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6 **REAL-TIME MONITORING OF ORGANIC APPLE (VAR. *GALA*) DURING HOT-AIR**  
7 **DRYING USING NEAR-INFRARED SPECTROSCOPY**

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18 **ABSTRACT**

19 Dried apple (*Malus domestica* B.) shows a growing trend to its worldwide consumption as raw  
20 material to produce organic snacks, integral breakfast foods, chips, etc. Apple is often dried by  
21 conventional methods (e.g. hot-air drying, freeze-drying, etc.), which are usually uncontrolled and  
22 then prone to product quality deterioration. Thus, there is a need for the development of new drying  
23 systems able to guarantee high-value end products. In this study, the feasibility of NIR spectroscopy  
24 as smart drying technology to non-destructively detect and monitor physicochemical changes in  
25 organic apples wedges during 8-h hot-air drying at 60°C has been investigated. Moreover, the impact  
26 of microwave heating pre-treatment (at 850W for 45 sec) as enzyme inactivators on model  
27 performances was also evaluated. Partial least squares (PLS) regression models were successfully

28 developed to monitor changes in water activity ( $R^2 = 0.97\div 0.98$ ), moisture content ( $R^2 = 0.97\div 0.98$ ),  
29 SSC ( $R^2 = 0.96\div 0.97$ ) and chroma ( $R^2 = 0.77\div 0.86$ ) during drying. Classification analysis was  
30 performed for the development of discriminant models able to recognise dehydration phases of apple  
31 wedges on the basis of their spectral profile. The classification models were computed using K-means  
32 and Partial Least Squares Discriminant Analysis (PLS-DA) algorithms in sequence. The performance  
33 of each PLS-DA model was defined based on its accuracy, sensitivity and specificity rates. All of the  
34 selected models provided a very-good ( $>0.90$ ) or excellent ( $>0.95$ ) sensitivity and specificity for the  
35 predefined drying phases. Feature selection procedures allowed to obtain both regression and  
36 classification models with performances very similar to models computed from the full spectrum.  
37 Results suggest that effect of microwave heating on both water loss and microstructure of apple tissue  
38 was pronounced, mainly affecting the features selection procedure in terms of selected wavelengths.

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40 **Keywords:** *Malus domestica* B., smart drying, apple wedges, convective air drying, chemometrics,  
41 feature selection

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