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Omics for a Quick Survey of Microorganisms with Characteristics Interesting for Environmental Remediation of Radionuclides

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Extended Abstract

Life can be found in a wide range of possible niches. Microorganisms have been isolated from unexpected environments, such as the cooling water of nuclear reactors. Such environment is, indeed, not appropriate for life with the presence of high radiation levels, low nutrient concentrations and the presence of high levels of dissolved radioactive metals. Nevertheless, different microorganisms, such as bacteria, fungi and even a recently identified micro-alga, have already been found in several nuclear power plants around the world [1-3]. The organisms found in nuclear facilities could be used for the decontamination of radioactive water or water with high levels of heavy metals. While the existing decontamination methods, which are based on physico-chemistry, are already extremely efficient, biotechnology could be used to advantageously treat large volume of waste or low concentration of contaminants, and could be the only possible alternative for dealing with large-scale environmental pollution. Such bio-inspired technology will also be more eco-friendly than the existing methods employed, and thus more accepted by the public opinion.

A new green micro-alga was found in a spent nuclear fuel pool in a French nuclear installation [3]. *Coccomyxa actinabiotis* can not only withstand high radiation level (up to 20 kGy) but is also able to accumulate toxic metals, such as silver, cobalt, uranium and cesium (^{110m}Ag, ^{60}Co, ^{238}U, ^{137}Cs, ^{14}C), as well as precious metals [4]. A laboratory scale process has been developed in order to use this micro-alga as a bio-decontaminant mean of nuclear effluent [5]. Based on this experiment, the use of microorganisms could be possible to not only decontaminate effluents inside a nuclear installation but also to concentrate the radioactivity and heavy metals ions released outside the facility during a nuclear catastrophe, such as Fukushima or Chernobyl.

The inventory and isolation of microorganisms living in nuclear reactors and especially in spent nuclear fuel pools can help to have a large panel of such microorganisms disposable in different environments. We have started to list and characterize microorganisms living in the pool of a nuclear facility in France. Up to now, the organisms described in the literature have been identified after a cultivation step. However not all the living organisms present in water are cultivable. Thus, we focused our attention on metagenomics and metaproteomics methodologies in order to have the most comprehensive survey. These omics approaches allow identifying the main composition of the microflora present in such samples, but also allow to point at the key molecular players. We demonstrated that this approach is an interesting shortcut [6]. Moreover, we started isolating bacteria, fungi, and new green micro-algae. Their characteristics in terms of radio-tolerance are investigated. The present work represents an original approach to identify the microbial flora present in nuclear facilities and highlight the most interesting microorganisms in terms of bio-remediation technological applications.

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