A comparison of the nutritional contribution of thirty-nine aromatic plants used as condiments and/or herbal infusions

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Running title: Nutritional contribution of aromatic plants

Abstract

Aromatic plants have been used worldwide in human diet to improve the flavor and taste of meals or as herbal infusions. Beyond the culinary purposes, these plants are also used for their medicinal purposes, as antimicrobial, anti-inflammatory, antimutagenic and anti-carcinogenic, among others. In the present study, thirty-nine species of condiments and/or herbal infusions were assessed in order to provide scientific information concerning their nutritional value and energetic contribution; furthermore, the fatty acids composition was also evaluated. Carbohydrates were the most abundant compounds in the condiments that also revealed a varied range of sugars with fructose, glucose, sucrose and trehalose detected in all the condiments. In respect to fatty acids, PUFA were prevalent with the great contribution of linoleic and α-linolenic acids among the different thirty-two detected fatty acids. The herbal infusions revealed low quantities of sugars with most of the plants revealing fructose, glucose and sucrose. In a general way, the energetic value of the condiments and herbal infusions was very low and these plants revealed good nutritional properties that make them suitable for a balanced and diversified low caloric diet. The results obtained in the present systematization study will allow the readers to perform easy and quick comparisons among these different aromatic plants regarding nutritional purposes.

Keywords: Aromatic plants; Condiments/Herbal infusions; Macronutrients; Energetic contribution; Nutritional database

Introduction

Aromatic plants have been used worldwide for centuries for nutritional and medicinal purposes. Traditionally, these plants are used fresh, dried, whole, chopped or ground, and are prepared from several plant parts such as bark (cinnamon), flowers (lavender), roots (ginger), fruits (pimento), fully ripe berries (white pepper) or leaves (rosemary) [1], being added to improve the flavor and taste of meals and substitute the excessive use of salt or fatty condiments [2] or used as herbal infusions, known for their attractive aroma and specific taste [3]. Beyond the culinary purposes, aromatic plants are also used in folk medicine as carminative agents against bronchitis and ulcers, as diuretics, depuratives and vermifuges, as also for their antiscorbutic, antispasmodic, tonic, antimicrobial, anti-inflammatory, antimutagenic and anti-carcinogenic properties [4-8]. Indeed, herbs and spices are perceived since antiquity as functional foods and are still recommended in contemporary dietary programs to provide additional physiological benefits to the normal nutritional requirements as well as prevent or delay the onset of chronic diseases [9, 10]. Previous studies describe the benefits of a diversified diet based on leafy greens and relate it to phytochemicals, both nutrient and non-nutrient [11]. Most of the studies highlight their high contents in micronutrients such as vitamins and minerals [12], that are able to improve general health acting as antidote to heavy metals and in the prevention of several diseases such as cancer, arteriosclerosis, cataract, diabetes and liver cirrhosis, among others [13].

Nevertheless, despite the increasing recognition of the relevance of biodiversity for improved nutrition and the awareness of the risks inherent to nutritional deficiency [14, 15], there is a growing loss of diversity of these herbs [16].

In this framework, and given the important role of aromatic plants in human nutrition and health, the present work aimed to provide scientific information concerning the nutritional value and energetic contribution of plant species widely used as condiments and/or infusions; furthermore, the fatty acids composition of the condiments was also assessed, once they are directly introduced in food preparations. Although different authors [17-19] have previously reported the nutritional contribution of some of these species (*Foeniculum vulgare* Mill., *Laurus nobilis* L., and *Hibiscus sabdariffa* L.), herein we aimed to systematize, for an easier comparison, the results obtained for thirty-nine condiments and/or herbal infusions, including the most consumed worldwide.

Materials and Methods

Samples and samples preparation

The samples were obtained from Cantinho das Aromáticas, organic farmers from Vila Nova de Gaia (Portugal), as dry material for direct use as condiment and/or for herbal infusion preparation. Among the thirty-nine species, twelve are used as condiment, fourteen are used as condiment and for infusion preparation, and thirteen only for infusion preparation. For the performed assays, the condiments were previously reduced to powder, while to prepare the infusions the material was directly used. The last were prepared according to the recommended conditions for each species, by adding 500 mL of distilled water (in temperatures ranging from 75 to 90ºC) to 1.5 g of dry material, and left to stand from 5 to 10 minutes. More details regarding the studied samples are provided in Fig. 1.

Standards and reagents

Acetonitrile 99.9% was of HPLC grade from Fisher Scientific (Lisbon, Portugal). Fatty acids methyl ester (FAME) reference standard mixture 37 (standard 47885-U) was purchased from Sigma (St. Louis, MO, USA), as also were other individual fatty acid isomers and sugar standards. All other chemicals and solvents were of analytical grade and purchased from common sources. Water was treated in a Milli-Q water purification system (TGI Pure Water Systems, Greenville, SC, USA).

Nutritional value

Protein, fat, carbohydrates and ash were determined following the AOAC procedures [20]. The samples crude protein content (N×6.25) was estimated by the Kjeldahl method; the crude fat was determined using a Soxhlet apparatus by extracting a known weight of sample with petroleum ether; the ash content was determined by incineration at 600±15 °C. Total carbohydrates were calculated by difference and total energy was calculated according to the following equations: Energy (kcal)=4×(g protein+g carbohydrates)+9×(g fat).

Sugars

Free sugars were determined by high performance liquid chromatography coupled to a refraction index detector (HPLC-RI), after an extraction procedure previously described by the authors [21]. The equipment consisted of an integrated system with a pump (Knauer, Smartline system 1000, Berlin, Germany), degasser system (Smartline manager 5000), auto-sampler (AS-2057 Jasco) and an RI detector (Knauer Smartline 2300), operating at 30 ºC (7971 R Grace oven). The chromatographic separation was achieved with a Eurospher 100-5 NH_2 column (4.6 × 250 mm, 5 mm, Knauer) operating at 30 ºC (7971 R Grace oven). Sugars identification was made by comparing the relative retention times of sample peaks with standards. Data were analyzed using Clarity 2.4 Software (DataApex, Prague, Czech Republic). Quantification was based on the RI signal response of each standard, using the internal standard (IS, melezitose) method and by using calibration curves obtained from commercial standards of each compound. Sugar contents were further expressed in g per 100 g of dry weight for condiments and mg per 100 mL for infusions.

Fatty acids

Fatty acids were determined after a lipid extraction of the sample (3 g) using a Soxhlet apparatus with petroleum ether; afterwards a transesterification procedure was applied to the lipid extract as described previously by the authors [21], and the analysis was performed using a gas chromatography equipment (DANI 1000, Contone, Switzerland), with a split/splitless injector and a flame ionization detector (FID at 260 ºC) and a Macherey-Nagel (Duren, Germany) column (50% cyanopropyl-methyl-50% phenylmethylpolysiloxane, 30 m × 0.32 mm ID × 0.25 µm d_f). Fatty acids identification was made by comparing the relative retention times of FAME peaks from samples with standards. The results were recorded and processed using CSW 1.7 software (DataApex 1.7, Prague, Czech Republic), and expressed in relative percentage.

Statistical analysis

For all the experiments three samples were analyzed and all the assays were carried out in triplicate. The results are expressed as mean values and standard deviation (SD). The results were analyzed using one-way analysis of variance (ANOVA) followed by Tukey's HSD Test with $\alpha = 0.05$. This treatment was carried out using SPSS v. 22.0 program (SPSS Inc.).

Results and Discussion

Nutritional contribution of the condiments

The nutritional value and energetic contribution of the species used as condiments are shown in **Table 1**. Carbohydrates were the most abundant macronutrients in all the species, with *Thymus x citriodorus*, *T. mastichina* and *T. vulgaris* revealing the highest values, without significant statistical differences (91.51, 91.10 and 91.08 g/100 g), while *Anethum graveolens* presented the lowest content (71.36 g/100 g). These compounds can function as signaling, recognition and adhesion molecules, being involved in many important physiological functions such as normal embryonic development, growth, cell-cell recognition, host-pathogen interaction during infection, diseases development and metastasis, among others [22, 23]. *Foeniculum vulgare* revealed the highest amount of protein (14.14 g/100 g), followed by *Anethum graveolens* (10.17 g/100 g), whereas this species showed the highest ash content (16.46 g/100 g) and *Capsicum* sp. gave the highest amount of fat (4.55 g/100 g). The plants that revealed the lowest amount of fat were *Satureja montana*, *Chamaespartium tridentatum*, *Petroselinum crispum* and *Mentha pulegium* (0.60, 0.63, 0.74 and 0.77 g/100 g, respectively). The results obtained for *F. vulgare*, in terms of ash and carbohydrates amount, are in agreement with a previous study [17], despite the differences in protein and fat contents. In respect to the nutritional composition of *Laurus nobilis*, the results found in a previous study performed by Dias et al. [18] were quite similar to those obtained in the present work.

Regarding to sugars composition (Table 1), all the studied condiments revealed the presence of fructose, glucose, sucrose and trehalose. The highest amount of fructose was found in *Allium schoenoprasum* (11.28 g/100 g), being the latest and *Petroselinum crispum* the richest plants in glucose (5.99 and 6.20 g/100 g). On the other hand, sucrose was detected in highest quantities in *Cymbopogon citratus* and *Thymus x citriodorus* (9.75 g/100 g), whereas trehalose was mostly found in *Anethum graveolens* and *Origanum majorana* (1.40 g/100 g). Raffinose was identified in *Foeniculum vulgare* (1.18 g/100 g), *Thymus x citriodorus* (0.71 g/100 g) and *Stevia rebaudiana* (0.19 g/100 g), while turanose was found in *Laurus nobilis* (1.02 g/100 g) and xylose in *Aloysia triphylla* (4.30 g/100 g), *Stevia rebaudiana* (4.21 g/100 g) and *Thymus mastichina* (1.13 g/100 g). Differently from the results described in a previous work [18] where *Laurus nobilis* wild and cultivated samples only revealed the presence of fructose, glucose and sucrose, herein this plant also presented trehalose and turanose, which could be explained by the different origins or even by the possible different ripeness of the plant. Similar differences were observed in comparison to the results described by Barros et al. [17] that reported the presence of fructose, glucose and sucrose in *Foeniculum vulgare* leaves whereas in the present work, trehalose and raffinose were also found. Unknown sugars were detected in *Origanum majorana* (9.45 g/100 g), *Origanum vulgare* (9.05 g/100 g) and *Stevia rebaudiana* (12.24 g/100 g), and were also found in amounts varying between 1.09 g/100 g and 2.34 g/100 g in *Artemisia dracunculus*, *Capsicum sp.*, *Cymbopogon citratus*, *Mentha x piperita* and *Petroselinum crispum*. *Stevia rebaudiana* was the species that revealed the highest variety of sugars, with seven different sugars quantified. Energetically, *Capsicum* sp. gave the highest results followed by *Laurus nobilis* (399.30 and 395.76 kcal/100 g); the lowest values of energy were given by *Anethum graveolens* and *Ocimum basilicum* (344.25 and 342.75 g/100 g), without significant statistical differences.

Table 1 presents the main fatty acids among the thirty-two different fatty acids found in the condiments. *Chamaespartium tridentatum* revealed the highest percentage of saturated fatty acids (SFA; 60.12%), with the significant contribution of palmitic

(C16:0, 25.66%) and arachidic (C20:0, 13.39%) acids. The latest fatty acid was also found in *Artemisia dracunculus* in a percentage of 6.91. *Capsicum* sp. revealed a prevalence of monounsaturated fatty acids (MUFA) with high percentages of oleic acid (C18:1n9, 19.26%), while *Allium schoenoprasum* and *Foeniculum vulgare* presented the highest percentages of polyunsaturated fatty acids (PUFA), both with large percentages of linoleic (C18:2n6; 22.85 and 24.38%, respectively) and α-linolenic (C18:3n3; 47.77 and 45.89%, respectively) acids, which is in agreement with the results reported by Barros et al. [17] in what concerns *F. vulgare*. Given the important roles of linoleic and α-linolenic acids as precursors of omega-6 and omega-3 fatty acids and the fact that these compounds cannot be synthesized in the human body and must be obtained from diet [24], it is of great interest to verify their presence in the studied plants. In a general way, the studied species revealed higher quantities of PUFA (29.19-71.72%), followed by SFA (25.41-60.12%) and MUFA (1.86-21.11%). Regarding to fatty acids, the results obtained for *Laurus nobilis* in the present study were quite different from those reported by Dias et al. [18], where the SFA and PUFA percentages were, respectively, higher (65.11%) and lower (24.01%) than the quantified herein (44.05% and 48.40%, respectively); despite these discrepancy, the percentage of MUFA was similar in both studies. Myristic acid (C14:0) was present in *Petroselinum crispum*, *Thymus mastichina* and *Thymus x citriodorus* in amounts varying from 5.20 to 16.04%; *Rosmarinus officinalis*, *Lavandula angustifolia* and *Petroselinum crispum* also presented caproic acid (C6:0, 10.78%), pentadecylic acid (C15:0, 5.05%) and lignoceric acid (C24:0, 11.23%). As far as we know, there are no studies performed in most species herein studied, which corroborates the importance of describing these plants in order to promote their rational use.

Nutritional contribution of the herbal infusions

For the herbal infusions analyzed (Table 2), fructose, glucose and sucrose were detected in very low amounts, with concentrations ranging from 6.15 to 26.80 mg/100 mL. The infusions of *Aloysia triphylla*, *Echinacea purpurea*, *Gomphrena globosa*, *Gomphrena globosa var. albiflora*, *Gomphrena haageana*, *Gomphrena* sp., *Ocimum basilicum* and *Rosmarinus officinalis* did not reveal the presence of any carbohydrate. The highest content of fructose was found in *Chamaespartium tridentatum* (13.60 mg/100 mL), that also showed glucose (5.40 mg/100 mL); this sugar was found in higher amounts in *Equisetum* ssp (12.65 mg/100 mL), also revealing fructose (7.70 mg/100 mL). Regarding to sucrose, *Cymbopogon citratus* revealed the highest concentration (11.50 mg/100 mL); this infusion also presented fructose and glucose (2.55 and 6.40 mg/100 mL, respectively). Among all the infusions, *Lavandula angustifolia* gave the highest energetic contribution (107.20 cal/100 mL), whereas *Mentha x piperita* (25.20 cal/100 mL), *Thymus x citriodorus* (24.60 cal/100 mL) and *Thymus mastichina* (33.60 cal/100 mL) presented the lowest energy, without significant statistical differences. At the best of our knowledge, there are no previous reports of the nutritional composition of these herbal infusions.

In conclusion, the thirty-nine studied aromatic plants presented suitable nutritional properties for inclusion in low caloric diets with, generally, a very low energetic contribution. Carbohydrates were the most abundant compounds in the condiments that also revealed a varied range of sugars. In respect to fatty acids, PUFA were prevalent with the great contribution of linoleic and α-linolenic acids. The herbal infusions showed low quantities of sugars with most of the plants presenting fructose, glucose and sucrose. With the present study it was possible to deepen the knowledge of several species nutritional parameters in order to corroborate the relevance of their contribution for an enhanced human nutrition, and highlight the importance of a diversified diet. Furthermore, the majority of the studies with plants consumed as infusions that are available in literature do not include analyses in the infusion (which is the real consumed form), but in dry material. Besides, the samples supplier develops an important work on the optimization of the ideal temperature to prepare the infusions (reported in Fig. 1). The present work includes novel and systematic information that will provide readers with an important comparison among the most consumed aromatic plants (most of the articles report studies in one or two species, spraying the information and defaulting an integrated analysis).

Conflict of Interest

The authors declare they have no conflict of interest.

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Figure legends

Figure 1. Additional information regarding the studied samples, including the temperature and time for herbal infusions preparation.

Table 1. Nutritional parameters (g/100 g dw, unless for fatty acids- relative percentage) and energetic value (kcal/100 g dw) of the condiments (mean ± SD).

Sample	Protein	Ash	Carbohydrates	Sugars					Energy
				Fructose	Glucose	Sucrose	Trehalose	Total	
Allium schoenoprasum	0.37 ± 0.01r	7.63 ± 0.11l	88.55 ± 0.16de	11.28 ± 0.55a	5.99 ± 0.07a	2.59 ± 0.10gh	1.12 ± 0.07cd	20.98 ± 0.59c	386.74 ± 0.11d
Aloysia triphylla	0.93 ± 0.02o	8.16 ± 0.34jk	89.73 ± 0.28b	0.67 ± 0.02mn	0.39 ± 0.01k	0.54 ± 0.03no	0.43 ± 0.01i	6.33 ± 0.08mno	373.27 ± 0.77jk
Anethum graveolens	10.17 ± 0.47b	16.46 ± 0.18a	71.36 ± 0.16o	3.30 ± 0.04c	2.95 ± 0.01f	5.85 ± 0.02d	1.40 ± 0.04a	13.50 ± 0.02f	344.25 ± 0.35r
Artemisia dracunculus	0.70 ± 0.02q	8.62 ± 0.29ij	88.49 ± 0.28de	2.37 ± 0.04e	0.08 ± 0.01l	2.52 ± 0.38h	0.72 ± 0.01g	8.03 ± 0.37l	376.40 ± 0.47i
Capsicum sp.	3.64 ± 0.01k	5.87 ± 0.29pq	85.94 ± 0.05hij	1.81 ± 0.03gh	1.64 ± 0.06h	1.42 ± 0.09l	0.21 ± 0.08jk	6.17 ± 0.14no	399.30 ± 1.58a
Chamaespartium tridentatum	7.11 ± 0.04e	2.31 ± 0.09s	89.95 ± 0.09b	8.05 ± 0.16b	3.24 ± 0.13e	0.30 ± 0.00o	0.10 ± 0.01k	11.69 ± 0.28h	393.87 ± 0.15bc
Coriandrum sativum	1.61 ± 0.05m	14.76 ± 0.02c	82.00 ± 0.04mn	3.09 ± 0.05cd	2.31 ± 0.16g	7.63 ± 0.18b	0.95 ± 0.04ef	13.98 ± 0.43f	349.14 ± 0.33q
Cymbopogon citratus	3.29 ± 0.14l	7.84 ± 0.38kl	86.19 ± 0.18ghi	0.84 ± 0.04lm	3.79 ± 0.28c	9.75 ± 0.30a	0.27 ± 0.01j	15.38 ± 0.70e	382.04 ± 1.53ef
Foeniculum vulgare	14.14 ± 0.54a	13.08 ± 0.14d	71.50 ± 0.06o	1.77 ± 0.06hi	2.97 ± 0.16f	2.18 ± 0.10ij	0.95 ± 0.04ef	9.05 ± 0.16k	354.08 ± 0.57p
Laurus nobilis	5.36 ± 0.11i	4.98 ± 0.09r	86.53 ± 0.16g	2.41 ± 0.01e	3.39 ± 0.04de	3.50 ± 0.03f	0.14 ± 0.01k	10.46 ± 0.02ij	395.76 ± 0.27b
Lavandula angustifolia	3.32 ± 0.17l	5.43 ± 0.04qr	88.28 ± 0.01ef	3.18 ± 0.03cd	4.51 ± 0.03b	2.32 ± 0.12hi	0.52 ± 0.01i	10.53 ± 0.05i	393.12 ± 0.22c
Mentha cervina	5.86 ± 0.23g	6.93 ± 0.14m	85.82 ± 0.15ij	3.34 ± 0.07c	3.54 ± 0.11d	2.13 ± 0.04ij	0.65 ± 0.01g	9.66 ± 0.01k	379.20 ± 0.17gh
Mentha pulegium	0.76 ± 0.03pq	9.60 ± 0.06g	88.87 ± 0.06cd	1.51 ± 0.01ij	1.52 ± 0.01hi	1.96 ± 0.09jk	0.63 ± 0.01gh	5.62 ± 0.10o	365,43 ± 0.10n
Mentha spicata	6.39 ± 0.32f	9.18 ± 0.17gh	83.31 ± 0.10l	1.49 ± 0.03ij	1.36 ± 0.02i	2.89 ± 0.06g	0.66 ± 0.01g	6.40 ± 0.07mn	368.86 ± 0.60m
Mentha x piperita	5.66 ± 0.28h	10.20 ± 0.48f	81.77 ± 0.29n	1.25 ± 0.08jk	1.31 ± 0.01i	0.82 ± 0.03n	0.53 ± 0.02hi	3.91 ± 0.03p	371.07 ± 1.67klm
Ocimum basilicum	0.89 ± 0.04op	15.60 ± 0.14b	82.49 ± 0.12m	0.52 ± 0.01n	0.40 ± 0.01k	1.02 ± 0.07m	0.85 ± 0.05f	2.79 ± 0.12q	342.75 ± 0.33r
Origanum majorana	7.26 ± 0.34d	5.01 ± 0.09r	86.38 ± 0.25gh	2.95 ± 0.06d	4.42 ± 0.11b	5.80 ± 0.08d	1.37 ± 0.11a	23.99 ± 0.36b	386.72 ± 0.49d
Origanum vulgare	0.62 ± 0.01q	8.97 ± 0.01hi	89.15 ± 0.04c	0.60 ± 0.03mn	1.41 ± 0.07hi	6.90 ± 0.38c	0.87 ± 0.05f	18.82 ± 1.11d	370.40 ± 0.25lm
Petroselinum crispum	0.65 ± 0.03q	10.69 ± 0.42ef	87.91 ± 0.30f	2.30 ± 0.25ef	6.20 ± 0.25a	2.07 ± 0.25ij	0.29 ± 0.01j	12.60 ± 0.07g	360.92 ± 1.17o
Rosmarinus officinalis	3.96 ± 0.11j	6.30 ± 0.05nop	86.07 ± 0.17ghij	1.03 ± 0.01kl	1.04 ± 0.03j	1.98 ± 0.06jk	0.47 ± 0.03i	4.52 ± 0.05p	393.17 ± 0.50c
Salvia officinalis	3.33 ± 0.01l	11.10 ± 0.12e	82.31 ± 0.03m	2.92 ± 0.09d	3.24 ± 0.17e	2.01 ± 0.04ijk	1.32 ± 0.12ab	9.49 ± 0.35k	371.91 ± 0.88kl
Satureja montana	7.57 ± 0.05c	6.94 ± 0.09m	84.89 ± 0.06k	2.06 ± 0.04fg	2.15 ± 0.09g	1.71 ± 0.05kl	0.96 ± 0.04ef	6.88 ± 0.22mn	375.22 ± 0.31ij
Stevia rebaudiana	5.56 ± 0.23h	7.51 ± 0.37l	85.56 ± 0.27j	2.46 ± 0.06e	3.50 ± 0.08d	3.93 ± 0.14e	1.02 ± 0.01de	27.55 ± 0.20a	376.85 ± 0.96hi
Thymus mastichina	1.33 ± 0.01n	6.11 ± 0.30op	91.10 ± 0.19a	2.33 ± 0.04ef	2.10 ± 0.18g	3.30 ± 0.07f	0.87 ± 0.07f	9.73 ± 0.12jk	382.88 ± 1.01e
Thymus vulgaris	0.67 ± 0.03q	6.67 ± 0.06mn	91.08 ± 0.01a	1.60 ± 0.03hi	1.65 ± 0.01h	2.56 ± 0.07gh	1.21 ± 0.07bc	7.02 ± 0.18m	381.17 ± 0.40efg
Thymus x citriodorus	0.91 ± 0.03o	6.42 ± 0.31no	91.51 ± 0.18a	0.43 ± 0.02n	0.54 ± 0.07k	10,04 ± 0.17a	0.90 ± 0.01f	12.62 ± 0.11g	380.14 ± 1.04fg
Sample	**Fat**	**C16:0**	**C18:0**	**C18:1n9**	**C18:2n6**	**C18:3n3**	**SFA**	**MUFA**	**PUFA**
Allium schoenoprasum	3.45 ± 0.12c	14.76 ± 0.47	2.38 ± 0.15	1.97 ± 0.30	22.85 ± 0.17	47.77 ± 0.95	25.41 ± 0.74o	2.87 ± 0.33lmn	71.72 ±1.07a
Aloysia triphylla	1.18 ± 0.06mnop	19.80 ± 0.13	3.09 ± 0.06	6.24 ± 0.02	9.40 ± 0.09	50.10 ± 0.22	32.27 ± 0.11k	7.31 ± 0.02f	60.42 ± 0.14f
Anethum graveolens	2.02 ± 0.05h	21.81 ± 0.31	3.35 ± 0.32	2.46 ± 0.22	22.03 ± 0.03	32.30 ± 1.21	41.23± 1.00fg	3.14 ± 0.20lm	55.63 ± 1.20g
Artemisia dracunculus	2.18 ± 0.10gh	14.37 ± 0.66	1.86 ± 0.01	1.01 ± 0.03	18.44 ± 0.24	43.28 ± 0.47	34.82 ± 0.30hi	2.28 ± 0.01no	62.90 ± 0.30e
Capsicum sp.	4.55 ± 0.22a	28.70 ± 0.62	2.64 ± 0.04	19.26 ± 0.32	38.08 ± 0.29	6.24 ± 0.06	33.96 ± 0.70ij	21.11 ± 0.32a	44.93 ± 0.37j
Chamaespartium tridentatum	0.63 ± 0.03q	25.66 ± 0.03	6.96 ± 0.06	10.69 ± 0.01	10.35 ± 0.01	18.35 ± 0.02	60.12 ± 0.03a	10.69 ± 0.01cd	29.19 ± 0.03n
Coriandrum sativum	1.63 ± 0.08i	14.87 ± 0.10	2.91 ± 0.29	3.51 ± 0.05	18.69 ± 0.09	48.68 ± 0.25	26.63 ± 0.32no	4.55 ± 0.08hij	68.81 ± 0.41b
Cymbopogon citratus	2.68 ± 0.13f	15.86 ± 0.61	3.17 ± 0.01	2.57 ± 0.03	22.97 ± 0.39	44.54 ± 1.09	28.82 ± 0.64l	2.57 ± 0.03mno	68.61 ± 0.61b
Foeniculum vulgare	1.28 ± 0.05klmno	17.46 ± 0.26	1.82 ± 0.07	0.82 ± 0.01	24.38 ± 0.09	45.89 ± 0.29	26.90 ± 0.35mn	1.86 ± 0.02o	71.24 ± 0.37a
Laurus nobilis	3.13 ± 0.15de	25.02 ± 0.02	3.79 ± 0.01	6.55 ± 0.72	14.45 ± 0.25	32.86 ± 0.69	44.05 ± 0.28e	7.55 ± 0.71f	48.40 ± 0.99i
Lavandula angustifolia	2.96 ± 0.03e	28.48 ± 0.44	6.64 ± 0.06	3.55 ± 0.04	12.93 ± 0.16	34.71 ± 0.40	47.24 ± 0.54d	4.16 ± 0.01ij	48.59 ± 0.53i
Mentha cervina	1.39 ± 0.07jkl	20.95 ± 0.48	4.01 ± 0.34	8.04 ± 0.80	10.45 ± 0.23	45.65 ± 0.50	34.08 ± 0.98ij	9.51 ± 0.76e	56.42 ± 0.21g

Mentha pulegium	0.77 ± 0.02q	17.83 ± 0.03	3.13 ± 0.01	2.67 ± 0.01	14.18 ± 0.16	55.11 ± 0.14	27.03 ± 0.31mn	3.23 ± 0.01lm	69.74 ± 0.30b
Mentha spicata	1.12 ± 0.03op	22.30 ± 0.20	4.36 ± 0.05	3.95 ± 0.06	7.52 ± 0.16	51.06 ± 0.41	35.97 ± 0.16h	4.02 ± 0.07jk	60.01 ± 0.22f
Mentha x piperita	2.37 ± 0.09g	16.22 ± 0.21	2.23 ± 0.05	3.30 ± 0.01	10.01 ± 0.03	55.68 ± 0.16	28.07 ± 0.13lm	5.08 ± 0.02h	66.85 ± 0.11c
Ocimum basilicum	1.03 ± 0.02p	17.79 ± 0.31	4.22 ± 0.02	3.48 ± 0.06	9.84 ± 0.03	55.89 ± 0.26	29.14 ± 0.26l	4.79 ± 0.03hi	66.07 ± 0.23cd
Origanum majorana	1.35 ± 0.06klmn	22.68 ± 0.01	3.85 ± 0.01	2.20 ± 0.01	6.19 ± 0.01	55.94 ± 0.01	34.11 ± 0.01ij	2.70 ± 0.01lmn	63.19 ± 0.01e
Origanum vulgare	1.26 ± 0.06lmno	15.66 ± 0.65	5.03 ± 0.14	2.36 ± 0.02	10.70 ± 0.96	50.35 ± 1.93	32.14 ± 0.82k	2.99 ± 0.01lmn	64.87 ± 0.81d
Petroselinum crispum	0.74 ± 0.01q	12.03 ± 1.36	3.79 ± 0.31	9.85 ± 0.87	16.70 ± 0.76	13.76 ± 0.28	54.83 ± 1.59b	11.31 ± 0.81c	33.86 ± 0.78m
Rosmarinus officinalis	3.67 ± 0.18b	24.35 ± 0.08	6.67 ± 0.19	6.15 ± 0.22	12.80 ± 0.18	22.77 ± 0.52	55.14 ± 0.63b	7.80 ± 0.28f	37.06 ± 0.90k
Salvia officinalis	3.26 ± 0.16cd	18.60 ± 0.05	3.41 ± 0.18	6.06 ± 0.34	10.21 ± 0.26	57.19 ± 0.86	25.28 ± 0.28o	6.23 ± 0.34g	68.49 ± 0.62b
Satureja montana	0.60 ± 0.01q	19.94 ± 0.02	3.97 ± 0.03	3.50 ± 0.13	13.65 ± 0.20	45.37 ± 0.01	33.39 ± 0.09jk	4.55 ± 0.01hij	62.06 ± 0.10e
Stevia rebaudiana	1.38 ± 0.02jklm	20.29 ± 0.20	3.96 ± 0.07	6.96 ± 0.29	12.18 ± 1.08	39.95 ± 0.09	40.11 ± 1.28g	7.76 ± 0.29f	52.13 ± 0.99h
Thymus mastichina	1.46 ± 0.04ijk	21.38 ± 0.20	6.97 ± 0.30	11.70 ± 0.69	7.95 ± 0.14	25.93 ± 0.43	52.07 ± 0.19c	12.32 ± 0.69b	35.61 ± 0.50l
Thymus vulgaris	1.57 ± 0.06ij	16.48 ± 0.10	2.99 ± 0.08	2.94 ± 0.15	14.35 ± 0.01	55.16 ± 0.21	27.07 ± 0.09mn	3.42 ± 0.12kl	69.51 ± 0.21b
Thymus x citriodorus	1.16 ± 0.05nop	15.85 ± 0.03	5.74 ± 0.09	9.59 ± 0.01	10.37 ± 0.10	36.32 ± 0.14	41.92 ± 0.16f	10.26 ± 0.09d	47.82 ± 0.07i

nd- not detected. Thirty-two different fatty acids were detected. SFA – Saturated fatty acids; MUFA – Monounsaturated fatty acids; PUFA – Polyunsaturated fatty acids; C16:0 – Palmitic acid; C18:0 – Stearic acid; C18:1n9 – Oleic acid; C18:2n6 – Linoleic acid; C18:3n3 – α-Linolenic acid. In each row different letters mean significant differences ($p<0.05$).

Table 2. Nutritional parameters (mg/100 mL) and energetic value (cal/100 mL) of the infusions (mean ± SD).

Sample	Carbohydrates	Sugars			Energy
		Fructose	Glucose	Sucrose	
Aloysia triphylla	0	nd	nd	nd	0
Calluna vulgaris	11.50 ± 0.42f	5.90 ± 0.14ef	5.60 ± 0.28gh	nd	46.00 ± 1.70f
Chamaemelum nobile	14.95 ± 0.21d	8.60 ± 0.01c	4.20 ± 0.01i	2.15 ± 0.21f	59.80 ± 0.85d
Chamaespartium tridentatum	19.00 ± 2.55c	13.60 ± 2.12a	5.40 ± 0.42h	nd	76.00 ± 10.18c
Cymbopogon citratus	20.45 ± 0.50b	2.55 ± 0.07hi	6.40 ± 0.01ef	11.50 ± 0.57a	81.80 ± 1.98bc
Echinacea purpurea	0	nd	nd	nd	0
Equisetum ssp	20.35 ± 0.35b	7.70 ± 0.28cd	12.65 ± 0.07a	nd	81.40 ± 1.41bc
Foeniculum vulgare	15.00 ± 0.85de	3.20 ± 0.57h	5.45 ± 0.07h	6.35 ± 0.35bc	60.00 ± 3.39d
Gomphrena globosa L.	0	nd	nd	nd	0
Gomphrena globosa var. albiflora	0	nd	nd	nd	0
Gomphrena haageana K.	0	nd	nd	nd	0
Gomphrena sp.	0	nd	nd	nd	0
Hibiscus sabdariffa	13.00 ± 0.14def	6.00 ± 0.14ef	7.00 ± 0.01de	nd	52.00 ± 0.57def
Hypericum androsaemum	22.20 ± 0.28b	10.35 ± 0.07b	9.40 ± 0.28c	2.45 ± 0.07ef	88.80 ± 1.13b
Lavandula angustifolia	26.80 ± 3.96a	8.75 ± 1.63c	10.80 ± 0.71b	7.25 ± 1.63b	107.20 ± 15.84a
Malva silvestre	14.65 ± 0.07de	6.30 ± 0.01de	5.25 ± 0.21h	3.10 ± 0.14e	58.60 ± 0.28d
Melissa officinalis	15.35 ± 0.21d	6.95 ± 0.21de	6.15 ± 0.21fg	2.25 ± 0.21ef	61.40 ± 0.85d
Mentha pulegium	11.85 ± 0.21ef	4.75 ± 0.21fg	2.95 ± 0.35j	4.15 ± 0.35d	47.40 ± 0.85ef
Mentha spicata	13.20 ± 0.85def	3.35 ± 0.35gh	3.95 ± 0.35i	5.90 ± 0.14c	52.80 ± 3.39def
Mentha x piperita	6.30 ± 0.28g	1.60 ± 0.01ij	1.55 ± 0.21l	3.15 ± 0.07e	25.20 ± 1.13g
Ocimum basilicum	0	nd	nd	nd	0
Rosmarinus officinalis	0	nd	nd	nd	0
Salvia officinalis	14.60 ± 0.01d	4.80 ± 0.14f	6.70 ± 0.28def	3.10 ± 0.14e	58.40 ± 0.01d
Stevia rebaudiana	14.15 ± 0.21de	2.85 ± 0.21hi	7.15 ± 0.35d	4.15 ± 0.07d	56.60 ± 0.85de
Thymus mastichina	8.40 ± 0.42g	0.95 ± 0.21j	1.85 ± 0.35kl	5.60 ± 0.28c	33.60 ± 1.70g
Thymus x citriodorus	6.15 ± 0.21g	2.15 ± 0.07hij	2.20 ± 0.28k	1.80 ± 0.01f	24.60 ± 0.85g
Tilia platiphyllos	15.00 ± 0.14d	8.75 ± 0.07c	6.25 ± 0.21f	nd	60.00 ± 0.57d

Protein, ash and fat contents were zero; carbohydrates content was obtained by the total of sugars; nd- not detected. In each row different letters mean significant differences ($p<0.05$).