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Modulation and resilience of the metabolome of *Pseudomonas graminis*, a cloud bacterium, facing H_2O_2 atmospheric stress

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In cloud waters, microorganisms are metabolically active although they are exposed to very strong stresses, especially due to the presence of reactive oxygenated species, including H_2O_2 and radicals. In order to understand how microorganisms can modulate their metabolism facing H_2O_2 stress, we have investigated by a metabolomics approach the response of a *Pseudomonas graminis* strain, isolated from cloud waters, to hydrogen peroxide exposure. For this purpose *P. graminis* cells were incubated in microcosms containing artificial cloud waters in the presence or absence of H_2O_2. Metabolites were extracted at two time points (50 min and 24 h) that were important regarding the evolution of ATP cellular content and H_2O_2 degradation over time. These bacterial extracts were analysed by LC-MS and 1H-NMR using the Metabolic Profiler® facility (Bruker). Metabolic profiles were converted into matrices and statistical analyses (PCA, PLS-DA) were performed; key markers of this oxidative stress were identified by 2D NMR and LC-MS-Orbitrap. At time 50 min, when H_2O_2 was still present in the incubations, the bacteria adapted and modulated their metabolome facing this stress. The major metabolic pathways of *Pseudomonas graminis* (13b-3) impacted by the presence of hydrogen peroxide were the carbohydrate pathway, glutathione, energy, lipid and amino-acid metabolisms. Unexpectedly, the concentration of a few dipeptides containing mainly Ala, Val, Leu (Ile) was also highly modified in the presence of H_2O_2. These dipeptides are reported here for the first time as biomarkers of oxidative stress. Interestingly, at time 24 h, when H_2O_2 has been completely biodegraded by the cells, no more significant difference was observed between the metabolites of exposed and non-exposed cells to H_2O_2. This shows the resilience of this bacterium metabolome after H_2O_2 stress exposure. These results are discussed in terms of impacts on cloud chemistry.

Biography

Anne-Marie Delort is a Senior Scientist at CNRS. She is working at Institute of Chemistry of Clermont-Ferrand in France. In addition to a general background in chemistry and molecular biology, her expertise covers Microbiology and Metabolomics. She specifically studies microbial metabolism in relation with the environment. She has been a pioneer in studying the microbial population in clouds. Recent studies concern the adaptation of microorganisms to atmospheric stresses and the role of microorganisms in atmospheric chemistry and physics. This includes the transformation of organic matter, interaction with oxidants and formation of ice nuclei and cloud condensation nuclei (biosurfactants). Her group is part of MetaboHUB, the French national infrastructure of excellence in metabolomics and fluxomics.

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