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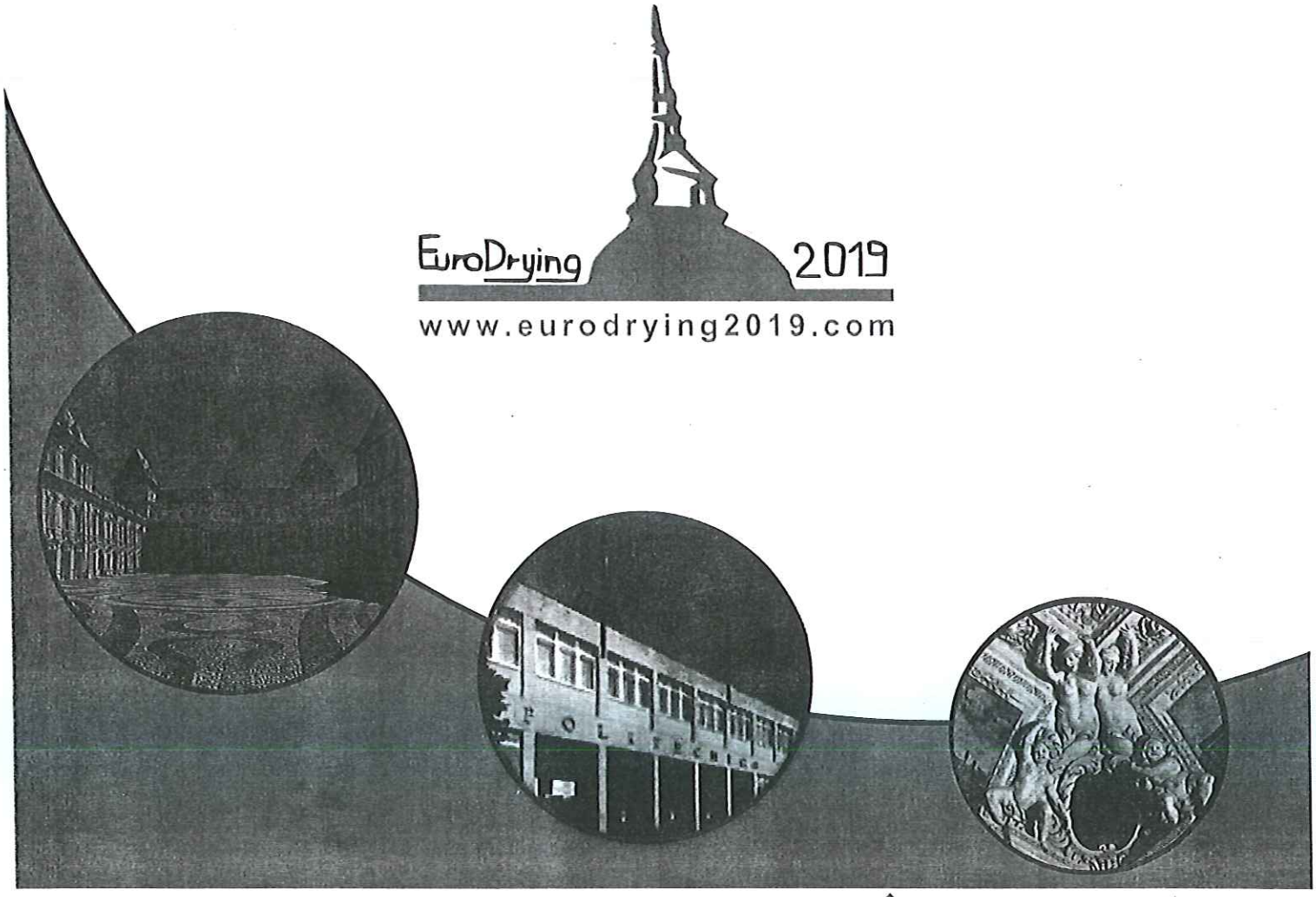

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EFFECT OF DRYNG CONDITIONS AND STORAGE TIME ON COMPOSITIONAL AND SENSORY CHARACTERISTICS OF UNSHELLED HAZELNUTS

Manuela Giordano[1], Daniela Ghirardello[1], Marta Bertolino[1], Monica Locatelli[2], Davide Bardone[3], Giuseppe Zeppa[1]

[1]Department of Agriculture, Forest and Food Sciences (DISAFA), University of Turin, Grugliasco (TO), Italy; [2]Dipartimento di Scienze del Farmaco, Università degli Studi del Piemonte Orientale, Novara, Italy; [3]AizoOn Technology Consulting, Turin, Italy

Abstract
The aim of the work was to assess the effect of different drying conditions and storage time on raw unshelled Tonda Gentile Romana hazelnuts (harvest 2017). Drying was conducted with a laboratory desiccator at 20, 30, and 40 °C, applying two air circulation velocity until the moisture content of samples was lower than 6%. The oxidation state of the lipid fraction and volatile profile of hazelnuts were studied during 12 months of storage. In addition, sensory analysis was performed among samples.

***Keywords**: hazelnut, drying, shelf-life, oxidation index, volatile compounds*

1. Introduction

Fresh unshelled hazelnuts must be dried immediately after harvest in order to have a moisture content lower than 6% (w/w) (USDA 2016) and a water activity lower than 0.70 at 25°C (FDA 2018) in order to reduce lipid oxidation (Ghirardello *et al.* 2013) and microbiological activity. Since different drying techniques could be used the aim of this study was to assess the effects of three drying temperatures and two air fluxes on lipid oxidation, volatile composition and sensory profile of raw unshelled Tonda Gentile Romana (TGR) hazelnuts during 12 months of storage.

2. Material and method

2.1 Hazelnut samples

Unshelled raw hazelnuts of TGR variety, harvested in Italy in 2017, were dried by Soremartec Srl (Alba, CN, Italy) with a pilot plant at 20, 30 and 40 °C applying two fluxes of air (v_1 and v_2 where $v_1<v_2$) until the moisture content was about 6%. The hazelnuts storage was performed for 12 months at 20 °C in vacuum-sealed aluminium bags until analyses were performed (0, 6 and 12 months).

2.2 Chemical analyses

Hazelnuts were milled with a laboratory mill and the obtained powders (size<500 μm) were used for the evaluation of moisture with a thermobalance Eurotherm (Gibertini, Milano, Italy), water activity with an Aqualab Pre (METTLER Group, USA) and volatile components with a gas chromatograph/mass spectrometer working in SPME-GC-MS mode. An oxidation test was performed with an Oxytest (Velp Scientific, Usmate Velate, MB, Italy) while the volatile profile was defined with an electronic nose Pen 3 (Airsens Analytics, Schwerin, Germany). Hazelnut oil was extracted with a cold-press system and the obtained oil was stored at -18 °C before analyses. Peroxide value and total acidy of oils were determined with a FoodLab system (CDR srl, Firenze, Italy). Colour of external and internal kernels were evaluated with a CM-5 spectrophotometer (Konica Minolta, Milano, Italy) and reported as CIELab values.

2.3 Sensory analysis

A descriptive sensory analyses was performed with a group of 20 trained panellists (15 male, five female, 25–35 years old). Sixteen descriptors were used and quantified with a five point scale (1-very low; 5-very intense).

2.4 Statistical analysis

Variance analysis with Duncan test ($p<0.05$) for each factor (storage time and drying conditions) was performed with STATISTICA ver. 13 software (StatSoft Inc, USA).

3. Results and discussion

For a large number of chemical and sensory parameters, the variance analyses showed significant differences due to storage times and drying conditions. The Odour intensity generally increases during the storage with a maximum at 6 months but there is not an increment on the Rancidity odour. There are instead increments for Woody and Vegetable odour/aroma. The inibition period, evaluated with the Oxitest, change during the storage with the lower values at 12 months of storage. In addition significant differences were highlighted among the drying procedure for each storage time. While colour of the internal kernel was not influenced by storage times and drying methods, the colour of the external kernel change during the storage time. In particular for all the drying methods there was an increment of L and a* and a decrement for b* values. Then during the storage there was a darkening of colour with more red tone. Among the volatile compounds very important were the linear C_6 alcohol (1-hexanol) and the linear aldehydes and ketones. These compounds are known as markers to the lipid oxidation with green, vegetable and fatty odours. During the storage time these compounds significantly increased with an evolution similar to peroxides (Table 1). Generally the drying performed using the highest air flux showed the highest values for volatile compounds correlated to oxidation.

Table 1. Mean value of peroxides (P- meq O_2/kg) and octanal (O-ppb) and results of variance analysis with Duncan test performed for each drying method and time

	Drying methods											
	20°C/v_1		20°C/v_2		30°C/v_1		30°C/v_2		40°C/v_1		40°C/v_2	
Months	P	O	P	O	P	O	P	O	P	O	P	O
0	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
6	0.13	43	0.11	27	0.37	12	0.13	26	0.18	30	0.19	50
12	0.40	61	0.36	77	0.65	70	0.35	47	0.37	63	0.52	83
Signif.	***	***	***	***	***	***	***	***	***	***	***	***

*nd-not detected; ***p<0.001*

4. Conclusions

Although it is necessary to confirm the obtained data with other tests, this experiment confirm that the drying conditions are very important for the chemical and sensory quality of hazelnut. In particular the lipid oxidation is lower using a low drying temperature (20 °C) and a high flux of air.

5. References

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