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Metal Binding Phage Clones in a Quest for Heavy Metal Recovery from Water

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Abstract : Toxic heavy metal ion contamination of industrial wastewater has recently become a significant environmental concern in many regions of the world. Although the majority of heavy metals are naturally occurring elements found on the earth's surface, anthropogenic activities such as mining and smelting, industrial production, and agricultural use of metals and metal-containing compounds are responsible for the majority of environmental contamination and human exposure. The permissible limits (ppm) for heavy metals in food, water and soil are frequently exceeded and considered hazardous to humans, other organisms, and the environment as a whole. Human exposure to highly nickel-polluted environments causes a variety of pathologic effects. In 2008, nickel received the shameful name of “Allergen of the Year” (GILLETTE 2008). According to the dermatologist, the frequency of nickel allergy is still growing, and it can’t be explained only by fashionable piercing and nickel devices used in medicine (like coronary stents and endoprostheses). Effective remediation methods for removing heavy metal ions from soil and water are becoming increasingly important. Among others, methods such as chemical precipitation, micro- and nanofiltration, membrane separation, conventional coagulation, electrodialysis, ion exchange, reverse and forward osmosis, photocatalysis and polymer or carbon nanocomposite absorbents have all been investigated so far. The importance of environmentally sustainable industrial production processes and the conservation of dwindling natural resources has highlighted the need for affordable, innovative biosorptive materials capable of recovering specific chemical elements from dilute aqueous solutions. The use of combinatorial phage display techniques for selecting and recognizing material-binding peptides with a selective affinity for any target, particularly inorganic materials, has gained considerable interest in the development of advanced bio- or nano-materials. However, due to the limitations of phage display libraries and the biopanning process, the accuracy of molecular recognition for inorganic materials remains a challenge. This study presents the isolation, identification and characterisation of metal binding phage clones that preferentially recover nickel.

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