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ISOLATION OF ICE-NUCLEATION ACIVE MICRORGANISMS FROM CLOUD WATER.

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Airborne micro-organisms have long been considered as particles simply transported by the atmospheric circulation that can subsequently colonize or invade new environments. In this context, their importance is mostly related to ecological and socio-economical issues (bio-terrorism, health, etc). However, the structure and function of microbial communities in clouds remain largely unknown. Atmospheric water represents, in some respects, an extreme aquatic environment characterized by low temperatures, relatively low pH and complex mixtures of organic and inorganic compounds. However, bacteria, fungi, yeast and protozoa not only survive in such media but some of them could also multiply and potentially modify the physical and chemical properties of clouds This is due mainly to their hygroscopic and ice nucleation properties that could affect the initial process of droplet and crystal formation. Secondly, micro-organisms can be considered as biocatalysts thereby transforming organic and inorganic compounds in cloud water (Amato et al. 2005).

In this study, the structure of the microbial population present in atmospheric water samples from clouds at the Puy de Dme (altitude 1465 m, Massif Central, France) is described (Amato et al. 2007). The total microflora was quantified by epifluorescence microscopy; ATP concentration was measured by an enzymatic method and culturable aerobic micro-organisms were isolated. Bacteria were identified by 16S rDNA sequencing and fungi by morphological criteria. Most of the isolated culturable micro-organisms, including 90 bacterial strains and more than 40 fungi and yeasts, are described here for the first time in atmospheric water. Many bacterial strains have characteristics indicating that they are adapted to the extreme conditions found in cloud water: (1) most of them are psychrotolerant, as shown by their good growth at 15C, or even for some of them at 5C which is the average temperature in troposphere clouds at the Puy de Dme; (2) they generally have pigments (or are at least spore-forming), which are well-known to protect against cold and light exposure; (3) some bacterial strains are closely related to polar ones.

Twelve of these strains of fungi and bacteria, including Pseudomonas, Panteoa, Verticullum, Botrytis and Fusarium species, were tested for their ice nucleation activity by immersion freezing using the droplet freezing method. One bacterial strain of Pseudomonas synringae and one fungal strain of Fusarium avenaceum showed very high activities (ice-forming nuclei temperatures of -6C and -3C respectively).

In conclusion the presence of ice nucleation active microorganisms in cloud water suggests that microorganisms could play an active role in controlling the physical properties of atmospheric waters.

P. AMATO, M. MENAGER, M. SANCELME, P. LAJ, G. MAILHOT, A.-M. DELORT. Atmosph. Environ., 2005, 39, 4143-4153.

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