ISMEC 2021

International Symposium on Thermodynamics of Metal Complexes

Białystok, June 16th-18th

# Acta of the International Symposia on Thermodynamics of Metal Complexes

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UNIWERSYTET W BIAŁYMSTOKU

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International Group of the Thermodynamics of Complexes

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# Understanding the mechanism of ZinT-mediated metal acquisition: a thermodynamic study

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ZinT is a periplasmic protein found in Gram-negative bacteria. It is involved in cellular metal trafficking and may function as zinc-chaperone for the ZnuABC transporter. There is a general consensus that the three highly conserved histidine residues (His167, His176 and His178) facing the centre of ZinT calycin like-domain and the amino-terminal fragment between residues 24 and 29 (-HXHHXH-) should be effective zinc binding sites [1, 2]. The $Zn^{2+}$-ZinT complex from *S. enterica* can interact with ZnuA forming a ternary complex where both proteins expose their binding pocket to the $Zn^{2+}$ ion and where the His-rich loop of ZnuA functions as a hypothetical metal transfer intermediary between the two proteins [3, 4]. The main aim of this work is therefore to provide insight into the correlation between the metal-binding ability of ZinT and its biological role. The chosen unstructured fragments, which serve as models to simulate the coordination and transport of metal ions in ZinT protein (see Figure 1) from *Escherichia coli* and *Salmonella enterica*, correspond to the 24–29 and 166–178 amino acid sequences and are protected at the amino- and carboxyl-termini: Ac-$^{24}$HGHHSH$^{29}$-Am and Ac-$^{166}$DHIIAPRKSSHFH$^{178}$-Am (*E. coli*), Ac-$^{24}$HGHHAH$^{29}$-Am and Ac-$^{166}$DHIIAPRKSAHFH$^{178}$-Am (*S. enterica*). Interestingly, both the metal-binding sites of ZinT from *S. enterica* undergo a Ser-to-Ala substitution (position 28 and 175). A deep investigation of the complex-formation equilibria and coordination chemistry of the formed species has been performed through different experimental techniques, including potentiometry, mass spectrometry and various spectroscopies.

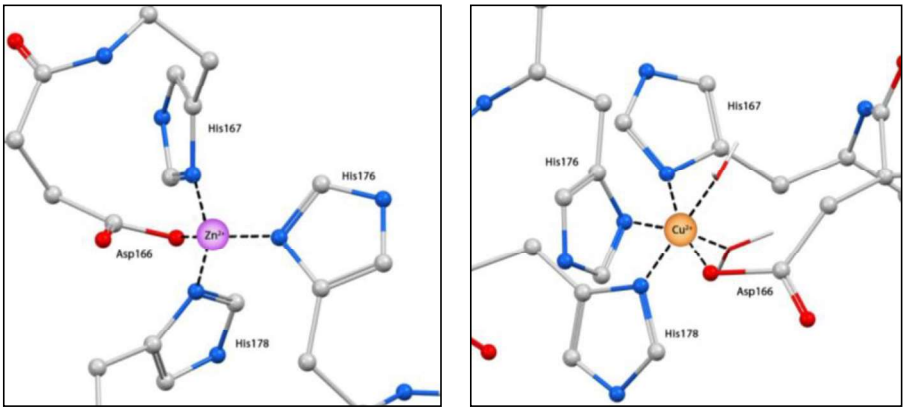


Figure 1. **Proposed coordination sphere for $Zn^{2+}$ (*left*) and $Cu^{2+}$ (*right*) complexes with ZinT model peptide (166–178 sequence) at acidic pH. Explicit hydrogen atoms are omitted for clarity.**

The obtained results highlight novel insight into the mechanism of ZinT-mediated metal acquisition and allow a comparison with other biologically relevant metal-binding systems, such as the antimicrobial peptide calcitermin which can, in principle, participate in human nutritional immunity, competing with ZinT for the metal ion acquisition.

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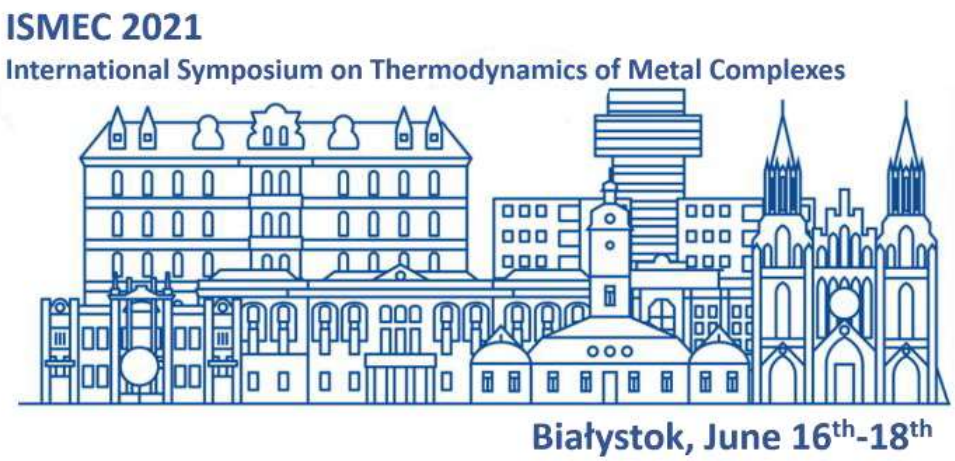
**References:**

[1] J. Chen, L. Wang, F. Shang, Y. Dong, N.-C. Ha, K. H. Nam, C. Quan, Y. Xu, *Biochem. Biophys. Res. Commun.* **2018**, *500(2)*, 139-144.
[2] H. G. Colaço, P. E. Santo, P. M. Matias, T. M. Bandeiras, J. B. Vicente, *Metallomics* **2016**, *8(3)*, 327-336.
[3] A. Ilari, F. Alaleona, G. Tria, P. Petrarca, A. Battistoni, C. Zamparelli, D. Verzili, M. Falconi, E. Chiancone, *Biochim. Biophys. Acta* **2014**, *1840(1)*, 535-544.
[4] D. Bellotti, M. Rowińska-Żyrek, M. Remelli, *Dalton Trans.* **2020**, *49(27)*, 9393-9403.

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