

Avancées récentes sur la production et la stabilisation de bactéries lactiques à haute fonctionnalité

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From ancient times, lactic acid bacteria (LAB) have been used for preserving agricultural raw materials. Today LAB are of great importance for the food and biotechnology industry. They are widely used as starters for manufacturing food (e.g., yogurt, cheeses, fermented meats and vegetables) and probiotic products, as well as for green chemistry applications. The market of concentrated cultures (starters) is continuously growing, with an increase of 4-6% per year.

Before being used in industrial applications, starters are manufactured according to production (fermentation, concentration) and preservation (freezing, freeze-drying, and drying) techniques with the objective of maximizing their viability and their functionality following long-term storage. Freeze-drying is a commonly used technique for the long-term preservation of LAB due to its low storage and transportation costs compared with freezing. Preservation processes induce however different types of stress (thermal, osmotic, mechanical, oxidative), which can result in cell damage or death. Various approaches are proposed to help the bacteria to overcome such stresses: i) the addition of protective molecules before the stabilization process; ii) the selection of operating conditions such as freezing kinetics, product temperature during freeze-drying, final water content and storage conditions; iii) the preparation of bacterial cells during the fermentation process. Cell membrane is the primary site for freezing and drying injuries. Changing the fermentation conditions makes it possible to modulate the membrane properties, and thus the bacteria resistance. However, a large variability is observed within bacterial strains in terms of recovery of viability and functionality of freeze-dried bacteria and some promising strains still remain in cryogenic cabinets and wait for new solutions to be commercialized. Furthermore, the environmental footprint of the production process, which becomes a crucial concern, shall be accounted for. Environmental assessment revealed that freeze-drying, frozen storage and fermentation are the hotspots of the production system. The processes of starters production need thus to be completely revisited in order to propose original and innovative alternatives to companies and society.

We address here a review of promising complementary approaches for improving viability and functionality recovery of LAB starters while improving the sustainability of the system. Some of these approaches are investigated in the European project PREMIUM (RISE project, Preservation of micro-organisms by understanding the protective mechanisms of oligosaccharides). This four years multidisciplinary project aims at developing new strategies to preserve lactic acid bacteria from

laboratory to industrial scale. The innovative approaches of the project lay on: i) producing oligosaccharides of original composition for protecting cells; ii) developing novel preservation process based on encapsulation and iii) evaluating the environmental impact of the whole system of production and stabilization.