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Content and Chemical Profile of Essential Oil from Eucalyptus Fresh and Dry Leaves

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Abstract

The essential oils yield, and chemical composition can vary depending on several factors, among them the raw material condition. For this reason, the objective of the present work was to compare the yield and chemical profile of Eucalyptus essential oils [*Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson], obtained from the dried and fresh leaves by hydrodistillation method. The essential oils were obtained after one hour of hydrodistillation, submitted to gravimetric analysis to determine the yield (%, w/w) and GC-FID and GC-MS analysis for chemical profile evaluation. The results showed that the yield of essential oil was higher in the dry leaves, which in turn, also showed changes in essential oil profile.

Keywords: Volatiles; hydrodistillation oil; Citronellal; Citronellol; Myrtaceae, *Corymbia citriodora*

Introduction

The genus Corymbia belongs to the family Myrtaceae and comprises tree species popularly called eucalyptus, which have common characteristics such as rapid growth and productivity, great adaptability, and have different purposes and uses for the industrial, commercial and popular economy sectors [1]. Eucalyptus diversity center is in Australia and some neighboring islands, where more than 700 species have been identified and subdivided into some genera [2,3]. However, it is currently distributed throughout Europe, Africa, Asia and the Americas.

The main product obtained from eucalyptus, is the wood that can be used for the production of coal, for the civil construction like poles and fences and for the obtaining of celullose and paper [4]. The leaves show a diversified aroma that allows the obtaining of essential oils, which constitutes a secondary economic activity for the commercial eucalyptus crop [1].

Essential oils are products extracted from plants through techniques involving steam distillation, hydrodistillation and also by citrus fruit pericarp expression [5]. In the eucalyptus volatile substances are secreted in schizolysigenous cavity, present in abundance in the leaf mesophyll [6,7]. The content and quality of the essential oils obtained from the leaves can vary according to genetic factors, adaphoclimatic and ecological conditions and according to the management adopted after the harvest, as well as, the method adopted during the extraction [3,8-12]. The essential oil contents in the leaves of *Corymbia citriodaora* varying from 0.6 to 5.9% [8] and a chemical profile rich in oxygenated monoterpenes, mainly citronellol and citronellal [10,3,14].

Materials and Methods

General

All procedures were performed at the Laboratory of Medicinal and Aromatic Plants in Federal Rural University of Rio de Janeiro. Eucalyptus, *Corymbia citriodora* (Hook.) K.D. Hill & L.A.S. Johnson, was collected in Federal Rural University of Rio de Janeiro, Seropédica, Rio de Janeiro, Brazil in August (winter) 2016, identified by comparison with existing herbarium specimens of the Biology Institute (UFRRJ). The soil is classified in the haplic planosol class, the mean temperatures in August was 22.7 °C, with rainfall of 33mm and relative humidity values of 68.50% [15].

Essential oil extraction and yield

After harvesting, part of the leaves was separated and dried in a forced-air oven (Eletrolab EL 403, Brazil) at 37 °C for 48 hours, when they reached constant weight. Essential oils from fresh or dried leaves of eucalyptus were obtained by hydrodistillation in a Clevenger apparatus for one hour. The hydrodistilled fraction, containing water and essential oil, was collected and dried with anhydrous Na_2SO_4. The gravimetric analysis to obtain the essential oil yield (%, w/w) was performed based on dry or fresh weight according to the following equation: OE% = (OEW * 100) / LW. Where: EO%, EOW and LW are essential oil yield, essential oil weight and leaf weight respectively.

Essential oil extraction and chemical composition

GC analysis was carried out with a Hewlett-Packard 5890 II apparatus (Palo Alto, USA) equipped with a flame ionization detector (FID), and a split/splitless injector at a 1:20 split ratio was used to separate and detect essential oil constituents. Substances were separated into a VF-5ms fused silica capillary column (30m × 0.25mm i.d., film thickness 0.25µm, Agilent J&W). The oven, injector and detector temperatures were programmed as reported by Adams [16]. The carrier gas used was He (1mL/min). Injected volume was 1µL at a 1:20 split ratio. Percentage of essential oil compounds was calculated from the relative area of each peak analyzed by FID. Essential oils were also analyzed with a GC/MS QP-2010 Plus instrument (Shimadzu, Japan). Carrier gas flow, capillary column and temperature conditions for GC/MS analysis were the same as those described for GC/FID and reported by Adams [16]. Mass spectrometer operating conditions were ionization voltage of 70eV, mass range of 40-400m/z and 0.5scan/s. The compounds' retention indexes were calculated based on co-injection of samples with a C_8-C_{20} hydrocarbon mixture, as reported by van Den Dool and Dec Kratz [17]. Constituents were identified by comparison of their mass spectra with the NIST library (2008) and with those reported by Adams [16].

Statistical analysis

Data were expressed as arithmetic means ± SE and submitted to ANOVA, and differences between means were determined using the Tukey test at P=0.05, using the GraphPad Prism 6.0 software.

Results

Table 1 shows the eucalyptus essential oils chemical profile obtained from fresh and dried leaves, as well as, the essential oils yield (%, w/w). The main substances identified were citronellal (76.1 and 79.5%) and citronellol (15.9 and 14.3%) oxygenated monoterpenes, respectively, in the essential oils of fresh and dried eucalyptus leaves. The main difference observed in the essential oils chemical profile was the absence of the fenchene (monoterpene hydrocarbon) in the dried leaves essential oil and their presence at 1,5% in the fresh leaves essential oil. The yield of essential oil obtained from dried leaves (2.02%, w/w) was higher than that obtained from fresh leaves (0.89%, w/w) of eucalyptus.

Table 1: Yield and chemical profile from fresh and dry leaves of Corymbia citriodora.

Compounds	LRI	KI	Fresh Leaf	Dry Leaf	Mean Test
			-------------- (%) -------------		
Fenchene	953	952	1,5 ± 0,40	-	
Eucalyptol	1028	1031	2,5 ± 0,25	2,5 ± 0,13	
Bergamal	1051	1052	0,9 ± 0,04	0,8 ± 0,05	
Neo-Isopulegol	1142	1148	4,2 ± 0,10	3,4 ± 0,45	*
Citronellal	1152	1153	76,1 ± 0,72	79,5 ± 0,94	*
Citronellol	1228	1225	15,9 ± 0,92	14,3 ± 0,73	
Yield (%, w/w)			0,89 ± 0,09	2,02 ± 0,12	*

LRI – linear retention index, KI – Kovats index, ± standard error, * – significant result based on the Tukey test (n=3 and α=0,05) and (%) – relative to peak area of GC-FID.

Discussion

As the eucalyptus essential oil is a by-product of the crop, the adopted management does not always follow an appropriate procedure aiming at a quality standard adequate to the industrial sectors requirements. If the one hand, the leaves drying process led to an increase by 226% in essential oil yield, on the other, the change in the chemical profile led to an increase of citronellal by 10% and the suppression of fenchene in the essential oil were observed. It is necessary to verify if these chemical changes imply loss or gain of quality from the commercial point of view.

Previous report showed that the essential oils contents varying from 0.6% to 5.9% in dry leaves of *Corymbia citriodora* [8]. However, the variation in essential oil yield, as observed in this work, is relates to the drying process, and similar results were reported by Zrira and Benjilali [12]. Regarding the essential oils chemical profile, several works showed predominance of oxygenated monoterpenes, with citronellal and citronellol being the major substances [10,13,14,18,19], similar to what we present in the present work. Other works also showed small variation in the profile of essential oil due to drying, although it did not drastically alter the quality of the same [3,12].

From the purely economic point of view, the drying process reduces the energy spent during the essential oil extraction, considering that the capacity of raw material allocation in distillation tank is defined by weight and the water reduction in the vegetal tissue allows the allocation of higher amount of raw material.

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Conclusion

From the present work it can be concluded that the drying process did not promoted significant changes in the essential oil composition, based on information available in the literature. Thus, the condition indicated for the *Corymbia citriodora* essential oil extraction involves the drying leaves previously, under the conditions presented in this work.

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Conflict of Interest

This manuscript has not been published and is not under consideration for publication elsewhere. The authors declare if any economic interest or any conflict of interest exists.

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