The proportion of the volatile compounds biology essay

[Science](), [Biology]()

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Abstract

As a consequence of the global market demand for natural flavourings, natural sources such as essential oils, extracts, distillates and tinctures are being looked at to provide sources for the isolation of natural chemicals. Peppermint is very useful in the flavouring industry, but on the other hand peppermint volatile aroma compounds are the most sensitive components in the process of drying The leafage of menthes (Mentha piperita) from southern Albania were dried using three different drying methods (sun-drying for 36 h, shade-drying for 48 h and oven-drying at 35 °C for 7 h). The essential oil was obtained by hydro-distillation of the leaves dried by every treatment, and was analyzed by capillary GC and GC/mass instruments. Statistical analysis showed significant differentiations in the essential oil content of foliage dehumidified by different drying methods. Oven drying gave the highest essential oil percentage (3. 2%) compared to shade-drying (2. 78%) and sun-drying methods (2. 10%). Twenty-two components were identified in the essential oil of fresh and dried M. piperitae leaves obtained by different drying methods, including free menthol and menthol acetate, mentone, piperithone, alpha pinen, phelandren, cineol, jasmon, menthophurane, isovaleraldehyde, valeranic acid as main components. The drying methods had a marked effect on the proportion of the various components

Keywords: drying characteristics, essential oil, menthone, pulegone, menthofuran, Clevenger-type apparatus, GC–MS

Introduction

Mentha piperita is cultivated on large scale, especially in Mediterranean, tropics and subtropics (Sima, 2012). According to Solcki, in 1960 in a cave in northern Iraq, has been found substantial facts of the use of peppermint remedies some sixty thousand years ago by Neanderthal man. Other authors shows that peppermint has a long tradition of medicinal use, with archaeological evidence placing its use at least as far back as ten thousand years ago (Jones, 1981), for example as a flavoring in baked foods, candies, and medicinal preparations. In the form of peppermint water, which was prepared by diluting the volatile oil in water, it made not only a pleasant drink but was also used as a vehicle for taking unpalatable medicines (Friedrich., 1994). For illustration, castor oil, prepared as a first line purgative on the end of the 18th century, was often taken " swimming on a glass of water or peppermint water" (Scott, 1970). Today is used mostly as a source of cooling molecules formulated as spry dried yeast agglomerates with stability of several months. Peppermint volatile aroma compounds are the most sensitive components in the process of drying. Second to Tamás Antal et al., the changes in the concentration of the volatile compounds during drying depend on several factors, such as the drying methods and drying conditions (temperature, air velocity, relative humidity) (Tamás, et al., 2011)A literature survey was endorsed on the consequence of different methods of drying on chemical composition and content of the essential oil (Rohloff, 1999) (Jens Rohloff, 2005) (M. Consuelo Díaz-Maroto, 2003). The results underlined that drying method had a significant effect on oil content and composition of aromatic plants. Second various authors, the drying method affect significantly the proportion of the various components. Therefore, we have asked the following questions: 1) Are there structural changes in the components of essences regarding Mentha piperita, caused by dehumidified methods? 2) If, so, what factors are involved in the process? 3) Does the proportion of the chemical components concerning the essential oil change by the methods applied for dehumidification? 3) Does the oil content changes by the dehumidified methods applied on drug?

Materials and methods

Raw materialThe fresh leaves of Mentha piperita were collected from the Albanian southern mountain chain of Shendelli-Dhembel-Nemercke, in the second half of May 2012, just before flowering. Only leaves were used for analyses. Fresh leaves were stored in the refrigerator at 4 ±2˚C before the isolation of volatile compounds. The rest of material was put on dying immediately after sorting. . Drying equipment and drying procedureTo study the effect of drying method, three methods of drying, (sun-drying, shade-drying with source of ventilation and oven-drying at 35 °C for 7 h) were investigated. In case of sun and shade-drying, 500 g fresh leaves was spread over 3 m2 of area for 36 and 48 h, respectively. The sample weight was kept constant for all runs. The moisture loss was recorded at one hour intervals during drying. Drying tests were replicated three times to obtain a reasonable average. The dried samples were powered prior to extraction of volatiles.

Methods

Extraction procedure

Fresh and dried leaves of every treatment (100 g in three replications that were cut into small pieces (l × 1 cm)) were subjected to hydro-distillation for 3 h, using Clevenger-type apparatus, according to the method recommended by German et al., (Carmen Ghermana, 2000). The extracted essential oils were dried using anhydrous sodium sulfate and stored in sealed vials at low temperature (2 °C) before analysis.

Gas chromatography and GS–mass spectroscopy

GC analyses were performed, using a HP 6890 GC gas chromatograph equipped with a fused capillary column (30 m × 320 μm i. d., film thickness 0. 25 μm) coated with 5% Phenyl Methyl Siloxane (HP-5). Oven temperature was held at 50 °C for 2 min and then programmed to 240 °C at a rate of 8 °C/min. Detector (FID) temperature was 280 °C and injector temperature was 240 °C; Nitrogen was used as carrier gas with a linear velocity of 30 ml/min. The percentages of compounds were calculated by the area normalization method, without considering response factors. GC–MS analyses were carried out using a Varian 240 GC–MS system equipped with a VF-5 fused capillary column (30 m × 0. 25 mm i. d., film thickness 0. 25 μm); oven temperature was 50–180 °C at a rate of 5 °C/min, transfer line temperature 250 °C, carrier gas was helium with a flow rate of 1 ml/min, spilt ratio 1: 20, ionization energy 70 eV, and mass range 35–390 a. m. u. The components of the oils were identified by comparison of their mass spectra with those of a computer library or with authentic compounds. The result was an average of three determinations.

Statistical analysis

Fisher's LSD at 0. 05% method was used, for comparing drying methods, after The ANOVA null hypothesis of equal means has been rejected. Also ANOVA F-test was used (Salkind, 2010). We applied an exponential model for the drying curves: Where the parameter a is an asymptotic value of water content during drying; the parameter b is a theoretical interval of moisture content values and M is moisture content (kg water/kg dry matter). The sample moisture content M was calculated on a dry bases db according to the equation: Where the Wt is the sample weight at a specific time for kg, Wk is the sample weight in kg. Result and discussion[Table 1] shows the effect of the drying method on the twenty one volatile compounds. Quantitatively, menthone, isomenthone, menthyl acetate and limonene were the most important of all the components identified. A pale yellow essential oil with yield of 3. 20% (on fresh weight basis) was obtained from fresh Mentha piperita plant, 1. 6 times higher that the reported values (Jens Rohloff, 2005). The method of drying had a significant effect on the essential oil content of Mentha piperita [Table 1 and 2]. The synthesis of oxygenated therpens from pipertonon is affected by the sunlight and by the heat and the best drug quality is obtained when the quantity of Mentone is high and the quantity of menthofuran is low [Figure 1]. Mentha piperita leaves dried in an oven at 35 °C had the highest essential oil content (2. 34%) on dry weight basis. While, menthe leaves dried in sunshine and in shade afforded oil at percentages of 2. 10% and 2. 12%, respectively with no significant difference between them. Twenty one components were identified in the essential oil of fresh and dried Mentha piperita leaves by different drying methods, which represented 99. 29–88. 41% of the oil components. The chemical constituents of oils are presented in [Table 1]. The components are listed in order of their retention time on the VF-5 column. The major components of the essential oils were total menton (52%-53. 8%) mentil acetate (7. 8%-8. 5%) and free menton (28%-31. 5%) in oils extracted from peppermint leaves dried by sun, shade and oven drying, respectively; the quality of peppermint is generally determined by its menthol content. Refereeing to Sima et al., in Albanian Mentha piperita oil menthol (37. 4%), menthyl acetate (17. 4%) and menthone (12. 7%) were the main components, whereas those of M. spicata oil were carvone (69. 5%) and menthone (21. 9%). In addition to essences, the essential oil of Mentha piperita consists of small quantities of a-pinene, b-pinene, sabinene, b-myrcene, linalool, b-caryophyllene, pulegone, a-terpineol, germacrene-D [Tabele 1]. Another study for M. piperitae (Menary, 1980) discuses factors that favor the maintenance of high levels of photosynthesis that resultes in high concentrations of menthone and low concentrations of pulegone and menthofuran [Figure1]Comparison of the results showed that different used drying methods had no effect on the major components of the essential oil, but had a significant effect on their percentages. These results are in agreement with those obtained in other essential oil-bearing plants (Rohloff, 1999). It could be concluded that drying of Mentha piperita leaves in the oven at 35 °C for 7 h. is more suitable and recommended for obtaining higher essential oil content. Also, for higher percentages of major components (a-pinen, limonen, iso-menthone and menthole) oven drying is more suitable [Table 2]. Figure 1: Essential oil components biosynthesis pathway[3]Figure 2: Effect of drying methods on essential oil percentage in the leavs of Mentha piperita (on dry wt. basis)[4]

No.

Compound

Fresh

Shade-drying

Sun-drying

Oven- drying

1a-pinene1. 0240. 6780. 6721. 42b-pinene0. 6870. 4550. 4510. 943sabinene0. 0590. 0390. 0380. 084b-myrcene0. 4100. 2710. 2690. 565limonene1. 6161. 0711. 0612. 2161, 8 cineole0. 0250. 0170. 0160. 0347(E)-b-ocimene0. 0220. 0150. 0140. 038(Z)-3-hexenol0. 0270. 0180. 0180. 03793-octanol1. 0600. 7020. 6961. 4510menthone2. 6331. 7441. 7283. 611(E)-sabinene hydrate0. 0510. 0340. 0340. 0712iso-menthone2. 1061. 3951. 3822. 8813linalool0. 1460. 0970. 0960. 214menthyl acetate1. 8501. 2261. 2142. 5315isopulegol0. 9290. 6150. 6091. 2716b-caryophyllene0. 0650. 0430. 0430. 08917neo-menthol1. 3310. 8820. 8731. 8218terpinen-4-ol0. 2050. 1360. 1340. 2819pulegone0. 0670. 0440. 0440. 09120menthol57. 19137. 88937. 53278. 2121isomenthol0. 3440. 2280. 2260. 4722a-terpineol0. 0650. 0430. 0430. 08923germacrene-D0. 1830. 1210. 1200. 2524piperitone0. 3360. 2230. 2210. 4625carvone0. 0510. 0340.

0340. 07Oil content (%)2. 34t < 0. 05. Table 1: The significant effect of drying methods on the essential oil content of Mentha piperita[5]

Source of variation

DF

MS

Drying method

30. 31*

Error

80. 015

Total

11

* Significant at < 0. 05

Table 2: Statistical analysis of discrepancies between drying methods[6]