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Investigation of the volatile fraction of chamomile (*Matricaria recutita* L.) infusions prepared from Brazilian commercial sachets

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Abstract

The aim of this research was to characterize the volatile fraction of teas, prepared from chamomile sachets marketed in the Rio de Janeiro city, using solid phase extraction and chromatographic techniques. Forty two compounds were tentatively or definitely identified. Among them, nineteen (19) compounds were identified for the first time as chamomile constituents. Believing that the samples were collected from reliable producers and suppliers, the identification of these new volatile compounds could be explained by the selectivity of the volatile fraction isolation process. The samples belong to the chemotype A, in which the main component is the bisabolol oxide A. The compounds 1.8-cineol and linalool presented odour activity values greater than one, being classified as potent odorants. The presence of ascaridole, coumarin and 7-methoxycoumarin denotes that this beverage must be consumed with care by specific groups like pregnant women and people that are accomplishing anticoagulant therapy.

Introduction

The tea of chamomile (*Matricaria recutita* L.) is widely consumed by the world population due to its characteristic pleasant flavour and therapeutic properties, like its bactericidal, anti-fungal, anti-malarial, anti-mutagenic, anti-genotoxic, anti-cancer, anti-inflammatory, antioxidant, anti-spasmolytic, anti-chemotactic, anti-platelet, hypocholesterolemic, carminative and sedative actions (Júnior, 2009; Bhaskaran *et al*., 2010; Rahimia *et al*., 2011; Petronilho *et al*., 2012). The consumption of this infusion is rated as more than one million cups per day (Maschi *et al.*, 2008). Almost all of the above mentioned therapeutic properties could be related to compounds that are present in the volatile fraction of this herb, like α-bisabolol and its oxides A and B, chamazulene, cis-spiroether, β- and α-farnesene, α-pinene, β-caryophyllene and its oxide, spathulenol, nerolidol and germacrene D. The concentration of these compounds could vary considerably depending on the environmental conditions and agricultural practices employed during the management of the herb (Szoke *et al.*, 2004; Mohammad *et al*., 2010). So, it was suggested to classify chamomile in different chemotypes based on the concentrations of some of its major volatile compounds. This kind of classification is interesting, since a more efficient phytoterapeutical action could be achieved by the selection of the most appropriate chemotype to treat a specific pathological condition (Rubiolo *et al*., 2006; Mohammad *et al*., 2010; Petronilho *et al*., 2011). In this context, the importance to know the specific chemical composition of the chamomile herb consumed in every region of the world is obvious. The researches related to the volatile bioactive compounds of chamomile are generally focused in its essential oil obtained by the hydrodestillation of its flowers (more than 66% of the scientific publication in this area) (Sashidara *et al*., 2006; Borsato *et al*., 2008). On the other hand, there are very few studies that seek to evaluate the profile and concentration of these compounds in the chamomile teas (Tschiggerl and Bucar, 2012). Comparing the chamomile essential oil with the tea we will probably find significant differences that could influence the therapeutic actions of these products. Besides, every volatile fraction isolation technique presents some degree of selectivity. So, to establish an overall view of the volatile fraction of a specific matrix is necessary to employ several different isolation techniques. Thus, the aim of this work was to investigate the composition of the volatile fraction of the chamomile tea prepared from sachets marketed in the Rio de

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Janeiro city, using a solid phase extraction method instead of hydrodestillation.

Materials and Methods

Samples

Seven different brands of commercial chamomile (reliable providers) were analysed. These samples were marketed as little boxes with ten sachets containing each one about 1.0 g of dry ground chamomile inflorescences.

Isolation of volatile flavour compounds (column extraction method)

Before the preparation of the chamomile tea, 100 µL of an ethanolic solution of pentanoic acid (2.5 µg μL^{-1}) were added to the samples (2.0 g) as an internal standard. This standard compound (LRI = 1710; purity grade ≥ 99%) was purchased from Aldrich (Milwaukee, WI, USA). After that, this material (sample + internal standard) was infused in boiling water (50 mL) with shaking (10 minutes). This extract was cooled with tap water, filtered by gravity and adjusted to a final volume of 100 mL with distilled water. The isolation of the volatile fraction of this solution was developed using a technique modified from a previously proposed method (Moreira *et al*., 2002). First, a glass column (14.0 cm x 1.0 cm i.d.) packed with 700 mg of Porapak Q was activated by heating at 220°C during 3 hours under a N_2 flow of 0.9 - 1.0 L min^{-1}. The chamomile tea was, then, passed through the column by means of a peristaltic pump (Model P-3, Pharmacia, Swiss) at a flow rate of 1.5 mL min^{-1}. After that, the column was inverted and washed with 20 mL of water. Adsorbed volatiles were eluted with 100 mL of acetone and concentrated with a vacuum rotary evaporator system (20°C) and nitrogen to a volume of 200 µL.

Capillary gas chromatography combined with flame ionization detection (GC-FID).

Capillary GC-FID analysis was carried out on a Carlo Erba gas chromatograph model FTV 4300 (Italy) equipped with a FID. The chromatograms were obtained using a Shimadzu Chromatopak C-R6A integrator (Japan). Separation was achieved on a 30 m x 0.25 mm i.d. fused silica capillary column, coated with cross-linked poly (ethylene glycol) 20 M, with a film thickness of 0.25 µm (SupelcowaxTM-10, Supelco, USA). The oven temperature was programmed to rise from 50 to 230°C at 3°C/min. The last temperature was maintained for 30 minutes. The injector temperature was 230°C and the detector was held at 240°C. Helium was the carrier gas at an optimum linear speed of 28 cm s^{-1} (50°C). Samples of 2 µL were injected manually, with a split ratio of 20:1. Retention indexes were estimated by a modified Kovats method (Van den Dool and kratz, 1963), using a C7-C40 alkane mixture (1,000 µg mL^{-1} of each component in hexane). The concentrations of the volatile compounds were estimated by the internal standardization method. Calibration curves were constructed by analysing standard solutions at three different concentrations under identical experimental conditions. In the case of the tentatively identified compounds, the semi-quantification process was performed with regard to the most structurally similar reference compounds available in our laboratory: the concentrations of 1.8-cineol, nerol, limonene diepoxy, dihydrocarveol acetate, trans-carveol, ascaridole and isopinocampheol were estimated with regard to linalool (LRI = 1583); 6-methyl-5-hepten-2-one concentration was estimated with regard to acetoin (LRI = 1278); the concentrations of the alcohols 2-ethyl-hexanol and 4-methyl-5-decanol were estimated with regard to 3-methyl-1-butanol (LRI = 1203); the concentrations of spathulenol, bisabolol oxide A and bisabolol oxide B were estimated with regard to farnesol (LRI = 2368); octadecanal concentration was estimated with regard to decanal (LRI = 1492) and the concentrations of coumarin and 7-methoxycoumarin were estimated with regard to methyl-isoeugenol (LRI = 1995). The present method gave excellent recoveries (≥ 94%) for medium to high boiling volatile compounds. The recovery tests were carried out adding to a sample known quantities of the following volatile compounds: acetoin, linalool, hexanoic acid and benzyl alcohol. The samples were analysed in triplicate before and after the additions. The coefficients of variation (n = 5) of arbitrarily selected twenty peaks were in the range of 16% - 25% for the present method as relative standard deviations. A blank analysis was also carried out to allow the detection of artifacts that belonged to the isolation process.

Capillary gas chromatography combined with mass spectrometry (GC-MS).

Electron-impact mass spectrometric analyses were developed on a gas chromatograph – mass spectrometer system GC-2010Plus/GCMS-QP2010 from Shimadzu (Japan). The column and chromatographic conditions were the same as described for GC-FID analyses. The mass spectrometer was operated at an ionization voltage of 70 eV, taking scans from 20 to 300 m/z in a 1 s cycle. The ion source temperature was maintained at 240°C and the solvent delay was 5 min. The MS identification

was on the basis of comparison with the NIST12. lib and NIST62.lib mass spectral libraries. Besides the mass spectral libraries, the identification was also carried out using reference substances and the comparison between the calculated retention indexes and those available in the scientific literature. Only the compounds identified using at least reference compounds and mass spectral data were considered to be definitely identified.

Results and Discussion

The solid phase extraction method employed in this study produced acetone extracts with strong chamomile tea-like aromas, signalizing that the most important odorants were preserved. A total of 42 volatile compounds were tentatively (16) or definitely (26) identified (Table 1). These volatile compounds were divided in the following groups: terpenic compounds (13 members), hydrocarbons (11), carboxylic acids (6), alcohols (4), ketones (3), aldehydes (2) and miscellanea (3).

A percentage of 31.0% of the volatile compounds could be classified as terpenic compounds. Moreover, this major group was responsible for 73.28% (4,866.8 ppb) of the total content of the acetone extracts. Four terpenic compounds were identified by the first time as commercial chamomile constituents: limonene diepoxy, dihydrocarveol acetate, ascaridole and isopinocampheol. 1.8-Cineol (eucalyptol) has a low odour threshold (OT) in water (12 μg L^{-1}) (Fazzalari, 1978) and its aroma was associated to camphor and eucalyptus (Safayhi *et al*., 1994). The odour activity value (OAV = concentration in ppb/odour threshold in ppb) estimated for this compound in the acetone extracts was 11.5. This OAV > 1 showed that 1.8-cineol was an odour active compound of this matrix. Linalool has an OT in water still lower (6 μg L^{-1}) than 1.8-cineol (Leffingwell and Leffingwell, 1991) and its aroma was associated to orange, flowers and citric notes (Safayhi *et al*., 1994). Linalool OAV in the acetone extracts was 18.5. Thus, linalool must also be considered an odour active compound of the analysed samples. Nerol had an OT in water of 300 μg L^{-1} (Ohloff, 1978) and its aroma was characterized as floral (with a metallic note) and fruity (Jirovetz *et al*., 2006). α-Terpineol (OT in water = 330-353 μg L^{-1}) also showed fruity aroma (Leffingwell and Leffingwell, 1991; Jirovetz *et al*., 2001) and trans-carveol presented an OT in water of 200 μg L^{-1}, with its aroma being described as similar to caraway (Jirovetz *et al*., 2001). These substances can not be considered odor active compounds of this kind of beverage, since their estimated OAVs were lower than 1.0. Bisabolol oxide A was the major compound of the volatile fraction of the samples [(2,071.0 ± 88.8) ppb], representing 31.2% of its total amount. Thus, the chamomile samples selected in this study are probably from the chemotype A (Rubiolo *et al*., 2006). Several substances that belong to the terpenic group have potential to grant important therapeutic properties to the chamomile teas. α-Bisabolol shows antiseptic, sedative, anti-nociceptive, anti-inflammatory, gastric mucosa protective, antioxidant, anti-spasmodic, anti-mutagenic and anti-malarial actions (Mackay and Blumberg, 2006; Van Zyl *et al*., 2006; Kamatou and Viljoen, 2010; Petronilho *et al*., 2012). Bisabolol oxides A and B also show anti-inflammatory and anti-spasmodic actions (Silva *et al.*, 2005; Mckay and Blumberg, 2006). Anti-bacterial activity was ascribed to spathulenol (Limberger *et al*., 2004). Linalool showed anti-inflammatory, anti-nociceptive and anti-hyperalgesic effects in several animal models (Vila *et al.*, 2010). 1.8-Cineol has anti-microbial, anti-fungal, gastroprotective and anti-inflammatory actions (Juergens *et al.*, 2004; Franco *et al*., 2005; Santos *et al*., 2011). The anti-microbial and anti-fungal properties were also attributed to α-terpineol (Cosentino *et al*., 1999; Sibanda *et al.*, 2004). Ascaridole presents sedative, anti-bacterial, anti-fungal, anti-cancer and anti-malarial properties. This compound is also able to inhibit the *Trypanosoma cruzi* and *Leishmania amazonensis* development (Dembitsky *et al*., 2008; Ruiz *et al*., 2008). Ascaridole is the principal component of the Santa Maria herb (*Chenopodium ambrosioides)* essential oil and it is known in the folk medicine as a vermifuge, anthelmintic, emmenagogue and abortive substance (Rimada *et al*., 2007; Dembitsky *et al.*, 2008). Thus, the presence of ascaridole [(639.6 ± 284.3) ppb] in the chamomile teas must be treated with caution, since it may grant beneficial properties and new medicinal applications to this plant, but also some toxicity, mainly for pregnant women.

Around 26.2% of the compounds that were detected in the acetone extracts were classified as hydrocarbons. The majority of these hydrocarbons was aliphatic, acyclic, saturated and unbranched (10), among which tetradecane, pentadecane and nonadecane were identified by the first time in the chamomile tea. The unique aromatic hydrocarbon detected in this study (styrene) was also never mentioned before as a chamomile component. The hydrocarbon group was the second major group in respect to the number of constituents. On the other hand, the quantitative contribution of this group to the total content of the acetone extracts was extremely low (0.59%; 39.4 ppb). Due to the low

Table I. Volatile compounds of the chamomile tea (commercial sachets from Rio de Janeiro city)

Compounds	LRI	LRI from literature	Concentration (ppb, Avg ± SD)
1,8-Cineol[b, c]	1184	1211[5]	137.6 ± 43.3[A]
*Styrene[a,b,c]	1239	1261[18]	Tr
*Acetoin[a,b,c]	1278	1295[1]	54.2 ± 19.0
*Acetol[a,b,c]	1296	1291[12]	33.7 ± 8.8
*Tridecane[a,b,c]	1300	1300[18]	Tr
6-Methyl-5-hepten-2-one[b,c]	1323	1319[18]	Tr[B]
*Tetradecane[a,b,c]	1400	1400[18]	3.7 ± 1.7
2-Ethyl-hexanol[b,c]	1476	1494[7]	Tr[C]
*Pentadecane[a,b,c]	1500	1500[18]	4.5 ± 1.5
*Linalool[a,b,c]	1583	1558[18]	110.9 ± 36.6
*Hexadecane[a,b,c]	1600	1600[18]	5.9 ± 1.5
Nerol[b,c]	1633	1753[18]	102.0 ± 27.2[A]
4-Methyl-5-decanol[b]	1645	na	4.3 ± 0.8[C]
*α-Terpineol[a,b,c]	1678	1687[2]	135.4 ± 58.8
Limonene diepoxy[b]	1690	na	Tr[A]
Dihydrocarveol acetate[b,c]	1698	1670[18]	621.8 ± 97.7[A]
*Octadecane[a,b,c]	1800	1800[18]	3.7 ± 0.9
Trans-carveol[b,c]	1829	1790[2]/1847[1]	152.2 ± 76.5[A]
*Hexanoic acid[a,b,c]	1831	1829[18]/1851[1]	59.8 ± 35.3
Ascaridole[b,c]	1843	1812[2]	639.6 ± 284.3[A]
*Benzyl alcohol[a,b,c]	1850	1847[13]/1822[3]	5.4 ± 1.3
*Phenylethyl alcohol[a,b,c]	1893	1882[15]/1934[6]	Tr
*Nonadecane[a,b,c]	1900	1900[18]	5.1 ± 1.7
Isopinocampheol[b]	1916	na	180.9 ± 51.1[A]
*Methyl-isoeugenol[a,b,c]	1995	2023[9]	36.8 ± 3.5
*Eicosane[a,b,c]	2000	2000[11]	Tr
*p-Anisaldehyde[a,b,c]	2005	2038[8]	Tr
*Octanoic acid[a,b,c]	2042	2083[18]	395.2 ± 56.31
Spathulenol[b,c]	2096	2118[16]/2124[10]	93.7 ± 22.1[D]
Bisabolol oxide B[b,c]	2115	2125[16]/2156[15]	282.1 ± 44.4[D]
*Nonanoic acid[a,b,c]	2147	2202[18]	111.5 ± 61.2
*α-Bisabolol[a,b,c]	2188	2200[5]/2214[16]	339.6 ± 222.1
*Decanoic acid[a,b,c]	2253	2270[2]/2290[16]	111.8 ± 43.2
Octadecanal[b,c]	2357	2354[11]	32.3 ± 6.8[E]
Bisabolol oxide A[b,c]	2391	2420[16]/2438[15]	2071.0 ± 88.8[D]
Coumarin[b,c]	2433	2465[17]	75.1 ± 17.2[F]
*Dodecanoic acid[a,b,c]	2465	2517[18]	57.1 ± 9.5
*Pentacosane[a,b,c]	2500	2500[11]	4.7 ± 1.8
*Hexacosane[a,b,c]	2600	2600[11]	6.9 ± 0.6
*Heptacosane[a,b,c]	2700	2700[11]	4.9 ± 1.2
*Hexadecanoic acid[a,b,c]	2876	2920[14]	122.7 ± 53.4
7-methoxy-coumarin[b,c]	2977	2981[4]	635.2 ± 102.6[F]

[a]Identified by coelution with standard volatile compounds; [b]Identified by the mass spectra data; [c]Identified by comparing the calculated LRI with the theoretical LRI (literature); na – not available; *compound considered definitely identified (identified at least by coelution with standard volatile compounds and mass spectra data); LRI – modified Kovats index[29] calculated using C7 – C40 alkanes; Avg - average value; SD - standard deviation; Tr - trace amount (< 1.0 ppb); References: 1 - Boonbumrung *et al.*, 2001; 2 - Hadacek and Weber, 2002; 3 - Pino *et al.*, 2002; 4 - Chisholm *et al.*, 2003; 5 - Raal *et al.*, 2003; 6 - Comuzzo *et al.*, 2006; 7 – Viegas and Bassoli, 2007; 8 - Zeller and Rychlik, 2007; 9 - Schossler *et al.*, 2009; 10 - Orav *et al.*, 2010; 11 - Zito *et al.*, 2010; 12 - Chin *et al.*, 2011; 13 - Meret *et al.*, 2011; 14 - Raal *et al.*, 2011; 15 - Can *et al.*, 2012; 16 - Raal *et al.*, 2012; 17 – Flavornet and 18 – Pherobase. A - concentration given in ppb linalool equivalent; B - concentration given in ppb acetoin equivalent; C - concentration given in ppb 3-methyl-1-butanol equivalent; D - concentration given in ppb farnesol equivalent; E - concentration given in ppb decanal equivalent; F - concentration given in ppb methyl-isoeugenol equivalent.

concentrations of the hydrocarbons and to their probably high OTs, none of them could be classified as a powerful odorant. There are also no information in the literature about the contribution of these compounds to the pharmacological properties of the chamomile teas.

The organic acid group was composed by 6 saturated fatty acids (14.3% of the diversity of the identified compounds). Besides, this group was responsible by a mean value of 12.92% (858.1 ppb) of the total content of the acetone extracts of these teas. Octanoic and dodecanoic acids were identified by the first time as chamomile constituents. The most common odoriferous notes attributed to the fatty acids identified in the present work were sweat, rancidity and cheese-like aroma (Boonbumrung *et al.*, 2001; Comuzzo *et al.*, 2006; Jiang *et al.*, 2008). In water, the OTs of hexanoic, octanoic, nonanoic, decanoic, dodecanoic and hexadecanoic acids were 1,840 μg L^{-1}, 3,000 μg L^{-1}, 3,000 μg L^{-1}, 130 μg L^{-1}, 10,000 μg L^{-1} and 10,000 μg L^{-1}, respectively (Fazzalari, 1978; Boonbumrung *et al.*, 2001). Based on the concentrations of these fatty acids in the chamomile teas and in the above-mentioned OTs, the OAVs of the group were estimated between the range of 0.0057 (dodecanoic acid) and 0.86 (decanoic acid).

Thus, their contribution to the overall aroma of the chamomile teas should be considered despicable. Concerning the pharmacological properties, decanoic and hexadecanoic acids exhibit antibacterial and anti-fungal activities (Cañas-Rodriguez and Smith, 1996; Bodoprost and Rosemeyer, 2007; Kumar *et al*., 2011).

There were 4 members in the alcohol group, representing 9,5% of the diversity of compounds identified in the chamomile teas. 2-Ethyl-hexanol, 4-methyl-5-decanol and phenylethyl alcohol were detected by the first time in this matrix. Concerning the quantitative aspect, this group (0.15% - 9.7 ppb) was the less important. Due to the low concentrations of these alcohols and to its high odour thresholds in water (e.g., benzyl alcohol OT = 10,000 μg L^{-1}; phenylethyl alcohol OT = 750-1,100 μg L^{-1}), the compounds of this group were not considered aroma impact volatiles (Buttery *et al.*, 1988). Benzyl alcohol can act increasing the lipid fluidity of the cellular membrane (Ebihara *et al.*, 1979) and exhibits antioxidant activity (Politeo *et al*., 2007). In turn, phenylethyl alcohol is capable to exert inhibitory effect against the development of several Gram-negative microorganisms (Lilly *et al*., 1953).

Only three ketones were detected in the volatile fraction of the chamomile teas (acetoin, acetol and 6-methyl-5-hepten-2-one), representing 7.1% of the diversity of compounds in these beverages. The ketone group is responsible for 1.32% (87.9 ppb) of the total content of the acetone extracts. Acetoin (3-hydroxy-2-butanone) and acetol (1-hydroxy-propanone) had not been identified as chamomile tea constituents until now. Different values were available in the scientific literature to the odour threshold in water of the acetoin. According to Buttery *et al.* (1990), for instance, acetoin showed an odour threshold in water of 800 μg L^{-1}. Notwithstanding, Boonbumrung et al. (2001) impute to acetoin an odour threshold in water of 14 μg L^{-1}. Based on the concentration of acetoin indicated on Table 1 and on the above mentioned odour thresholds, two OAVs were estimated for this ketone: 0.068 (OAV < 1) and 3.87 (OAV > 1). Thus, we were in doubt about the actual contribution of this compound to the overall aroma of the chamomile teas. 6-Methyl-5-hepten-2-one showed a low odour threshold in water (50 μg L^{-1}) (Buttery *et al.*, 1990), but it was not classified as an odour active compound due to its extremely low concentration in the acetone extracts. There are no important pharmacological effects on the human organism attributed to the above-mentioned ketones.

Close to 4.8% of the compounds listed on Table 1 could be classified as aldehydes (p-anisaldehyde and octadecanal). Both of them were indicated by the first time as chamomile constituents, representing only 0.49% (32.3 ppb) of the total content of the acetone extracts. The odour threshold in water of p-anisaldehyde was 47 μg L^{-1} and its aroma was described as almond and anise-like (Zeller and Rychlik, 2007). This aldehyde presents acaricide activity (Shojaii and Fard, 2012). Octadecanal held an oil aroma (Choi, 2003), but its odour threshold was not available. This compound seems to possess anti-microbial activity (Zito *et al*., 2010).

In the miscellanea group we found the following compounds: methyl-isoeugenol, coumarin and 7-methoxy-coumarin. Among them, only 7-methoxy-coumarin had already been identified as a component of the volatile fraction of chamomile. These three compounds represented together 7.1% of the diversity of compounds listed on Table 1 and 11.25% (747.1 ppb) of the total content of the analysed acetone extracts. Apparently, this group did not present powerful odorants that could actually influence the aroma of this kind of tea. Methyl-isoeugenol, for instance, with its smoke and clove-like aroma, had an odour threshold in water of 68 μg L^{-1} and an OAV of about 0.54 (Buttery *et al.*, 1974). 7-Methoxy-coumarin was the major component of the miscellanea group [(635.2 ± 102.6) ppb]. This compound showed a woody, balsamic and caramel-like aroma and an odour threshold of 9,500 μg kg^{-1} in cellulose (Chisholm *et al*., 2003; Zeller and Rychlik, 2007). Thus, it could not be classified as an odour active compound of the analysed chamomile teas. In respect to the pharmacological actions of the miscellanea group, we could detach the presence of coumarin and 7-methoxy-coumarin, since many coumarins are recognized as anti-tumor, anti-bacterial, anti-fungal, anti-inflammatory and anti-coagulant agents (Manolov and Danchev, 1995, Emmanuel-Giota *et al*., 2001; Al-Haiza *et al.*, 2005). Due to the presence of these coumarinic substances, the ingestion of excessive doses of the chamomile teas would not be recommended for people who were undergoing anti-coagulant therapy.

Conclusions

The composition of the volatile fraction of the chamomile teas was partially characterized. The isolation technique used in this work produced acetone extracts with a characteristic chamomile tea-like aroma. Believing that the samples were collect from reliable producers and suppliers, the identification of 19 new volatile compounds in this beverage could be explained by the selectivity of the

analytical approach employed in this study, mainly in respect to the volatile fraction isolation process. The compounds 1.8-cineol, linalool and, maybe, acetoin had the potential to greatly influence the overall aroma of the chamomile teas. The composition of these teas showed some differences in relation to the profile normally found in the chamomile essential oils. For instance, the diversity of terpenic compounds found in the teas seemed to be lower than that noted in its essential oils. Thus, we can infer that the chemical and medicinal properties of the chamomile essential oil are not entirely reproduced in the teas. The presence of some compounds (ascaridole, coumarin and 7-methoxycoumarin) denotes that this beverage must be consumed with care by specific population groups like, for instance, pregnant women and people that are accomplishing anticoagulant therapy.

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