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Phenolic content and antioxidant activity in medicinal raw material of introduced *Artemisia* L. species in Lithuania

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In the last decade, special attention has been paid to *Artemisia* (L.) genus plants, the possibilities of using their medicinal raw material for therapeutic purposes. The aim of the research was to determine the variability of the phenolic compounds in the medicinal raw material of four introduced *Artemisia* L. species and to evaluate the antioxidant activity of extracts *in vitro*. The highest total amount of phenolic compounds (297.37±9.18 mg RE/g DW) and flavonoids (77.73±7.40 mg RE/g DW) evaluated via spectrophotometry was detected in *Artemisia annua* L. medicinal raw material samples. Qualitative and quantitative analysis of individual phenolics in the samples of *Artemisia* extracts was carried out by applying the HPLC method. In the studied extracts, the predominant phenolic compounds were chlorogenic acid and 3,5-dicaffeoylquinic acid. It was determined that the methanol extracts of *A. annua* medicinal raw material have the strongest antiradical and reducing properties.

Keywords: *Artemisia* L., polyphenols, flavonoids, antioxidant activity

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INTRODUCTION

Asteraceae (Bercht. & J. Presl) is one of the largest plant families consisting of about 1,600 genera and about 33,000 various plant species [13]. The genus *Artemisia* L. contains more than 500 species that grow naturally or are introduced and cultivated [3]. Only three naturally growing species are found in Lithuania [9].

The medicinal raw material of different *Artemisia* L. species contain high amounts of essentail oils and other beneficial biologically active compounds such as phenolics, minerals, lignans, alkaloids, coumarins, tannins and fatty acids [1, 8, 12, 17, 33]. Biologically active compounds in *Artemisia* plants positively affect the human health. Previous research has shown that *Artemisia* species have multifaceted pharmacological activities, such as antioxidant, anticancer, antimicrobial, antimalarial, antidiabetic and antitumor [1, 4, 6, 11, 14, 15, 16]. Due to the growing interest in medicinal and aromatic plant agents enriched with pharmacological properties, *Artemisia* plants acquire an increasingly wider application in the medicine, pharmaceutical, veterinary, dental, cosmetics and food industries [1, 2, 5, 10, 14].

The aim of the study was to establish the variability of the qualitative and quantitative composition of phenolics in medicinal raw material samples of different species of *Artemisia* L. and to evaluate the antioxidant potency of extracts *in vitro*. The findings of the conducted evaluations will provide new knowledge and will be highly relevant in selecting the most promising *Artemisia* species whose medicinal raw material accumulates the highest amounts of phenolic compounds – natural, strong antioxidants, and the extracts have an antiradical and reducing effect *in vitro.*

EXPERIMENTAL

Plant material. In the evaluations, we used the medicinal raw material samples of four *Artemisia* L. species (*A. alba*, *A. annua*, *A. pontica* and *A. stelleriana*) introduced in the Middle of Lithuania. The medicinal raw material samples of *Artemisia* L. were collected at the full flowering vegetation stage in 2021 from the Medicinal Plants Collection of the Scientific Sector of Medicinal and Aromatic Plants, Scientific Department of Botanical Garden at Vytautas Magnus University.

Chemicals and solvents. The reagents used in the analysis satisfied all quality requirements and were of analytical grade. The following substances were used in the study: ethanol 96% (v/v) (manufactured by AB Vilniaus Degtinė, Vilnius, Lithuania), the Folin-Ciocalteu reagent, calcium carbonate, acetonitrile, methanol 99.9% (v/v), aluminium chloride hexahydrate, DPPH (2,2-diphenyl-1-picrylhydrazyl), hydrochloric acid, copper (II) chloride, TPTZ (2,4,6-tripyridyl-s-triazine) (Sigma-Aldrich Steinheim, Germany), acetic acid (Lachner, Neratovice, Czech Republic), trifluoroacetic acid, sodium carbonate (Carl Roth GmbH, Karlsruhe, Germany), ABTS (2,20'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid), potassium persulfate, sodium acetate, Trolox ((±)-6-hydroxy-2,5,7,8-tetramethylchromano-2-carboxylic acid), ammonium acetate and iron (III) chloride hexahydrate (Scharlau, Sentmenat, Spain). Chlorogenic acid, neochlorogenic acid, coumaric acid, 3,4-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, luteolin-7-rutinoside, luteolin-7-glucoside, luteolin, rutin, apigenin, hyperoside, quercetin and kaempferol were obtained from Sigma-Aldrich GmbH (Steinheim, Germany). Purified deionized water was produced using the Milli-Q® 180 (Millipore, Bedford, MA, USA) water purification system.

Equipment used. Dried samples of *Artemisia* L. medicinal raw material were ground with a Retsch GM 200 electric grinder (Retsch GmbH, Hahn, Germany). The raw material was weighed on a Sartorius CP64-0CE analytical balance (Sartorius AG, Gottingen, Germany). Methanol extracts of *Artemisia* L. medicinal raw material samples were prepared in an ultrasonic bath WiseClean WUC-A06H (PMI Labortechnik GmbH, Switzerland). Spectrophotometric studies were accomplished on a UV-visible light (UV-Vis) spectrophotometer Halo DB-20 (Spectronic CamSpec, Garforth, UK). Qualitative and quantitative analysis of phenolics in the extracts of *Artemisia* L. samples was accomplished using a Waters 2998 PDA detector (Waters, Milford, CT, USA).

Preparation of the medicinal raw material. *Artemisia* L. medicinal raw material samples were dried at +25°C temperature and 60% relative humidity in a well-ventilated lodge avoiding direct

solar radiaton for 4 weeks. The dried samples were ground with a Retsch GM 200 electric grinder (particle size about 355 μm). The medicinal raw material was stored in a dark and dry place in tightly closed containers. The loss on drying of the raw material was evaluated by applying the methodology reported in the European Pharmacopoeia [7].

Preparation of the methanol extracts. During the research, 0.25 g (exact weight) of dried and crushed *Artemisia* L. medicinal raw material was used, adding 20 mL of 70% (v/v) methanol, and extracted in an ultrasonic bath for 30 min at 37 kHz frequency and 480 W power. The received extract was filtered, and the dried samples powder mass remaining on the filter was washed with 70% (v/v) methanol. The filtered extract was poured into 50 mL measuring flasks, adding 70% (v/v) methanol up to the marking. Prior to the HPLC analysis, the extracts were filtered through Carl Roth membrane filters (Carl Roth GmbH & Co. KG, Karlsruhe, Germany) with 0.45 μm pore size.

Determination of total phenolic and flavonoid content. The total phenolic content (TPC) in the methanol extracts of *Artemisia* L. medicinal raw material was determined by using the Folin–Ciocalteu method [34], calculated from a rutin calibration curve, and expressed as mg/g of rutin equivalent (RE) per one gram of absolutely dry weight (DW) (mg RE/g DW). The total amount of flavonoids (TFC) in the methanol extracts of *Artemisi* L. medicinal raw material was determined using the described methodology [35], calculated from a rutin calibration curve, and expressed as mg/g of rutin equivalent (RE) per one gram of absolutely dry weight (DW) (mg RE/g DW).

Evaluation of antioxidant activity. The antioxidant activity of the extracts of *Artemisia* L. was calculated from the Trolox calibration curve and expressed as μmol of the Trolox equivalent (TE) per gram of absolutely dry weight (DW). TE was calculated according to the following formula: TE = (c×V)/m, where c is the concentration of Trolox established from the calibration curve (in μmol), V is the volume of the extract (in L), and m is the weight (exact) of the medicinal raw material powder (in grams).

$ABTS^{•+}$ assays were performed by readjusting the method described by Sussela et al. [18]. $ABTS^{•+}$ solution (3 mL) was mixed with 10 μL of extracts. A decrease in absorbance was determined at a wavelength of 734 nm after keeping the samples for 30 min in the dark. A calibration curve ($y = 0.00011x - 0.00385$; $R^2 = 0.9994$) was prepared using standard Trolox solutions of 8000 to 24.000 μmol/L concentration.

$DPPH^{•+}$ assays were performed by readjusting the method described by Messaili et al. [19]. 30 μL of extract were mixed with 12 μL of DPPH reagent. An increase in absorbance was recorded at λ = 515 nm after keeping the samples for 30 min in the dark. A calibration curve ($y = 0.00032x + 0.09980$; $R^2 = 0.9997$) was prepared using standard Trolox solutions of 1000 to 30.000 μmol/L concentration.

FRAP assays were performed by readjusting the method described by Mumivand et al. [20]. The FRAP solution included TPTZ (0.01 M, dissolved in 0.04 M HCl), $FeCl_3{\cdot}6H_2O$ (0.02 M in water) and acetate buffer (0.3 M, pH 3.6) (1:1:10). During the evaluation, 3 mL of a freshly prepared FRAP reagent was mixed with 10 mL of extracts. An increase in absorbance was recorded at λ = 593 nm after keeping the samples for 30 min in the dark. A calibration curve ($y = 0.00035x + 0.09850$; $R^2 = 0.9996$) was prepared using standard Trolox solutions of 400 to 24.000 μmol/L concentration.

CUPRAC assays were performed by readjusting the method described by Koyncu [21]. The CUPRAC solution included copper (II) chloride (0.01 M in water), ammonium acetate buffer solution (0.001 M, pH 7) and neocuproine (0.0075 M in ethanol) (ratio 1:1:1). During the evaluation, 3 mL of CUPRAC reagent was mixed with 10 mL of extracts. An increase in absorbance was recorded at λ = 450 nm. A calibration curve ($y = 0.0000325x - 0.0131455$; $R^2 = 0.9985$) was prepared using standard Trolox solutions of 2000 to 48.000 μmol/L concentration.

Chromatographic studies. The qualitative and quantitative high-performance liquid chromatography (HPLC) analysis of phenolic compounds was performed with a Waters 2998 PDA detector. Chromatographic separations were carried out by using a YMC-Pack ODS-A (5 μm, C18, 250 × 4.6 mm i.d.) column. The column was operated at a constant temperature of 25°C. The volume of the analyzed extract was 10 μL. The flow rate was 1 mL/min. The mobile phase consisted of 2% (v/v) acetic acid (solvent A) and acetonitrile (solvent B). Gradient variation: 0–30 min, 3–15%

B, 30–45 min, 15–25% B, 45–50 min, 25–50% B and 50–55 min, 50–95% B. For the quantitative analysis, the calibration curves were obtained by injecting the known concentrations of different standard compounds. All the identified phenolic compounds were quantified at $\lambda = 210–400$ nm wavelength.

Data analysis. Data analysis was carried out using the computer software Microsoft Excel 2016 (Microsoft, Redmond, WA, USA) and SPSS Statistics 27.0 (SPSS Inc., Chicago, IL, USA). During the analysis, we calculated arithmetic means and standard deviations of three repeated measurements.

A univariate dispersion analysis model (ANOVA) was applied for determining whether the differences between the compared data were statistically significant. Differences between the samples were determined by applying Tukey's multiple comparison test. Differences at $p < 0.05$ were considered to be statistically significant.

RESULTS AND DISCUSSION

Determination of total phenolic and flavonoid content

The results obtained via the application of spectrophotometric methodologies allow for estimating the qualitative and quantitative composition of different groups of biologically active compounds.

The evaluation of the medicinal raw material samples of four *Artemisia* L. species introduced in Lithuania showed that the total amount of phenolic compounds ranged from 176.77±8.59 mg RE/g DW ($p < 0.05$) in the samples of *A. stelleriana* to 297.37±9.18 mg RE/g DW ($p < 0.05$) in the samples of *A. annua* (Fig. 1). Gouveia and Castilho in their study found that the total amount of phenolic compounds in *A. annua* medicinal raw material ranged from 384.1±6.7 mg GAE/100 g DW to 521.2±5.4 mg GAE/100 g DW [22]. In the study by Iqbal et al., the amounts of phenolic compounds in the samples of *A. annua* leaves ranged from 90.12 mg GAE/g DW to 134.50 GAE/g DW [23]. Carvalho et al. determined the qualitative and quantitative composition of raw material samples of different *Artemisia* species. The total amount of phenolic compounds found in methanol extracts studied by these researches varied from 0.22 ± 0.002 mg GAE/g DW to 0.39 ± 0.000 mg GAE/g DW [24]. In the study by Mishra et al., the amounts of phenolic compounds in samples of *A. stelleriana* leaves ranged from 2.36±0.03 mg GAE/g DW to 10.09±0.24 mg GAE/g DW [25].

The overall variation of flavonoid content was found to be from 37.78±4.67 mg RE/g DW to

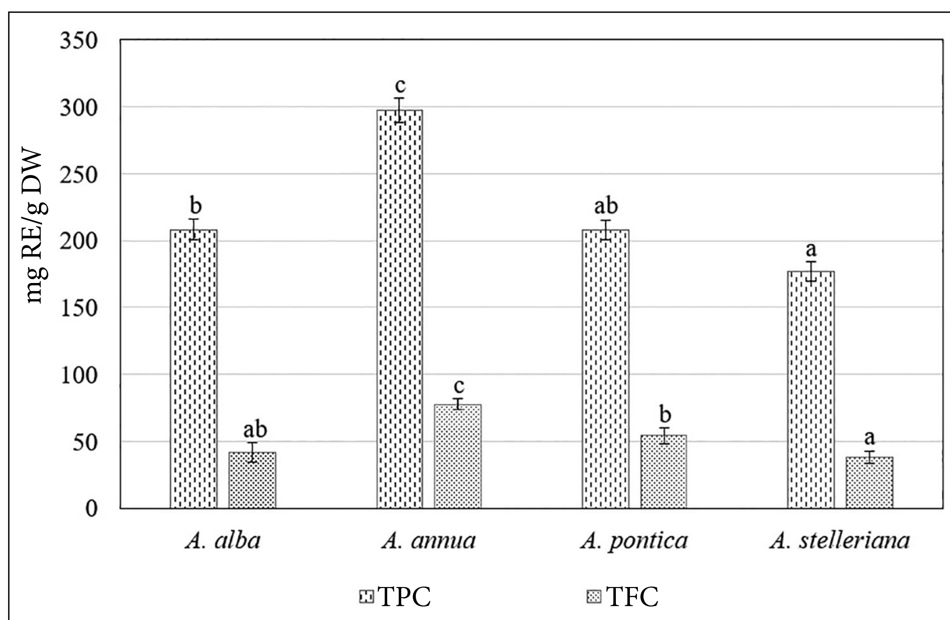

Fig. 1. Variability of the total content of phenolic compounds (TPC) and flavonoids (TFC) in medicinal raw material samples of four *Artemisia* L. species. Different letters indicate statistically significant ($p < 0.05$) differences in the amount between the samples

77.73±7.40 mg RE/g DW (Fig. 1). The largest total flavonoid content (77.73±7.40 mg RE/g DW) was found in the medicinal raw material samples of *A. annua*, while the lowest (37.78±4.67 mg RE/g DW) content was determined in the samples of *A. stelleriana* ($p < 0.05$). Carvalho et al. studied the variation in total flavonoid levels in leaf samples of *A. annua*, *A. arborescens*, *A. ludoviciana*, *A. oleandica*, *A. priceps* and *A. stelleriana*, where the total flavonoid content ranged from 0.03±0.005 mg QE/100 g DW to 0.19±0.002 mg QE/100 g DW [24].

Identification and quantification of phenolic compounds

HPLC analysis of four *Artemisia* L. species extracts was conducted under identical solution and instrumental conditions. The obtained results revealed the identification and quantification of a total of 14 polyphenols in all analyzed extracts (Table 1). The identified polyphenols fall into phenolic acids group, hydroxycinnamic acid derivatives and flavonoids, flavones and flavonols, respectively. The identified compounds were chlorogenic acid, coumaric acid, neochlorogenic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, apigenin, rutin, hyperoside, quercetin, kaempferol, luteolin, luteolin-7-rutinoside and luteolin-7-glucoside, expressed as mg/g. The most important polyphenols identified in all extracts, consistent with their concentration, were chlorogenic acid, 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, coumaric acid and rutin, the most abundant one being chlorogenic acid. Meanwhile, 4,5-dicaffeoylquinic acid, apigenin, quercetin, kaempferol, luteolin, luteolin-7-rutinoside and luteolin-7-glucoside were identified in smaller concentrations, or even in traces, falling below the limit of quantification in some cases. The total amount of phenolic acids in *Artemisia* medicinal raw material samples ranged from 0.16±0.04 mg/g (*A. stelleriana*) to 309.71±0.35 mg/g (*A. stelleriana*) ($p < 0.05$). Minda et al. have indicated that chlorogenic acid detected in medicinal raw material samples of three *Artemisia* species (*A. annua*, *A. dracunculus* and *A. absinthium*) had an anti-irritative effect by increasing the wound healing [26]. Studies have shown that phenolic acids (chlorogenic acid, syringic acid, caffeic acid, ferulic acid and vanillic acid) and flavonoids (kaempferol, rutin, luteolin, quercetin and catechin) accumulated in *Artemisia* plants have a strong effect in the cure of mental illness [27–28].

Flavonols are a group of flavonoids that is commonly found in *Artemisia* L. plants and compounds in this group have a many-sided pharmacological effect [6]. Therefore, it is important to determine

Table 1. **Variability of the quantitative composition of phenolic compounds in the medicinal raw material samples of four *Artemisia* L. species. The different letters indicate significant differences between the values ($p < 0.05$)**

No.	Compound, mg/g	*A. alba*	*A. annua*	*A. pontica*	*A. stelleriana*
1.	Chlorogenic acid	$235.07±6.03^{e}$	$36.10±2.46^{d}$	$157.49±2.70^{h}$	$309.71±0.35^{f}$
2.	Coumaric acid	$65.24±3.50^{c}$	$0.92±0.28^{a}$	$62.44±3.69^{e}$	$0.16±0.04^{a}$
3.	Neochlorogenic acid	$4.94±0.18^{a}$	$1.74±0.04^{ab}$	$5.40±0.33^{bc}$	$5.08±0.35^{b}$
4.	3,4-Dicaffeoylquinic acid	$24.39±3.47^{b}$	$3.45±0.34^{ab}$	$26.76±2.59^{d}$	$43.08±2.12^{d}$
5.	3,5-Dicaffeoylquinic acid	$146.06±5.12^{d}$	$38.68±4.34^{d}$	$100.82±2.76^{g}$	$161.00±6.04^{e}$
6.	4,5-Dicaffeoylquinic acid	ND	$1.57±0.29^{ab}$	$25.78±0.96^{d}$	$15.77±2.06^{c}$
7.	Apigenin	$0.64±0.02^{a}$	ND	$0.20±0.02^{a}$	$0.26±0.03^{a}$
8.	Rutin	$5.82±0.22^{a}$	$4.13±0.09^{b}$	$72.94±3.03^{f}$	$0.18±0.04^{a}$
9.	Hyperoside	$3.65±0.25^{a}$	$2.60±0.37^{ab}$	$1.78±0.12^{a}$	$0.64±0.05^{ab}$
10.	Quercetin	$1.22±0.23^{a}$	$2.58±0.29^{ab}$	$7.08±0.20^{c}$	$0.40±0.03^{ab}$
11.	Kaempferol	$0.63±0.06^{a}$	$2.44±0.25^{ab}$	$1.47±0.30^{a}$	$0.43±0.06^{ab}$
12.	Luteolin	$5.05±0.42^{a}$	$1.92±0.12^{ab}$	$1.81±0.06^{a}$	$2.29±0.29^{ab}$
13.	Luteolin-7-rutinoside	$6.04±0.74^{a}$	ND	$2.40±0.32^{ab}$	$1.44±0.12^{ab}$
14.	Luteolin-7-glucoside	$3.88±0.41^{a}$	$2.77±0.26^{ab}$	$2.50±0.14^{ab}$	$1.76±0.60^{ab}$

Notes: ND is not detected, below the limit of detection.

the variability in the qualitative and quantitative composition, and the content of flavonols in medicinal raw material. The highest total amount of compounds of the flavonol group (20.81±0.91 mg/g) was detected in the medicinal raw material samples of *A. pontica* and the lowest (0.41±0.04 mg/g) in the samples of *A. stelleriana* ($p < 0.05$). Among the identified compounds of the flavonol group, quercetin glycosides – i.e. quercetin and its three glycosides (rutin, hyperoside and kaempferol) – predominated (Table 1).

Four compounds of the flavones group (apigenin, luteolin, luteolin-7-rutinoside and luteolin-7-glucoside) were identified in the medicinal raw material samples of *Artemisia* L. plants. The highest total amount of the compounds of the flavones group (3.90±0.39 mg/g) was detected in the medicinal raw material samples of *A. alba* and the lowest (1.43±0.26 mg/g) in the samples of *A. stelleriana* ($p < 0.05$). Research has proven that luteolin inhibits the proliferation of human liver cancer cells and has a strong antidiabetic activity [29–30]. Two compounds of the flavones group were identified in the *A. annua* leaf samples – rutin (0.765 μg/g DW) and apigenin (0.135 μg/g DW). Both are known for their comprehensive biological effects. Researches have indicated that *A. annua* extracts may be suitable for use in food industry as substitutes for synthetic antioxidants [24].

Measurements of antioxidant activity in *Artemisia* (L.) extracts

After the evaluation of the qualitative and quantitative composition and content of phenolic acids and flavonoids in the medicinal raw material samples prepared from different *Artemisia* L. species introduced in Lithuania, it is important to examine and assess the antioxidant activity of their extracts *in vitro*.

The evaluation using the DPPH assay showed that the strongest antiradical activity was observed in the medicinal raw material sample extracts of *A. annua* and *A. pontica* species (respectively, 39.75±3.30 μmol TE/g DW and 31.98±4.47 μmol TE/g DW), while the weakest antiradical activity was observed in the raw material sample extracts of *A. stelleriana* (21.82±3.04 μmol TE/g DW) ($p < 0.05$) (Fig. 2). The coefficient of variation reflecting the variability in antiradical activity *in vitro* between the medicinal raw material extracts of different *Artemisia* species was significantly high – 17.13% ($p < 0.05$). In the study by Bordean et al., the antiradical activity *in vitro* of *A. annua* leaf extracts was 250.51±0.01 μmol TE/g DW and was stronger than that observed in stem extracts (respectively, 60.87±0.02 μmol TE/g DW) [31].

We evaluated the antiradical activity of the extracts of *Artemisia* L. medicinal raw material samples *in vitro* by using the $ABTS^{\bullet+}$ radical-cation scavenging assay. The strongest antiradical

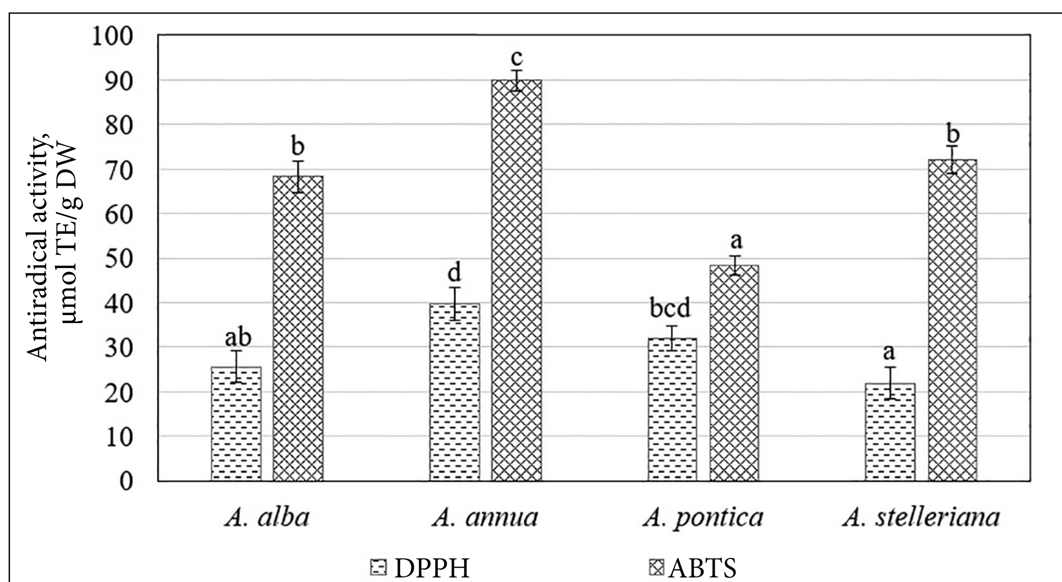

Fig. 2. Variability in the antiradical activity *in vitro* in the medicinal raw material sample extracts of four *Artemisia* L. species; different letters indicate statistically significant ($p < 0.05$) differences between the studied samples

activity (89.86±5.87 µmol TE/g DW) was observed in the raw material extracts of *A. annua*, which did not differ statistically significantly from the antiradical activity raw material extracts of *A. stelleriana* and *A. alba* species. The weakest (48.33±6.18 µmol TE/g DW) antiradical activity evaluated by the ABTS assay was observed in the *A. pontica* medicinal raw material extracts ($p < 0.05$) (Fig. 2). The variability in the antiradical activity *in vitro* evaluated by this assay between the raw material extracts of four *Artemisia* species was high, with the calculated coefficient of variation being 15.68%. In the study by Bordean et al., the antiradical activity *in vitro* of *A. annua* leaf extracts was 816.55±0.05 µmol TE/g DW and was stronger than that observed in stem extracts (respectively, 659.57±0.02 µmol TE/g DW) [31].

When applying the FRAP assay, the strongest reducing activity *in vitro* was found in the medicinal raw material sample extracts of *A. annua* (68.45±1.52 µmol TE/g DW), yet it did not differ statistically significantly from that observed in the sample extracts of *A. stelleriana* ($p < 0.05$). The weakest reducing activity detected by using this assay (36.40±4.52 µmol TE/g DW) was found in the raw material sample extracts of *A. pontica* (Fig. 3). The coefficient of variation of the reducing activity of *Artemisia* raw material extracts evaluated using the FRAP assay was high – 18.41%. In the study by Skowyra et al., the reducing activity *in vitro* of *A. annua* leaf extracts was 212.18±6.02 µmol TE/g DW and was stronger than that observed in our study [32].

The strongest reducing activity evaluated via the CUPRAC assay was detected in the extracts of *A. annua* medicinal raw material samples (107.79±2.73 µmol TE/g DW), while the weakest reducing activity *in vitro* (78.19±2.47 µmol TE/g DW) was found in the medicinal raw material sample extracts of *A. alba* ($p < 0.05$) (Fig. 3). In the study by Messaili et al., the reducing activity *in vitro* of *A. annua* medicinal raw material extracts was 12.35±0.2 µmol TE/g DW and was weaker than that observed in our study [19].

CONCLUSIONS

In conclusion, the results of this study will provide new knowledge about the composition and content of phenolic compounds in the medicinal raw material of four *Artemisia* L. species (*A. alba*, *A. annua*, *A. pontica* and *A. stelleriana*) introduced in the Middle of Lithuania, and the antioxidant activity of their extracts *in vitro*. The highest total amount of phenolic compounds (297.37±9.18 mg RE/g DW) and flavonoids (77.73±7.40 mg RE/g DW) was found in the medicinal raw material samples of *Artemisia annua* L. In order to clarify

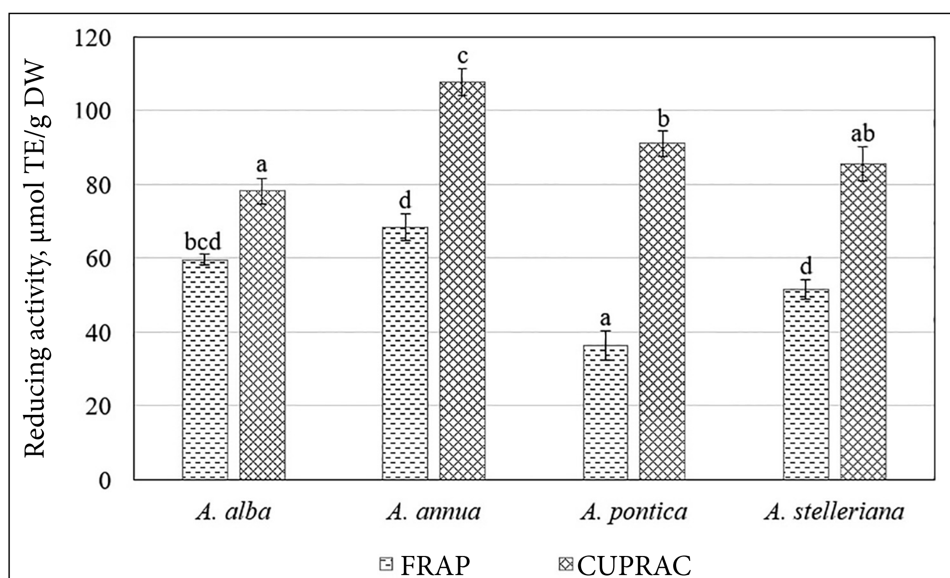

Fig. 3. Variability in the reducing activity *in vitro* in the medicinal raw material sample extracts of four *Artemisia* L. species; different letters indicate statistically significant ($p < 0.05$) differences between the studied samples

the variability in the content of individual phenolic compounds in the medicinal raw material samples of the studied *Artemisia* species we conducted HPLC analysis. In the medicinal raw material of the studied *Artemisia* species, chlorogenic acid and 3,5-dicaffeoylquinic acid predominated among the identified phenolic compounds, while the amounts of other compounds were significantly lower. The medicinal raw material samples of *A. annua* stood out among the others due to their exclusive phytochemical composition and strong antiradical (89.86±5.87 µmol TE/g DW by ABTS assay) and reducing activity (107.79±2.73 µmol TE/g DW by CUPRAC assay) ($p < 0.05$).

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LIETUVOJE INTRODUKUOJAMŲ KIEČIO (*ARTEMISIA* L.) GENTIES RŪŠIŲ VAISTINĖJE AUGALINĖJE ŽALIAVOJE SUKAUPTŲ FENOLINIŲ JUNGINIŲ IR ANTIOKSIDACINIO AKTYVUMO ĮVERTINIMAS

Santrauka

Pastarąjį dešimtmetį išskirtinis dėmesys atkreiptas į kiečio (*Artemisia* L.) genties augalų rūšis ir jų vaistinės žaliavos panaudojimo galimybes gydymo tikslams. Tyrimo tikslas – nustatyti Lietuvoje introdukuojamų keturių kiečio (*Artemisia* L.) genties rūšių vaistinėje augalinėje žaliavoje susikaupusių fenolinių junginių kiekybinę ir kokybinę sudėtį bei įvertinti augalinių ekstraktų antioksidacinį aktyvumą *in vitro*. Taikant spektrofotometrinės analizės metodus, maksimalus bendras fenolinių junginių (297,37 ± 9,18 mg RE/g DW) ir flavonoidų (77,73 ± 7,40 mg RE/g DW) kiekis nustatytas vienamečio kiečio (*Artemisia annua* L.) vaistinės augalinės žaliavos ėminiuose. Kokybinė ir kiekybinė fenolinių junginių sudėtis atlikta, taikant efektyviosios skysčių chromatografijos (ESC) metodą. *Artemisia* (L.) rūšių ekstraktuose nustatyti dominuojantys junginiai – chlorogeno ir 3,5-di-kafeoilchino rūgštys. Nustatyta, kad stipriausiomis antiradikalinėmis ir redukcinėmis savybėmis pasižymėjo *A. annua* vaistinės augalinės žaliavos metanoliniai ekstraktai.