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Total Polyphenols and Antioxidant Properties of Selected Fresh and Dried Herbs and Spices

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Abstract: In this study, the content of total polyphenols (TP) and the antioxidant activity (AA) of fresh herbs (13 in total) and those subjected to the freeze-drying process (stems and leaves separately) were compared. Moreover, the content of TP and AA of retail, commercial food spices (19 in total) of the two leading companies on the Polish market were compared. The novelty of our studies is the comparison between fresh and dried forms of herbs and spices and additionally between dried in a freeze-drying process and commercially available (in dried forms). It was found that fresh herbs and spices showed a large accumulation of polyphenolic compounds (from 466.55 to 17.23 CAE/100 g, respectively, for lemon balm and ginger). For freeze-dried herbs and spices, the highest TP content was found for marjoram (3052.34 CAE/100 g—leaves). Among commercial herbs and spices, sage (971.28 CAE/100 g) deserves attention. Fresh herbal spices, in particular oregano, (236.21 µM TE/g) had the highest AA. AA of freeze-dried herbs and spices was much lower (5.27–1.20 µM TE/g). The average value obtained for commercially available herbs and spices purchased was 1.44 µM TE/g. In the case of AA measured by the DPPH radical, thyme was characterized by the highest activity among fresh marjoram for freeze-dried herbs and spices. For dried commercial spices, the highest levels of AA were found for cumin.

Keywords: fresh and dried spices; fresh and dried herbs; antioxidant activity; polyphenols; healthy properties

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1. Introduction

Reactive oxygen species (ROS), which includes oxygen free radicals, are formed in the body during its metabolism. Under the conditions of homeostasis, free oxygen radicals play the role of regulators of many processes taking place in cells [1]. Under physiological conditions, ROS is used by immune cells to destroy viruses and bacteria [2]; however, in the absence of physiological pro-oxidative-antioxidant balance, oxidative stress arises. In the human body, the toxic effects of oxygen metabolism are counterbalanced by the enzymatic and non-enzymatic systems, inhibiting the degree of molecule oxidation and converting ROS into their inactive derivatives [1–3]. The enzyme antioxidant system consists of a series of enzymes that work together to prevent damage to important cellular structures. The most important antioxidant defense enzymes include superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), and glutathione reductase (GR) [1]. The non-enzymatic antioxidant system consists of low molecular weight compounds of endogenous origin. These include blood plasma proteins, albumin, transferrin, ceruloplasmin, and ferritin. They work by binding transition metal ions such as copper or iron or donating their electrons to free radicals. The action of these two systems affects the total antioxidant potential of the body. In addition, this balance can be significantly influenced by antioxidant vitamins (vitamin C, E, β-carotene) and other compounds of plant origin, such as polyphenols, provided with the diet [4,5]. In nature, polyphenols occur in fruits, vegetables, seeds, and spice plants. Herbs and spices have been used since ancient times to enhance the taste and aroma of dishes. Over the years, their healing effects have also been known. In addition to their wide application in gastronomy and the food industry, they are also used in herbal medicine [6,7]. The quantification of phenolic compounds in plants is important to evaluate the benefits of their antioxidant properties. Essential oils derived from plants and spices have gained importance as natural replacers of compounds of synthetic origin [8–10] such as BHT (Butylated hydroxytoluene), BHA (Butyled hydroxyanisole), TBHQ (Tertiary-butylhydroquinone), or PG (Propyl gallate).

Herbs and spices contain a number of bioactive compounds responsible for the aroma, taste, and color properties, and most importantly for health-promoting properties. One of the bioactive ingredients of herbs and spices are antioxidant compounds mainly represented by phenolic acids, phenolic diterpenes, and flavonoids, essential oils [7–11]. These products are widely used in gastronomy, herbal medicine as well as in the food and cosmetic industries [6,8,12–14].

In herbal medicine, spices and herbs have a number of therapeutic applications. Many of them regulate the functioning of the digestive tract. These products stimulate the appetite, increasing, among others, secretion of gastric juice—basil, tarragon, ginger, cumin, marjoram, oregano, rosemary, sage, thyme, lemon balm, parsley leaf, cayenne pepper, and black pepper [13,14], stimulate intestinal peristalsis (basil, ginger), have a relaxing effect (garden savory, marjoram, oregano, rosemary leaves, sage, thyme), and prevent flatulence (white mustard, cumin, fennel fruit, lovage, lemon balm, sage) [7,15].

Herbs and spices regulate blood pressure, lower total cholesterol level, reduce the risk of atherosclerosis, and have anti-diabetic properties (ginger, cinnamon, bay leaf, mustard) [16–22]. They are used as antiseptic, antiviral, antifungal, antibacterial, anti-inflammatory, painkillers (ginger, marjoram, oregano, thyme, rosemary, lemon balm, sage, cloves, parsley leaf, cayenne pepper) [14,23–25]. Numerous studies also show the anti-cancer effects of herbs and spices [26–29]. Another important action of these products is their inhibition of the growth of intestinal parasites [22], and they are also significant in the treatment of respiratory diseases (thyme, sage).

The aim of the research was to investigate the antioxidant activity and total polyphenol content of fresh and dried herbs and spices (stems and leaves) as well as dried commercial herbs and spices of two market-leading companies.

2. Materials and Methods

2.1. Materials

Samples of fresh herbs and spices (basil—*Ocimum basilicum* L., savory—*Satureja hortensis* L., tarragon—*Artemisia dracunculus* L., ginger—*Zingiber officinale* L., dill—*Anethum graveolens* L., lovage, marjoram—*Origanum majorana* L., lemon balm—*Melissa officinalis* L., parsley—*Petroselinum crispum*, oregano—*Origenum vulgare*, rosemary—*Salvia rosmarinus*, sage—*Salvia officinalis*, thyme—*Thymus vulgaris*) commercially obtained at a shopping square in Krakow (Poland) were divided into two subgroups. The first was treated as a fresh product, and the second was separated into leaves and stems and freeze-dried (Chaist brand lyophilizer) and ground to a fine powder using a laboratory blender (Type WŻ-1). Commercial spices of two leading companies on the market in Poland were purchased as retail in stores. The samples were taken in accordance with the PN-ISO 948:2009 standard [30].

2.2. Methods

70% methanol extracts of the tested spices and herbs were prepared for the analyses, according to Pekarinen et al. [31]. For this purpose, 5 g of the sample (weighed on a Radwag brand analytical balance) were shaken in 80 mL of methanol for 2 h at room temperature, in the absence of light, in an Elpan laboratory shaker (type 357). Then, the solutions were filtered and the obtained extracts were stored in plastic containers at a temperature of −22 °C.

Total polyphenols were determined by the Folin–Ciocalteu method in a 70% methanol extract according to Swain and Hillis [32]. The colored compounds, formed as a result of the reaction between phenolic compounds and the product components present in the extract, were determined spectrophotometrically (using a Rayleigh UV-1800 spectrophotometer) at a wavelength of 760 nm. The standard calibration curve was obtained using several concentrations of chlorogenic acid. Total polyphenols content expressed as mg of chlorogenic acid equivalent (CAE) per 100 g of fresh (FW) or dried mass (DM) samples.

The antioxidant activity was carried out using the stable free radical $ABTS^{\bullet+}$ according to Re et al. [33]. The amount of the colored radical $ABTS^{\bullet+}$ (2,2′-azino-bis (3-ethylobenzthialoline-6-sulphonic acid), which remained after the reaction with the antioxidant compounds of the extract (in 70% methanol), was determined spectrophotometrically (Rayleigh UV-1800 spectrophotometer) at a wavelength of 734 nm. Results are expressed in μmol Trolox equivalents (TE) per 1 g of fresh (FW) or dried mass (DM). Calibration curve was constructed using Trolox over a concentration range of 10–800 μM.

Antioxidant activity was also determined using a stable free radical DPPH (1,1-diphenyl-2-picrylhydrazyl) [31]. The crystalline DPPH radical was dissolved in 99% methanol and left for 1 h without light. Before each analysis, the radical solution was diluted so that the mixture contained 4 mg of DPPH in 100 mL of methanol. In order to perform the determination, 0.2 mL of test extracts were collected into test tubes and made up to 1.5 mL by adding 70% methanol. In addition, 3 mL of diluted DPPH solution was added successively, mixed (vortex), and then the absorbance (wavelength 516 nm) was measured against methanol. Subsequent measurements were carried out at intervals of 1 min for 10 min from the addition of the radical. The % RSA antioxidant activity is presented as the degree of free radical scavenging:

$$\% \text{ RSA} = [(E_1 - E_2)/E_1] \times 100$$

E_1—absorbance in 0 min, E_2—absorbance in 10 min.

2.3. Statistical Analysis

All determinations were made in triplicate. The obtained results were subjected to one- and two-way analysis of variance with the use of the Statistica 10.0 program, with the Duncan test. The obtained differences were assessed at the significance level of $p \leq 0.05$.

3. Results

3.1. Total Polyphenols Content

Extracts of fresh herbs and spices were characterized by a diversified content of total polyphenols (Table 1). The highest amount was found in lemon balm, followed by oregano and rosemary, while the lowest amount was recorded in the case of ginger.

In the case of dried herbal stems and ginger root, the highest average total polyphenol content was recorded in the stems of lemon balm (2462.86 ± 11.46 mg CAE/100 g) followed by marjoram (2065.38 ± 3.82 mg CAE/100 g) and oregano (1622.44 ± 3.82 mg CAE/100 g) (Table 1), while the lowest in dried parsley stems (110.83 ± 2.87 mg CAE/100 g). Taking into account the dried leaves of herbs, the highest content of total polyphenols was found in the herbs of marjoram (3052.34 ± 0.98 mg CAE/100 g), followed by lemon balm (1984.34 ± 13.86 CAE/100 g) and rosemary (1406.76 ± 21.98 CAE/100 g). Dried lovage leaves showed the lowest mean content of these compounds (542.23 ± 13.86 CAE/100 g). In the group of herbs and spices from Company 1, the highest content of polyphenols (Table 1) was found in cloves spice (941.22 ± 3.82 CAE/100 g of product). In the case of cumin (196.96 ± 11.94 mg of CAE/100 g of product), this value was the lowest in comparison with other herbs. Statistical analysis of Company 1's herbs and spices showed statistically significant differences ($p < 0.05$) between the individual spices within the group. Commercial herbs and spices from Company 2 also had a high total polyphenol content. The highest amounts were found in sage (971.28 ± 5.26 mg CAE/100 g). In cumin seeds, the amount was the lowest (144.59 ± 0.96 mg CAE/100 g).

Table 1. The content of total polyphenols in herbs and spices (mg CAE/100 g).

Herbs and Spices	Fresh	Freeze-Dried		Commercial	
		Stems	Leaves	Company 1	Company 2
Basil	37.84 ± 0.96 [b]	726.56 ± 2.39 [h]	682.77 ± 3.34 [b]	707.43 ± 10.51 [h,B]	548.99 ± 12.90 [f,A]
Savory	156.08 ± 11.47 [e]	671.62 ± 5.73 [g,A]	906.38 ± 3.82 [e,B]	740.88 ± 4.30 [h]	-
Tarragon	194.26 ± 2.39 [f]	577.70 ± 1.91 [e,A]	858.78 ± 22.93 [d,B]	740.20 ± 0.48 [h,B]	539.86 ± 1.91 [f,A]
Ginger	17.23 ± 1.43 [a]	328.04 ± 52.08 [c]	-	370.27 ± 9.56 [d,e,A]	431.76 ± 10.51 [e,A]
Dill	25.68 ± 00 [a]	609.41 ± 1.43 [f,A]	865.23 ± 3.82 [d,B]	285.81 ± 7.64 [b–d,A]	379.05 ± 0.00 [d,B]
Lovage	62.84 ± 2.87 [d]	267.90 ± 2.39 [b,A]	542.23 ± 13.86 [a,B]	355.41 ± 2.87 [d,B]	272.97 ± 0.96 [c,A]
Marjoram	51.69 ± 0.48 [c,d]	2065.38 ± 3.82 [i,A]	3052.34 ± 0.98 [i,B]	848.99 ± 11.94 [i,j,A]	789.86 ± 0.96 [j,A]
Lemon balm	466.55 ± 1.43 [h]	2462.86 ± 11.46 [l,B]	1984.34 ± 13.86 [h,A]	810.81 ± 7.64 [i]	-
Parsley	47.30 ± 1.91 [b,c]	110.83 ± 2.87 [a,A]	750.93 ± 8.60 [c,B]	202.70 ± 4.78 [a,b,A]	187.50 ± 6.21 [b,A]
Oregano	430.41 ± 3.82 [g]	1622.44 ± 3.82 [k,B]	1077.70 ± 54.23 [f,A]	777.36 ± 7.17 [h,i,A]	822.30 ± 23.89 [k,A]
Rosemary	423.31 ± 2.39 [g]	1217.61 ± 9.56 [j,A]	1406.76 ± 21.98 [g,B]	579.39 ± 152.41 [g,A]	573.31 ± 2.39 [g,A]
Sage	167.91 ± 13.86 [e]	516.55 ± 3.34 [d,A]	1066.22 ± 3.82 [f,B]	-	971.28 ± 5.26 [l]
Thyme	161.15 ± 2.39 [e]	-	1181.78 ± 10.52 [a]	867.57 ± 18.16 [j,k,B]	632.09 ± 17.68 [i,A]
White mustard	-	-	-	247.64 ± 0.48 [a–c]	-
Cloves	-	-	-	941.22 ± 3.82 [k]	-
Cumin	-	-	-	196.96 ± 11.94 [a,A]	144.59 ± 0.96 [a,A]
Bay leaf	-	-	-	512.84 ± 2.87 [f,g,B]	203.38 ± 1.91 [b,A]
Cayenne pepper	-	-	-	325.34 ± 3.34 [c,d,A]	263.18 ± 8.12 [c,A]
Black pepper	-	-	-	443.24 ± 18.16 [e,f,A]	610.14 ± 0.96 [h,B]

[a–l]—values in the columns, marked with different letters, differ statistically significantly at $p \leq 0.05$. [A,B]—values in the rows between dried stems and leaves, marked with different letters, differ statistically significantly at $p \leq 0.05$.

3.2. Antioxidant Activity Measured by the ABTS$^{+\bullet}$ Method

The highest antioxidant activity was found in fresh herbs (in the range of 9.62–236.21 µM TE/g), and the highest value was found in oregano. In the case of the ginger rhizome, this activity was the lowest (6.50 ± 0.00 µM TE/g) (Table 2).

Table 2. Antioxidant activity of herbs and spices, measured by the ABTS method (µM TE/g).

Herbs and Spices	Fresh	Freeze-Dried		Commercial	
		Stems	Leaves	Company 1	Company 2
Basil	14.18 ± 0.08 [d]	1.20 ± 0.00 [a,A]	5.27 ± 0.00 [l,B]	1.44 ± 0.00 [d]	1.44 ± 0.00 [h]
Savory	150.48 ± 0.00 [j]	1.38 ± 0.00 [b,A]	1.43 ± 0.00 [g,B]	1.44 ± 0.00 [d]	-
Tarragon	125.21 ± 0.66 [h]	1.43 ± 0.00 [i]	1.43 ± 0.00 [h]	1.43 ± 0.00 [a]	1.41 ± 0.00 [b,A]
Ginger	6.50 ± 0.00 [a]	1.44 ± 0.00 [k]	-	1.44 ± 0.00 [f]	1.43 ± 0.00 [e,A]
Dill	11.60 ± 0.00 [c]	1.44 ± 0.00 [j,A]	1.44 ± 0.00 [k,B]	1.45 ± 0.00 [g]	1.44 ± 0.00 [f,A]
Lovage	10.15 ± 0.02 [b]	1.42 ± 0.00 [f,A]	1.44 ± 0.00 [j,B]	1.45 ± 0.00 [g]	1.42 ± 0.00 [c,A]
Marjoram	41.06 ± 0.00 [e]	1.42 ± 0.00 [g,B]	1.42 ± 0.00 [e,A]	1.44 ± 0.00 [d]	1.44 ± 0.00 [g]
Lemon balm	188.10 ± 0.34 [k]	1.43 ± 0.00 [h,B]	1.42 ± 0.00 [f,A]	1.44 ± 0.00 [d]	-
Parsley	9.62 ± 0.02 [b]	1.44 ± 0.00 [j,B]	1.39 ± 0.00 [b,A]	1.45 ± 0.00 [h]	1.42 ± 0.00 [d,A]
Oregano	236.21 ± 0.84 [l]	1.40 ± 0.00 [c,A]	1.41 ± 0.00 [d,B]	1.44 ± 0.00 [e]	1.45 ± 0.00 [j]
Rosemary	146.20 ± 0.55 [i]	1.42 ± 0.00 [e,A]	1.44 ± 0.00 [i,B]	1.45 ± 0.00 [h]	1.45 ± 0.00 [j]
Sage	60.17 ± 0.00 [f]	1.40 ± 0.00 [d,B]	1.41 ± 0.00 [c,A]	-	1.44 ± 0.00 [g]
Thyme	121.16 ± 0.00 [g]	-	1.30 ± 0.00 [a]	1.44 ± 0.00 [c]	1.44 ± 0.00 [f]
White mustard	-	-	-	1.45 ± 0.00 [g]	-
Cloves	-	-	-	1.43 ± 0.00 [b]	-
Cumin	-	-	-	1.44 ± 0.00 [f]	1.44 ± 0.00 [g,A]
Bay leaf	-	-	-	1.44 ± 0.00 [f]	1.45 ± 0.00 [i]
Cayenne pepper	-	-	-	1.44 ± 0.00 [e]	1.44 ± 0.00 [f]
Black pepper	-	-	-	1.44 ± 0.00 [c]	1.32 ± 0.00 [a,A]

[a–l]—values in the columns, marked with different letters, differ statistically significantly at $p \leq 0.05$. [A,B]—values in the rows between dried stems and leaves, marked with different letters, differ statistically significantly at $p \leq 0.05$.

The drying process of the herbs and spices significantly lowered the antioxidant activity of the herbs, ranging from 77.7% for tarragon to 99.4% for oregano.

In the spices of commercial herbs of Company 1, the antioxidant activity ranged from 1.45 µM TE/g to 4.32 µM TE/g, and was the highest for parsley and rosemary. In the spices of Company 2, antioxidant activity ranged from 1.32 µM TE/g (black pepper) to 1.45 µM TE/g (oregano).

3.3. Antioxidant Activity Measured by the DPPH Method

In the group of fresh herbs and spices, thyme had the highest mean antioxidant activity (74.41 ± 0.96% RSA) followed by sage and savory. In the case of dried herbs and spices, marjoram had the highest antioxidant activity, both in the case of the stems and leaves. Antioxidant activity was comparable to marjoram in the ginger rhizome (63.20 ± 1.29% RSA) (Table 3).

Table 3. Antioxidant activity of fresh and freeze-dried herbs and spices measured by the DPPH method (% RSA).

Herbs and Spices	Fresh	Freeze-Dried		Commercial	
		Stems	Leaves	Company 1	Company 2
Basil	13.21 ± 1.21^{a}	5.80 ± 0.42^{b}	$1.59 \pm 0.42^{a,A}$	*	4.55 ± 0.84^{a}
Savory	43.10 ± 0.37^{e}	-	23.19 ± 0.69^{e}	34.55 ± 1.93^{f}	-
Tarragon	31.82 ± 0.94^{d}	-	2.74 ± 0.54^{b}	*	*
Ginger	13.56 ± 1.24^{a}	63.20 ± 1.29^{f}	-	65.38 ± 0.36^{i}	71.30 ± 0.50^{g}
Dill	8.46 ± 1.10^{c}	-	*	37.82 ± 0.76^{g}	4.17 ± 0.42^{a}
Lovage	33.08 ± 1.38^{d}	46.08 ± 0.81^{e}	$1.43 \pm 0.68^{a,A}$	43.40 ± 1.88^{h}	11.43 ± 0.86^{b}
Marjoram	8.12 ± 0.87^{c}	64.15 ± 0.84^{f}	$41.86 \pm 1.00^{f,A}$	3.85 ± 0.12^{c}	5.88 ± 0.32^{a}
Lemon balm		8.20 ± 0.68^{c}	$2.08 \pm 0.66^{a,b,A}$	4.62 ± 0.24^{d}	-
Parsley	3.18 ± 0.79^{b}	15.26 ± 1.27^{d}	-	44.00 ± 0.73^{g}	29.69 ± 1.44^{c}
Oregano	1.49 ± 0.42^{b}	3.33 ± 0.62^{a}	-	23.08 ± 1.37^{e}	*
Rosemary	11.11 ± 1.32^{a}	5.62 ± 0.35^{b}	4.23 ± 0.56^{c}	2.33 ± 0.09^{b}	*
Sage	49.22 ± 1.46^{f}	*	*	-	*
Thyme	74.41 ± 0.96^{g}	-	9.21 ± 0.47^{d}	1.35 ± 0.17^{a}	*
White mustard	-	-	-	45.88 ± 0.89^{h}	-
Cloves	-	-	-	38.24 ± 0.79^{g}	-
Cumin	-	-	-	26.53 ± 1.18^{f}	62.16 ± 1.31^{e}
Bay leaf	-	-	-	1.92 ± 0.06^{a}	84.78 ± 1.97^{h}
Cayenne pepper	-	-	-	77.33 ± 0.61^{j}	45.32 ± 0.39^{d}
Black pepper	-	-	-	37.37 ± 1.32^{g}	67.22 ± 2.18^{f}

$^{a-j}$—values in the columns, marked with different letters, differ statistically significantly at $p \leq 0.05$. ^{A,B}—values in the rows between dried stems and leaves, marked with different letters, differ statistically significantly at $p \leq 0.05$. *—undetected value.

In the group of the spices of Company 1, the following stood out: cayenne pepper and ginger rhizome (77.33 ± 0.61% RSA and 65.38 ± 0.36% RSA, respectively). Among the herbs and spices of Company 2, the highest antioxidant activity was found in the bay leaf (84.78 ± 1.97% RSA).

4. Discussion

4.1. Total Polyphenols Content

Polyphenols are secondary plant metabolites involved in the defense of plants against the effects of harmful factors. According to Jówko [2], plant extracts rich in polyphenols have a stronger antioxidant effect than vitamin C, tocopherol, or carotene. Herbs and spices are an important source of biologically active substances [7]. Apart from polyphenols, the antioxidant compounds of herbs and spices are represented by flavonoids included in essential oils [31]. Due to the differences in chemical structure, they can be divided into flavonols, flavononols, flavones, flavanols, flavanones, anthocyanidines, and isoflavonoids [31,34–36].

Most studies reported the antioxidant activity of a few fresh [37–39] or dried [1,5,34,40–42] herbs or food spices. In this study, the content of biologically active components (polyphenols) and the antioxidant activity of fresh and freeze-dried herbs were compared. Additionally, in freeze-dried spice plants, the above components were taken into account, distinguishing between the stems and leaves of these spices. Moreover, the content of polyphenols and the antioxidant activity of retail, commercial food spices of two leading companies on the Polish market were compared.

The total content of polyphenols, determined in the analyzed fresh and powdered spices, is presented in Table 1. The highest content of polyphenols in fresh herbs and spices were found in lemon balm, followed by oregano and rosemary.

Differences in the obtained results may be due to the origin of the herbs, climatic conditions during cultivation or the fertilizers used, which significantly affect the content of polyphenolic compounds. Additionally, according to Hossain et al. [43], in fresh herbal spices, phenolic compounds may be degraded as a result of enzymatic activity.

In the present study, in the majority of cases, in the freeze-dried herbs and spices, a significantly ($p < 0.05$) higher content of total polyphenols in the dried leaves was found in relation to the stems of these herbs (r = 0.8102). There are no comparative data for this type of research in the available literature. Among the analyzed commercial spices of two companies, a comparable content of these compounds was found for six spices, such as ginger, cumin, parsley, oregano, rosemary, and cayenne pepper.

The commercial spices showed that Company 1's thyme, tarragon, basil, bay leaf, and lovage were characterized by a higher average total polyphenol content than the same herbs and spices from Company 2 ($p < 0.05$). On the other hand, in spices such as black pepper, ginger, or dill from Company 2, higher amounts of the discussed compounds were recorded than in the analogues of Company 1 ($p < 0.05$). According to the data of other authors [44], the total content of polyphenols in dried herbs or spices was higher (rosemary, sage), comparable (thyme), or lower (ginger, basil) than those determined in this study. Completely different results were obtained by Assefa et al. [45]. The total content of polyphenols in the analyzed products may be affected by the extraction efficiency (type of solvent, temperature, and extraction time) [46,47]. High content of polyphenolic compounds, shown in dried herbal spices, may result from the activation of masked polyphenols as a result of high temperature [48].

4.2. Antioxidant Activity Measured by the ABTS$^{+\bullet}$ Method

In the majority of the examined extracts, the high content of polyphenolic compounds determined high antioxidant activity. Wojdyło et al. [37] investigated antioxidant activity and phenolic compounds in 32 selected herbs and found that herbs of the *Lamiaceae* family have significantly higher antioxidant activity compared to others.

Fresh basil had an antioxidant activity at the level of 14.18 ± 0.08 μM TE/g (Table 2). This value was lower compared to the results of the studies by Wójcik-Stopczyńska and Jakowienko [49], in which the antioxidant potential of fresh basil was 199–345 μM TE/g. In the present study, the antioxidant potential of freeze-dried ginger, Company 1 and Company 2, was 1.44 ± 0.00 and 1.43 ± 0.00 μmol TE/g, respectively. These values were lower than those obtained by other authors. According to Lu et al. [42], the antioxidant activity of dried ginger was 75.66 ± 1.15 [μM TE/g]. As the mentioned authors noted, the spices used were purchased in China. This can result in differences in the way the spices are processed, and in particular in the drying process of the herbs. The antioxidant activity of Company 1 and Company 2 bay leaves in the presented research was 1.44 ± 0.00 and 1.45 ± 0.00 μmol TE/g. These values were also lower than those reported by Lu et al. [42], according to which the antioxidant activity of dried bay leaves was 412.24 ± 12.59 (μM TE/g). In the case of white mustard, the antioxidant activity obtained in the study (1.45 ± 0.00 μmol TE/g) was lower than the results presented in the literature. For dried white mustard, it was 39.21 ± 1.28 μM TE/g [42].

The available literature does not present studies on the antioxidant activity of other herbal plants.

4.3. Antioxidant Activity Measured by the DPPH Method

In powdered ginger of the analyzed commercial products of Company 1 and Company 2, antioxidant activity amounted to 65.38 ± 0.36% RSA and 71.30 ± 0.50% RSA, respectively. Other authors showed comparable antioxidant activity in dried ginger [44]. Research by Newerli-Guz and Pych [40] showed much lower values in the products of the same companies. Similarly, the lower scavenging capacity of free radicals contained in 80% ginger methanol extract (28.4% RSA) as measured by DPPH was demonstrated by Sepahpour et al. [11]. The authors also achieved lower AA in 80% acetone (32.7%). In black pepper, antioxidant activity of commercial products was achieved at the level of 37.37 ± 1.32% RSA and 67.22 ± 2.18% RSA, respectively, for Companies 1 and 2. Newerli-Guz [38] presents higher antioxidant activity values in the commercial products of the same companies (amounting to approx. 85% RSA).

In this study, both companies' commercial marjoram was characterized by a low antioxidant activity (3.85 ± 0.12% RSA and 5.88 ± 0.32% RSA), compared to the results of Newerli-Guz [39], who obtained values of 88.78% RSA for this spice.

According to Perez et al. [44], the antioxidant activity of dried sage was 88% RSA. In the same study, antioxidant activity measured by the DPPH method of oregano was found at the level of 70% RSA, which significantly exceeds the results obtained. For fresh ginger, Newerli-Guz and Pych [40] obtained antioxidant activity at the level of 40.88% RSA, which also exceeds the results presented in this study. Similarly, the antioxidant activity of marjoram in the surveyed trading companies was significantly lower compared to the results of Newerli-Guz [39], who had the value of 88.78% RSA.

The influence of the drying process on the content of biologically active compounds is not clear. Most often, higher temperature and longer process time cause greater degradation of active substances; however, these changes may depend on the species of herb. Therefore, it is extremely important to select the appropriate methods and parameters of the drying process, which condition the high retention of active compounds [50].

5. Conclusions

The novelty of our studies is the comparison between fresh and dried forms of herbs and spices and additionally between dried in a freeze-drying process and commercially available. Our results assist the point that fresh herbs and spices are sources of antioxidants, while dried herbs or spices are not such a rich source of biologically active compounds compared to fresh ones. It seems to be significant to increase the consumption of mainly fresh herbs and spices. Taking into consideration the obtained results, the most attention should be paid to enriching the consumer diet with the following fresh herbs or spices: oregano, lemon balm, rosemary, and thyme. They are a very good source of bioactive substances and have a positive effect on improving health and have a healing effect. Appropriate selection of herbs and spices could complement the treatment of many diseases, including chronic non-communicable diseases. However, it should be noted that they work slowly and only their systematic use will have a positive effect on the body.

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