Laboratory of Environmental Bioengineering

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High salinity environments can be found all over the globe due to the fact that oceans cover approximately 70% of the Earth's surface and global warming has resulted in both rises in sea level and salinity intrusion into coastal areas throughout the world. High salinity and serious environmental pollution are often observed together since salts and pollutants are dissolved in water and concentrated alongside each other due to evaporation. Therefore, the development of practical environmental technology that can be used in high-salinity environments is necessary.

Our laboratory has been studying the molecular mechanisms underlying salt- and metal-stress responses in halophilic and salt-tolerant plants and microbes. With the knowledge obtained from our studies, we are developing metal-biotechnologies to remediate and recycle inorganic metals from salty wastewater (Topic 1). We are also working on biorefinery projects using halophilic bacteria as a cell factory to convert organic pollutants in salty wastewater into valuable chemicals such as biofuels, bioplastics, and functional peptides (Topic 2).

Topic 1. Using metal biotechnologies to recycle metal pollutants in salty wastewater.

We are developing technology for harvesting valuable metals from salty wastewater using cellular activities such as oxidation, reduction, chelation, and accumulation. Our approach involves either screening for, or engineering, halophilic bacteria that thrive in metal-containing high-salinity environments and using them as live-cell metal accumulators, absorbers or mineralizers (Fig. 1).

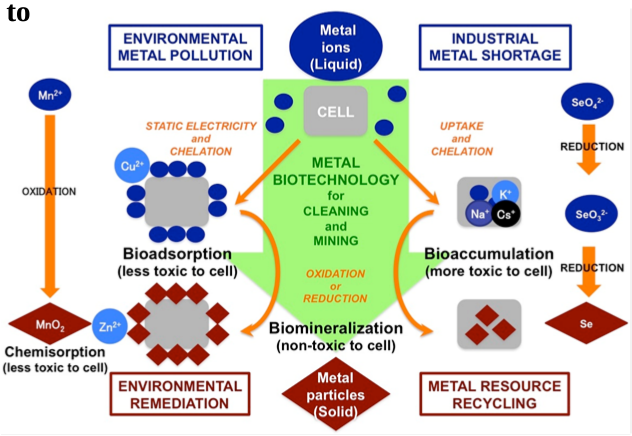

Fig. 1. Metal biotechnology for metal remediation and recycling.

Topic 2. Biorefinery technologies used to convert organic pollutants in salty wastewater into valuable chemicals.

We established cell-surface engineering technology for the moderate halophile *Halomonas elongata*, which can assimilate various carbon and nitrogen sources in high-salinity environments. We are now attempting to use *H. elongata* as a super cell factory to produce valuable chemicals, e.g., the VP28 peptide of the white-spot syndrome virus (WSSV) for use as an anti-WSSV agent for sustainable shrimp farming (Fig. 2).

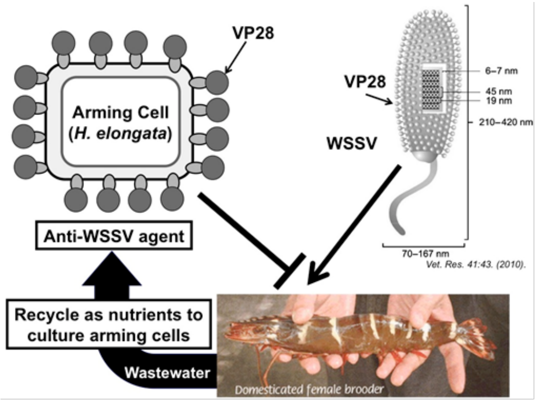

Fig. 2. Biorefinery for sustainable shrimp farming.