

Comparative Analysis of the Composition of the Volatile Oils of Two Forms of *Achillea crithmifolia* W. et K. – Diploid and Tetraploid

Adam Kowalczyk^{a*}, Janina Dąbrowska^b,
Marek Mardarowicz^c, Izabela Fecka^a, and
Wojciech Cisowski^a

^a Dept. of Pharmacognosy, Wrocław Medicinal
University, Nankiera 1, 50-140 Wrocław, Poland.

Fax: ++48-71-7840218. E-mail: akow2@poczta.onet.pl

^b Institute of Botany, Wrocław University, Maxa
Borna 9, 50-206 Wrocław, Poland

^c Dept. of Chemical Physics and Physico-Chemical
Methods of Separation, Maria Curie-Skłodowska
University, M. Curie-Skłodowska sq. 3, 20-031 Lublin,
Poland

* Author for correspondence and reprint requests

Z. Naturforsch. **58c**, 146–147 (2003);

received June 11/August 29, 2002

The genus *Achillea* L. includes more than 100 species
and is a polyploid complex of di-, tetra-, hexa- and octa-
ploids, individuals.

Key words: *Achillea crithmifolia*, Volatile Oil, Diploid Te-
traploid

Achillea crithmifolia W. et K. is one of the ten
currently known *Achillea* taxa and exists in two
forms: diploid ($2n = 18$, noted for example in
Greece) and tetraploid ($2n = 36$). Between these
forms there are some differences, which were ob-
served by Dąbrowska (Dąbrowska, 1971, 1972,
2001).

Diploid and tetraploid forms (or the poly-
ploids) may differ chemically so it is an interest-
ing problem to what extent the compositions of
the volatile oils of these two forms of *A. crithmi-
folia*.

Material and Methods

Material

The analysed plants were growing in a collection
in Wrocław, but were originally collected in na-
ture. The diploid form was from Greece and tetra-
ploid from Poland (Lower Silesia, Gubin).

Herbs were collected during flowering in the
summer 2001. Plant material was identified and
determined by J. Dąbrowska.

Isolation of oil fractions

20.0 g of each material, previously air-dried, was
distilled with water vapour in Deryng apparatus,
according to the method of obtaining and measur-
ing volatile oil described in the Polish Pharmaco-
peia FPV for *Achillea millefolium* (Polish Pharma-
copeia 1999). The plant material was placed in the
glass flask with the 200 ml water. The flask was
connected with Deryng apparatus and heated 3 h
on the water bath. After that the oil fraction was
analysed by GC-MS.

Chromatographic analysis

Chromatographic analysis was carried out using
gas chromatograph HP 5890, series II, coupled
with mass spectrophotometer HP 5971A. Analysis
parameters were: capillary column HP-1.25 m,
ionisation energy 70 eV, carrier gas helium, flow
speed: 0.5 ml/min, temperature increase from 80
to 300 °C at a rate of 8 °C/min. The resulting
spectra were compared with the data from the
data library IVB575KL (Finnigan Mat, San José,
USA).

All the experiments were repeated three times.

Results and Discussion

The mean content of volatile oil in the herb
A. crithmifolia diploid is $2\% \pm 0.05$ (v/w) and in
the tetraploid – $2.1\% \pm 0.052$ (v/w). Most of the
oil was distilled during the first 30 min of heating.
Chromatographic analysis GC-MS revealed the
main differences and similarities between the di-
ploid and the tetraploid forms of *A. crithmifolia*
(Fig. 1).

In the volatile oil of the diploid 1,8-cineole
($17.9\% \pm 0.03$) is the main component and in the
tetraploid – camphor ($21.4\% \pm 0.02$).

The diploid oil in comparison with the tetraploid
has more β -thujone ($18.3\% \pm 0.01$), trans-chrysan-
thenyl acetate ($14.9\% \pm 0.02$), germacrene D
($2.5\% \pm 0.04$) and less camphor ($4.1\% \pm 0.01$)
and borneol ($1.7\% \pm 0.03$).

The tetraploid form of the oil contains more
borneol ($12.1\% \pm 0.02$) and less 1,8-cineole ($2.5\% \pm 0.03$), β -thujone ($4.8\% \pm 0.03$), trans-chrysan-

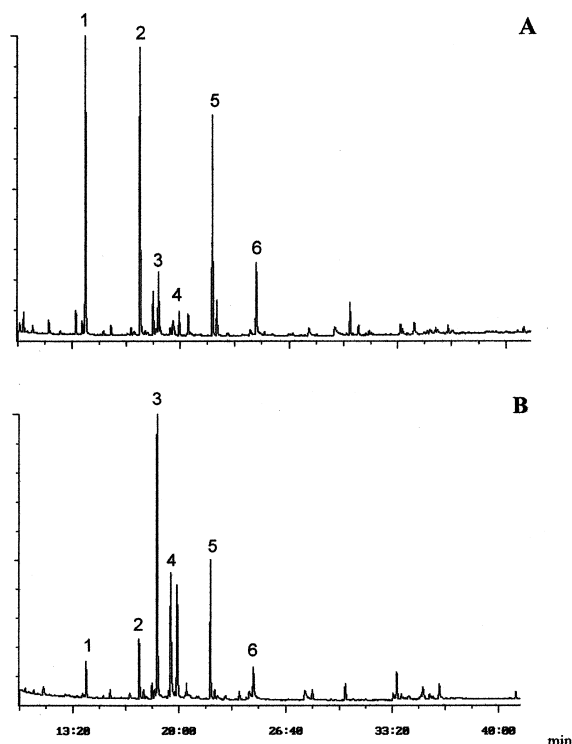


Fig. 1. GC chromatograms of volatile oil of *A. crithmifolia* – **A** – diploid; **B** – tetraploid.

1 – 1,8-cineole **2** – β -thujone **3** – camphor **4** – borneol
5 – *trans*-chrysanthenyl acetate **6** – germacrene D.

thenyl acetate (10.2 ± 0.02), germacrene D ($1.5\% \pm 0.01$) than the diploid form.

The differences in the chemical compositions of the volatile oils in both forms, diploid and tetraploid, are valuable data which can emphasize that it is very important to know the numbers of chromosomes in the analysed plant material, because the presence of natural compounds could be different in taxa with similar morphology and anatomy.

Chromatographic analysis together with the chromosome data may give more information about plants and can help to establish relationships between taxa.

Dąbrowska J. (1971), Korelacja między liczbą chromosomów w komórkach szparkowych a poziomem poliploidalności czernastu taksonów *Achillea* L. Herba Polon. **17**, 200–208.

Dąbrowska J. (1972), *Achillea crithmifolia* W. et K. – A synanthropic species new to the flora of Poland Fragm. Flor. et Geobot. **18**, 147–151.

Dąbrowska J. (2001) *Achillea crithmifolia* in di- and tetraploid forms Proceedings of the 2nd Balkan Botanical Congress, Istanbul, Turkey, 2000, 447–450.

Polish Pharmacopeia, Polskie Towarzystwo Farmaceutyczne, Warszawa (1999), p. 464.