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SYNTHESIS OF AN INORGANIC-ORGANIC HYBRID MANGANESE(II)-QUINATE FROM AQUEOUS SOLUTIONS

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Abstract

The inorganic-organic hybrid manganese(II)-quinate was synthesized in aqueous solutions at the optimum pH 3. It was isolated in pure crystalline form and characterized by elemental analysis, FT-Infrared and X-Ray crystallography. The new inorganic-organic hybrid contains manganese ions in an octahedral environment where each manganese ion coordinates to two quinic acids.

***Key words**: manganese(II), D-(-)-quinic acid*

Introduction

Manganese is one of the twenty-five life elements and participates in the formation of a variety of metalloenzymes (Frieden, 1985; Sigel, 1995). It is encountered in a wide range if systems, covering both cell growth and metabolism as well as protection of vital components throughout the human body. Manganese's association with a number of physiological impairments, especially those of the central nervous system, such as Parkinson's disease, has elevated that metal ion to the status of a competent neurotoxicant (Aschner, 1997). Also Mn(II) has been found to bind to the inner membrane of brain mitochondria, where electron transport occurs.

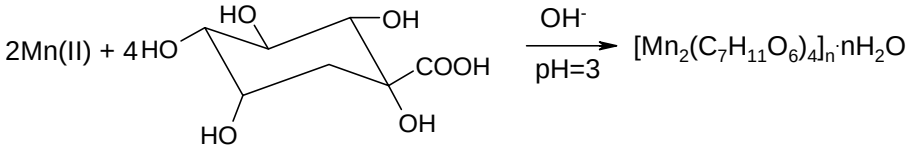
D-(-)-Quinic acid, (-)-1α,3α,4α,5β-tetra-hydroxy-1-cyclohexane-carboxylic acid, is an organic binder widely found in plants (Bohm, 1965; Corse, 1966; Kelley, 1976). The acid is a polyfunctional molecule, which can coordinate to metalloelements in a variety of ways.

In an effort to delineate the role of Mn(II) in interactions with biologically significant targets, we have explored the relevant synthetic aqueous chemistry. Through that, we hoped to develop a good understanding of the requisite chemistry and its linkage to both biology as well as the field of inorganic-organic hybrid materials.

Experimental

It was investigated the aqueous chemistry of binary system $MnCl_2.4H_2O$-D-(-)-quinic acid, where under specific stoichiometric conditions, reactions led to the isolation of the inorganic-organic hybrid $[Mn_2(C_7H_{11}O_6)_4]_n.nH_2O$ (**1**).

The reaction was investigated at pH 2 and pH 3, but the optimum is pH 3. The addition of ammonia, KOH, NaOH for the adjustment of the pH, resulted in isolation of the same product. The product was identified by FT-IR in each case. The isolation of the resulting product was achieved by two techniques. The first one was by slow evaporation. Addition of ethanol (as a precipitating agent) at 4°C was the second technique tried. Following several hours in the open air, a reaction afforded colorless crystals, which were collected by filtration. The crystalline solid has proven to be stable in the air for long periods of time. The stoichiometric reaction for the synthesis of inorganic-organic hybrid of Mn(II) with D(-)-quinic acid is given below:



quinic acid

Elemental analysis pointed to the molecular formulation $[Mn_2(C_7H_{11}O_6)4]_n{\cdot}nH_2O$ (MW=892.56). The yield was 30%. The inorganic-organic hybrid **1** was further characterized by FT-IR and X-Ray crystallography on one of the isolated crystals from $[Mn_2(C_7H_{11}O_6)_4]_n{\cdot}nH_2O$.

The FT-IR spectrum of the inorganic-organic hybrid was recorded in KBr and reflected the presence of vibrationally active carboxylate groups (figure 1).

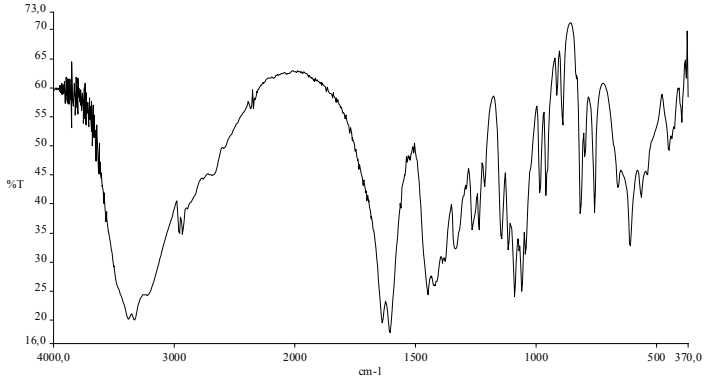


Fig. 1. FT-IR spectra of **1**in KBr

The structure of the inorganic-organic hybrid $[Mn_2(C_7H_{11}O_6)_4]_n \cdot nH_2O$ is presented in Figure 2.

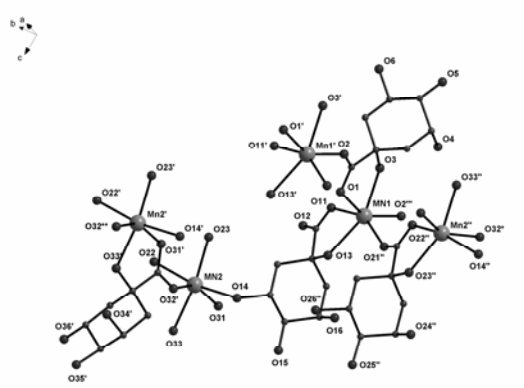


Fig. 2. ORTEP diagram of the inorganic-organic hybrid $[Mn_2(C_7H_{11}O_6)_4]_n \cdot nH_2O$.

Conclusions

The synthesis of **1**, its isolation and its spectroscopic and structural characterization provide a clear case of an interaction of quinate with

manganese, leading to a new material. The physicochemical properties of that material are currently being investigated.

Acknowledgment

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