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Physicochemical Characterization and Antimicrobial Activity of Mechanochemically and Solvent-based Synthesized Mn(II) Complexes of Cefixime and Cefuroxime

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ABSTRACT

Mechanochemical and solvent-based complexes of Mn(II) with cefixime and cefuroxime were synthesized and characterized by melting point and conductivity measurements, elemental analysis, FTIR spectral studies, and electronic spectral analysis. The Mn(II) complexes with cefixime and cefuroxime synthesized mechanochemically were both ash colored, while Mn(II) cefixime and cefuroxime complexes synthesized through solvent-based method were milky and ash respectively. The molar conductivity values (14.9 – 16.6 Scm^2mol^{-1}) indicate non-electrolytic nature of the complexes. The FTIR revealed that the ligands were coordinated to the Mn(II) ion through the carboxylate ions (C=O). A six coordinate octahedral geometry has been proposed for the complexes. The result of the antibacterial assay of the synthesized complexes of Mn(II) with cefuroxime generally showed better activity against *Staphylococcus aureus, Streptococcus pyogenes* and *Methicillin-resistant Staphylococcus aureus (MRSA)* than the free ligand cefuroxime. Similarly, the Mn(II) complex of cefuroxime synthesized by mechanochemical method shows higher activity against the aforementioned organisms as compared to the solution-based complex which might be as a result of solvent effect.

1. Introduction

Mechanochemical reactions utilize mechanical force to accomplish chemical transformation and can be carried out in a number of ways. It can be both solvent free and less energy consuming than standard solution reaction. Mechanochemical transformations are rapidly becoming popular as a suitable alternative to conventional solution-based [1]. Mechanochemical synthesis can provide compounds phases and microstructures that are essentially different from the products of ordinary reactions [2]. Many mechanochemical reactions of organic compounds take place at low milling energy that is not sufficient to break primary bonds, but the gentle mechanical grinding can influence the relative position of macromolecules, leading to the formation of unique co-crystals and compounds [2].

Cephalosporin antibiotics are wontedly indicated for the treatment of infection which is due to particular bacterium that is resistant to the antibiotic needed for its treatment. Most of the initial cephalosporins are effective against Gram-positive bacteria while other types proved to be active against Gram–negative bacteria. Although, the use of broad spectrum cephalosporin has increased, resistance cephalosporin still exists [3]. The cephalosporins antibiotics are semisynthetic antibacterial derived from cephalosporin C, a natural antibiotic produced by the mould, *Cephalosporin acremonium* [4]. The antibiotics are very closely related to penicillin. Its mechanism of action, mechanism of resistance and some other properties are identical [5]. Both cephalosporins and penicillins belong to the β-lactam antibiotics [6]. Cephalosporins are classified into four generations according to their spectrum of activity [4]. The first generation cephalosporins are very active against Gram-positive *cocci*. They have limited activity against Gram-negative bacteria [7].

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