Optimization of drying step for enzyme application: a heat sensitive ingredient

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Drying process can be used to stabilize heat sensitive ingredients like enzymes, probiotics bacteria… For these applications, freeze drying is often preferred. However, with more and more carbon footprint interest, drying alternatives must be developed or the formulation has to be optimized. This study proposes to answer these challenges by introducing other drying technologies and / or optimize the protective matrices formulation. To conduct this study, ?-galactosidase from Aspergillus oryzae was chosen. This enzyme degrades the lactose, and represents the best treatment for lactose intolerant people in food and pharmaceutical industries. This molecule was microencapsulated in different stabilizing matrices: maltodextrin, trehalose and skim milk. Two other drying technologies: conventional spray drying and electrostatic spray drying were investigated and showed low energy consumption compared to freeze drying.
Matrices and drying processes effects on ?-galactosidase activity were studied regarding lactose degradation. The reconstitution ability of all microparticles was also studied during 12-months storage at ambient temperature. A carbon footprint analysis was also conducted using a life cycle assessment.
The results show that the activity was mainly influenced by drying technology with lower stability for conventional spray drying. The enzyme activity was very efficiently preserved for 12 months in all matrices except for trehalose with conventional spray drying and skim milk with freeze drying. Nevertheless, the reconstitution ability of all microparticles was affected by both drying processes and matrices. This work allowed to define the best combination of drying process and matrix for powders preservation, considering ?-galactosidase properties and evaluating the capacity to response for reducing the carbon footprint.

Keywords: ?-galactosidase, electrostatic spray drying, spray drying, freeze drying, carbon foot print, reconstitution ability, storage stability.