# Actinomycetes isolated from soils of extreme and less known environments - taxonomic diversity and biological activity.

Magdalena Świecimska

## Abstract

Actinomycetes are microorganisms commonly found in natural environments. They are best known for their ability to synthesize various bioactive secondary metabolites, especially antibiotics. The search for new and effective antibiotics is of particular importance in the era of increasing resistance of microorganisms to these drugs. In addition to antibiotics, actinomycetes produce a number of compounds with anticancer, biocontrolling and immunosuppressive activities, as well as biofertilizers and others. New bioactive compounds of natural origin now being sought from extreme habitats as harsh environmental conditions therein select for novel strains with distinctive genetic and molecular features, notably an ability to produce specialized metabolites of biotechnological value.

The aim of this study was to determine the generic diversity among actinomycetes isolated from highly dried and insolated soils of the Atacama Desert, saline soils of Lonar Lake and acidic soils from two sites in a pine forest, the membership of actinomycetes to known or potentially novel species, and to establish a collection of strains with high biotechnological potential for use in medicine, industry and agriculture.

In the present study, one hundred and fifteen representative strains, isolated from four environments, selected from individual colour groups established on the basis of colony colour and pigments diffusing into the medium, were identified based on the nucleotide sequence of the 16S rRNA gene to the genera and their affiliation to the validly published or potentially new species of actinomycetes was determined.

The results of these studies showed that the majority of isolates belonged to the genus *Streptomyces*, regardless of the source of isolation. However, among the tested isolates, representatives of rare genera were also detected, including *Modestobacter* (among the Atacama Desert isolates) or *Actinacidiphila, Catenulispora* and *Streptacidiphilus* (among forest soil isolates). Among the examined isolates, the presence of several potentially new species has been demonstrated. Using a polyphasic approach, based on phylogenetic studies, comparative analyses of genome sequences and phenotypic studies, two new species of the following genera were described, namely *Catenulispora* (*C. pinisilvae* and *C. pinistramenti*), *Modestobacter* (*M. excelsi* and *M. altitudinis*) and *Streptomyces* (*S. alkaliterrae* and *S. pinistramenti*).

Numerous gene clusters that encode for known and unknown secondary metabolites with antibacterial, antifungal, antiviral and antitumor activity have been recorded in the genomes of isolates belonging to new species. The genomes of the isolates were also rich in stress-related genes responsible for adaptation to harsh environmental conditions and genes encoding for plant growth promoting factors, such as siderophores.

The representative strains, in the standard culture tests, showed antibacterial and antifungal activity while isolates from forest soil strong antifungal activity against phytopathogens. In addition, isolates showed hydrolytic activity (cellulases, chitinases, lipases, pectinases, proteases and ureases), the ability to synthesize plant growth promoting factors (ammonia, auxins, hydrogen cyanide and siderophores) and solubilize phosphates.

In conclusion, the obtained results showed that among the actinomycetes isolated from extreme and rarely explored environments, such as hyper-arid, high-altitude Atacama Desert soils, saline and alkaline Lonar lake soil and acidic pine forest soils, both commonly known and rare taxa of actinomycetes, including new species, and isolates with diverse biological activity and biotechnological potential for use in medicine, industry and plant production were present.

16.01.2023 Magdalena Świecimska