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Analysis of the Essential Oil of the Leaves of the Medicinal Plant *Chenopodium ambrosioides* var. *anthelminticum* (L.) A. Gray from India*

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****Dedicated to Prof.Dr.W. Kubelka on the occasion of his 65th birthday.***

The composition of the essential oil of *Chenopodium ambrosioides* var. *anthelminticum* L. (Chenopodiaceae) leaves (also commonly known as American Wormseed, wormseed goosefood or sweet pig weed) from India (Himalayan area) was analyzed by GC-FID, GC-MS and olfactometry. As main compounds α-terpinene (65.4%) and para-cymene (29.4%) were found. Surprisingly the concentration of ascaridole, the main compound of *Chenopodium* species from various origin, was very low (0.7%) in this sample.
The chromatographic-spectroscopic and olfactoric data as well as a possible influence of the identified volatiles on the reported biological effects will be discussed.

Keywords: *Chenopodium ambrosioides* var. *anthelminticum*, Chenopodiaceae, essential oil of the leaves, GC-FID, GC-MS, α-terpinene, ascaridole

Introduction

Chenopodium ambrosioides var. *anthelminticum* (L.) A. Gray belongs to the family of *Chenopodiaceae* and is commonly known as American wormseed, wormseed goosefood or sweet pig weed [1,2]. This *Chenopodium* species (from the genus *Chenopodiaceae* about 250 species are described) is native to Central America and West-India. *C. ambrosioides* is a branched herb of 2-4 ft. high. The entire plant is emanates a camphoraceous and *Valeriana-officinalis*-like odor [3,4]. The volatile oil from the leaves, the roots, the herb and the seeds have various pharmacological properties. The herb with the seeds as well as the seed oil possess anthelmintic and insecticidal activities [1-8], while from the leaves and roots antiasthmatic, antirheumatic and antitumor effects have been reported [3]. Additional applications of *C. ambrosioides* leaf oils are as follows: effects

against intestinal parasites, amoebic dysentry and for eradication of round- as well as hookworms; treatment of *Ascaris* infection in combination with santonin and use as an abortivum (folk medicine) since ancient times [1]. The toxicological potential of this *Chenopodium* species was correlated to the content of the monoterpenoid compound ascaridole, found in different essential oils of various origin in a concentration range from about 1 to 75% [2-8].

Results and discussion

The essential oil of *Chenopodium ambrosioides* var. *anthelminticum* (L.) A. Gray (*Chenopodiaceae*) from India (Himalayan area) was olfactorically evaluated by professional perfumers as follows: Medicinal and terpinene-like odor with weak fresh and camphoraceous notes.
Using gas chromatographic-spectroscopic methods (GC-FID and GC-MS) 37 constituents of this *Chenopodium* oil could be identified (see Table 1). As main compounds the monoterpenes α-terpinene (65.4%) and para-cymene (29.4%) could be found. Beside one minor compound, pinocarvone (1.0%), the concentration of the other identified constituents was lower than 1.0%.

Table 1: Constituents of the essential oil of *Chenopodium ambrosioides* L. leaves from India (in order of their concentrations: calculated as %-peak area GC-FID analysis)

Compound	%	identification
α-Terpinene	65.4	GC, GC-MS, O*
para-Cymene	29.4	GC, GC-MS, O
Pinocarvone	1.0	GC, GC-MS, O
Ascaridole	0.7	GC, GC-MS, O
Dihydrocarvyl acetate	0.4	GC, GC-MS
Piperitone oxide	0.3	GC, GC-MS, O
γ-Terpinene	0.2	GC, GC-MS, O
Limonene	0.2	GC, GC-MS, O
Aritasone	0.2	GC, GC-MS
cis-β-Ocimene	0.1	GC, GC-MS
Dehydro-para-cymene	0.1	GC, GC-MS
β-Phellandrene	0.1	GC, GC-MS,O
Benzaldehyde	0.1	GC, GC-MS, O
Limonene oxide	0.1	GC, GC-MS, O
para-Cymol	0.1	GC, GC-MS, O
Terpinolene	0.1	GC, GC-MS, O
trans-β-Ocimene	0.1	GC, GC-MS, O
β-Myrcene	0.1	GC, GC-MS, O

α-Terpinyl acetate	0.1	GC, GC-MS, O
Thymol	tr[#]	GC, GC-MS, O
Myrcenol	tr	GC, GC-MS
α-Terpineol	tr	GC, GC-MS, O
Hexanol	tr	GC, GC-MS, O
Nonanal	tr	GC, GC-MS, O
Citral	tr	GC, GC-MS, O
(E)-Hex-3-enol	tr	GC, GC-MS, O
1,8-Cineole	tr	GC, GC-MS, O
Bornyl acetate	tr	GC, GC-MS, O
(Z)-Hex-3-enol	tr	GC, GC-MS, O
Phenyl acetate	tr	GC, GC-MS, O
fatty acids and their esters (3 compounds)	0.3	GC, GC-MS,
higher hydrocarbons (higher than 16 C, 4 compounds)	0.2	GC, GC-MS,

*olfactoric detection
GC retention indices correlation in accordance to ref. [9-12]
GC-MS mass spectra correlations with library spectra
[#]trace compound (less than 0.1%)

Contrary to the most of the published data on *C.-ambrosioides*-essential-oil-constituents the content of the monoterpenoid component ascaridole -the target compound of *Chenopodium-ambrosioides*-oils used as anthelminticum [7,8]- was very low (0.7%). Only one paper mentioned an essential oil of this *Chenopodium* species from Japan with a similar low content of ascaridole of about 1% [4]. Therefore the anthelmintic activity of this essential oil from India must significantly be weaker (α-terpinene is known to have little anthelmintic properties [13] in correlation to official used (mentioned in the Austrian and German pharmacopoea) *Aetheroleum Chenopodii*-samples in the past.

As an advantage of the investigated essential oil, a lower toxicity on account of the low concentration of ascaridole, can be mentioned. This fact and the knowledge that terpinene-derivatives as well as para-cymene show bactericidal and fungicidal effects [13-23] render this Indian *Chenopodium-ambrosioides*-oil more interesting for a possible application in the treatment of infections.

Additional the significant odor of this *Chenopodium*-sample (medicinal, terpinene-like, week fresh and camphoraceous notes) can be attributed to the odor of the identified main (α-terpinene and para-cymene show terpinene-like and medicinal odor notes), minor (e.g. pinocarvone and piperitone oxide exert fresh and camphoraceous odor notes) and trace (e.g. 1,8-cineole is known to be standard for the fresh camphoraceous odor) compounds.

In conclusion we report that the investigated essential oil of *Chenopodium ambrosioides* var. *anthelminticum* from India can be characterised by a typical

odor, an high concentration of α-terpinene (65.4%) and para-cymene (29.4%) and a very low concentration of ascaridole (0.7%). Therefore this *Chenopodium* sample may be useful in the treatment of infections, because of its bactericidal and fungal activity. The application of the oil as anthelminticum is of no importance, because of the low content of ascaridole and of only a weak anthelmintic potential of the main compounds α-terpinene and para-cymene.

Experimental

Plant material and isolation of the essential oil:

The plant leaves of *Chenopodium ambrosioides* were collected during august 1997 (raining season) in Palampur (India). The plant was identified by local botanists of the Institute of Himalayan Bioresource Technology (India) and a voucher specimen was kept in the Herbarium of this institute (No. BKS-32).
The essential oil (dark red color) was obtained by hydrodistillation of the plant material for 3 hours with a yield of 0.17% on fresh weight basis.

Olfactoric evaluation of the essential oil:

200 microlitre of the essential oil (diluted with dichloromethane) was placed on an commercial odor strip (Dragoco Co.) and the odor evaluated after 10 seconds (solvent evaporation) by professional perfumers.

Instrumentation:

The volatiles of the leaf essential oil of *C. ambrosioides* were at first analyzed by GC (Shimadzu 14A resp. Varian-3700) with FID and integrator systems (Shimadzu C-R6A-Chromatopac resp. Shimadzu C-R1B-Chromatopac). Carrier gas: hydrogen; injector-temperature: 250°C; detector-temperature: 320°C; temp.-program: 40°C/ 5min. to 280°C/ 10min. with heating-rate of 8°C/min.; columns: 30m x 0.32mm bonded FSOT-RSL-200 fused silica (film thickness: 0.25 micron; Biorad Co.); quantification by %-peak-area-calculation; compound identification partly by co-injection of pure compounds and retention-indices correlations in accordance with [9-12].
The second used hyphenated system was GC-MS (Shimadzu GC-17A with QP5050A and datasystem PC-Pentium II with Class5k-software resp. Hewlett-Packard GC-HP5890 with HP5970-MSD and datasystem PC-Pentium [Böhm Co.] with HPCHEM-software). Carrier gas: helium; injector-temperature: 250°C; interface-heating: 300°C; ion-source-heating: 200°C; EI-mode; 70 eV; scan-range: 41-450 amu; temp.-program and column see GC-FID part. Mass spectra correlations with Wiley-, NBS- and NIST-library spectra on-line resp. in accordance to [12] off-line.

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