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Bacteriophages on the cheese surface: what diversity and what ecological role?

Eric Dugat-Bony¹, Thomas Paillet¹, Julien Lossouarn², Marie-Agnès Petit², Stéphane Chaillou²

¹Université Paris-Saclay, INRAE, AgroParisTech, UMR SayFood, F-78850, Thiverval-Grignon, France

²Université Paris-Saclay, INRAE, AgroParisTech, Micalis Institute, F-78352, Jouy-en-Josas, France

Bacteriophages (bacterial viruses) are always present in microbial ecosystems and contribute to their functioning by regulating the population structure through predation and cell lysis. Regarding the cheese microbial ecosystem, research efforts have essentially focused on phages infecting lactic acid bacteria (LAB), thereby generating informations about their genomic, biology and ecology. Cheese surface host a complex microbiota where many microorganisms - including yeasts, filamentous fungi, Actinobacteria and Proteobacteria - coexist with LAB, contributing to the overall quality of the products.

We hypothesize that 1) the phage diversity is at least as important as the bacterial diversity on the cheese surface, and 2) phages constitute an ecological factor affecting the stability and functioning of the cheese microbial ecosystem.

We first develop a protocol for extracting viral particles from the cheese surface and used it to produce the first viral metagenome from this ecosystem, using Epoisses cheese as example. With more than one hundred distinct contigs, most of which consisting of complete phage genomes, this study highlighted the high diversity of the cheese viral community.

A central composite design was next carried out to allow variations of two abiotic parameters, namely temperature and oxygen level, during the ripening of Epoisses cheese. This design was chosen with the purpose to induce changes in microbial populations and hence in the co-evolving viral populations. Correlation analysis between metagenetic profiles of microbial populations and the metavirome enable to characterize bacterial/phages co-abundance or co-exclusion and to model the response of these relationships according to the ripening parameters.

Several phage-host couples were isolated from the Epoisses cheese surface and characterized, confirming that active phages occur in this environment.

Collectively, our results confirm the presence of diverse viral communities on the cheese surface and provide the first stones suggesting an active ecological role of those entities in this ecosystem.