Fungal protector against bacterial attackers

Research team from Jena deciphers complex interplay between bacteria, fungi and plants

Jena. Bacteria of the genus *Streptomyces* produce numerous substances that ensure their survival. Azalomycins are such an example: they have an antimicrobial effect and can also damage cells of higher organisms, including the green alga *Chlamydomonas reinhardtii*. The algae actively seeks a partnership with the mould fungus *Aspergillus nidulans.* Through this partnership, it is protected from the damaging effect of azalomycin F. A team of researchers from Jena has studied the complex interplay between bacteria, fungi and plants in detail.

Three research teams led by Axel Brakhage, Christian Hertweck and Maria Mittag from the Leibniz Institute for Natural Product Research and Infection Biology - Hans Knöll Institute (Leibniz-HKI) and the Friedrich Schiller University of Jena investigated the coexistence of fungi, algae and bacteria. They discovered that the mould fungus *Aspergillus nidulans* and the green alga *Chlamydomonas reinhardtii* form a lichen-like association and so fend off the attack of the bacterium *Streptomyces iranensis* on the algae. " In particular, the green algae benefits from this partnership because they are susceptible to the bacterial agent azalomycin F, which leads to their death," said Brakhage, director of the Leibniz-HKI, who also holds a chair at the University of Jena. The presence of *C. reinhardtii* triggers the release of the antibiotic azalomycin F in *S. iranensis*. This kills the green algae, but does not harm the fungus *A. nidulans*. In fact, *A. nidulans* binds azalomycin F to certain lipids in its cell membrane, rendering it harmless to the green algae. "However, the green algae and the fungus must already have been cultivated together before adding *S. iranensis*. If the three microorganisms are brought together at the same time, the protective mechanism is not yet effective," said Brakhage.

Using a special method, the microbiologists were also able to observe that the partnership between *C. reinhardtii* and *A. nidulans* is not incidental: the green algae actively swim towards the fungus. In addition to its protective effect against the toxin, the lichen-like association accelerates the growth of the green algae and increases its cell density, as the researchers also found out. "However, we still do not understand why azalomycin F only kills the green alga in the presence of light but not in darkness. This example shows on the one hand the amazing dynamics in microbial communities, but on the other hand it also reminds us that we are still in the early stages of investigating these relationships," said Brakhage.

The scientists in the Cluster of Excellence "Balance of the Microverse" (spokesperson Axel Brakhage) and the Collaborative Research Centre "ChemBioSys" at Friedrich Schiller University Jena (spokesperson Christian Hertweck) are dedicated to studying such complex interactions. They aim to gain a holistic understanding of the interactions in microbial communities and to adapt their findings for the development of technologies that have benefit humans and nature.

The results have just been published in *The ISME Journal*.

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Original publication

Krespach MKC, García-Altares M, Flak M, Schoeler H, Scherlach K, Netzker T, Schmalzl A, Mattern DJ, Schroeckh V, Komor A, Mittag M, Hertweck C, Brakhage AA (2020) Lichen-like association of *Chlamydomonas reinhardtii* and *Aspergillus nidulans* protects algal cells from bacteria. ISME J 2020, doi:10.1038/s41396-020-0731-2.

Caption

20-15_Alge und Pilz.jpg
The microscopic image shows the green algae *Chlamydomonas reinhardtii* (green) and the fungus *Aspergillus nidulans* (filamentous).
Source: Mario Krespach, Leibniz HKI

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- 20-15_Fungal protector against bacterial attackers.pdf (1,6 MiB)