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Title: Drying of grape pomace by conventional and intermittent processes: mathematical modeling and effect on the phenolic content and antioxidant activity

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Abstract: During wine production a large amount of waste (grape pomace) is obtained corresponding to about 31.7 kilograms per 100 liters produced [1]. This material is considered a rich source of bioactive compounds and therefore is of interest for several industries. However, grape pomace is susceptible to microbial degradation due to its high moisture content, thus drying is frequently considered an essential process for grape pomace conservation and stabilization [2]. Drying allows for a better conservation, easier storage due to a lower volume and improves product stability. However drying conditions such as temperature and time may affect grape pomace bioactive potential. As drying represents a high energy consumption, an alternative for reducing the energy costs is the use of intermittent operation, which operates with transient inputs of air conditions, such as the supply temperature. Intermittent drying, in addition to promoting lower energy consumption, also enables less damage to heat-sensitive materials. Thus, in the present work modeling of the drying process of grape skins from red wine grape pomace was performed at temperatures of 40 °C, 55 °C and 70 °C, both for drying in the conventional and in the intermittent mode, with tempering periods of 5 and 10 minutes. Moreover, total phenolic compounds, total flavonoids and antioxidant activity (DPPH and reducing power assays) were determined by spectrophotometric methods before and after the drying process at the proposed conditions.

Modeling results for conventional operation showed that, among the 8 models tested for the conventional drying, the one that best suited the experimental data was the Approximation of diffusion model. For the intermittent drying operation, equations were deduced based on mass and energy balance that led to a fit with a maximum global deviation of 10% in comparison to experimental data. After extracting the same amount of sample (fresh and after different drying processes) with hydroethanolic solution (80%, v/v), results expressed in dry basis of grape pomace samples showed that conventional drying had the highest impact on lowering the content of bioactive compounds and antioxidant activity. Among the drying conditions assayed, the one that allowed maintaining the highest amounts of bioactive compounds was the 5 min of tempering period performed at 40 ºC, corresponding to a loss of 20.6% and 14.5% total phenolic compounds and total flavonoids, respectively, when compared to the grape pomace sample before drying (162 mg gallic acid equivalents/g pomace, dry weight and 82 mg catechin equivalents/g pomace, d.w.).

The present work showed that intermittent drying can provide grape pomace samples with higher content of bioactive compounds and higher antioxidant activity when compared to conventional drying performed at the same temperature. Moreover, it provided information regarding the application of mathematical modeling to grape pomace drying showing that these models can be applied to drying optimization studies.

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Keywords: intermittent drying, modeling, grape pomace, by-products valorization

References

[1] Beres, C., Costa, G.N.S, Cabezudo, I., James, N.K., Teles, A.S.C., Cruz, A.P.G., Silva, C.M., et al. Waste Manage, 68 (2017) 581-584.

[2] Carmona-Jiménez, Y., García-Moreno, M.V., & García-Barroso, C. Plant Foods Hum. Nutr., 73 (2018) 74-81.