Characterization of biosurfactants from cloud microorganisms

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The formation of cloud droplets from aerosol particles in the atmosphere is still not well understood and a main source of uncertainties in the climate budget today. According to Köhler theory, three parameters drive these processes, the Raoult's term, the surface tension (σ) and the size of the initial atmospheric particle. The presence of trace compounds referred to as surfactants decreases the surface tension and increases the solute concentration of droplets in the cloud and thus might directly impact on climate by increasing the number of activated cloud condensation nuclei (CCN). CCN may increase the amount of solar radiation reflected by clouds (Twomey effect) and may increase cloud lifetime (Albrecht effect).

Within a project devoted to bring information on atmospheric surfactants and their effects on aerosol-cloud interactions, we dealt with production and characterization of *bio*surfactants (microbial origin) present in the atmosphere. From our unique cloud microbial bank (480 strains) isolated from cloud water collected at the Puy-de-Dôme (Vaïtilingom et al., 2012), we undertook screening production, extraction and purification of atmospheric biosurfactants.

After extraction of the supernatants of the pure cultures, surface tension of crude extracts was determined by the pendant drop technique. Figure 1 shows that a wide variety of microorganisms (41% of the strains) are able to significantly produce biosurfactants ($\sigma \leq 55$ mN.m^{-1}). The best producers (13% of the strains) exhibit strong biosurfactants or high yields of biosurfactants as the resulting surface tension quickly decreases to values less than 45 mN.m^{-1}, and until 25 mN.m^{-1}.

Purification of biosurfactants was achieved by adsorption chromatography on a polystyrene resin. The adsorption of the active compounds on the resin was monitored by measuring the surface tension of the column outlet. Biosurfactants were separated by ultra-performance flash purification column. The molecular structure of the biosurfactants is investigated by means of liquid chromatography/tandem mass spectrometry (LC/MS-MS) and Nuclear magnetic resonance (NMR) spectroscopy. Preliminary analytical characterization of biosurfactants, harvested after isolation from overproducing cultures of *Pseudomonas*, allowed us to identify them as belonging to two main classes, namely glycolipids and lipopeptides.

In our study, the screened microbial strains were isolated from 39 cloud events presenting different profiles. Cloud events are classified according to physico-chemical characteristics of cloud waters (Marine, Highly marine, Continental and Polluted) as described by Deguillaume et al. (2014). Noteworthy are highly marine strains, characterized by a high minimal surface tension (45 mN m^{-1}) and an almost total absence of ϒ-Proteobacteria (1/57 isolates).

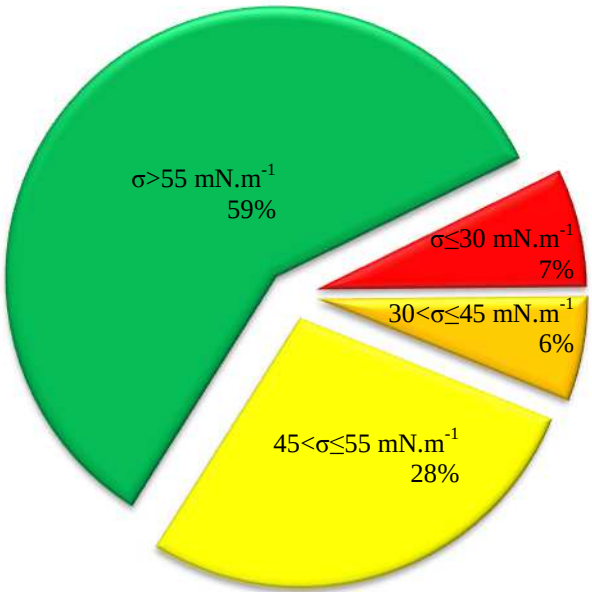

Figure 1. Overall distribution of 480 strains by surface tension (σ / mN.m-1).

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Vaïtilingom, M.; Attard, E.; Gaiani, N.; Sancelme, M.; Deguillaume, L.; Flossmann, A. I.; Amato, P.; Delort, A. M. (2012) *Long-term features of cloud microbiology at the puy de Dôme (France)*, Atmos. Environ., 56, 88-100.

Deguillaume, L., Charbouillot, T., Joly, M., Vaïtilingom, M., Parazols, M., Marinoni, A., Amato, P., Delort, A.-M., Vinatier, V., Flossmann, A., Chaumerliac, N., Pichon, J. M., Houdier, S., Laj, P., Sellegri, K., Colomb, A., Brigante, M. and Mailhot, G. (2014) *Classification of clouds sampled at the puy de Dôme (France) based on 10 yr of monitoring of their physicochemical properties*, Atmospheric Chem. Phys., 14(3), 1485–1506.