Microorganisms from clouds: Interactions with H_2O_2

A.-M. Delort[1], N. Wirgot[1], A. Lallement[1], M. Vaïtilingom[1,2], L. Deguillaume[2], M. Sancelme[1], P. Amato[1], V. Vinatier[1]

[1] Institut de Chimie de Clermont-Ferrand, [2]Laboratoire de Météorologie Physique, Université Blaise Pascal, Université Clermont Auvergne, 63171 Aubière, France

A-Marie.Delort@univ-bpclermont.fr

The concept of "cloud microbiome" which was recently suggested is unique mainly due to the specific status of cloud microorganisms compared to the other stable environmental ecosystems (waters, soil, plants, etc.). Cloud is a transient habitat lasting from a few hours to a few days as it is part of the life cycle of the microorganisms in the atmosphere. Microorganisms are aerosolized, transported in the air and deposited further or integrated in clouds by nucleation and scavenging processes and can be back to the earth by wet deposition using precipitation as shuttles. In clouds they are exposed to very strong stresses, especially to the presence of oxidants coming from H_2O_2 as OH radicals, or from dioxygen activation as superoxide …(see Figure 1)

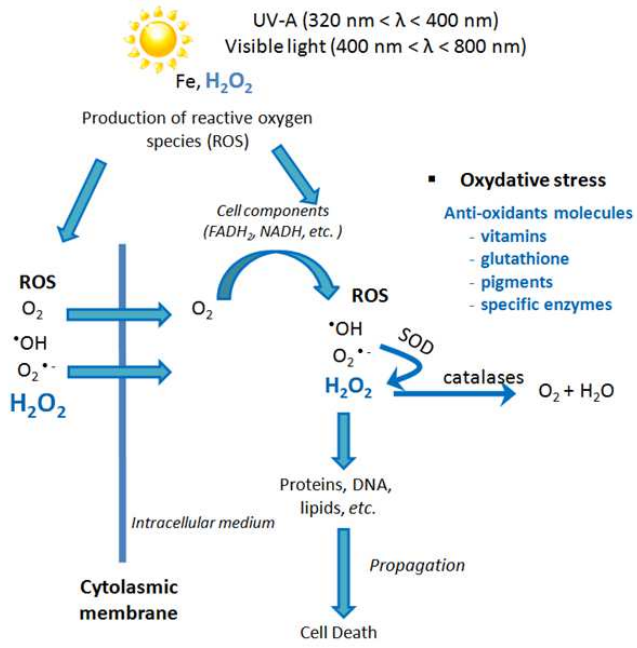

Figure 1: In clouds, microbial cells are exposed to reactive oxygen species (ROS) produced by the uptake of O_2 during respiration or by chemical reactions (photolysis of H_2O_2 Fenton or photo-Fenton reactions) occurring in cloud water. Cells react to this oxidative stress thanks to the production of vitamins, glutathione, pigments or specific enzymes degrading H_2O_2, $O_2^{\bullet-}$.

We report here the interactions between H_2O_2 and microorganisms using isolated strains from clouds or real cloud samples collected at the puy de Dôme station (France, 1475 m). We have shown that they can survive to this oxidative stresses (Joly *et al* 2015). Thanks to their efficient metabolism they can degrade H_2O_2 present in cloud waters and biodegradation is competitive compared to abiotic degradation processes such as photolysis (Vaïtilingom *et al* 2013)(Figure 2).

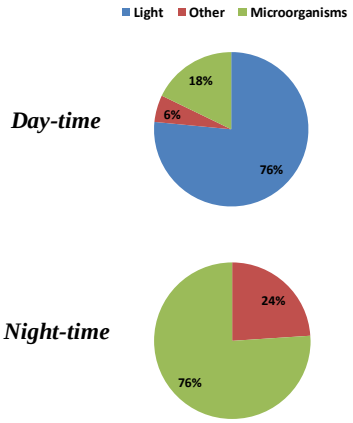

Figure 2: Relative contribution of biotic and abiotic processes to H_2O_2 degradation during the day-time and night-time. "Light" (in blue) corresponds to pure photochemical processes; "Other" (in red) corresponds to non photochemically induced radical processes; and "Microorganisms" (in green) corresponds to a pure biodegradation processes.

In parallel H_2O_2 modulates the global metabolism of cloud microorganisms as shown by the strong correlations between ATP (Adenosine triphosphate) and H_2O_2 concentrations (Wirgot *et al* 2016).

These results will be discussed in terms of their impact cloud chemistry.

Vaïtilingom, M., Deguillaume, L, Vinatier, V., Sancelme, M., Amato, P., Chaumerliac, N. and Delort, A.M. (2013). *PNAS*, **110**, 559–64.

Joly, M, Amato, P. Sancelme, M. Vinatier, V. Abrantes, M., Deguillaume, L. and Delort, A.M. (2015). *Atmos. Environ.* **117**, 92–98.

Wirgot, N. et al. In preparation

Aknowledgements:

This work was supported by the French ANR program « BIOCAP » and CNRS EC2CO.

N. Wirgot is a recipient of a PhD grant from the MESNR.