Think pink! Success of pink bacteria in oceans of the world

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Marine bacteria of the *Roseobacter clade* are found to be spread widely throughout the oceans of this planet from the tropics to as far as Antarctica. They live freely in the water, in sediments and as symbiotic partners of algae. Special photosynthetic pigments are responsible for their pink colour. Marine bacteria distinguish themselves through an unusually diverse metabolism, which opens interesting opportunities for biotechnological applications. A reconstruction of their evolutionary development will provide a key for scientists to understand the secret for their ecological success.

Researchers at the DSMZ have now discovered that, through plasmids, representatives of the Roseobacter group may exchange such important genetic characteristics as the capability to perform photosynthesis. This type of horizontal gene transfer across the species boundary might make it possible for bacteria of the *Roseobacter clade* to quickly and effectively conquer new ecological niches. The results of experiments have been published in the magazine Environmental Microbiology and are already available online.

Since 2010, scientists of the Leibniz-Institut DSMZ-Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH (Leibniz Institute DSMZ German Collection of Microorganisms and Cell Cultures) have been working together with marine microbiologists, ecologists, biochemists, geneticists and information technologists in the Transregio 51 Roseobacter collaborative research centre. The goal of this collaborative research group is to understand the evolutionary, genetic and

physiological principles which are responsible for the success of this group of bacteria that have not yet been the object of very extensive research to date. What special genetic features do these bacteria have to enable them to adapt to the most varied of natural habitats?

The DSMZ researchers in the team of Dr. Jörn Petersen, Private Lecturer and Dr. Silke Pradella have now found a clue leading to an important point of reference. The scientists examined the evolution and importance of so-called "plasmids" within the *Roseobacter clade* which are to be found there in great numbers and varieties.

"Plasmids are usually ring-shaped DNA molecules with a size of up to 1 million base pairs which can duplicate themselves independently of the bacterial chromosome. Natural plasmids encode such useful properties as nitrogen fixation. However, they are also responsible for the development of multiresistant hospital pathogens", the geneticist and evolutionary biologist Dr. Jörn Petersen explains.

Jörn Petersen continues saying that, "it had been assumed for a long time that all of the important genetic information in bacteria was to be found on the chromosome". For representatives of the *Roseobacter clade*, however, a colleague in the team, Dr. Silke Pradella, had already been able to refute this assumption in an earlier experiment. She proved that the central gene responsible for photosynthesis in Roseobacter litoralis and Sulfitobacter guttiformis is located on plasmids. With their newest work, this working group was even able to show that the complete photosynthesis gene cluster, with more than 40 genes, had been transferred from the chromosome to a plasmid.

What is the reason for this unusual genetic organization? "Our explanation for this is that the *Roseobacter clade* makes use of its plasmids as a 'mobile container of genetic information', in order to, whenever necessary, rapidly and mutually exchange important metabolic

functions even beyond the species boundaries", Dr. Petersen explains. "The access to the mutual gene pool can be understood as type of neighbourly assistance between these marine bacteria. Through the transfer of the photosynthesis genes, the bacteria not only become pink, but also acquire a special advantage for survival through their ability to now attain additional energy from sunlight. A genetic exchange with the use of plasmids as a vector would also conclusively explain why this capability of performing photosynthesis within the Roseobacter group is distributed only sporadically and without any recognizable pattern."

The broad range of methods established at the DSMZ and the new knowledge concerning plasmid biology provide the basis for a new systems biology collaborative project within the framework of the Roseobacter collaborative research centre. The goal of this is to clarify the physiological significance of plasmids in the model organism Phaeobacter gallaeciensis DSM 17395. For this purpose, the plasmid knock-out mutants produced by the working group should be analysed and compared with the Phaeobacter wild-type with the aid of the complete OMICS pipeline (genomes, transcriptomes, proteomes, metabolomes, fluxomes).

More information: Petersen J, Brinkmann H, Bunk B, Michael V, Päuker O, Pradella S (2012) Think pink: photosynthesis, plasmids and the Roseobacter clade. Environmental Microbiology. Published online: onlinelibrary.wiley.com/doi/10 … 920.2012.02806.x/pdf

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