NUTRITIONAL STUDYING OF PRIMARY METABOLITES AND MICROELEMENTS OF HAZELNUT

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ABSTRACT

Many studies report the low incidence of cardiovascular disease associated with the consumption of nuts, particularly hazelnuts, supporting this way the beneficial role of nuts in human health. The population of the Mediterranean is prone to the Mediterranean diet, which typically includes plenty of fruits, vegetables, bread and other grains, potatoes, beans, nuts and seeds; olive oil as a primary fat source; and dairy products, eggs, fish, and poultry in low-to-moderate amounts. Besides the Mediterranean diet, the Dietary Guidelines for Americans recommend including nuts in the diet because of the fatty acids found in the n-6 / n-3 ratio as it improves the lipid profile in blood. Hazelnuts are rich in macronutrients (protein, carbohydrates, and lipids) and micronutrients (trace elements, minerals, and vitamins). The present paper investigates the fatty acid and micronutrient profiles of hazelnut marketed and consumed in Albania. Oleic acid became the major fatty acid with up to 70% of the total fatty acids. The ICP-MS was employed to analyze metals like magnesium, calcium, potassium. Based on the determined amounts in the samples referring to minerals, we calculated a recommended daily consumption amount of nuts at 42.5 g.
***Keywords*:** hazelnut, nutritional interest, fatty acids, microelements

1. INTRODUCTION

Hazelnut (*Corylus avellana L*) is an endemic bush in many Mediterranean countries, consumed as fruit for a long time throughout the world since

prehistoric civilization. FAOSTAT (2020) stated that the world hazelnut production for 2019 was 1154496 tons. There is no information about Albania.

In modern times, hazelnuts are used as a processed ingredient in chocolates and other sweets (Platteau *et al*., 2011). They are well known and appreciated for their organoleptic properties. In addition, they are very nutritious and healthful because of their favorable composition of nutrients and nutraceutical compounds (Kelly and Sabaté, 2006). Because of their richness in nutrients and bioactive health-promoting compounds, there are good reasons for profitably including hazelnuts as part of a nutritious and functional diet (Contini *et al*., 2011). Hazelnuts are a rich source of fat (about 60%) and fiber (around 10%), as well as an excellent source of protein and carbohydrates; the most important minerals are potassium, phosphorus, calcium, and magnesium, while significant amounts of copper, manganese, and selenium (USDA 2009). The unsaturated FAs are main group in hazelnut's fatty acids profile, by 50—73%. Studies show that other secondary constituents are phytosterols, phenolic compounds, and other antioxidants. These compounds are supposed to intervene in the control of other cardiovascular diseases, such as blood hypertension, or control cholesterol levels in the blood (Alasalvar *et al*. 2006; Perna *et al*., 2016). Recently, hazelnut extracts showed antimicrobial activity to gram-positive bacteria (Oliviera *et al*., 2008). Several scientific studies have presented results on the mineral content and vitamins showed by geographical factors (Dunar and Altundag, 2004). Information about the chemical composition of hazelnuts in Albania could be found in (Osmani-Lataj *et al*., 2013).

FAOSTAT and INSAT do not provide any information about the production and consumption of this raw food, but such information could be found (Osmani-Lataj *et al*., 2013). In Albania, studies about foods as essential sources of fatty acids focus on olive oil (Topi *et al*., 2013). Data on the chemical composition of *Corylus avellana L*., cultivated in Albania, are presented last decade (Osmani-Lataj *et al*., 2013). The present study investigates the nutritional aspect of fatty acids of hazelnut as a representative of the nuts group, which are an essential part of the Mediterranean diet.

2. MATERIAL AND METHODS

Hazelnut samples were purchased in the local market of Tirana. Representative samples were prepared based on the sampling methods as recommended by the EN ISO 948 on Spices and condiments (coffee, tea, spices, beans, nuts, and dried fruits). The minimum quantity for each final sample is 100-500 g.

Analytical Methods

Total fats were extracted by Soxhlet at 60^0C for 6 hours, and n-hexane was used as a solvent. Hazelnut oil samples were kept at 4oC in the dark until GC analysis. The fatty acids were analyzed as Fatty Acid Methyl Esters (FAME) via GC-FID (Thermo Quest, 2000) equipped with a capillary column (23.3m x 0.25mm x 25 μm) according to the AOCS methods (AOCS, 1990). The total ash was calculated based on (Koksal *et al*., 2006).

The Spectrophotometer of Atomic Absorption (Varian SpectrAA – 400 Plus) was involved in investigating the mineral content. The phosphor was analyzed as phosphomolybdate vanadium according to James (1995) by Spectrophotometer.

Statistical analysis

The investigation was carried out in September 2019. Chemical analyses were carried out in triplicate for each hazelnut sample. An amount of 15 g of hazelnut sample was processed for further analysis. Data are presented as Mean±StDev. The Minitab Statistical software (MINITAB INC. 814-238-3280) was involved in the statistical analysis. The standard error was $P \leq 0.05$.

3. RESULTS AND DISCUSSIONS

Fatty acid composition and total fat

The total fat content was analyzed in both cultivars resulted in over 60%, with a range of 60.08-61.57%. Ten fatty acids were detected above the Limit of Detection, but the most important appear to be: palmitic, palmitoleic, stearic, oleic, linoleic, and linolenic acid (Table 1). Oleic acid was found at 80.34%, followed by linoleic acid at 14.54%. The results on analyzed samples present significant differences for five fatty acids. The palmitic acid varies from 4.53-5.69%, and the linoleic acid content resulted at the interval 11.67-14.54%.

Comparison of the results with data from the literature shows similarity in the mineral content with cultivars of the Eastern Mediterranean Sea (Alasalvar *et al*., 2003; USDA 2007). Köksal *et al*. (2006) compared the palmitic acid values between the hazelnuts of the Balkan eastern region of the Black Sea. He reported that the hazelnuts cultivars of the Balkan Region have a higher rate than the hazelnuts of the eastern Black Sea region (4.72—5.87%).

The saturated fatty acids (SFA) resulted in 6.62-67.34%, while PUFA was higher, 11.73-14.61%. SFA group is supposed to raise total cholesterol (TC) and low-density lipoprotein (LDL), which are undesirable to human health.

However, certain SFA (as consumed in our daily diet) have beneficial effects on the ratio of LDL to high-density lipoprotein (HDL) (Ding *et al*., 2017).

Table 1: Total fat (g/100g); fatty acids (% FAME) as Mean ± STDEV

Fatty acid	Hazelnut cultivars	Mean	SD
Palmitic	4.53-5.69	5.11	0.82
Palmitoleic	0.36-0.41	0.39	0.04
Stearic	1.65-2.09	1.87	0.31
Oleic	76.13-80.34	78.24	2.98
Linoleic	11.67-14.54	13.11	2.03
Linolenic	0.059-0.068	0.06	0.01
SFA	6.62-7.34	6.98	0.51
PUFA	11.73-14.61	13.17	2.04
PUFA/SFA	1.60-2.21	1.90	0.43
Total fat	60.08-61.57	60.78	1.12

Analysis of minerals

Ash content was in the interval 1.91- 1.97%, with a mean value of 1.92% ($P \leq 0.02$) (Table 2). Minerals in higher amount were measured potassium by 750.25 mg /100g, phosphor by 298 mg /100g and calcium (232 mg/ 100g). The potassium varied from 112.2 mg $100g^{-1}$ to 114.44 mg $100g^{-1}$, Magnesium content is 8.55 mg/100g, Copper content is 1.98 mg/100g. The iron content appears to be 4.11 mg/100g. Zinc amounts resulted to 2.28 mg/100g (Table 2). The essential minerals are: potassium (58.27%), cooper (0.14%), manganese (0.30%), iron (0.26%), magnesium (12.56%), phosphor (16.66%), zinc (0.17%). These data are comparable to the publications on the literature review.

Table 2: Minerals and non-minerals (mg $100g^{-1}$) expressed as Mean value ± STDEV ($P \leq 0.05$)

Minerals	Hazelnut samples	Mineral content (% of total)	Mean± STDev
Calcium	140-232	11.49	180.22±65.05
Cooper	1.67-1.98	0.14	1.82±0.22
Iron	3.12-4.11	0.26	3.58±0.70
Magnesium	153-192	12.56	171.39±27.58
Manganese	3.65-8.55	0.30	5.59±3.46
Natrium	2.09-2.84	0.17	2.44±0.53
Phosphor	203-298	16.66	245.96±67.18
Potassium	710-750	58.27	735.00±28.18
Zink	2.04-2.28	0.17	2.16±0.18
Ash (g/100 g)	**1.89-1.96**		1.92±0.05

There are similarities between the mineral composition of the hazelnuts here reported and (Dundar and Altundag, 2004; Simsek *et al*., 2007; Muller *et al*., 2020).

Although there is a lack of official information about the consumption per capita, Osmani-Lataj *et al*. (2013) said that the annual consumption is estimated to be 0.07 kg/person, based on the unpublished statistics. FAOSTAT and INSTAT databases do not provide any information about the production and consumption of hazelnuts. EU countries report that hazelnut consumption is >1kg/person.

4. CONCLUSIONS

The chemical composition of hazelnuts is here investigated for a better information on the nutritional aspect. The fat content of the cultivars resulted in over 60%, similar to other publications.

Hazelnut ash content shows the high potential for nuts to introduce in the diet of the different population groups. Considering the importance of several metals, for example, Zn, as co-factors in the enzymatic reactions, it is essential to use nuts for consumers' nutritional status. As hazelnuts are rich in potassium and calcium, they are an important source of microelements. Further studies would be necessary to compare the results and the setup of a database to provide more comprehensive information about the impact of climatic conditions and anthropogenic activity factors on hazelnut cultivation.

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