Original Article

ESTABLISHMENT OF METHODOLOGY FOR DRYING LEAVES AND STORAGE OF ESSENTIAL OIL OF LINALOOL CHEMOTYPE *Ocimum basilicum* L.

ESTABELECIMENTO DE METODOLOGIA PARA SECAGEM DE FOLHAS E ARMAZENAMENTO DO ÓLEO ESSENCIAL DE Ocimum basilicum L. QUIMIOTIPO LINALOL

Mércia Freitas ALVES[1]; Arie Fitzgerald BLANK[2]; Maria Fátima ARRIGONI-BLANK[2]; Saymo Santos FONTES[3]; Hugo César Ramos de JESUS[4]; Péricles Barreto ALVES[5]

1. Mestra, Departamento de Agronomia - UFS, São Cristóvão, SE, Brasil. mercia_floresta@hotmail.com; 2. Professor, Doutor, Departamento de Agronomia - UFS, São Cristóvão, SE, Brasil; 3. Engenheiro Agrônomo, Aracaju, SE, Brasil; 4. Mestre, Departamento de Química – UFS, São Cristóvão, SE, Brasil; 5. Doutor, Departamento de Química - UFS, São Cristóvão, SE

ABSTRACT: The aim of this study was to evaluate the influence of leaf drying and oil storage on the content and chemical composition of the essential oil of linalool type basil (*Ocimum basilicum* L.) cultivar Maria Bonita. In the first trial, the effect of the drying time of leaves a temperature of 40°C. In the second trial, the effect of storage time evaluated (0, 15, 30, 60, 90, 120, 150, 210, 240 and 270 days) at two temperatures [room (±27°C) and freezer (-20°C ± 2°C) temperature]. The essential oil was extracted by hydrodistillation of leaves and analyzed by GC and GC/MS. The drying process was efficient, reducing the moisture content 84.5% to 1.3% over a period of eight days. There was a linear reduction in the essential oil (6.0% to 3.9%), of linalool (6.38% to 74.09%), increase of the content of α–trans-bergamotene (1.1% to 1.8%) and epi-α-cadinol (1.57% to 1.77%). In the second trial, we noted increase of the linalool content from 76.99% to 79.40% after 210 days of storage at room temperature and to 79.82% after 240 days of storage in freezer. We can conclude that basil essential oil can be stored for up to seven months at room temperature and eight months in freezer.

KEYWORDS: Drying. Post-harversting. Essential oil. Linalool. Basil. Storage.

INTRODUCTION

Basil is a common name for the culinary herb *Ocimum basilicum* L. which belongs to the Lamiaceae family and is an annual plant originated from t Southeast Asia and Central Africa; it is used as a medicinal and aromatic plant and has properties of interest to the food, pharmaceutical and cosmetic industries (LORENZI; MATOS 2008).

In folk medicine, basil species are indicated as digestive stimulants and are believed to possess antispasmodic, gastric, galactagogue, cough suppressant and carminative effects (SAJJADI, 2006). Studies have shown the notable antimicrobial and antioxidant potential of basil (SARTORATOTTO et al., 2004; POLITEO et al., 2007), in addition to its potential for the treatment of headaches, diarrhea, intestinal worms and inflammation (PESSOA et al., 2002; ADIGUZEL et al., 2005; FRANCA et al., 2008). Basil essential oil with a high linalool concentration is highly valued in the international market and widely used in the spice and cosmetics industries (LUZ, 2009).

The drying of aromatic and medicinal plants is intended to minimize the loss of active ingredients and to slow their deterioration due to the reduction of enzymatic activity, enabling the preservation of the plants for longer periods of time and thus facilitating their subsequent commercialization and use. Furthermore, the drying processes greatly affect the yield and the chemical composition of various species, especially in aromatic plant species, which have very volatile components (HERTWIG, 1991).

The storage of essential oils, when properly conducted, enables the retention of the components in the product; therefore, it is convenient for the process to be conducted under conditions that do not allow contamination of the essential oil or the reduction of its therapeutic and commercial quality. Decreasing the temperature to avoid deterioration is a fairly common technique. In addition, the humidity of the product must be maintained at levels that prevent or hinder contamination; moreover, careful attention must be paid to the relative humidity of the air in the storage environment (MARTINAZZO, 2006).

Storage can influence the content and chemical composition of basil essential oil, which, in addition to several other factors, can affect the demand for and commercial value of the oil. The objective of this study was to evaluate the influence of leaf drying and storage of the essential oil from

Received: 17/04/14
Accepted: 20/01/15

the Maria Bonita cultivar of basil (*O. basilicum*) on the composition of the oil.

MATERIAL AND METHODS

Plant material

Leaves from the cultivar Maria Bonita were used for both trials. The seedlings were grown from seeds in expanded polystyrene trays with 72 cells. The substrate used was a mixture of washed coconut powder, cattle manure and soil from the Research Farm "Campus Rural da UFS" latitude 11°00' S and longitude 37°12' W, at a ratio of 1:1:1.

After 30 days, the seedlings were transplanted to the field and spaced at 0.50 m between rows and 0.60 m between plants. The soil pH was corrected with dolomitic limestone, according to a soil analysis. The cultivation was accomplished using black plastic film for mulching. A total of 60 m^3ha^{-1} of cattle manure was applied, and a drip irrigation system was utilized with a spacing of 10 cm between each drip emitter.

Drying time

Leaves of the Maria Bonita cultivar were harvested at 60 d of cultivation. The experimental design used was completely randomized with three repetitions, testing 0, 1, 2, 3, 4, 5, 6 and 8 d of leaf drying in a drying oven with forced-air circulation at a temperature of 40°C.

The essential oil was extracted at the end of each drying period by hydrodistillation, using a Clevenger apparatus with a 3-L round-bottomed flask containing 1.5 L of water for 140 min. Upon completion, the volume of the oil (mL) was recorded, and the oil was collected in amber vials and stored in a freezer at -20°C ± for chemical analysis.

The moisture content of each treatment was obtained from three samples of 100 g of fresh leaves that were dried at 105°C to a constant weight. To calculate the moisture content, the fresh and dried leaves were weighed, obtaining a value in (%) of water loss.

Storage of essential oil

To evaluate the influence of storage time on the chemical characteristics of the essential oil, the experimental design was completely randomized in a 2x10 factorial scheme, testing two storage environments (freezer at -20°C and room temperature) and 10 time periods (0, 15, 30, 60, 90, 120, 150, 210, 240 and 270 d). At the end of each period, the essential oil was subjected to chemical analysis, as described in the following section.

Chemical analysis of the essential oil

The essential oil was obtained from dry leaves by the process of hydrodistillation, using a Clevenger apparatus (GUENTHER, 1972), for 140 min. The content (%) was estimated based on the dry weight (v/m) and obtained from three samples of 100 grams.

Qualitative analysis of the chemical composition of the essential oils was performed using a gas chromatograph coupled to a mass spectrometer (GC-MS) (Shimadzu, model QP 5050A), fitted with an autoinjector AOC-20i (Shimadzu) and a J & W Scientific fused silica capillary column (5% phenyl-95% polydimethylsiloxane – DB-5) with 30 m x 0.25 mm diameter, 0.25 mM film, using helium as the carrier gas at a flow rate of 1.2 $mL \cdot min^{-1}$. The temperature was programmed to remain at 50°C for 2 min, followed by an increase of $4°C \cdot min^{-1}$ up to 200°C, then at $15°C \cdot min^{-1}$ until it reached 300°C, and remaining at this temperature for 15 min. The injector temperature was 250°C, and the detector (or interface) temperature was 280°C. A volume of 0.5 μL of ethyl acetate was injected at a 1:100 partitioning ratio of injected volume and a column pressure of 64.20 kPa. The mass spectrometry (MS) was performed with an operational anion capture detector in electron impact mode, with an impact energy of 70 eV, a scan interval of 0.50 fragments and fragments detected in the range of 40 to 500 Da. The essential oil components were identified by comparing the mass spectrum with spectra found in the literature (Adams 2007) and spectra from the equipment database (NIST21 and NIST107); in addition, the retention rates were compared with those found in the literature. The Kovats retention index (RI) was determined using a homologous series of n-alkanes (C_8-C_{18}) injected under the same chromatographic conditions as the samples (VANDENDOOL; KRATZ 1963).

A quantitative analysis of the essential oil components was conducted in a gas chromatograph equipped with a flame ionization detector (FID), using the Shimadzu GC-17A equipment with a ZB-5ms fused silica capillary column (5% polydimethylsiloxane) with 30 m x 0.25 mm diameter, 0.25 mM film and the same operating conditions as the GC-MS. The quantification of the components was achieved by normalizing the area (%). The concentrations of the compounds were calculated by area and arranged in order of GC elution.

The identification of the components was performed by comparing the results of this experiment with the retention index

(VANDENDOOL; KRATZ, 1963) for a homologous series of n-alkanes obtained by co-injection of petroleum samples with a mixture of linear hydrocarbons, as well as by comparison with the databases NIST21 and NIST107 from the GC-MS library and published mass spectra (ADAMS, 2007).

Statistical Analysis

The data were subjected to analysis of variance and subsequent comparison of means by the Scott-Knott test ($p<0.05$) for the moisture and essential oil content as a function of drying time.

RESULTS AND DISCUSSION

Drying Time

The drying process at 40°C was efficient, reducing the moisture content of basil from 84.5% to 1.3% over a period of 3d.

After the third day of drying, moisture stabilization was achieved, indicating that 4 days of drying at 40°C can be considered to be ideal to stabilize the dry weight of *O. basilicum* leaves. A similar trend was observed in the evaluation of the influence of harvest time, temperature and drying time on basil essential oil (CARVALHO-FILHO et al., 2006). The regression coefficient observed was 86.5%, with 5% probability, generating a regression curve with significant exponential behavior (Figure 1).

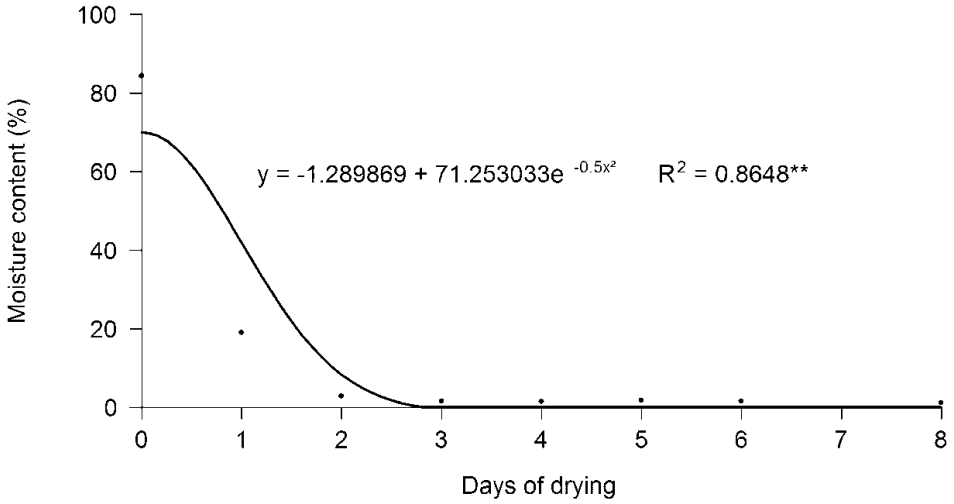

Figure 1. The moisture content of Maria Bonita cultivar *O. basilicum* leaves according to drying time (40°C).

The water content was rapidly reduced at the beginning of the drying process at 40°C and slowly at the end (Figure 1). These findings are similar to those of other studies on the drying of medicinal plants, seeds and fodder (BLANCO et al., 2002).

When comparing drying at room temperature to oven drying, changes in the color and odor of the leaves of *Lippia sidoides* Cham. were observed, which were likely caused by the longer period of drying and fungal growth (RADUNZ et al., 2002).

Regarding the essential oil content, there was a linear reduction in the oil content during the process of leaf drying at 40°C (Figure 2). Similar results were obtained from a study on the effect of storage on *O. basilicum* branches, which found a decrease in the essential oil content over the storage time that, according to the authors, may have been caused by volatilization and thus may have compromised the quality of this essential oil (SILVA et al., 2005).

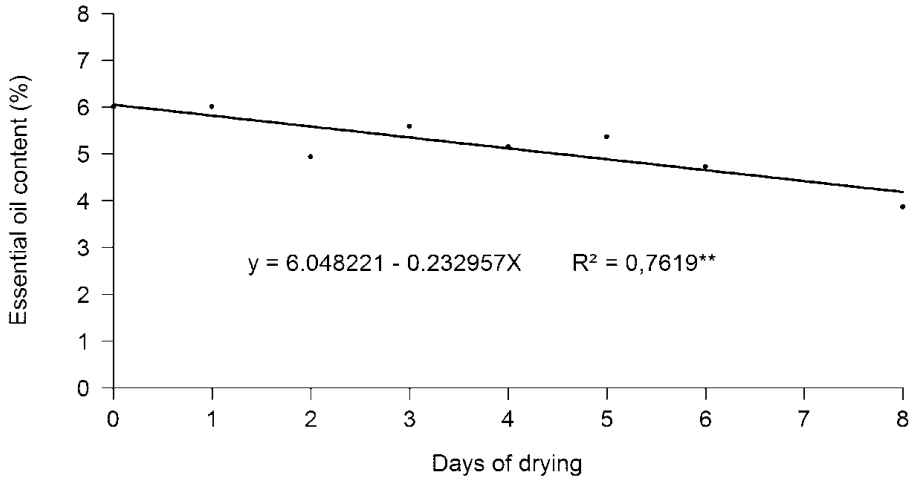

Figure 2. The essential oil content of the Maria Bonita cultivar of *O. basilicum*, according to drying time at 40°C.

O. basilicum essential oil predominantly contains oxygenated monoterpenes. The chromatographic analyses allowed the identification of monoterpenes (1,8-cineol, α-terpineol, geraniol and linalool) and sesquiterpenes (isobornyl acetate, neryl acetate, α-*trans*-bergamotene, α-muurolene, γ-cadiene and epi-α-cadinol) in the essential oil. Among these constituents, linalool and geraniol comprised the majority (Table 1).

Table 1. The means of the chemical constituents of basil cultivar Maria Bonita essential oil during the drying process of its leaves at 40°C.

Compounds	RI	Drying time (d)							
		0	1	2	3	4	5	6	8
Sabinene	975	0.15 b	0.16 b	0.15 b	0.17 a	0.15 a	0.11 c	0.16 a	0.12 b
β-Pinene	980	0.36 b	0.37 b	0.37 b	0.46 a	0.41 a	0.29 c	0.43 a	0.38 a
1,8-Cineol	1033	5.14 a	5.64 a	5.59 a	6.24 a	5.86 a	5.28 a	6.00 a	5.95 a
Linalool	1098	76.36 a	74.41 b	73.56 b	73.36 b	73.66 b	72.67 b	74.33 b	74.07 b
α-Terpineol	1189	0.60 a	0.60 a	0.56 a	0.55 a	0.60 a	0.63 a	0.56 a	0.61 a
Geraniol	1255	12.32 a	13.45 a	12.75 a	12.10 a	12.84 a	13.93 a	11.52 a	12.45 a
Bornyl acetate	1284	0.20 a	0.18 a	0.24 a	0.27 a	0.18 a	0.23 a	0.32 a	0.25 a
Neryl acetate	1374	1.38 a	1.44 a	1.94 a	1.69 a	1.85 a	2.03 a	1.29 a	1.63 a
α-*trans*-Bergamotene	1436	1.08 c	1.24 c	1.76 b	1.94 b	1.78 b	2.08 a	2.24 a	1.78 b
Germacrene D	1480	0.42 a	0.47 a	0.50 a	0.58 a	0.41 a	0.37 a	0.64 a	0.40 a
γ-Cadinene	1520	0.34 b	0.38 b	0.55 a	0.59 a	0.53 a	0.59 a	0.69 a	0.51 a
epi-α-Cadinol	1640	1.55 a	1.62 a	1.94 a	1.91 a	1.55 a	1.69 a	1.80 a	1.75 a
Monoterpenes (%)		94.93	94.63	92.98	92.88	93.52	92.91	93.00	93.58
Sesquiterpenes (%)		4.97	5.33	6.93	6.98	6.30	6.99	6.98	6.32

Means with the same letters in rows do not differ significantly according to the Scott-Knott test ($p<0.05$). RI: Retention Index

Linalool is the major chemical constituent present in the essential oil of this cultivar, having contents in the range of 72.69 to 76.38% (Table 1). While analyzing the linalool content, it was observed that there weren't considerable differences in this value among the drying times used to obtain basil essential oil from the Maria Bonita cultivar. In contrast, other components showed differences of less than 50% in the relative content, as with α–*trans*-bergamotene (1.1% to 1.8%) and epi-α-cadinol (1.57% to 1.77%) for the drying that occurred between day 0 and day 8. Similar results were obtained in a study on the influence of harvest time, temperature and drying time on the *O. basilicum* essential oil, which found that the linalool concentration changed in response to the treatments (CARVALHO FILHO et al., 2006).

For the content of geraniol, the compound with the second highest concentration, there was no significant difference, and the same finding was observed with 1,8-cineol, another component of basil essential oil, which has allopathic, anesthetic, antibronchitic, antiseptic, bactericidal, expectorant, herbicidal and insecticidal properties. Furthermore, linalool has antiseptic, insecticidal and termiticidal properties (DUKE 1994).

Thus, the drying of the Maria Bonita cultivar of *O. basilicum* must be performed in accordance with the purpose of use, bearing in mind that this herb requires 0 d of drying to obtain the highest linalool content in the essential oil but 3 d to stabilize the moisture content.

Storage of Essential Oil

In the analysis of the influence of the storage time of the essential oil of the Maria Bonita basil cultivar on the compounds present in the essential oil, 24 compounds were identified and are listed according to elution order (Table 2).

Of the compounds found in the essential oil, linalool is emphasized because its concentration accounts for most of the essential oil, ranging from 73.08 to 79.85%. The highest concentrations were observed at 30 (79.85%) and 210 days (79.4%) of storage at room temperature. Similar results were observed for the effects of storage of *O. basilicum* branches on the composition of the essential oil, which found an increase in the eugenol and linalool concentrations as the storage time increased (SILVA et al., 2005), and in the study of the effect of storage and harvest time of *O. basilicum*, in which there was an increase in the concentration of linalool during storage (CARVALHO FILHO et al., 2006).

For the 1,8-cineol content, the storage at room temperature produced higher values than storage in a freezer only for the storage periods of 90, 180, 210 and 270 days. In other storage periods, there were no significant differences between the storage environments. The geraniol content was higher at 270 days in the freezer (11.56%). Thus, basil essential oil can be stored for a period of up to 8 months at either temperature without changing its chemical composition (Table 2).

During the post-harvest processes both drying of the leaves and storage of essential oil, there may be some evaporation of volatiles, the partial retention of others (JERKOVIC et al., 2001) as well as the appearance of oxidation products derived from (LUNING et al., 1995), which changes the composition of the oil essential.

Table 2. The mean concentrations of the compounds of *O. basilicum* cultivar Maria Bonita essential oil, according to storage time and temperature.

Compound	RI	Storage time (days)										
		0	15	30	60	90	120	150	180	210	240	270
							Room temperature					
α-Pinene	939	0.15 cA	0.13 cA	0.13 cA	0.12 cA	0.15 cA	0.13 cA	0.15 cA	0.38 bA	0.4 aA	0.46 aA	0.50 aA
Sabinene	975	0.15 aA	0.16 aA	0.15 aA	0.14 aA	0.18 aA	0.15 aA	0.16 aA	0.48 aA	0.00 bA	0.00 bA	0.00 bA
β-Pinene	979	0.52 aA	0.46 bA	0.47 bA	0.43 bA	0.52 aA	0.45 bB	0.51 aA	0.00 cB	0.00 cB	0.00 cB	0.00 cB
Myrcene	990	0.00 aA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.28 cA	0.17 Bb	0.00 cA	0.00 cA	0.00 cA	0.00 cA
Limonene	1029	0.18 aA	0.15 bA	0.15 bA	0.15 bA	0.23 aA	0.17 aA	0.19 aA	0.00 bA	0.00 bA	0.00 bA	0.00 bA
1,8-Cineol	1031	6.97 aA	6.45 cA	6.9 aA	6.55 cA	6.93 aA	6.39 cA	6.99 aA	6.72 bA	6.77 aA	6.65 bA	7.05 aA
(E) β-Ocimene	1050	0.00 eA	0.00 eA	0.00 eA	0.00 eA	0.00 eA	0.00 eA	0.00 eA	0.00 dA	0.00 cA	0.00 bA	0.00 aA
cis-Linalool oxide	1067	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aB	0.00 aA	0.25 aA	0.41 aA	0.47 aA	0.75 aA
trans-Linalool oxide	1084	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.39 cA	0.44 bA	0.67 aA
Linalool	1096	76.99 cA	78.53 bB	79.85 aA	78.62 bA	77.2 cA	77.59 cA	77.19 cA	79.07 bA	79.4 aA	78.78 bB	77.04 dB
α-Terpineol	1188	0.67 bA	0.65 bA	0.56 dA	0.61 cA	0.70 aA	0.66 bA	0.67 bA	0.65 bA	0.62 cA	0.64 bA	0.75 aA
Geraniol	1252	9.55 bA	8.58 bA	8.61 cA	9.76 bA	9.81 bA	7.45 aA	9.87 bA	9.08 cA	8.74 cA	8.95 cA	10.74 aB
Geranial	1264	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.32 bA	0.00 cA	0.35 bA	0.73 aA
Bornyl acetate	1288	0.26 aA	0.23 bA	0.21 bA	0.22 bA	0.23 aA	0.22 bA	0.22 bA	0.00 cA	0.00 cA	0.00 cA	0.00 cA
Isobornyl acetate	1283	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aB	0.00 aB	0.00 aB
Neryl acetate	1361	2.03 aA	1.69 dA	1.49 fA	1.61 eA	1.81 cA	1.88 bA	1.77 cA	0.00 gA	0.00 gA	0.00 gA	0.00 gA
Geranyl acetate	1379	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	1.77 bA	1.74 bB	1.75 bB	2.47 aB
α-*trans*-Bergamotene	1434	1.34 aA	1.01 bA	0.98 bA	1.00 bA	1.07 bA	1.04 bA	1.01 bB	1.00 bA	0.98 bB	0.99 Ab	1.18 Aa
γ-Muurolene	1478	0.00 aA	0.00 aA	0.00 aA	0.00 Aa	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aB	0.00 aA	0.00 aB
Germacrene D	1485	0.26 aA	0.18 bA	0.00 cA	0.00 cB	0.00 cA	0.00 cB	0.00 cB	0.00 cA	0.00 cA	0.00 cA	0.00 cA
γ-Cadinene	1513	0.36 aA	0.29 aA	0.25 aA	0.28 aA	0.29 aA	0.28 aA	0.29 aA	0.27 aB	0.00 bB	0.27 bA	0.00 bB
epi-α-Cadinol	1640	0.58 aA	0.54 aA	0.30 aA	0.57 aA	0.60 aA	0.60 aA	0.59 aA	0.52 aA	0.54 aA	0.55 aA	0.70 aA
							Freezer temperature					
α-Pinene	939	0.15 aA	0.13 aA	0.14 aA	0.12 aA	0.13 aA	0.16 aA	0.15 aB	0.15 bB	0.00 bB	0.00 bB	0.00 bB
Sabinene	975	0.15 aA	0.16 aA	0.26 aA	0.15 aA	0.17 aA	0.18 aA	0.16 aA	0.18 aA	0.16 aA	0.16 aA	0.17 aA
β-Pinene	979	0.52 aA	0.47 bA	0.41 bA	0.44 bA	0.47 bA	0.53 aA	0.50 aA	0.49 bA	0.48 bA	0.49 bA	0.57 aA
Myrcene	990	0.00 aA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.30 cA	0.19 bA	0.00 cA	0.00 cA	0.00 cA	0.00 cA
Limonene	1029	0.18 aA	0.15 aA	0.19 bA	0.17 bB	0.16 aA	0.22 Aa	0.16 aA	0.00 bA	0.00 bA	0.00 bA	0.00 bA
1,8-Cineol	1031	6.97 aA	6.59 bA	6.98 aA	6.53 bA	6.58 bB	6.77 Ab	6.89 aA	6.45 bB	5.52 cB	6.52 bA	6.53 bB
(E) β-Ocimene	1050	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.16 aA	0.00 aA	0.00 aB	0.00 aB	0.00 aB	0.00 aB
cis-Linalool oxide	1067	0.00 bA	0.00 bA	0.00 bA	0.00 bA	0.00 bA	0.00 aA	0.00 bA	0.00 bA	0.00 bA	0.00 bA	0.00 bA

trans-Linalool oxide	1084	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aB	0.00 aB	0.00 aB
Linalol	1096	76.99 cA	79.4 aA	79.5 aA	78.59 bA	77.4 cA	76.97 cA	77.02 cA	78.69 bA	73.08 Be	79.82 aA	75.56 dA
α-Terpineol	1188	0.67 bA	0.65 bA	0.52 dA	0.60 cA	0.70 bA	0.66 bA	0.66 bA	0.65 bA	0.61 cA	0.59 cA	0.78 aA
Geraniol	1252	9.55 cA	8.60 dB	8.90 cA	9.73 dA	10.26 bA	9.99 bA	10.26 bA	9.99 bB	11.84 dB	9.21 aA	11.56 Aa
Geranial	1264	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aA	0.00 aB	0.00 aA	0.00 aB	0.00 aB
Bornyl acetate	1288	0.26 aA	0.21 bA	0.21 bA	0.21 bA	0.23 bA	0.23 bA	0.22 bA	0.00 cA	0.00 cA	0.00 cA	0.00 cA
Isobornyl acetate	1283	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.00 dA	0.36 aA	0.24 cA	0.24 bA
Neryl acetate	1361	2.03 aA	1.62 dA	1.50 eA	1.54 eA	1.93 bA	1.72 cB	1.67 dB	0.00 fA	0.00 fA	1.03 fA	1.16 fA
Geranyl acetate	1379	0.00 dA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.28 cA	0.00 cA	1.75 bA	2.35 aA	1.46 cA	2.4 aA
α-*trans*-Bergamotene	1434	1.34 bA	1.02 cA	0.97 cA	0.99 cA	1.05 cA	1.11 cA	1.28 bA	1.02 cA	2.31 aA	0.00 cA	0.00 cA
γ-Muurolene	1478	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.00 cA	0.16 cA	0.00 cA	0.00 cA	0.83 aA	0.00 cA	0.25 bA
Germacrene D	1485	0.26 aA	0.21 bA	0.00 dA	0.18 cA	0.00 dA	0.21 bA	0.21 bA	0.00 dA	0.00 aA	0.00 dA	0.33 dA
γ-Cadinene	1513	0.36 bA	0.28 bA	0.25 bA	0.26 bA	0.30 bA	0.32 bA	0.29 bA	0.28 bA	0.78 aA	0.54 cA	0.68 bA
epi-α-Cadinol	1640	0.58 bA	0.52 bA	0.29 bA	0.57 bA	0.60 bA	0.62 bA	0.59 bA	0.56 bA	1.36 aA	0.00 bA	0.00 bA

Means followed by same lower case letters in the same row, between times, and upper case letters in the same column, between storage environments, do not differ significantly according to the Scott-Knott test ($p \leq 0.05$). RRI: Relative Retention Index

CONCLUSION

We can conclude that the drying time of the leaves significantly influenced the chemical composition, in terms of the linalool content and the essential oil content of the Maria Bonita cultivar of basil (*Ocimum basilicum* L.). The essential oil of basil cultivar Maria Bonita can be stored for up to eight months at either freezer and room temperature without significative changes in its chemical composition.

ACKNOWLEDGEMENTS

The authors are grateful to FAPITEC/SE, CNPq and CAPES for their financial support.

RESUMO: O objetivo deste estudo foi avaliar a influência da secagem de folhas e de armazenamento de óleo na composição de conteúdo e química do óleo essencial de manjericão (*Ocimum basilicum* L.) cultivar Maria Bonita. No primeiro ensaio, o efeito do tempo de secagem de folhas a uma temperatura de 40 °C. No segundo ensaio, o efeito do tempo de armazenamento avaliado (0, 15, 30, 60, 90, 120, 150, 210, 240 e 270 dias) em duas temperaturas [ambiente (± 27 °C) e freezer (-20 °C)] a temperatura. O óleo essencial foi extraído por hidrodestilação de folhas e analisados por GC e GC/MS. O processo de secagem foi eficiente, reduzindo o teor de humidade de 84,5% para 1,3% ao longo de um período de oito dias. Houve uma redução linear no óleo essencial (6,0% a 3,9%), de linalol (76,36% para 74,09%), o aumento do teor de α-trans-bergamoteno (1,1% a 1,8%) e epi-α-cadinol (1,57% a 1,77%). No segundo ensaio, observou-se aumento do teor de linalol do 76,99% para 79,40%, após 210 dias de armazenamento em temperatura ambiente e para 79,82% após 240 dias de armazenamento em freezer. Pode-se concluir que o óleo de manjericão essencial pode ser armazenado durante até sete meses à temperatura ambiente e oito meses em freezer.

PALAVRAS-CHAVE: Secagem. Pós-colheita. Óleo essencial. Linalol. Manjericão. Armazenamento.

REFERENCES

ADAMS, R. P. **Identification of Essential Oil Components by Gas Chromatography/Mass Spectrometry**. 4th edn. Illinois: Carol Stream, 2007. 803p.

ADIGUZEL, A.; GULLUCE, M.; SENGUL, M.; OGUTCU, H. F.; SAHIN and KARAMAN, I. Antimicrobial effects of *Ocimum basilicum* (Labiatae) extract. **Turkish Journal of Biology**, Ankara, v. 29, n. 3, p. 155-160, Mar. 2005.

BLANCO, M. C. S. G.; MING, L. C.; MARQUES, M. O. M.; BOVI, O. A. Drying temperature effects in rosemary essential oil content and composition. **Acta Horticulturae**, Amsterdam, v. 569, n. 1, p. 99-103, 2002.

CARVALHO FILHO, J. L. S.; BLANK, A. F.; ALVES, P. B.; RODRIGUES, M. O.; ARRIGONI-BLANK, M. F.; SILVA-MANN, R.; MENDONCA, M. C**.** Influence of the harvesting time, temperature and drying period on basil (*Ocimum basilicum* L.) essential oil. **Revista Brasileira de Farmacognosia**, João Pessoa, v. 16, n. 1, p. 24-30, Jan./Mar. 2006. http://dx.doi.org/10.1590/S0102-05362006000200014

BLANK, A. F.; SOUZA, E. M.; ARRIGONI-BLANK, M. F.; PAULA, J. W. A.; ALVES, P. B**.** Maria Bonita: cultivar de manjericão tipo linalool. **Pesquisa Agropecuária Brasileira**, Brasília, v. 42, n. 12, p. 1811-1813, Dez. 2007. http://dx.doi.org/10.1590/S0100-204X2007001200020

DUKE, J. A. Biologically active compounds in important spices. In: CHARALEMBOURS G. **Spices, herbs and edible fungi**. New York: Elsevier, 1994. p. 225-250.

FRANCA, C. S.; MENEZES, F. S.; COSTA, L. C. B.; NICULAU, E. S.; ALVES, P. B.; PINTO, J. E. B. P.; MARCAL, R.M. Analgesic and antidiarrheal properties of *Ocimum selloi* essential oil in mice. **Fitoterapia**, v. 79, p. 569-573, Dez. 2008. http://dx.doi.org/10.1016/j.fitote.2008.06.002

GUENTHER, E. **The Essential Oils:** Individual essential oils of the plant families Rutaceae and Labiatae. Malabar: Krieger, 1972. 777p.

JERKOVIC, I.; MASTELIC, J.; MILOS, M. The impact of both the season of collection and drying on the volatile constituents of *Origanum vulgare* L. ssp. hirsutum grown wild in Croatia. **International Journal of Food Science and Technology**, Croatia, v. 36, n. 6, p. 649-654, Dez. 2001. http://dx.doi.org/10.1046/j.1365-2621.2001.00502.x

LORENZI, H, MATOS, F. J. A. **Plantas medicinais do Brasil:** nativas e exóticas. 2nd edn., Nova Odessa: Instituto Plantarum, 2008. 576p.

LUNING, P. A.; EBBENHORSTSELLER, T.; DERIJK, T.; ROZEN, J. P. Effect of hot air drying on flavour compounds of bell peppers (*Capsicum annum*). **Journal for the Science of Food and Agriculture**, The Netherlands, v. 68, n. 3, p. 355-365, 1995. http://dx.doi.org/10.1002/jsfa.2740680315

LUZ, J. M. Q.; MORAIS, T. P. S.; BLANK, A. F.; SODRE, A. C. B.; OLIVEIRA, G. S. Teor, rendimento e composição química do óleo essencial de manjericão sob doses de cama de frango. **Horticultura Brasileira**, Brasília, v. 27, n. 3, p. 349-353, Set. 2009. http://dx.doi.org/10.1590/S0102-05362009000300016

MARTINAZZO, P. A. **Secagem, armazenamento e qualidade de folhas de *Cymbopogon citratus* (D.C.) Stapf.** 2006. 156 f. Tese (Doutorado em Engenharia Agrícola) - Universidade Federal de Viçosa, Viçosa, 2006.

PESSOA, L. M.; MORAIS, S. M.; BEVILAQUA, C. M.; LUCIANO, J. H. S.; Anthelmintic activity of essential oil of *Ocimum gratissimum* Linn. and eugenol against Haemonchus contortus. **Veterinary Parasitology,** Amsterdam, v. 109, n. 1-2, p. 59-63, Out. 2002. http://dx.doi.org/10.1016/S0304-4017(02)00253-4

POLITEO, O.; JUKIC, M.; MILOS, M. Chemical composition and antioxidant capacity of free volatile aglycones from basil (*Ocimum basilicum* L.) comparedwith its essential oil. **Food Chemistry,** Amsterdam, v. 101, n. 1, p. 379-385, Fev. 2007. http://dx.doi.org/10.1016/j.foodchem.2006.01.045

RADUNZ, L. L.; MELO, E. C.; MARTINS, P. M.; SANTOS, R. H. S.; SANTOS, R. R.; MACHADO, M. C. Secagem de alecrim pimenta (*Lippia sidoides* Cham.) em secador de leito fixo. **Revista Brasileira de Plantas Medicinais,** Botucatu, v. 5, n. 1, p. 79-82, 2002.

SAJJADI, S. E. Analysis of the essential oil of two cultivated basil (*Ocimum basilicum* L.) from Iran. **Daru**, Isfalan, v. 14, n. 3, p. 128-130, 2006.

SARTORATOTTO, A.; MACHADO, A. L. M.; DELARMELINA, C.; FIGUEIRA, G. M.; DUARTE, M. C. T.; REHDER, V. L. G.; BRAZ. Composition and antimicrobial activity of essential oils from aromatic plants used in Brazil. **Brazilian Journal of Microbiology,** São Paulo, v. 35, n. 4, p. 275-280, 2004. http://dx.doi.org/10.1590/S1517-83822004000300001

SILVA, F.; SANTOS, R. H. S.; ANDRADE, N. J.; BARBOSA, L. C. A.; CASALI, V. W. D.; LIMA, R. R.; PASSARINHO, R. V. M. Basil conservation affected by cropping season, harvest time and storage period. **Pesquisa Agropecuária Brasileira,** Brasília, v. 40, n. 4, p. 323-328, 2005. http://dx.doi.org/10.1590/S0100-204X2005000400002

VANDENDOOL, H.; KRATZ, J. D. J. A generalization of the retention index system including linear temperature programmed gas-liquid partition chromatography. **Journal of Chromatography,** v. 11, p. 463-471, Ago. 1963. http://dx.doi.org/10.1016/S0021-9673(01)80947-X

HERTWIG, I. F. **Plantas aromáticas e medicinais:** plantio, colheita, secagem, comercialização. 2nd edn, São Paulo: Icone, 1991. 414 p.