

VOLATILE CONSTITUENTS OF *Ballota nigra* SUBSP. *anatolica* FROM IRAN

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The genus *Ballota* (Lamiaceae) is comprised of about 90 species and widespread over the world. Remarkably, three species of this genus are found in the Flora Iranica. *Ballota nigra* subsp. *anatolica* is mainly distributed in Golestan, Qazvin and Mazandaran Province of Iran [1, 2]. This plant has been used in folk medicine as an antiseptic, anti-inflammatory, anti-rheumatic, antioxidant, and antimicrobial agent, and also for nausea, vomiting, and nervous dyspepsia [3, 4]. The essential oil of several *Ballota* species has been previously studied. Caryophyllene oxide (22.4%), germacrene D (19.1%), linalool (14.6%), and α -cadinol (21.0%) were reported as the major components of the essential oil of *B. pseudodictamnus*, *B. undulata*, *B. saxsatilis*, and *B. aucheri*, respectively. Only one study on the oil of *B. nigra* subsp. *foetida* exists, of which β -caryophyllene (25.1%) and germacrene D (24.2%) were the most abundant [5–7].

According to our literature survey, the volatile constituents of *B. nigra* subsp. *anatolica* have not been previously investigated. The identified components and their percentages are given in Table 1. These components are listed in order of their elution from a DB-5 column. Twelve compounds were identified, representing 91.8% of the total oil. As can be seen, germacrene D (18.1%), nerolidol epoxyacetate (15.4%), sclareol oxide (12.1%), linalyl acetate (11.5%), and β -caryophyllene (10.5%) were found to be the main constituents. This oil consisted of oxygenated monoterpenes (18.1%), sesquiterpene hydrocarbons (32.5%), and oxygenated sesquiterpenes (41.2%).

Plant Material. *Ballota nigra* subsp. *anatolica* were collected during the flowering stage from Shahnajar Village, Kojur, Mazandaran Province, located North of Iran, in July 2007.

Essential Oil Isolation. The air-dried aerial parts (100 g) of the plant were hydrodistilled for 3 hours using a Clevenger-type apparatus to yield 0.4% (w/w) of yellowish oil. After decanting and drying of the oil over anhydrous sodium sulfate, it was stored at low temperature before analysis.

TABLE 1. Composition of the Essential Oil of *Ballota nigra* subsp. *anatolica* from Iran (Identification method: RI, MS)

Compound	RI ^a	%	Compound	RI ^a	%
Linalool*	1096	5.2	Spathulenol	1583	9.0
α -Terpineol	1186	1.0	Longipinene epoxide	1590	4.7
Linalyl acetate	1246	11.5	Sclareol oxide	1900	12.1
Geraniol	1286	0.4	Nerolidol epoxyacetate	2100	15.4
α -Copaene	1380	2.4	Oxygenated monoterpenes		18.1
β -Caryophyllene*	1424	10.5	Sesquiterpene hydrocarbons		32.5
Germacrene D*	1482	18.1	Oxygenated sesquiterpenes		41.2
α -Humulene	1458	1.5	Total		91.8

^aRI: retention indices on DB5 column.

*Co: co-injection with an authentic sample.

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Gas Chromatography. GC analysis of the oil was conducted using a Thermoquest-Finnigan instrument equipped with a DB-5 fused silica column (30 m × 0.25 µm). Nitrogen was used as the carrier gas at a constant flow of 1.1 mL/min. The oven temperature was held at 60°C for 1 min, then programmed to 250°C at a rate of 4°C/min, and then held for 10 min. The injector and detector (FID) temperatures were kept at 250°C and 280°C, respectively. The split ratio was 1/50.

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