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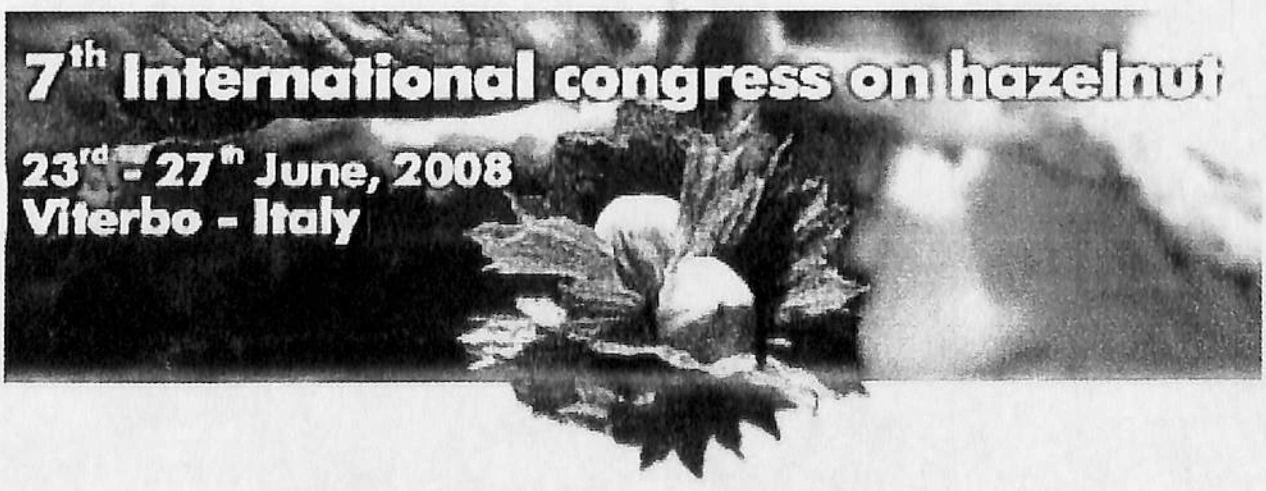
7° CONGRESSO INTERNAZIONALE SUL NOCCIOLO



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Photographs on the front:

1	2
3	4
5	6

1. Landscape of the Monti Cimini hazelnut area (courtesy of S. Gasbarra).
2. Hazelnut in vitro propagation (courtesy of L. Bacchetta).
3. Typical hazelnut orchard in Viterbo area (courtesy of V. Cristofori).
4. Hazelnut harvesting machines (coutesy of D. Monarca).
5. Hazelnut dieback (courtesy of L. Varvaro).
6. Industry hazelnut products (Courtesy of Stelliferi & Itavex Spa).

Quality and Nutritional Properties of Hazelnut (*Corylus avellana* L.) Oil and Defatted Flours

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Keywords: hazelnut oil, defatted flours, nutritional properties, quality

Abstract

The aim of this study was the characterization of some samples of partially - defatted hazelnut (*Corylus avellana* L.) flours and the cold-pressed hazelnut oils. The partially-defatted hazelnut flours (from un-roasted and roasted seeds) showed interesting nutritional properties, particularly concerning branched amino acid composition (1.67, 2.45 and 1.31 g/100 g, for valine, leucine and isoleucine respectively, high roasted flour, fresh weight). Glutamic acid was the main amino acid recovered both in un-roasted and roasted flours. The trend of acidification and peroxidation of flours during the shelf life (evaluated up to 6 months) showed that these products are quite stable if stored at room temperature (25°C) in the dark. The oil composition confirmed a strong impact of roasting practice on the vitamins fraction; alfa-tocopherol content showed a decrease of 19.5% after roasting.

We suggest improving the use of hazelnut-related products, because of their significant nutritional properties. Moreover, we highlight that roasting practices can decrease the content of some bioactive nutritional compounds, like tocopherols.

INTRODUCTION

Hazelnut oil and partially-defatted flours from *C. avellana* seeds are two interesting products, from nutritional and technological points of view. These products are not largely commercialized; despite the comprehensive knowledge about the chemical composition of hazelnut oil. The chemical characteristics of totally - or partially - defatted hazelnut flours have not previously been investigated apart from in the cv. 'Tonda Gentile delle Langhe'. The shelf-life of hazelnut flours is strictly correlated with the acidification/peroxidation of the residual fat content. In fact, the roasting process can strongly influence the quality and the stability of hazelnut seeds (as well as of flours after pressing) during their shelf-life, particularly concerning the peroxidation of the lipid fraction. Different binomial time-temperature programs lead to different impacts on hazelnut products.

The aim of this work was to investigate the chemical and nutritional properties of some samples of partially defatted hazelnut flours - and the relative cold - pressed oils - also to study the changes in chemical composition during their shelf-life, using simulated preservation of samples in the dark at 25°C.

All the samples were obtained from seeds of cv. 'Tonda Gentile delle Langhe', using a pilot plant with cold pressing technology. The effect of two different roasting temperatures (high and low roasting) was also studied.

MATERIALS AND METHODS

Two samples of 'Tonda Gentile delle Langhe' hazelnut (harvested in 2006, from Piedmont, Italy) were roasted in a conventional oven using different conditions: 180°C, 10 min (low roasting degree) and 180°C, 20 min (high roasting degree). A third un-roasted sample of 'TGDL' hazelnuts was also analysed.

The hazelnut oil, obtained by cold-pressing extraction, was filtered and preserved at 10°C in the dark under vacuum until the samples were analysed. The partially-defatted flours were preserved under the same conditions.

The amino acidic profile was obtained according to Alonso et al. (1994).

Atomic Absorption Spectrometry (AAS) was performed according to Brandolini et al. (2005).

Moisture, ash, fat and protein were determined according to AOAC methods (AOAC, 1996). Acidity, peroxide number and chemical composition of oil were determined following the European official methods for olive oil analysis.

The radical scavenging activity was measured using the DPPH• assay (Brand-Williams, 1995). The results were expressed as inhibition percentage (I%) of the DPPH radical.

SDS-PAGE was performed following the method proposed by Laemmli (1970), using a Mini Protean III Dual Slab Cell apparatus (Bio-Rad Laboratories S.r.l., Segrate, Italy). The gels were stained with Coomassie Blue R-250.

RESULTS AND DISCUSSION

Concerning the composition of the oil samples, two different roasting degrees were evaluated. The compositions of oils from roasted hazelnuts were compared with those typical of the oil obtained from un-roasted hazelnuts. The oil compositions (Table 1) were not significantly different in their content of fatty acids or sterols; the data obtained are in accord with the literature (Crews et al., 2005). The roasting process was confirmed to have a significant impact on the tocopherols fraction; beta plus gamma - tocopherols (unresolved using the chromatographic method used in this study) showed a decrease from 2.47 mg/100 g (oil from raw seeds) to traces. Alfa-tocopherol decreased up to 19.5% in the oil sample from the seeds roasted at the higher temperature.

Different samples of partially-defatted hazelnut flours analyzed in this study showed high variability in fat content (ranging from about 10 to 30%); this fact is probably due to the natural variability of the extraction yield, using the cold pressing method (Table 2). This fact could probably be considered the major problem affecting the quality and the stability of the samples during preservation.

The flours showed an amino acidic profile very similar to those of un-roasted seeds. An interesting amount of branched-chain amino acids was present, also in roasted flours (1.67, 2.45 and 1.31 g/100 g for valine, leucine and isoleucine respectively). These values are in accord with data from the literature on hazelnut from different cultivars and production areas (Tombul, Turkey) (Alasalvar et al., 2003; Koksal et al., 2006). Some chemical and nutritional properties of the flours were also evaluated after six months of preservation in the dark, at room temperature (25°C).

Concerning the quality of a partially-defatted hazelnut flour during the shelf-life (approximate composition of flour samples in starting conditions: 30% proteins, 31% fats, 9% moisture), it is worth noting that there was a slight increase in acidity (expressed as % of oleic acid) from 0.92 (after one month at 25°C in the dark) to 3.15% (six months). Conversely, the sample did not show a significant increase in the peroxide number, confirming a secondary role for the oxidation phenomenon. The antioxidant activity during the shelf-life period showed a constant decrease (95.98 after one month; 62.45 after six months in un-roasted samples). All roasted flours showed a strong decrease of antioxidant activity, if compared with corresponding un-roasted ones (70.25%, -62.76% and 63.19% respectively after one, three and six months of shelf-life). The protein electrophoretic fingerprints (Fig. 1) were the same ones at different times, excluding a significant proteolytic activity - or denaturation - during the preservation. This fact confirms the stability of the proteins in hazelnuts flours during their shelf-life, differently to what was observed for the polyphenols and the lipid fraction.

CONCLUSIONS

The nutritional quality of partially-defatted hazelnut flour, when used as a food ingredient to flavour bakery products, is characterised by a low-fat and/or highunsaturated fatty acid profile. The roasting process is a crucial factor influencing the nutritional quality of hazelnut flours, as confirmed by previous studies. The nutritional properties of hazelnut oil are strictly related to the presence of bioactive sterols and tocopherols; roasting temperature has a critical effect on these and therefore the quality of the product.

Considering the low-roasted sample, the oil result was quite similar to those obtained from un-roasted hazelnuts. The use of hazelnut oil in food - as well as in cosmetics - should be encouraged in the future, considering its significant nutritional characteristics.

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Tables

Table 1. Composition of hazelnut oils obtained after different roasting processes. Data are mean of two different analyses.

		Unroasted	Low-roasting	High-roasting
Peroxide number		-	2.22	4.22
Acidity	(% Oleic acid)	0.24	0.19	0.26
Rancimat		9.40	7.65	9.10
Fatty acids (FAME)	(%)			
	Palmitic acid	6.72	6.84	6.73
	Palmitoleic acid	0.39	0.38	0.38
	Heptadecanoic acid	-	0.05	0.05
	Heptadecenoic acid	0.06	0.06	0.07
	Stearic acid	2.60	2.68	2.62
	Oleic acid	81.57	82.28	81.85
	Linoleic acid	8.26	7.32	7.91
	Linolenic acid	0.10	0.09	0.10
	Arachidic acid	0.16	0.15	0.15
	Eicosenoic acid	0.14	0.14	0.13
Sterols	(%)			
	Cholesterol	0.14	0.11	0.18
	24-methylencholesterol	0.30	0.12	0.05
	Campesterol	3.30	3.41	3.63
	Campestanol	0.23	0.21	0.22
	Stigmasterol	1.28	1.18	1.23
	α-7-campesterol	0.26	0.49	0.25
	Δ-5,23-stigmastadienol	0.41	0.45	0.50
	Clerosterol	0.65	0.69	0.60
	β-sitosterol	76.5	75.7	76.7
	Sitostanol	2.59	2.33	2.49
	Δ-5-avenasterol	7.94	8.27	8.03
	Δ-7,9,(11)-stigmastadienol	1.09	1.15	0.77
	Δ-5,24-stigmastadienol	0.55	0.72	0.80
	Δ-7-stigmastenol	2.65	2.85	2.54
	Δ-7-avenasterol	2.09	2.16	1.98
Tocopherols	(mg/100 g)			
	α-tocopherol	33.9	35.6	27.3
	β and γ-tocopherol	2.47	-	-
	Δ-tocopherol	-	-	-
	α-tocopherol acetate	-	-	-

Table 2. Composition of hazelnut flour obtained after different roasting processes. Data are mean of two different analyses.

	Unroasted	Low-roasting	High-roasting
Energy (kJ)	1349	1904	1703
(kCal)	320	457	407
Proteins (N_{tot} x 6.25)	32.20	39.60	38.00
Fat (%)	9.86	25.30	14.10
Carbohydrates (%)	25.70	4.94	19.10
Fibre (%)	20.70	20.70	20.70
Moisture (%)	6.03	4.69	2.38
Ashes (%)	5.56	4.77	5.75
Phosphorus (%)	0.78	0.68	0.77
Potassium (%)	1.78	1.44	1.86
Iron (mg / 100 g)	6.83	5.92	7.20
Calcium (%)	0.41	0.36	0.38
Sodium (%)	1.76	0.64	2.34
Magnesium (%)	0.37	0.31	0.36
Aspartic acid	3.28	3.36	3.88
Glutamic acid	8.81	9.11	10.50
Alanine	1.92	2.10	2.33
Arginine	4.17	4.14	4.65
Phenylalanine	1.35	1.33	1.61
Glycine	1.49	1.54	1.79
Hydroxyproline	0.13	0.18	0.13
Isoleucine	1.11	1.10	1.31
Histidine	0.57	0.53	0.66
Leucine	2.07	2.08	2.45
Lysine	0.95	0.96	0.96
Proline	1.18	1.17	1.41
Serine	1.50	1.64	1.90
Tyrosine	0.84	0.89	1.05
Threonine	0.99	1.04	1.19
Valine	1.42	1.47	1.67
Cystein and Cystin	0.62	0.54	0.69
Methionin	0.40	0.36	0.43
Tryptophan	0.35	0.30	0.36

Figures

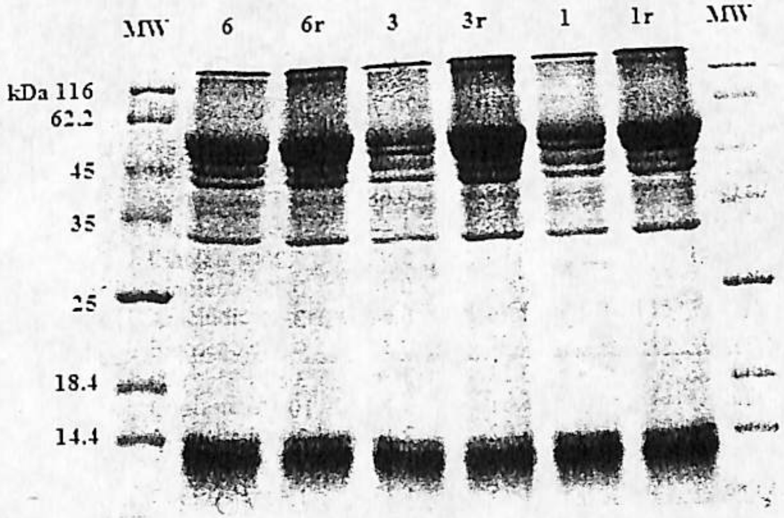

Fig. 1. SDS-PAGE of proteins (extracted with NaCl 0,5 M) from hazelnut flours. 6: Raw hazelnut flour (shelf life six months); 6r: roasted hazelnut flour (shelf life six months); 3: Raw hazelnut flour (shelf life three months); 3r: Roasted hazelnut flour (shelf life three months); 1: Raw hazelnut flour (shelf life one month); 1r: Roasted hazelnut flour (shelf life one month). MW: Molecular Weight.