Composition of Hazelnuts (*Corylus Avellana* L.) Grown in Albania

Agriculture

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Abstract

Located in the Western Balkan, Albaniais characterized by a Mediterranean climate, which is present in most of its territory. Its geography imposes the possibility of cultivating nuts, showing economic interest in agriculture. The hazelnuts (Corylus avelana L.) in the national subsidy scheme, currently under implementation, are showing high interest in increasing the cultivated nuts' plantation area. Beyond the economic interest, nuts show a high scientific interest due to their significant contribution to the Mediterranean Diet and their nutritional benefits, such as being an essential source of polyunsaturated fatty acids and essential minerals. Preliminary studies on the main constituents from the two hazelnut cultivars, Visoka and Tonda romana cv., were conducted in two selected regions during the 2011harvesting year. The fatty acid analysis used the AOAC (2000) method. The chemical characterization indicated that the main constituent in the dried hazelnuts results in triglycerides of 59.9- 61.02 g/100 g dry weight. The protein content varies from 14.25-15.14g/100g, and carbohydrates vary from 18.21-20.55 g/100 g dry-weight hazelnut. Minerals with higher values resulted in potassium of 907 mg100g-1 and calcium of 190.5 mg 100g-1. Iron, manganese, magnesium, and copper were other minerals of nutritional importance.

Introduction

Since prehistoric civilization, hazelnuts (Corylus avellana L.) have been consumed as fruit worldwide for a long time. It is an endemic bush in many Mediterranean countries. In Albania, until 1990, the annual domestic production was calculated to reach 100-ton hazelnuts and concentrated in the Visoka locality, Mallakastra region. Statistics from the 2011 harvesting season, show that the production has increased to 184 tons. It is mainly consumed as unprocessed fruit and in minor part to the confection industry (Rama et al., 2011). Along with olive, nuts constitute Albanian horticulture's most important plant trees (Topi and Thomaj, 2012; Topi et al., 2012).

The imports are calculated to be 18 tons (DSA, 2007). In modern times, it is used as a processed ingredient in chocolates and other sweets. The principal constituents of hazelnuts are fatty acids (FA). The profile mainly comprises unsaturated FA, 50–73% (Garcia et al. 1994). Chemical analyses show that other secondary constituents are phytosterols (Amaral et al. 2006a), phenolic compounds, and other antioxidants. This compound is supposed to control other cardiovascular diseases, such as blood hypertension (Alasalvar et al. 2006), or control cholesterol levels in the blood (Plat and Mensink 2001). Other secondary constituents are vitamins, α-tocopherols (Amaral et al. 2006), organic acids, and fibers (Botta et al. 1994; Alasalvar et al.

2006). Recently, is reported that hazelnut extracts show antimicrobial activity against gram-positive bacteria (Oliviera et al. 2008).

Several scientific studies have presented results on the mineral content and vitamins that may have been indicated by geographical factors (Dunar and Altundag 2004a; Amaral et al. 2006 b, c). Studies have confirmed that geography, climate, irrigation and fertilization practices, and the harvesting period following the ripening stage influence mineral content in hazelnuts. Minimal data on the chemical composition exists in the Corylus avellana L cultivated in Albania (Osmani-Lataj et al., 2011). Biochemical composition and nutritive values have been the aim of this study. Two different regions, Mallakastra and Fushekruja, were selected for that study.

The consumption of the nuts group is >1kg/person, which is very low compared to the EU countries. In that aspect, there is an excellent possibility of ensuring sustainable development of agriculture by adding the cultivation of Corylus avellana L. in the hilly regions of the country.

Material and Methods

Plant Material

Seeds of two hazelnut cultivars were harvested during their ripening stage from the harvesting season 2010-2011, from Visoka plantations, Mallakastra District. The plantation in the study was a 0.5 ha area, had an altitude of 150m above sea level, and a Geographic Latitude of 40' 36". The samples were stored with husk until the conduction of the chemical analysis.

Analytical Methods

Total fat was extracted by Soxhlet at 600C per 6 hours, and n-hexane was employed as solvent. The hazelnut oil produced was kept at 40C in a dark place until GC analysis. The fatty acids were analyzed as Fatty Acid Methyl Esters (FAME). The equipment employed was GC-FID (ThermoQuest, 2000) with a capillary column (23.3m x 0.25mm x 25 μm) according to the AOCS methods (AOCS, 1990). The total ash was calculated according to Koksal et al. (2006).

Minerals were analyzed using a spectrophotometer of atomic absorption (Varian Spectr AA – 400Plus). The phosphor was analyzed as phosphomolybdic vanadium, according to James (1995), by Spectrophotometer. The chemical analyses were conducted four weeks after harvesting of the samples.

Statistical Analysis

The studied samples were taken during harvesting (2010- 2011). Chemical analyses were conducted in three parallel samples from both cultivars. Each sample was of 100 seeds. Data were presented as Mean value ±StDev. Statistical analysis was conducted by Minitab Statistical software (MINITAB INC. 814-238-3280).

Results and Discussions

Chemical composition

The proximate composition of the studied cultivars was analyzed in the harvested nuts. As may be evident, the main constituent, the fat, resulted in values in the interval of 59.9 to 61.02 g/100 g. The statistical analyses revealed similarities to the cultivars regarding the fat content. The same conclusions from statistical analysis are drawn regarding carbohydrates and proteins.

Table 1: The proximate composition of the Tonda Romana and Visoka cultivars after harvesting

Composition	Tonda romana cv.	Visoka cv.
Protein	14.25±1.75	15.14±0.94
Fat	59.89±3.23	61.02±4.65
Carbohydrates	20.55±1.40	18.21±2.13
Ash	2.15±0.18	2.45±0.28

Data of one year of harvested nuts (n=3) on a dry weight basis. The carbohydrates were calculated by subtracting the proteins , fats, and ash values by 100 g.

Fatty acid composition

The total fat content was analyzed in both cultivars, resulting in around 60%. The Visoka cultivar resulted in 61.02%, not too different from Tonda Romana cv. (59.89%). Were identified several fatty acids were most important were six FA. Oleic acid was the most abundant by 80.01%, and others, respectively, presented in Table 2. The results on both cultivars present significative differences for five of FA, except the palmitoleic acid ($P \leq 0.05$) (Tabela 2). The palmitic acid vary from 4.36% (Tonda romana) to 5.95% (Visoka), while palmitoleic acid varied from 0.37% (Tonto romana) to 0.43% (Visoka). The linoleic acid content exceeded “Tonda romana” by 14.71%.

Table 2: Fatty acid content of hazelnut varieties

	Visoka	Tonda Romana	Mean	StDev
Fatty acid				
Palmitic	5.95	4.36	5.16	1.12
Palmitoleic	0.43	0.37	0.40	0.04
Stearic	1.62	2.17	1.90	0.39
Oleic	80.01	78.31	79.16	1.20
Linoleic	11.93	14.71	13.32	1.97
Linolenic	0.06	0.075	0.07	0.01
Total fat	61.02	59.89	60.46	0.80
SFA	7.57	6.53	7.05	0.74
PUFA	11.99	14.79	13.39	1.98
UFA	92.43	93.47	92.95	0.73
UFA/SFA	12.21	14.31	13.26	
PUFA/SFA	1.20	0.97	1.08	

SFA, Saturated Fatty Acid (C16:0+C18:0); PUFA, Polyunsaturated Fatty Acid (C18:2+C18:3); UFA, Unsaturated Fatty Acid (C16:1+C18:1+C18:2+C18:3).

The palmitoleic and Stearic acids had values similar to those of eastern regions of the Mediterranean Sea (Köksal et al. 2006). In our study, the stearic acid content (1.90%) was similar compared to region data (2.01%). Oliviera et al. (2008) reported that the mean values of Stearic acid were 1.80% for these cultivars. Oleic acid content is 80.01%, higher than the results published by Köksal et al. (2006) for cultivars of the Black Sea (79.58%). Our results on oleic acid for cultivars Visoka and Tonda Romana differ slightly from those of (Köksal et al. 2006). The mean value of linoleic acid (13.32%) was higher than that reported by Köksal et al. (2006), which was a value of 13.0% LA. Based on the data, the results of FA are attributed mainly to geography. However, the differences in the FA profiles are not significantly different.

Mineral analytical analysis

Ash content was significantly high, respectively 2.45±0.28% (Visoka) and 2.15±0.18% (Tonda Romana), with a mean value of 1.94% ($P \leq 0.02$) (Table 1). The minerals presented in Table 3 resulted in high values for potassium at 931 mg 100g-1 and calcium at 237 mg 100g-1. The potassium levels varied from 883 mg 100g-1 (Visoka) to 931 mg 100g-1 (Tonda Romana). A higher magnesium content resulted in Tonda Romana at 184 mg 100g-1. The Visoka cultivar resulted in a higher content of copper by 2.02 mg 100g-1, while the Tonda Romana by 1.74mg 100g-1. The iron measured to Visoka resulted in 3.21 mg 100g-1 and Tonda Romana by 4.06 mg 100g-1. Zinc resulted in 2.09 mg 100g-1 (Tonda Romana) and the max value 2.35 mg 100g-1(Visoka).

Comparison of the results with data from the literature indicates similarity in the mineral content with cultivars of the Eastern Mediterranean (Alasalvar. et al., 2003; Koksal et al., 2006; USDA, 2007). A recent publication in the Balkan region has published that palmitic acid values were higher levels than the cultivars of the eastern region of the Black Sea, 4.72–5.87% (Köksal et al. 2006).

Table 3: Ash content (%), Minerals (mg/100g) expressed as Mean value ± STDEV

Chemical element	**Cultivar**			**Mineral percentage (%)**
	Visoka	**Tonda Romana**	**Mean ±SD**	
Potassium	883	931	907 ± 33.94	70.62
Calcium	144	237	190.5± 65.76	14.83
Magnesium	157	184	170.5± 19.09	13.28
Natrium	2.89	2.15	2.52± 0.52	0.20
Manganese	3.4	8.68	6.04± 3.73	0.47
Cupper	2.02	1.74	1.88± 0.20	0.15
Iron	3.21	4.06	3.63± 0.60	0.28
Zink	2.35	2.09	2.22± 0.18	0.17

This study analyses the chemical composition of two hazelnut cultivars in the Mallakastra region. The fat content of the cultivars resulted in ~ 60%, following results from the literature.

Minerals with higher values resulted in potassium of 907mg 100g-1 and calcium of 190.5mg 100g-1. The maximum iron content in the Visoka cv. was 4.06 mg 100g-1. The maximum zinc content resulted in the "Tonda Romana" cultivar of 2.35mg 100g-1. Both cultivars in the study are good sources of bioactive fatty lipids and essential minerals. The essential minerals for both cultivars resulted in copper (0.15%), Zinc (0.17%), Iron (0.28%), Manganese (0.47%), Magnesium (13.28%), Calcium (14.83%), and Potassium (70.62%). These data are comparable to the publications in the literature review, showing a significant interest in the studied hazelnut cultivars in Visoka plantations. Further studies are essential to comparing the results and having a database to givea broad panorama related to the other climatic and human factors in hazelnut cultivation.

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