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CHEMICAL COMPOSITION OF COMMERCIALLY AVAILABLE ESSENTIAL OILS FROM BLACKCURRANT, GINGER, AND PEPPERMINT

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Essential oils are characterized by their overall capacity to generate aroma and flavor. Therefore, they are widely used as flavoring additives in food production, fragrances in cosmetics, and components of soaps, air fresheners, and detergents. Essential oils extracted from plants also contain the biologically active fraction of chemicals that are biosynthesized in nature and very often possess pesticidal, insecticidal, and antibacterial properties [1]. An important field of application is also clinical aromatherapy in which oils are heated and volatilized [2].

Chemically the term essential oil refers to any class of volatile oils containing a multipart mixture of monoterpenoids, smaller amounts of sesquiterpenoids, and other volatile aromatic compounds steam-distilled from different parts of plants.

Up to now most reports of the compositional variation of essential oils deal with plant extracts obtained directly by steam distillation. Usually the wide variation in composition and content of essential oils is strongly influenced by harvest date and plant age, light regime, fertilization, and planting time. While this is of value in determining the ability of certain plants to produce secondary volatile metabolites, it does not reflect the final composition of commercial preparations containing essential oils.

Therefore this study was undertaken in order to analyze three commonly used essential oils commercially available in Poland and elsewhere in the world: blackcurrant bud oils, ginger oil, and oil from peppermint.

Table 1 lists the compounds identified in the blackcurrant (*Ribes nigrum* L.) essential oil sample. The blackcurrant oil contained 27 volatile compounds, and each of them was identified in this study. The compounds present in the highest concentrations were camphene (15.23±0.31%), β-pinene (13.86±0.38%), β-caryophyllene oxide (9.47±0.67%), δ-3-carene (8.68±0.22%), limonene (8.47±0.57%), sabinene (8.38±0.38%), and bornyl acetate (7.03±0.34%).

Table 2 shows the results obtained for ginger essential oil. This consisted of 10 compounds, where three were identified as monoterpens and four compounds as sesquiterpens. The dominant components of this oil are zingiberene (35.89±0.30%), β-bisabolene (16.27±0.95%), β-sesquiphellandrene (11.56±0.33%), and <AR> curcumene (12.18± 1.58%). Table 3 lists the compounds found in the essential oil from peppermint. Of 8 compounds, 7 could be identified: menthol (49.43±0.40%), menthone (23.47±0.38%), isomenthone and neomenthol (16.61±0.44%), isomenthyl acetate (77.54±0.98%), α-pinene (2.19±0.36%), and β-pinene (2.31±0.39%).

The very extensive study on essential oil compositions isolated from 23 varieties of blackcurrant buds revealed that the percentage content of particular volatiles may vary significantly [3]. For example, sabinene can be present in traces but also up to 69% of the total essential oil. In our case the sabinene content was 8.38±0.38%. The other compounds were also found to vary in a wide range, e.g., δ-carene from 0.17 to 45.5%, β-phelandrene from 1.72 to 24.63%, or terpinolene from 0.40 to 20%. The authors of [3] have also found that out of 50 analyzed compounds in blackcurrant essential oils only 15 are above 2%, out of which the contents of seven dominating ones are higher than 7%. This is consistent with our study where also seven dominating compounds (>7%) were separated and identified. The concentrations of some compounds, however, are higher in the commercial oil analyzed in this study in comparison with the literature data [3–5]. This was especially observed for camphene (15.23%), β-pinene (13.86%), and bornyl acetate (7.03%). In this study we have also isolated and identified *trans*-piperitol and α-cubabene, rarely found in essential oils from blackcurrant [6].

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TABLE 1. Chemical Composition of the Commercial Blackcurrant Essential Oil

Compound	RI_{lit}	RI_{exp}	Mean content, %	Compound	RI_{lit}	RI_{exp}	Mean content, %
α-Pinene	939	942	1.18±0.18	*trans-p*-Menth-2-en-1-ol	1140	1140	0.75±0.11
Camphene	953	949	15.23±0.31	*trans*-Myroxide	1142	1145	0.50±0.12
Tui-2,4(10)-diene	957	960	5.43±0.38	Terpin-4-ol	1177	1178	1.39±0.41
Sabinene	976	980	8.38±0.38	*p*-Cymen-8-ol	1183	1183	0.83±0.40
β-Pinene	980	984	13.86±0.38	α-Terpineol	1189	1189	3.67±0.57
Myrcene	991	991	0.34±0.13	*trans*-Piperitol	1205	1211	0.50±0.11
α-Phelandrene	1005	1005	1.60±0.42	Citronellol	1228	1223	0.50±0.10
δ-Carene	1011	1012	8.68±0.22	Linalyl acetate	1257	1252	0.48±0.14
o-Cymene	1022	1021	0.83±0.26	Bornyl acetate	1285	1288	7.03±0.34
p-Cymene	1026	1025	4.33±0.70	*trans*-α-Dihydroterpinyl acetate	1315	1315	2.10±0.23
Limonene	1031	1030	8.47±0.57	α-Cubebene	1351	1350	0.61±0.24
γ-Terpinene	1062	1066	0.58±0.13	β-Caryophyllene oxide	1581	1591	9.47±0.67
Terpinolene	1088	1089	0.62±0.04	1.10-di*epi*-Cubenole	1614	1615	1.97±0.19
cis-Limonene-1,2-epoxide	1134	1135	0.65±0.11				

TABLE 2. Chemical Composition of the Commercial Ginger Essential Oil

Compound	RI_{lit}	RI_{exp}	Mean content, %	Compound	RI_{lit}	RI_{exp}	Mean content, %
α-Pinene	939	949	2.46±0.29	Curcumene<AR>	1483	1484	12.18±1.58
Camphene	953	960	8.12±0.75	α-Zingiberene	1495	1497	35.89±0.30
β-Phelandrene	1031	1029	3.86±0.45	Unknown	-	1500	6.22±0.40
Unknown	-	1031	2.92±1.08	β-Bisabolene	1509	1510	16.27±0.95
Unknown	-	1170	0.67±0.36	β-Sesquiphelandrene	1524	1526	11.56±0.33

TABLE 3. Chemical Composition of the Commercial Peppermint Essential Oil

Compound	RI_{lit}	RI_{exp}	Mean content, %	Compound	RI_{lit}	RI_{exp}	Mean content, %
α-Pinene	939	949	2.19±0.36	Isomenthone and	1164	1154	16.61±0.44
β-Pinene	980	982	2.31±0.39	Neomenthol	1165	1154	
Unknown	-	1028	3.20±0.41	Menthol	1173	1176	49.43±0.40
Menthone	1154	1155	23.47±0.38	Isomenthyl acetate	1306	1295	3.09±0.08

The composition of the commercial ginger essential oil was similar to that reported in the literature. All compounds identified in this study were also present in extracts of *Zingiber officinale* Roscoe, a common source of ginger oil [7, 8]. However, compounds such α-pinene, camphene, and β-phelandrene are not commonly found in all Zingiberales plants (including *Zingiber officinale* R.), for example those from central Africa [9]. The principal compound in the ginger essential oil analyzed in our study was α-zingiberene (35.89%). Comparably high concentrations of this compound were also found in the natural extract of *Z. officinale* from Taiwan (35.01%) [8], but 10 times lower content is found in the same species from central Africa (3.6%) [9]. The same tendency is observed for the content of β-bisabolene: 16.26% in our study, 13.35% in *Z. officinale* from Taiwan, and 5.3% in *Z. officinale* from central Africa. The remaining components in the ginger essential oil found in our study (camphene, β-phelandrene, and <*AR*>curcumene, and β-bisabolene) were characterized by much higher concentrations than in the extracts from *Z. officinalle* with the exception of β-sesquiphelandrene content, found to be higher in the plant extract [7, 8]. In the commercial essential oil from ginger, however, we have not found geranial, neral, α-curcumene and 1,8-cineol identified in African *Z. officinale* [9].

All compounds identified in the peppermint oil in this study were also present in extracts of leafs from *Mentha x piperita* L. harvested in Norway [10]. The principal compound in these oils was menthol. Its concentration is comparably high in the commercial oil from peppermint extract analyzed in our study (49.43 and 46.53% respectively) (Table 3). The remaining components in the peppermint oil found in our study (menthone, α-pinene, β-pinene, isomenthone and neomenthol) were characterized by higher concentrations than in the extracts from *Mentha x piperita* L. [9].

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