

ORIGINAL RESEARCH ARTICLE



Sugar analysis of “Menalou vanilia” fir honey

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Summary

“Menalou vanilia” fir honey is the only Greek honey that has a protected designation of origin and it is highly appreciated by consumers. In this study we examined the sugar content of “vanilia” fir honey along with two other criteria that are used for the determination of the botanical origin of honey according to the European and Greek legislation. The results showed that this type of honey is characterized by high electrical conductivity and low honeydew elements/pollen ratio which were in accordance with the European and national legislation. However, the sum of fructose and glucose content in all samples was significantly low and did not meet the standards described by the European Council Directive for honeydew honeys.

Keywords: fir honey, sugar analysis, pollen analysis, botanical origin, protected designation of origin

Introduction

Honey is produced by honeybees from the nectar of plants, as well as from honeydew, a sugar-containing substance excreted by some plant-sucking insects (Maurizio, 1979). “Menalou vanilia” fir honey (*Abies cephalonica* Loudon) is produced in the mountain Menalon in South Greece and is extracted by plant sucking insects such as *Physokermes hemicryphus* Dalman, *Eulecanium sericeum* Lindiger and *Mindarus abietinus* Koch (Santas, 1983). This honey is characterized by its distinguished flavour and aroma; as well as its unique amber colour with light sheens. “Menalou vanilia” fir honey is the only Greek honey that has a protected designation of origin, and it is highly desired by consumers.

The definition of the botanical origin of honey is a complex procedure and several quality characteristics should be examined. In the last few years, novel evaluation techniques based on analytical chemistry and statistics have been tested (Hermosín *et al.*, 2003; Iglesias *et al.*, 2006; Ruoff *et al.*, 2006; Bogdanov *et al.*, 2007; Tananaki *et al.*, 2007; Aliferis *et al.*, 2010). However, at the moment, the evaluation of the botanical origin of honey is still based on a combination of traditional methods such as sensory,

microscopical and physicochemical analysis (Persano Oddo & Bogdanov, 2004).

In particular, according to the European Council Directive (2001/110/EC), honeydew honeys have to meet specific composition criteria concerning the electrical conductivity and sugar content. The Council Directive states that the electrical conductivity in honeydew honeys must not be less than 0.8 mS/cm and the sum of fructose and glucose should be no less than 45 g/100 g. Additionally, Greek legislation (Government Newspaper, FEK/B/239/23-5-2005) requires for fir honeys to have electrical conductivity no less than 1.0 mS/cm and the presence of honeydew elements such as fungi. However, during official national quality controls on “vanilia” fir honey type samples, the content of fructose and glucose was lower, causing serious problems to the commercialization of the product (Manikis *et al.*, 2007).

In this study, we examined the sugar content of “Menalou vanilia” fir honey along with two other criteria that are used for the determination of the botanical origin of honey according to the European and national legislation, such as melissopalynological analysis and electrical conductivity.

Materials and methods

Twenty five honey samples produced in the area of Menalo (37°32'N 22°19'E) were collected during three consecutive years (seven, ten and eight samples per year respectively) and stored at -18°C until analysis. All samples met the sensory characteristics of "Menalou vanilia" fir honey. Pollen analysis was carried out using the methods established by the International Commission of Bee Botany (Louveaux *et al.*, 1978). Electrical conductivity was determined according to the standardised methods of the European Honey Commission (Bogdanov *et al.*, 1997). Sugar spectra (fructose, glucose, sucrose, maltose and turanose) were identified and determined by high performance liquid chromatography (HPLC) according to DIN 10758.

Results

Fructose was the main sugar found in the samples (20.99 ± 0.85 g/100 g), followed by glucose (13.46 ± 0.68 g/100 g) and turanose (5.75 ± 1.15 g/100 g). Maltose was detected in only five samples and its content varied among them. Sucrose was not detected in the samples (Table 1). The sum of fructose and glucose content in all samples was much lower than the thresholds that the European Council Directive specifies for honeydew honeys (>45 g/100 g); and ranged between 32.6 and 38.2 g/100 g (Table 1).

The melissopalynological analysis showed that the samples were low in sediments. The number of pollen grains in 10 g of honey ranged from 5,000 to 100,000 and fell into Maurizio's classes I (28%) and II (72%). The mean ratio between the frequency of honeydew elements and total pollen grains from nectar production plants (HDE/P; Louveaux *et al.*, 1978) in "vanilia" fir

honey was 0.87 ± 0.73 . ANOVA showed no statistically significant differences with respect to the number of pollen grains or HDE among the years ($P=0.572$ and $P=0.136$ respectively).

The electrical conductivity of the samples was over 1.550 mS cm⁻¹ for the majority of the samples (1.640 ± 0.094 mS cm⁻¹).

Discussion

Honeydew honey occupies a large market share in several European countries. "Menalou vanilia" fir honey is the only Greek honey that has a protected designation of origin and it is highly valued by the consumers. The authenticity of the product is important for both consumers and beekeepers. European and national legislation has enacted specific criteria with respect to the botanical origin of honey such as sugar content, electrical conductivity and honeydew element (HDE).

The results obtained in the present study showed that the sum of fructose and glucose content in all samples was significantly low. Furthermore, it was much lower than the criteria required by the European Council Directive and consequently the Greek legislation, prohibiting the commercialization of the product. Manikis *et al.* (2007), in a preliminary study, also reported that the sum of fructose and glucose content of this particular type of honey was lower than 45%. Other studies that concerned the fructose and glucose content of other types of fir honeys showed that it met the requirements of the Council Directive; however, they also reported a significantly low level of these two sugars (Cotte *et al.*, 2004; Bacandritsos *et al.*, 2006). The sugar content of the honeydew secretions is highly variable and depends strongly on the insect and plant species, as well as on the climate (Hendrix *et al.*, 1992; Salvucci & Crafts-Brandner, 2000). Thus, detailed studies concerning the production of fir honey from the honeybees in the area of mountain Menalon are essential.

The samples were characterised by high electrical conductivity which meets the standards set by the Greek legislation. The content of pollen and HDE as well as the HDE/P ratio was low and significantly lower than Louveaux *et al.* (1978) suggest for honeydew honeys. Similar results about the low HDE/P ratio of fir honeys have also been demonstrated previously in Mediterranean countries (Persano Oddo *et al.*, 1995; Tsigouri *et al.*, 2004; Dimou *et al.*, 2006). The presence of fungi in air and on plants, and consequently in honey, is strongly connected to the climate factors, environmental conditions and vegetation (Pepeljnjak & Šegvić, 2003; Dimou *et al.*, 2006; Solla & Camarero, 2006). Thus, the number of HDE in honey can vary significantly among different ecosystems.

In conclusion, the results of this study showed that the modification of the Greek and European Directives concerning the quality criteria and particularly the sum of fructose and glucose content of the "Menalou vanilia" fir honey should be strongly

Table 1. Sugar content of "Menalou vanilia" fir honey (g/100 g).

Sugar	mean (n=25)	Standard deviation	Range
Fructose	20.99	0.85	20.00-23.10
Glucose	13.46	0.68	12.10-15.10
Sucrose	ND ⁽¹⁾		
Turanose	5.75	1.15	4.10-8.00
Maltose ⁽²⁾	2.74	0.37	ND ⁽¹⁾ -3.10
Fructose + Glucose	34.45	1.41	32.60-38.20

⁽¹⁾ ND- not detected < 0.5 g/100 g (Fru, Glu, Suc); < 1.0 g/100 g (Tur, Mal)

⁽²⁾ The data concerns only the five samples where maltose was detected.

considered in order to avoid legal issues during the marketing of this particular type of honey. Additionally, comparative studies about the sugar content of the insects' honeydew secretions and the produced honey in the area of mountain Menalo are necessary to further examine their relationship.

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