Intermittent drying of walnuts: evaluations of warm air consumption on a thin layer

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**Abstract.** Walnuts trade standards require a maximum moisture of the 8% (w/w) to protect the commercialized fruits during their shelf-life. At harvest walnuts moisture usually exceed that threshold and consequently the fruits have to be dried. Dryiers use warm air at 38-40°C to remove the water from walnuts. During drying, the water migrates by diffusion from the inner to the outer parts of the fruits before its transfer to the warm air. However, the diffusion phenomena are slow and only a small amount of water is actually in contact with the warm air flow, resulting in a poor efficiency of the use of the heat in the warm air. The intermittent drying was developed with the aim of improve the efficiency in the use of heat. It alternates periods when warm air is driven to fruits, with tempering periods allowing the water to diffuse to the fruit surface. The aim of the work is to test if the intermittency in walnuts drying could provide advantages in the use of warm air and quantify them.

Two trials were carried out al laboratory scale. In trial1 two different batches of in-shell walnuts were dried continuously, and at two different frequencies of intermittency (i.e., 30 min and 60 min). In trial2, two batches of walnuts were dried continuously and with 30 min intermittency as in-shell and shelled walnuts, for a total of 4 treatments in each replicate. Walnuts were dried at 38 °C in thin layers in both trials. Dring kinetics were followed by monitoring the weight loss of the fruits up to the 8 % (w/w) moisture as required by the trade standard. In trial1 the walnuts continuously dried were the faster to reach the 8% humidity. However, in the 2 intermittent drying methods the heated air was used for the 50% of the time. Thus, intermittent drying allowed to decrease the use of heated air. The more pronounced decrease was found in 30 min intermittent drying, reducing the use of heat air of the 30%, while a reduction of the 25% was achieved with 60 min intermittency. Trial2 confirmed the results obtained in trial1 for in-shell walnuts. Moreover, the continuously heated walnut batches were the faster to reach the commercial humidity, but the 30 min intermittency allowed to save the 32% of heated air. Considering shelled walnuts, continuously dried fruits were the faster to reach the commercial moisture, and intermittent drying allowed to save the 36% of time using heat air.

In conclusion, intermittency in walnuts drying could decrease the use of heat air of the process, and consequently it could improve process sustainability, by decreasing the use of warm air of roughly the 30-35%. Further improvement in the process sustainability could be achieved through the optimization of the intermittency conditions.