STUDY AND OPTIMISATION OF FREEZE-DRYING CYCLES OF MODEL PROBIOTIC STRAIN OF LACTOBACILLUS CASEI TYPE

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A particular interest is dedicated on probiotic's industrial production in various sectors such as food industry for the transformation of animal or vegetal raw materials into functional food and, more recently, in pharmaceutical industries.

Freeze-drying is recognized as the drying method which gives the bests results in terms of survival and dried powder quality, regardless of the thermal stresses generated by the freezing step. But this method has the major inconvenient to have the more expensive operating costs due to severe operating conditions (very low temperature and pressure). Nevertheless, there exist a great number of types of strain and subspecies with completely different behaviors and properties. This is why the conservation and stabilization of these fragile micro-organisms is a very hard task, more often solved by trial and error runs with few experimental data in the literature. That's why the goal of the project was to study and to validate a global optimization methodology allowing to control the main quality factors like the highest bacteria survival ratios after a long storage period and the costs of the freeze-drying process.
Our rational scientific approach was based on the experimental study, step by step, of the freeze-drying process (freezing, sublimation, desorption) to understand the complex impact of the numerous factors impacting the survival ratios of a model probiotic strain of lactobacillus caseï.
We have chosen a formulation matrix with lactose basis with or without a polymer, namely the polyvinylpyrrolidone. Our preliminary important work consisted in establishing the state diagram of our formulation (freezing and glassy transition curves). These are the key thermo dynamical data necessary to adjust the optimal sublimation and desorption parameters.
Firstly, we studied the freezing step which was suggested by few authors as the most lethal step. This is why we firstly investigated some freezing protocols (cooling's rate, nucleation temperature, annealing treatment) leading to the highest survival ratios.
Next, with the preselected formulation we investigated the sublimation step. The heat transfer coefficient was characterized by an overall heat transfer coefficient determined with pure water. In our very soft operating conditions.