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Finding novel genes coding for eco-friendly surfactants from hypersaline Iberian locations using metagenomic approaches

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Surfactants are tensioactive chemical compounds extensively used worldwide in a myriad of industrial sectors and in our daily lives, being present in numerous products including cosmetics, detergents, fabric softeners, toothpaste, among many others. Millions of tonnes of surfactants are thus manufactured every year. Most commercially available surfactants are non-renewable petroleum-based compounds that can have a profound environmental impact. This has prompted the search for new eco-friendly alternatives, including the so-called biosurfactants, which are surfactants produced by microorganisms that are sustainable alternatives to their chemical counterparts. Hypersaline environments are an attractive source of microbial communities that, due to their adaptation to extreme abiotic conditions, produce special secondary metabolites being hotspots for the discovery of new biosurfactants. Sampling campaigns were conducted at strategic hypersaline locations holding distinct features, namely Peña Hueca lagoon (hypersaline sulphated lagoon, Spain), and salinas of Aveiro (solar coastal salina, Portugal) and Rio Maior (terrestrial inland salina, Portugal). DNA was extracted from collected water samples and two different metagenomic approaches were carried out, sequence- and function-based, both aiming to identify new biosurfactant-producing genes. The latter used a robotic screening system to screen more than 500 clones for biosurfactant production. Physicochemical characterization of samples showed an interesting variability in terms of salinity, pH and ionic content. Analysis of shotgun metagenomic sequencing data revealed that the isolated metagenomes are enriched in genes involved in biosurfactant biosynthesis, and that the microbial community is shaped by the physicochemical features. The screening tests showed an interesting number of clones with biosurfactant activity. Therefore, the bioprospection of hypersaline locations of the Iberian Peninsula allowed the identification of biosurfactant-producing clones, which can have promising industrial applications and contribute to the quest for more sustainable alternatives to chemical surfactants.