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Comparative X-ray microtomography and SEM to investigate the encapsulating matrix of freeze-dried probiotics

Content

The health effects of probiotics are exerted by live and viable microorganisms delivered to their site of action in the intestine. Thus, formulating a probiotic product that ensures viable cells with long shelf life is one of the main challenges for the industry. A common way to enhance the shelf life is to freeze dry the probiotics with lyo-protectants, and a large research effort is directed towards finding the best lyo-protectant formulation and drying process. Unfortunately, there is almost no focus on how the structure of the freeze dried material can influence the shelf life. Traditional pharmaceutical formulations often demand elegant porous freeze dried cake without collapse. This kind of freeze dried materials often have thin walls and result in a poor encapsulation of the cells, which may be detrimental for the stability. The study to be presented aims at understanding how the formulation and drying process together influence the three-dimensional structure of the freeze-dried material and the cell encapsulation. X-ray micro tomography (μCT) is an excellent tool to study freeze-dried material, including the impact of various freeze-drying protocols, by generating a three-dimensional image, which can be used for further investigating quantitative 3D-parameters, e.g. the pore size, pore connectivity, wall thickness and tortuosity at a sub-micrometer resolution. Here, μCT is combined with Scanning Electron Microscopy (SEM) and analysis of the specific surface area to give a broader understanding of the structure development and how this is reflected in mass transfer resistance during drying and encapsulation of the bacterial cells.

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