Research Unit
Environmental Engineering and Biotechnology

SusBioTech

IP Sustainable Biotechnology and Bioeconomy
Lecture

Lucian C. Staicu, Ph.D.
University of Warsaw, Warsaw, Poland

Tuesday, 01 October 2019, 11:00
Leipziger KUBUS, Lecture Hall 1B
Permoserstr. 15, 04318 Leipzig

Selenium respiration in bacteria: does energy generation pay off?

Although thermodynamically-favorable and documented in phylogenetically-diverse bacteria, Selenium (Se) respiration appears to be accompanied by a number of challenges and numerous unanswered questions. Selenium oxyanions, SeO_4^{2-} and SeO_3^{2-}, are reduced to elemental Se, Se(0), through anaerobic respiration, the end product being solid and displaying a considerable size (up to 400 nm) at the bacterial scale. Moreover, various allotropic forms and shapes of biogenic Se(0) are potentially detrimental for cellular integrity and homeostasis. Compared to other electron acceptors used in anaerobic respiration, Se is the only element whose end product is solid. Furthermore, unlike other known bacterial intracellular accumulations, Se(0) has not been shown to play a nutritional or ecological role for its host nor does it display any other function. In the context of anaerobic respiration of Se oxyanions, biogenic Se(0) appears to be a by-product, a waste that needs proper handling and this raises the question of the evolutionary implications of this process. Why would bacteria select for a metabolic process that is useful, in the first place, and then highly detrimental? Interestingly, in certain artificial ecosystems (e.g. up flow bioreactors), Se(0) might help bacterial cells to increase their buoyancy and thus avoid biomass wash-out, ensuring survival. However, this process has only been revealed for “recent” man-made ecosystems and mixed microbial communities (granular sludge). This presentation will explore in depth the thermodynamics, enzyme systems, genetic determinants and the evolutionary implications of selenium respiration in bacteria, attempting to answer a number of questions including i) where does the nucleation process of Se(0) occur in bacteria, ii) are there any viable possibilities for Se(0) extracellular transport, and iii) what are the evolutionary implications for bacteria that adopted this strategy to generate cellular energy.

In 2014, Lucian Staicu obtained his Ph.D. in Biotechnology (joint degree, University Paris Est, FR and UNESCO-IHE, NL), followed by a postdoctoral stage at the University Franche-Comté (Besançon, FR) and a second one at the University Blaise Pascal (Clermont Ferrand, FR). Since 2018, he is working as principal investigator at the University of Warsaw where he conducts research on anaerobic respiration of As and Se in phylogenetically-diverse bacteria, as well as on critical raw material recovery.

All interested colleagues are kindly invited.