Application of physical and chemical pre-treatmens to improve quality and reduce energy consumption during freeze-drying of blueberries

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Freeze-drying is the best drying alternative to extend shelf-life while preserving bioactive properties of products. Interest in freeze-drying of blueberries is due to their high perishability, high content of bioactive compounds and relatively short harvest period.
Blueberries have high resistance to vapor transfer due to the structure of blueberry peel which is covered by a waxy layer. Because of this, blueberry freeze-drying is a slow and costly process. This high resistance also impacts quality of final product as internal vapor pressure variations during drying can cause structure collapse.
The aim of this work was to evaluate the impact of different physical and chemical pre-treatments in blueberry freeze-drying rate and bioactive compounds content.
Blueberries (c.v. Emerald) were obtained from a local producer and processed within 24 h from harvest. Five different pre-treatments were applied: cut in halves; dipping in dichloromethane; dipping in methanol; dipping in sodium hydroxide and dipping in sodium carbonate. Control sample consisted of non-treated blueberries. Each pre-treatment was performed in triplicate. The different blueberry samples were frozen (-20 ºC) and freeze-dried in a Virtis bench-top freeze dryer. Weigh loss throughout drying was measured every 24 h. Total freeze-drying time was considered when no weight change was observed in 24 h. Total monomeric anthocyanins and total phenolic compounds of control and pre-treated freeze-dried samples were determined. In order to evaluate structure damage after freeze-drying, rehydration test was carried on by dipping samples in water for 6 h and periodically weighting them.
Cut blueberries showed the lowest total freeze-drying time; 4 times less than control. Also, cut blueberries reached the lowest final total weight (14.8% of initial weight). Among the different chemical pre-treatments, sodium hydroxide showed the higher dehydration rate (half drying time compared with control). Dichloromethane samples showed the highest rehydration rate probably because the solvent acts on the superficial wax but does not penetrate, avoiding internal structural damage. No significant difference ($p<0.05$) of total phenolic or total monomeric anthocyanins content was observed among the different treated and non-treated samples.
Pre-treatments assayed in this study allowed to reduce freeze-drying time of blueberries while preserving bioactive compounds.