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# EDITORIAL

# Freeze-drying: perceptions and challenges for drying foodstuffs and plant extracts

# La liofilización: percepciones y desafíos para el secado de productos alimenticios y extractos vegetales

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One of the most important features of foodstuffs and plant extract-based products is related to their fragile stability, especially when exposed to several ambient factors such as air, light radiation, heat and water vapour. The latter may contribute to the increase of free or bound water associated to the product. In this scenario, these variables may lead to different phenomena such as self-oxidation and hydrolysis of functional compounds and thus, a considerable inconsistency of products where these substances are part of occurs. On the other hand, these factors affect more drastically the product stability, especially when they possess a high intrinsic surface area and thus, are more likely to absorb a significant amount of water. Furthermore, in liquid products oxidation, hydrolysis and precipitation problems are more probable to happen. Nevertheless, the common methods for water removal by heat treatment cannot be used in this class of products. This is explained by the potential degradation and hence activity loss of their functional constituents. This phenomenon is even more critical when volatile compounds play a substantial role in the organoleptic properties of the finished product. Therefore, the water removal process results in a complex and expensive task that cannot be accomplished with conventional methodologies.

The above mentioned environmental factors have led to the search for alternative processes which support the isolation, manufacture and storage of this class of products under very specific and strict conditions. These processes include mainly freeze-drying, which is also known as lyophilization. Thus, freeze-drying corresponds to a process where water is removed through a phase transition known as sublimation. In this case, the thermodynamic direct transition from the solid to the gas phase occurs. For this reason, an intermediate transformation to the liquid phase is by-passed. Technically, water must be submitted to a very strict conditions of temperature and pressure; usually, below -20°C and less than 4.58 Torr (610.5 Pa), respectively. Under these conditions, equilibrium between the solid and gas phases takes place. Therefore, in this transition a low amount of heat flows spontaneously from the environment to the frozen product preventing the product from overheating and degradation. Nowadays, freeze-drying shows a great benefit for drying unstable materials since it increase their stability significantly. However, this process exhibits some drawbacks. First, the infrastructure required for the process is expensive and energy-consumption is considerable. On the other hand, a freeze-drier is difficult to operate and careful training must be taken into account for adequate standardization and validation of the drying process. Failure to follow these conditions leads to a high variability in the external morphology of the dried material. The freeze-drying conditions affect significantly the resulting product and hence, its subsequent processing and packaging. Therefore, it is imperative to control the morphological characteristics of the solids while employing this process.

The paradox of drying unstable and labile substances without affecting their functional properties is the choice for the optimal conditions in terms of cost and quality benefits. As a result, the production, development and storage conditions when these labile substances are included into finished products is eased, and help to fulfil their required quality requirements established by the regulatory agencies.

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