

COMPLEXES OF THE NATURAL ANTIBIOTIC MONENSIN A WITH ENVIRONMENTAL DIVALENT METAL IONS

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Abstract

Monensin A is polyether type natural antibiotic with a quasi-ring structure. The structure is the consequence of hydrogen-bond formation between the two terminal functional groups. The outer side of the molecule is lipophilic due to the alkyl function groups. The cavity has a hydrophilic character. Based on the above properties, this molecule is able to coordinate monovalent metal ions and transfer them across cell membranes. This way of transportation may cause bacterial cell death by disruption of the metal ion balance. The environmental divalent metal ions may influence this process. The results of the experiments serve the better understanding of the behavior of monensinate toward these metal ions.

The coordination ability of the monensin molecule can be studied through its chirality in solution by circular dichroism (CD) spectroscopy. The measured CD data showed that the deprotonated ligand forms two different types of divalent metal complexes depending on the metal to ligand molar ratio. In the presence of ligand excess a biscomplex exists, however if the amount of metal ions is increased, a monocomplex is formed. The $[M(\text{Mon})_2(\text{H}_2\text{O})_2]$ biscomplex is neutral and the metal ion's coordination sphere is octahedral. The formation processes followed by UV-CD were presented earlier [1]. CD spectroscopy in the visible and near-infrared range was used to investigate the monensin A complexes with colored metal ions. The colored metal ions can be chirally perturbed by the ligand, thereby they show optical activity in the visible wavelength region [2]. Furthermore, the implementation and evaluation of measurements in this range is simplified by the fact that the free components do not exert CD spectra. The complexation with Co(II) and Ni(II) cations was investigated in methanolic solution, where the ligand was deprotonated by tetramethyl-ammonium-hydroxide. Competition experiments between selected colored and colorless divalent metal ions (Mg(II), Ca(II) and Zn(II)) were also performed. The observed characteristics of the mono- and bis-complexes of Co(II) and Ni(II) were used to investigate the competition with divalent colorless metal cations. The conditional stability constants of these complexes were calculated by PSEQUAD program.

As a conclusion, monitoring the complex formation in the VIS-NIR range with CD spectroscopy reduces the data for evaluation. The evaluation of the measurements with visible chiral complexes can be easily carried out, as the ligand and the metal ion have no CD signal. Moreover the measurement conditions are simplified in these cases. Our data show that, to decide whether the monensin molecule is suitable for chelating agent, it is necessary to consider its interactions with non-native metal ions in the living system and in the environment.

References

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