

## How Zinc-Binding Systems, Expressed by Human Pathogens, Acquire Zinc from the Colonized Host Environment: A Critical Review on Zincophores

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Some transition metals, like manganese, iron, cobalt, nickel, copper and zinc, required for the biosynthesis of metalloenzymes and metalloproteins, are essential micronutrients for the growth and development of pathogenic microorganisms. Among the defenses put in place by the host organism, the so-called “nutritional immunity” consists of reducing the availability of micronutrients and thus “starving” the pathogen. In the case of metals, microorganisms can fight the nutritional immunity in different ways, i.e. by directly recruiting the metal ion or capturing an extracellular metalloprotein or also through the synthesis of specific metallophores which allow importing the metal in the form of a chelate complex. The best known and most studied metallophores are those directed to iron (siderophores), but analogous chelators are also expressed by microorganisms to capture other metals, such as zinc. An efficient zinc recruitment can also be achieved by means of specialized zinc-binding proteins. A deep knowledge of the properties, structure and action mechanisms of extracytoplasmic zinc chelators can be a powerful tool to find out new therapeutic strategies against the antibiotic and/or antifungal resistance. This review aims to collect the knowledge concerning zincophores (small molecules and proteins in charge of zinc acquisition) expressed by bacterial or fungal microorganisms that are pathogenic for the human body.

### Słowa kluczowe

Zincophores, metal binding proteins, zinc, nutritional immunity, bacteria, fungi, antimicrobial agents

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