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Press release

Leibniz-Institut DSMZ-Deutsche Sammlung von Mikroorganismen un[illegible]bH
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04/07/2021
http://idw-online.de/en/news766311

Research results, Scientific Publications
Biology, Environment / ecology, Nutrition / healthcare / nursing, Oceanology / climate
transregional, national

Complexity instead of contamination: cyanobacteria prefer camaraderie

Interdisciplinary approach allows investigation of hitherto unknown microorganisms

Dr Jörn Petersen and Dr. Boyke Bunk at the Leibniz Institute DSMZ–German Collection of Microorganisms and Cell Cultures GmbH in Braunschweig, Lower Saxony, used an interdisciplinary approach to investigate with their teams three different cyanobacteria and their associated microorganisms. Simultaneously, they were able to determine the position of these important cyanobacteria within the tree of life. The researchers recently published their findings in a special issue of the journal Genes with a special focus on metagenomics (https://doi.org/10.3390/genes12030389).

A contemporary taxonomic characterisation of cyanobacteria is extraordinarily difficult: It has long been a bone of contention between microbiologists and botanists, with the unsurprising result that their kinship has not yet been adequately studied. Using a combined approach of microbiology, metagenomics and bioinformatics, the Braunschweig scientists were able to conduct an exemplary, far more thorough investigation of three different cyanobacteria. “The challenge is that these cyanobacteria are not present in pure culture”, explains study leader Jörn Petersen. In their natural habitat, the so-called cyanosphere, cyanobacteria are surrounded by a high number of other, frequently unknown types of bacteria. Without these housemates, who were commonly seen as an annoying form of contamination, certain cyanobacteria would not even be able to survive. But it is this complex cohabitation that makes the characterisation of the central cyanobacterium so difficult on the genetic level, as it is impossible to isolate pure DNA. “Only the combination of different bioinformatic methods allowed us to draw clear conclusions on the phylogenetic assessment of the examined three cyanobacteria themselves, as well as on the composition of the cyanosphere.”
In their study, the researchers found up to 40 heterotrophic bacteria that live off assimilates of a single photosynthetic host; in addition, they discovered many new species of so far uncultivated bacteria as well as more than a dozen new genera. In the last few years, it was metagenomic studies of exotic habitats such as the deep sea or the human microbiome that made insights into the variability of uncultivated microorganisms possible. According to bioinformatician Bunk, this „microbial dark matter“ is, unfortunately, so far only available as digital legacy of previously isolated DNA samples. By contrast, research can now investigate complex cohabitations in our cultures that have been preserved steadily for decades under laboratory conditions – for example, one of the investigated cyanobacteria, Stigonema ocellatum, was isolated more than fifty years ago from a Sphagnum moss in the Allgäu region of Bavaria. “Our findings show that the cyanosphere contains a wealth of directly accessible, so far entirely untapped biodiversity. The study of cyanobacteria, their close interactions with their surrounding microorganisms and the metabolic pathways involved is still very much in its infancy. But the scientific potential is huge, including a later biotechnological usage of resources”, summarizes Jörn Petersen.

Cyanobacteria: creators of the planet
Cyanobacteria, sometimes mistakenly called ‘blue-green algae’, are one of the oldest forms of life. Their oxygen production has shaped the earth’s atmosphere for over three billion years. Even today, these bacteria are the main suppliers of oxygen in rivers, lakes and oceans. They have a major ecological impact: Up to an estimated 30% of

photosynthetic carbon dioxide fixation occurs via these microorganisms. In India, certain isolates are used in the re-cultivation of barren saline soils. From an economic perspective, cyanobacteria are mainly of interest due to their use as food supplement, e.g. Spirulina, and in the use of biotechnological processes including the production of amino acids or biofuel. However, cyanobacteria are also able to produce bioactive substances such as neuro and liver toxins. In summer months in particular, when climatic conditions cause cyanobacterial blooms in stagnant waters, this toxin production poses a threat to humans and animals. One tragic example is the mass death of more than 300 elephants last summer due to contaminated water holes in northwest Botswana.

Original publication
Marter, P., Huang, S., Brinkmann, H. Pradella, S., Jarek, M., Rohde, M., Bunk, B., Petersen, J. (2021) Filling the Gaps in the Cyanobacterial Tree of Life—Metagenome Analysis of Stigonema ocellatum DSM 106950, Chlorogloea purpurea SAG 13.99 and Gomphosphaeria aponina DSM 107014. Genes 2021, 12(3), 389; https://doi.org/10.3390/genes12030389

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About the Leibniz Institute DSMZ
The Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures is the world's most diverse collection of biological resources (bacteria, archaea, protists, yeasts, fungi, bacteriophages, plant viruses, genomic bacterial DNA as well as human and animal cell lines). Microorganisms and cell cultures are collected, investigated and archived at the DSMZ. As an institution of the Leibniz Association, the DSMZ with its extensive scientific services and biological resources has been a global partner for research, science and industry since 1969. The DSMZ is the first registered collection in Europe (Regulation (EU) No. 511/2014) and certified according to the quality standard ISO 9001:2015. As a patent depository, it offers the only possibility in Germany to deposit biological material in accordance with the requirements of the Budapest Treaty. In addition to scientific services, research is the second pillar of the DSMZ. The institute, located on the Science Campus Braunschweig-Süd, accommodates more than 75,000 cultures and biomaterials and has around 200 employees. www.dsmz.de

The Leibniz Association
The Leibniz Association connects 96 independent research institutions that range in focus from the natural, engineering and environmental sciences via economics, spatial and social sciences to the humanities. Leibniz Institutes address issues of social, economic and ecological relevance. They conduct knowledge-driven and applied basic research, maintain scientific infrastructure and provide research-based services. The Leibniz Association identifies focus areas for knowledge transfer to policy-makers, academia, business and the public. Leibniz institutions collaborate intensively with universities – in the form of "Leibniz ScienceCampi" (thematic partnerships between university and non-university research institutes), for example – as well as with industry and other partners at home and abroad. They are subject to an independent evaluation procedure that is unparalleled in its transparency. Due to the importance of the institutions for the country as a whole, they are funded jointly by the Federation and the Länder, employing some 19,100 individuals, including 9,900 researchers. The entire budget of all the institutes is approximately 1,9 billion Euros.
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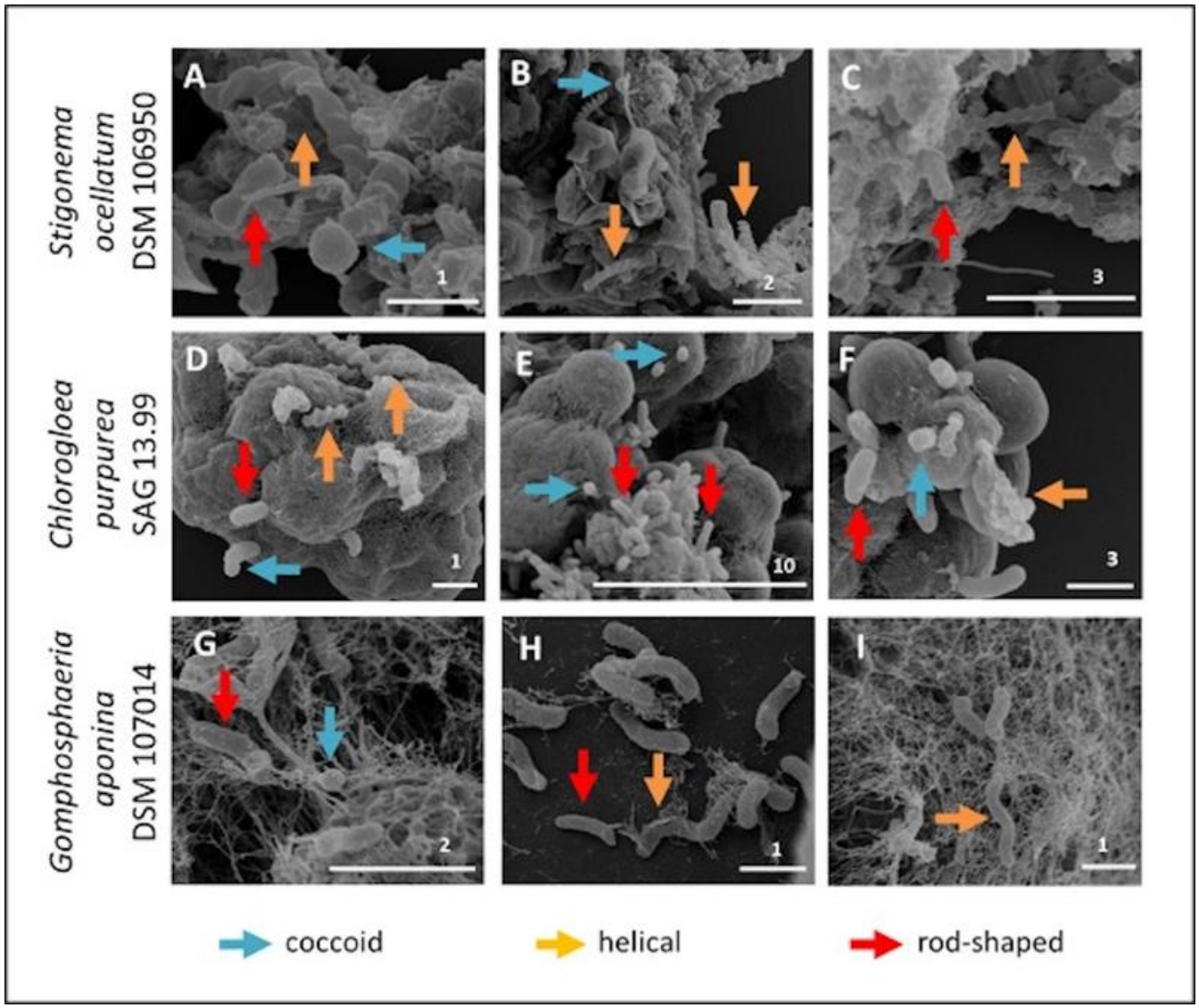

Scanning electron microscopy of three non-axenic cyanobacteria. Some coccoid, helical and rod-shaped bacteria are highlighted by arrows. (HZI/M. Rohde & DSMZ/J. Petersen)
DSMZ

PD Dr. Jörn Petersen
DSMZ