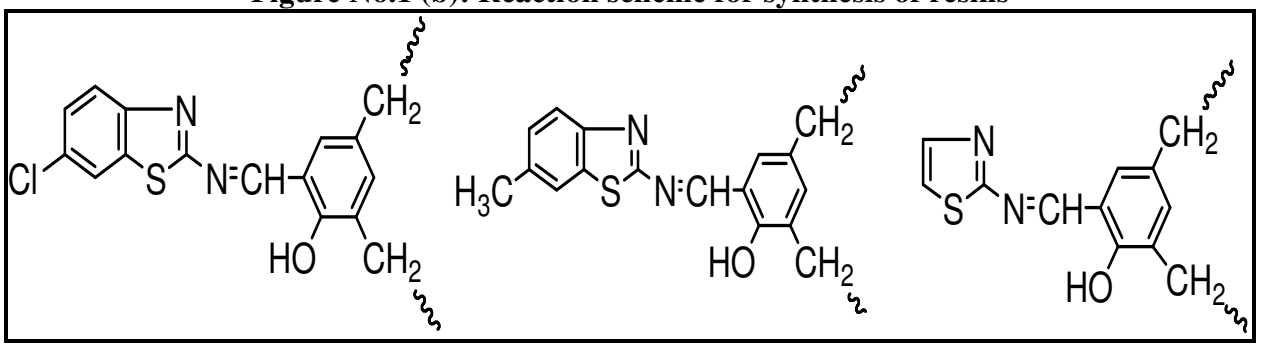

Figure No.1 (c): Structure of the, *o*-HB-AT-HCHO, *o*-HB-CABT-HCHO and *o*-HB-MABT-HCHO resins

CONCLUSION

Phenolic Schiff bases containing aminothiazole moiety were synthesized. Then these multifunctional phenolic Schiff bases were converted to resins by condensation with formaldehyde. These resins were characterized by a number of routine characterization techniques such as FTIR, ^{1}HNMR, TG-DTG, and DSC. The resins were tested for the antibacterial activity against some common bacterial strain like *Escherichia coli* and *Staphylococcus aureus*. They show very good antibacterial activity against bacterial strain like *Escherichia coli* and *Staphylococcus aureus*. Therefore we can conclude that these novel chelating resins can be used in drinking water in rural areas as protector against pathogenic bacteria.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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