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Natural Product Research
Formerly Natural Product Letters

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/gnpl20

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To cite this article: Smaili Tahar, Hamdi Bendif, Abdelghani Zedam, Guido Flamini & Filippo Maggi (2021): A new chemotype with high tricyclene content from the essential oil of *Salvia aegyptiaca* L. growing in Algerian Pre-Sahara, Natural Product Research, DOI: 10.1080/14786419.2021.1929218

To link to this article: https://doi.org/10.1080/14786419.2021.1929218

NATURAL PRODUCT RESEARCH
https://doi.org/10.1080/14786419.2021.1929218

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SHORT COMMUNICATION

A new chemotype with high tricyclene content from the essential oil of *Salvia aegyptiaca* L. growing in Algerian Pre-Sahara

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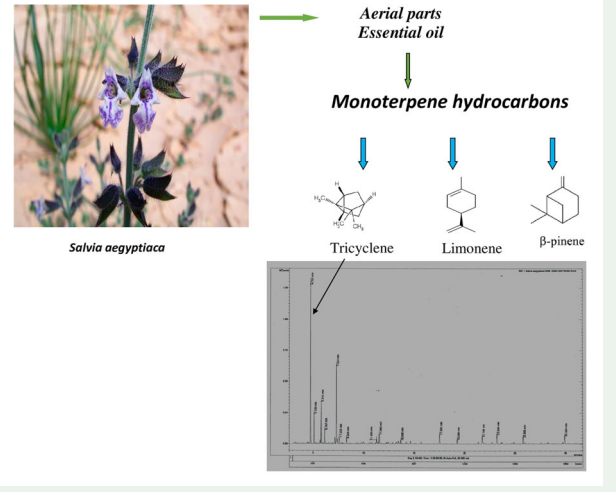
ABSTRACT

The essential oil obtained by hydrodistillation from the aerial parts of *Salvia aegyptiaca* L. (Lamiaceae) growing wild in pre-Saharan region of Algeria, was analysed by GC-MS. Forty-one compounds were detected, representing 87.9% of the whole oil. The essential oil of *S. aegyptiaca* is characterized by the predominance of monoterpene derivatives (70.6%). The major constituents were tricyclene (22.9%), followed by limonene (17.5%), β-pinene (7.4%), caryophyllene oxide (3.2%) and β-caryophyllene (3.1%). Tricyclene, the main component in our analysis is generally absent in the volatile oils from other *Salvia* species, therefore, the Algerian accession of *S. aegyptiaca* may be categorized as a new chemo-type.



ARTICLE HISTORY
Received 29 December 2020
Accepted 6 May 2021

KEYWORDS
Salvia aegyptiaca; Lamiaceae; essential oil; GC-MS; tricyclene; limonene

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/14786419.2021.1929218.

1. Introduction

Lamiaceae (Labiatae) is one of the most important botanical families, constituted by 240 genera and 6970 species (Meyer et al. 2004). Belonging to this family, is the genus *Salvia*, tribe Mentheae, that represented by 900 species spread throughout the world (Tenore et al. 2010). Nevertheless, this genus is scarce in the Sahara, with only three species: *S. chudaei*, *S. aegyptiaca* and *S. verbenaca* (Ozenda 1991). The genus *Salvia* comprises of many medicinal and aromatic plants, which have been studied for various pharmacological properties, including anti-inflammatory (Kamatou et al. 2005; Chan et al. 2011), antibacterial (Delamare et al. 2007; Akin et al. 2010), antifungal (Fraternale et al. 2005), antioxidant (Bozin et al. 2007; Miguel et al. 2011) and anticholinesterase activities (Kivrak et al. 2009; Orhan et al. 2007). The essential oils of *Salvia* species were also used as cosmetics, fragrant agents in perfumery and as food flavourings (Delamare et al. 2007).

In the flora of Algeria, *Salvia* includes 23 species, among which five are endemic (Quezel and Santa 1963). Several investigations demonstrated that *Salvia* species contain various secondary metabolites such as monoterpenes, diterpenoids, sterols, flavonoids and essential oils (Lu and Foo 2002). *Salvia aegyptiaca* L. (Egyptian sage) is a small, perennial plant, branched with light blue flowers. This species is locally called "Sasaf", and grows wild in desert pastures (Quezel and Santa 1963). The plant is used in traditional medicine to combat diabetes (Kemassi et al. 2014) and eye diseases (Basaif 2004). Previous studies on this species evidenced the presence of abietane diterpenes such as aegyptinones A and B (Sabri et al. 1989), aegyptinol and aegyptinone C (El-Lakany 2003), aegyptinone D (Aboul-Ela 2006), all from the root extracts. The whole plant extract gave three further diterpenoids, namely 6-methylcryptoacetalide, 6-methyl-epicryptoacetalide and 6-methylcryptotanshinone, together with higher isoprenoids such as 3β-hydroxyolean-12-en-28-oic acid, 3β-hydroxyoleana-11,13(18)-dien-28-oic acid, sitosterol 3β-glucoside, sitosterol, stigmasterol and the flavonoids 5-hydroxy-7,3′,4′-trimethoxyflavone and 5,6-dihydroxy-7,3′,4′-trimethoxyflavone (Al Yousuf et al. 2002). Other higher terpenoids were also reported by plants from Qatar (Bruno et al. 1993), where lupeol, sitosterol, lup-20(29)-ene-1β,3β-diol, ursolic and oleanolic acids were isolated. By means of HPLC fingerprinting analysis, Fotovvat et al. (2018) identified some phenolic acids in the leaves of this species, namely rosmarinic acid, salvianolic acid A, carnosic acid and caffeic acid. The essential oil of the aerial parts collected in Iran (Jassbi et al. 2012) was rich in monoterpenes (70.6%). Among the main constituents, the monoterpenes limonene (46.4%), α-pinene (8.3), the sesquiterpenes β-caryophyllene (8.3%), and spathulenol (3.6%) were reported. The essential oil of the flower from the same country (Pourhosseini and Asgarpanah 2015) contained octane (60.7%) as the principal compound. In continuation of our works on Saharian species (Smaili et al. 2011; Flamini et al. 2013), we report in this work, the chemical composition of the essential oil of S.*aegyptiaca* growing in BouSaâda, Pre-Saharan region of Algeria.

Based on our research, there is a paucity in research to show that investigation was done in this region."

2. Results and discussion

The chemical composition of the essential oils is summarized in Table S1. The yield of the essential oil obtained from the aerial parts of *S. aegyptiaca* was 0.93% (w/w) and forty-one compounds were identified, representing 87.9% of the whole oil.

The essential oil was mainly composed by monoterpenes (70.6%), with hydrocarbon derivatives (60%) as the major fraction, largely represented by tricyclene (22.9%), limonene (17.5%) and β-pinene (7.4%), while oxygenated monoterpenes accounted for only 10.6%, mainly represented by *cis*-verbenol (2.5%), myrtenal (1.2%) and *trans*-pinocarveol (1.2%), followed by sesquiterpene hydrocarbons (10.8%), mostly characterized by β-caryophyllene (3.1%), germacrene D (2.2%) and δ-cadinene (1.5%). Oxygenated sesquiterpenes (5%) were another important class of volatiles, mainly represented by caryophyllene oxide (3.2%), α-cadinol (0.5%) and *epi*-α-bisabolol (0.4%). Non-terpene derivatives were less represented (1.5%).

To compare the chemical composition of the essential oils of different samples of *S. aegyptiaca*, Mohammadi et al. (2014) studied the accession growing in Bechar, in the South-west of Algeria, finding β-caryophyllene (10.2%), selina-4,11-diene (9.7%), bornyl acetate (8.5%) and β-gurjunene (7.6%) as the main constituents. Whereas, the oil of *S. aegyptiaca* from Saudi Arabia was rich in 1,10-aristolene (19.3%) (Basaif 2004), while the most abundant components of the oil from Egypt were (*E*,*E*)-farnesol, phytol, spathulenol and (*Z*,*E*)-farnesol (El-Sawi 2003). In Egypt (Azza and Magda 2007) reported viridiflorol (18.4%), *cis*-nerone (18.1%) and carvenone (11.2%) as the main components of the essential oil. Thus, our sample was distinct from those coming from Saudi Arabia, Egypt and Algeria (Bechar).

Concerning the essential oil chemical composition of other *Salvia* species, there are many reports indicating the predominance of monoterpenes or/and sesquiterpenes (Kelen and Tepe 2008). Further, these studies indicated that essential oils of these species demonstrated significant variations in the concentration of compounds (Flamini et al. 2007; Ozturk et al. 2009). The findings also show that 1.8-cineole (eucalyptol) was the principal constituent of *Salvia* oils (Kelen and Tepe 2008). The analyses report from the essential oil studied show that the composition is distinct among them, and from the results of the present study, indicating a large variability of the composition, probably due to environmental factors.

From this comparison, we can conclude that the oil of Salvia aegyptiaca L., growing in the Algerian pre-Sahara and which is the subject of our study, shows a chemotype that is different from the species studied before, in Algeria or elsewhere. However, tricyclene which is the principal constituent in the volatile oils of *S. aegyptiaca* in our analyses is an uncommon compound of the essential oils of several species of *Salvia*. This body of work hypothesizes that this constituent is a chemical marker of this medicinal plant.

3. Experimental

See Supplementary Material.

4. Conclusion

Essential oil compositions of *S. aegyptiaca* was investigated. The results showed that the chemical composition of *S. aegyptiaca* essential oil was distinct from that of several species of *Salvia* and shows a new chemotype of constituents different from earlier reports. The presence of tricyclene may be considered as a particular trait of this Saharan species.The differences found in our previous research and literature on this plant suggested that there is chemovariation in this plant. However, comparison of DNA profiles of this plant from various locations could prove the existence of chemotypes, and therefore determine further variation in T. argyrophyllum var. argyrophyllum.

Acknowledgments

The authors are grateful to the financial support of the Ministry of Higher Education and Scientific Research, Algeria. We are grateful the thank Dr. Petulia Blake for collaboration.

Disclosure statement

No potential conflict of interest was reported by the authors.

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