

SHORT COMMUNICATION



## Chemical constituents and anticholinesterase activity of the essential oil of Algerian *Elaeoselinum thapsioides* (desf.) maire

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### ABSTRACT

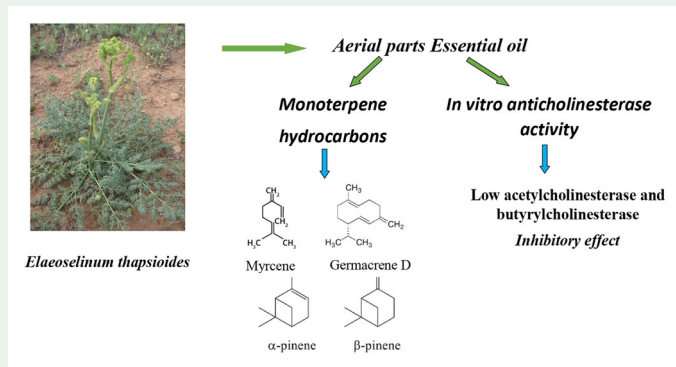
*Elaeoselinum thapsioides* is an Algerian medicinal plant used in traditional medicine to treat different diseases. The essential oil obtained by hydrodistillation from the aerial parts of *Elaeoselinum thapsioides* (Desf.) Maire (Apiaceae) growing wild in Algeria, was analyzed by GC-MS for the first time. Forty-five compounds were detected, accounting for 93.8% of the total oil, which was characterized by a high content of hydrocarbons derivatives of monoterpenes (75.9%). Myrcene (61.0%) was the principal constituent of the essential oil, followed by germacrene D (10.3%),  $\alpha$ -pinene (6.5%) and  $\beta$ -pinene (2.9%). *In vitro* anticholinesterase activity of the essential oil was investigated by the Ellman method that evidenced a low acetylcholinesterase and butyrylcholinesterase inhibitory effect.

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## 1. Introduction

In Algeria, Apiaceae (Umbelliferae) is one of the most important families, constituted by 55 genera and 129 species (Quezel and Santa 1963). Some are used in the folk medicine or as flavouring, spices and condiments (Beloued 1998). Plants belonging to this family show high diversity in their secondary metabolites, including essential oils, polyphenols and fatty acids (Bruneton 1999). The genus *Elaeoselinum* Koch ex DC belongs to the family Apiaceae, subfamily Apioideae, tribe Laserpitieae. This tribe includes eight genera and is considered to be typical to the Old World (Crowden *et al.* 1969; Heywood 1971). According to the Flora of Algeria (Quezel and Santa 1963), the genus *Elaeoselinum* comprises two species: *E. thapsioides* (Desf.) Maire, which can be found only in north-west Africa and *E. asclepium* (L.) Bertol., which comprises two subspecies: *E. asclepium* subsp. *asclepium* (L.) Bertol. and *E. asclepium* subsp. *meoides* (Desf.) Fiori, which is distributed in many parts of Europe, especially in Italy, Spain, Greece and in North Africa, mainly in Morocco and Algeria (Garcia, 1985). *Elaeoselinum thapsioides* (= *E. fontanesii* Boiss.) is an herbaceous and perennial plant with fistular rhizome, branched stems and very divided leaves. The species produces yellow flowers and winged fruits. This plant is locally called 'Becibsa' and is widely present in all parts of Algeria (Quezel and Santa 1963). Previous phytochemical investigations of the genus *Elaeoselinum* reported the presence of meoidic acid (Pinar et Galon 1986; Rosselli *et al.* 2008) and other diterpenes (atisane, beyerane and kaurane derivatives) (Grande *et al.* 1991; Villalobos *et al.* 1994). Furthermore, volatile constituents of *Elaeoselinum* species have been previously investigated and monoterpenes hydrocarbons were found as the main chemical group (Boucekrit *et al.* 2016). On other hand, some biological activities of this genus have also been reported, including antimicrobial (Badalamenti *et al.* 2020), cytotoxic (Rosselli *et al.* 2008), larvicidal (Evergetis *et al.* 2009) and hormone-like (Villalobos *et al.* 1994).

Natural products including volatile oils obtained from aromatic plants are receiving special attention due to their therapeutic properties such as antioxidant, antimicrobial and anti-cholinesterase. They have been found effective as much as some conventional drugs without exhibiting serious side effects (Berhail Boudouda *et al.* 2015). Acetylcholinesterase (AChE) is the principal enzyme involved in the hydrolysis of the neurotransmitter acetylcholine. According to Fujiwara *et al.* (2010) the great reduction of this neurotransmitter in the cerebral cortex is a significant factor playing a pivotal role in Alzheimer's disease. Many essential oils and their monoterpenes have been investigated for their capacity of inhibiting AChE. For example, studies concerning the AChE inhibitory activity and chemical composition of commercial essential oils performed by Dohi *et al.* (2009) demonstrated for the first time that eugenol is a potent acetylcholinesterase inhibitor. Benelli *et al.* (2018) showed that the insecticidal activity of hemp essential oil containing (*E*)-caryophyllene and cannabidiol as main constituents, might be mediated by the AChE inhibitory effects. Besides, *in vivo* anticholinesterase activities of bioactive components have been largely investigated (Ahirwar *et al.* 2012). For example, the essential oils of *Salvia lavandulifolia* Vahl, *Pinus nigra* J.F. Arnold, *Pinus halepensis* Mill., *Juniperus communis* L., *Dennettia tripetala* Baker f. and *Citrus limon* (L.) Osbeck were found to inhibit the cholinesterase in the rat brain (Perry *et al.* 2002; Cioanca *et al.* 2015; Oyemitan *et al.* 2019; Postu *et al.* 2019; Liu

*et al.* 2020). Moreover, the leaf extracts of *Rosmarinus officinalis* L. demonstrated significant AChE inhibition leading to improved long-term memory in rats (Ozarowski *et al.* 2013).

To contribute to the phytochemical studies of Algerian Apiaceae (Smaili *et al.* 2011; Flamini *et al.* 2013), we report for the first time the analytical work on the essential oil of *E. thapsioides* growing wild in Algeria and its anticholinesterase activity.

## 2. Results and discussion

### 2.1. Identification of volatile constituents

The yield of the essential oil obtained from the aerial parts of *E. thapsioides* was 0.4% (w/w). This means that the plant is a good oil source and its composition is reported in Table S1. Forty-five compounds were characterized, representing 93.8% of the whole oil composition. The essential oil was mainly composed of monoterpenes (79.9%), largely represented by hydrocarbon derivatives (75.9%), among which myrcene (61.0%) was the major compound followed by  $\alpha$ -pinene (6.5%) and  $\beta$ -pinene (2.9%). Oxygenated monoterpenes were less represented (4.0%). This amount of myrcene is noteworthy since it has not been detected in essential oils from other *Elaeoselinum* species. Another important chemical class of constituents in this essential oil was represented by sesquiterpene hydrocarbons (12.4%), mainly because of the high percentage of germacrene D (10.3%). This constituent is generally absent in the oils from other *Elaeoselinum* species (Bader *et al.* 2010). Diterpene derivatives were detected in trace amounts, and they were represented by kaurene and *epi*-13-manoyl oxide. Comparing the chemical composition of the oil from the Algerian *E. thapsioides* with other *Elaeoselinum* species, it can be noted that  $\alpha$ -pinene is a common constituent of the essential oils of several *Elaeoselinum* species. Ortega *et al.* (1986), in the essential oil from the fruit of *E. asclepium* subsp. *asclepium*, reported a high percentage of  $\alpha$ -pinene (67.0%), followed by  $\beta$ -pinene (21.4%). Similar results have been revealed by Carretero *et al.* (1988) that identified in the fruit essential oil of *E. asclepium* subsp. *millefolium* high amounts of  $\alpha$ -pinene (81.4%). In the volatile oils of *E. gummiferum* (Desf.) Tutin growing in Spain Pala-Paulet *et al.* (2001) also found  $\alpha$ -pinene (37.4%) as the main compound, followed by myrcene (22.8%),  $\beta$ -pinene (14%) and  $\alpha$ -fenchene (10.4%). In the case of the essential oil obtained from the aerial parts of *E. asclepium* growing in Greece, Evergetis *et al.* (2009) characterized sabinene (35.3%) as the principal constituent, followed by  $\alpha$ -pinene (27.4%) and  $\beta$ -pinene (6.3%). Recently, Bader *et al.* (2010) reported that the essential oils obtained from different parts (roots, fruit and aerial parts) of *E. asclepium* subsp. *meoides* growing in Italy were very rich in  $\alpha$ -pinene (60.8%, 77.1% and 92.2%, respectively). Badalamenti *et al.* (2020) studied the chemical composition of flowers and leaves from *E. asclepium* subsp. *meoides* growing in Sicily (Italy) and reported a different composition, with  $\beta$ -phellandrene (42.5%), terpinolene (15.7%), *p*-cymene (11.6%) and  $\beta$ -phellandrene (10.2%), and *p*-cymene (44.0%),  $\alpha$ -pinene (13.2%),  $\alpha$ -phellandrene (11.0%),  $\beta$ -phellandrene (10.2%) and  $\beta$ -pinene (9.2%) as the main constituents, respectively. Besides, Pala-Paul *et al.* (2001) revealed the presence of manoyl oxide in the volatile oil of *E. gummiferum* growing in Spain, confirming the ability of this genus to synthesize labdane diterpenes. In addition, Bader *et al.* (2010) also detected kaurene and *epi*-13-manoyl oxide in the

essential oil of *E. asclepium* subsp. *meoides*, even if in very small percentages (0.1%). Furthermore, previous investigations about the phytochemistry and the biological properties of the *Elaeoselinum* genus, evidenced the ability of these plants to synthesize kauranes, beyeranes and artisane tetracyclic diterpenes (Bruno *et al.* 2008). Hence, the presence of trace amounts of diterpene derivatives revealed by our analysis could confirm these substances as good chemical markers of the genus *Elaeoselinum*.

## 2.2. *In vitro* anticholinesterase activity

The inhibitory activity of the essential oil of *E. thapsioides*, against AChE and BuChE enzymes, was given in Table S2. Galantamine was the standard drug used for comparison. The essential oil exhibited low inhibitory activity against both enzymes. The IC<sub>50</sub> values were  $461.57 \pm 1.72$  µg/mL and  $377.67 \pm 0.77$  µg/mL, respectively.

## 3. Experimental

See Supplementary Material.

## 4. Conclusion

In conclusion, the composition of the essential oil from the aerial parts of *E. thapsioides* was different from the ones from other *Elaeoselinum* species previously studied. The volatile oil was characterized by a high content of myrcene (61.0%) and by important amounts of the sesquiterpene hydrocarbon germacrene D (10.3%), which has been recorded for the first time in this genus. Furthermore, the presence of trace amounts of diterpenes, permitted to confirm the production of these compounds also by the secondary metabolism of these African species. The anticholinesterase inhibitory assays revealed a negligible effect of this essential oil.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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