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Chemical Composition of Different Parts of *Matricaria chamomilla*

Kemijski sastav različitih dijelova kamilice

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Summary

In this paper, the quantity and composition of essential oil and flavonoids from camomile grown in Eastern Croatia were assayed. The mentioned quality parameters were determined in the flower heads, but also in some parts of the plant – yellow florets, petals and, stems and leaf. Essential oil content was determined by steam distillation (Clevenger's apparatus), and the oil was then analyzed by a gas chromatograph.

Flavonoids were determined spectrophotometrically after the formation of chelates between flavonoid aglycones and Al^{3+}-ions.

Sažetak

U radu su određeni količina i sastav eteričnog ulja i flavonoida kamilice s područja Slavonije. Navedeni pokazatelji kakvoće točno su utvrđeni u cvijetu, pulvisu (žutim cvjetićima), laticama te stabljici i listu. Količina eteričnog ulja određena je metodom po Clevengeru, a zatim je sastav ulja ispitan plinskom kromatografijom.

Flavonoidi su određeni spektrofotometrijski, nakon stvaranja kelata između flavonoidnih aglikona i Al^{3+}-iona.

Introduction

Camomile (*Matricaria chamomilla* L.) is one of the most commonly used medicinal plants, due to its antiphlogistic *(1–4)*, spasmolytic *(1,2,5–7)*, ulcusprotective *(1,8,9)*, antibacterial *(10)* and other effects. Active substances include essential oil components (chamazulene, (-)-α-bisabolol, bisabolol oxides A and B, spirocyclic enoletherpolins: cis and trans en-in-dicycloethers), but also flavonoids, coumarines and pyrons.

The purpose of this work has been to determine the quantity and composition of essential oil and also the content of flavonoids extracted from flower heads and different parts of camomile. Both quantity and composition of essential oil and flavonoids are indispensable for the quality assessment of this drug. This paper also contributes to a better knowledge on camomile from Eastern Croatia.

Materials and Methods

Three samples of diploid camomile grown in Eastern Croatia, were examined in three replications. The samples were separated into the 1. class camomile flower heads, stems and leaf, petals and yellow florets. Essential oil was extracted out of flower heads and plant parts using the method by Clevenger *(11)*.

Subsequently, the essential oil was analyzed by gas chromatograph Perkin-Elmer 3920 B. Flavonoid content in flower heads and plant parts was determined using the method by Christ and Müller *(12)*, with spectrophotometer Perkin-Elmer λ 17.

The results were processed using the multivariate statistical analysis (Statistical Graphics System Statgraphics).

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Results and Discussion

Arithmetic means of essential oil mass fraction in camomile flower heads are 0.43 %, 0.37 % and 0.48 %. There is a significant difference between the three samples according to the significance level at the 95 % confidence (0.02). Statistically significant difference also exists when essential oil contents of the plant parts are compared. The results are in concordance with the well-known facts *(10)*, i.e. yellow florets contain most of camomile essential oil (w = 0.49 %; 95 %-confidence interval = 0.39 – 0.58 %), while petals (w = 0.28 %; 95 % confidence interval = 0.19 – 0.38 %) and stems and leaf (w = 0.08 %; 95 %-confidence interval = –0.02 – 0.17 %) have much smaller mass fractions of it (Table 1).

The mean mass fractions of chamazulene in the essential oil of flower heads is 6.97 % (95 %-confidence interval = 5.65 – 8.22 %). There is no statistically significant difference among the samples (sign. level = 0.69), but the difference between the parts of camomile is statistically significant (sign. level = 0.002). Apparently, yellow florets - containing the greatest fraction of essential oil, have the highest fraction of chamazulene (w = 10.36 %; 95 %-conf. interval = 9.07 – 11.64 %, Table 1), which also accounts for the blue colour of greatest intensity of the essential oil from yellow florets.

No significant difference exists between the samples by farnesen mass fraction (sign. level = 0.53; w = 7.84 %; 95 %-conf. interval = 5.38 – 10.29 %). The parts do not differ significantly in this sense either (sign. level = 0.11), though the essential oil from petals has notably greater quantity of farnesen (w = 12.91 %; 95 %-conf. interval = 10.45 – 15.36 %; Table 1).

Bisabolol oxide B shows no statistically significant difference among the samples (sign. level = 0.70; w = 19.11 %; 95 %-conf. interval = 16.42 – 21.81 %), and the significance level of 0.11 indicates that there is no significant difference among the plant parts either (Table 1).

The difference in bisabolol oxide A content in the essential oil of the 3 samples of flower heads is not significant (sign. level = 0.84; w = 26.49 %; 95 %-conf. interval = 22.80 – 30.17 %), while the essential oils from the plant parts differ significantly, because of the lower content of bisabolol oxide A in the essential oil from petals (w = 19.68 %; 95 % conf. interval = 15.99 – 23.36 %; Table 1).

The mass fraction of (-)-α-bisabolol shows no statistically significant difference among these samples of flower heads. Mean fractions in the samples are 1.65 %, 1.98 % and 2.61 %, respectively (sign. level = 0.07). The difference between the plant parts is insignificant (sign. level = 0.47; Table 1). More or less the same pattern of varying the concentrations of (-)-α-bisabolol and its oxides in camomile parts is observable (i.e. greatest content in yellow florets, and lowest in petals), although no statistically significant difference exists for the content of (-)-α-bisabolol and bisabolol oxide B between the parts.

No statistically significant difference exists among the samples in the quantity of the spirocyclic enoletherpolins: trans and cis en-in dicycloethers, (w = 7.99 %; 95 %-conf. interval = 4.41 – 11.57 %; sign. level = 0.78), but there is a significant difference between the plant parts (sign. level = 0.05). The essential oil from petals is richest (w = 11.25 %; 95 %-conf. interval = 7.67 – 14.84 %), and the essential oil from yellow florets is poorest (w = 3.26 %; 95 %-conf. interval = –0.65 – 6.51 %) in cis and trans en-in dicycloethers (Table 1).

Table 1. Mean mass fractions of camomile essential oil, its components and flavonoids in flower heads, stems and leaf, petals and yellow florets of the three samples
Tablica 1. Prosječni maseni udjeli eteričnog ulja kamilice, njegov sastav i flavonoidi u cvjetnim glavicama, stapci i listu, laticama i žutim cvjetićima triju uzoraka

	Essential oil	Chamazulene	Farnesen	Bisabolol	Bisabolol oxide A	Bisabolol oxide B	En-in dicycloethers	Flavonoids
	w/%				w*/%			w/%
Flower heads	0.43	6.94	7.84	2.08	26.49	19.11	7.99	0.93
Stems and leaf	0.08	4.75	8.37	1.85	25.51	18.76	9.39	0.86
Petals	0.28	5.14	12.91	1.84	19.67	14.85	11.25	2.58
Yellow florets	0.49	10.35	9.49	2.21	28.50	19.50	2.93	1.10

* mass fraction in essential oil

Flavonoid content in the samples does not differ significantly (w = 0.93 %; 95 %-conf. interval = 0.36 – 1.49 %; sign. level = 0.57).

From Table 1, a much higher content in petals (w = 2.58 %; 95 %-conf. interval = 2.02 – 3.15 %), as compared with the other plant parts, is obvious.

At absorption maxima (approximately on 391 nm, which is the maximum of the standard apigenin Al^{3+} complex in the solvent mixture methanol-acetic acid 95:5 *(10)*) flavonoids in camomile petals are most abundant in a strong spasmolytic flavone derivative - apigenin (2-phenyl (4'-hydroxy)-4-oxo-5,7-dihydroxy benzopyrene *(5)*.

Conclusion

The range of mass fractions (i.e. the 95 % confidence interval) of the essential oil in camomile flower heads samples is 0.33 % to 0.53 %.

Because no statistically significant difference was found between the fractions of essential oil components of the three samples, the conclusion can be made of a common genotype of these three samples of camomile, confirming the hypotheses by a number of authors *(13–16)*.

Low mean mass fractions of bisabolol (w = 2.08 %), and en-in dicycloethers (w = 7.99 %) of the samples of flower heads, as compared with literature data *(8,10, 17,18)*, substantially diminish therapeutic properties of these samples.

The fractions of chamazulene in the essential oil seems to grow along with the content of essential oil in camomile parts.

Cis and trans en-in dicycloethers and farnesen have the highest content in the essential oil from petals although the difference between the parts is only, significant for the former ($p \leq 0.05$).

The quantities of bisabolol and bisabolol oxides A and B among camomile parts vary in the same pattern, which confirms the literature data of linked methabolic pathways of these components *(19)*.

Mean value of flavonoid mass fraction in the samples is 0.93 %. Petals, which are a by-product in the industrial processing of camomile, have a considerably higher content of flavonoids compared with the other plant parts, as has already been determined previously *(20, 21)*. Since these flavonoids are rich in apigenin, the application of petals for the preparation of natural spasmolytic formulations, should be considered.

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