Available online at www.sciencedirect.com
ScienceDirect
C. R. Chimie 10 (2007) 820–826
COMPTES RENDUS CHIMIE
http://france.elsevier.com/direct/CRAS2C/

Full paper / Mémoire

Essential oil composition and antibacterial activity of different extracts of *Allium roseum* L., a North African endemic species

Hanen Najjaa [a,b], Mohamed Neffati [b], Sami Zouari [b], Emna Ammar [a,*]

[a] *UR ''Gestion des environnements côtiers et urbains'', École nationale d'ingénieurs de Sfax, B.P. ''W'' 3038 Sfax, Tunisia*
[b] *Laboratoire d'écologie pastorale, Institut des régions arides, 4119 Médenine, Tunisia*

Received 16 January 2007; accepted after revision 7 March 2007
Available online 7 May 2007

Abstract

This study deals with the valorisation of medicinal and aromatic plants of the Tunisian flora, in order to find new bioactive natural products. The essential oil constituents from the flowers of *Allium roseum* var. *odoratissimum*, a North African endemic species growing in the south-east of Tunisia, were extracted by hydrodistillation and analysed by GC–MS. The most important compounds were sulphurous compounds (2,4-dimethylthiophene, 2-propenyl methyl disulfide, 1-propenyl methyl disulfide, dimethyl trisulfide, and 3-methyl-thiopropionaldehyde or methional). After an exhaustive literature review dealing with other varieties of the same species, it seems that the variety *odoratissimum* is the only taxon characterized by trisulfide and methional contents. Methional is of particular importance because it is found at high concentration (17%). The antibacterial activity of seven extracts was evaluated by the diffusion method and by determining the inhibition zone. All extracts exhibited an antibacterial activity at different levels against strains reported as the causal agents of food-borne diseases. Results suggest the potential use of the plant as condiment and preservative in the food industry. ***To cite this article: H. Najjaa et al., C. R. Chimie 10 (2007).***

Résumé

La présente étude porte sur les possibilités de valorisation d'une plante aromatique et médicinale de la flore tunisienne dans le but de mettre au point de nouveaux produits bioactifs. Il s'agit d'*Allium roseum* var. *odoratissimum*, qui est une espèce endémique nord-africaine, très commune en Tunisie méridionale. Les constituants des huiles essentielles des fleurs de cette plante, extraites par hydrodistillation, ont été analysés par GC–MS. Les principaux constituants de ces huiles étaient des dérivés soufrés (2,4-diméthylthiophène, 2-propénylméthyle disulfide, 1-propénylméthyle disulfide, diméthyl trisulfide et 3-méthyl-thiopropionaldéhyde ou méthional). Ces résultats, analysés à la lumière des données bibliographiques à propos d'autres variétés de la même espèce, permettent de dire que la variété *odoratissimum* est le seul taxon qui est caractérisé par la présence des trisulfides et du méthional. Ce dernier a été détecté à une forte concentration (17%). L'activité antibactérienne des sept extraits testés a été étudiée par la méthode de diffusion et de détermination de la zone d'inhibition. Tous ces extraits ont montré une activité antibactérienne plus ou moins importante vis-à-vis des souches signalées. Ces

* Corresponding author.
E-mail address: ammarenis@yahoo.fr (E. Ammar).

1631-0748/$ - see front matter © 2007 Académie des sciences. Published by Elsevier Masson SAS. All rights reserved.
doi:10.1016/j.crci.2007.03.003

résultats suggèrent la possibilité d'utiliser cette plante comme condiment et agent de conservation dans l'industrie alimentaire.
Pour citer cet article : H. Najjaa et al., C. R. Chimie 10 (2007).

Keywords: Allium roseum; Essential oil; Antibacterial activity; Chemical components; GC–MS

Mot-clés : Allium roseum ; Huile essentielle ; Activité antibactérienne ; Constituants chimiques ; GC–MS

1. Introduction

Allium is the largest and the most important representative genus of the Liliaceae family that comprises 700 species, widely distributed in the northern hemisphere [1,2]. Besides the well-known garlic and onion, several other species are widely grown for culinary use, such as leek (*Allium porrum* L.), scallion (*Allium fistulosum* L.), shallot (*Allium ascalonicum* Hort.) and wild garlic (*Allium ursinum* L.)[3]. *Allium* has an important economical value for vegetable and ornamental uses in Europe, Asia and America [4].

For many centuries, several species from the Liliaceae family have been used as vegetables and spices, and as folk medicines for curing various diseases [5]. The first citation of these plants is found in the *Codex Ebers* (1550 BC), an Egyptian medical papyrus reporting several therapeutic formulas based on garlic and onion as useful remedies for a variety of diseases such as heart problems, headache, bites, worms and tumours [3]. Scientific research on these plants started in the second half of the 19th century with Pasteur (1858), who evidenced the antibacterial properties of garlic.

Several *Allium* species such as *Allium sativum* and *Allium cepa* have been shown in previous studies to exhibit various activities. For example, a wide array of therapeutic effects of garlic has attracted particular attention of modern medicines because of its widespread use as antiatherosclerotic, antidiabetic, antihypertensive, antimicrobial, anticancerous, antioxidant, antifungal and antiviral [6–10].

Allium species, namely, onion, garlic, leek, and chive contain a variety of secondary sulphur compounds [11]. Sulphur-carrying flavour compounds are responsible for the characteristic smell and taste, the source of major active compounds which are the best known properties in *Allium* plants [1,5–7]. The antibacterial bioactive principal of garlic was identified in 1944 by Cavallito as diallylthiosulfinate and was given the trivial name allicin [12].

As a very polymorphous species, *Allium roseum* is represented in North Africa by 12 different taxa: 4 varieties, 4 subvarieties and 4 forms [13,14]. In Tunisia, the same authors mentioned the presence of only three varieties: var. *grandiflorum*, var. *perrotii* and var. *odoratissimum*. Considered as an endemic taxon in North Africa [13], the *odoratissimum* variety is a perennial spontaneous weed [15]. Its oblong bulb grows about 30–60 cm tall [16] and its flowers are wide, rosy or white coloured and with eyelet odor [17].

A. roseum var. *odoratissimum* prefers poor and sandy soils. It was also found in grassy and bushy places, cultivated fields and fallows, and roadsides. It was used since ancient times as a vegetable, spice or herbal remedy [14]. According to the same author, *A. roseum* is used to treat head and rheumatisms.

With the increase of bacterial resistance to antibiotics, there is considerable interest to investigate the antimicrobial effects of different extracts against a range of bacteria, to develop other classes of antimicrobials useful for the infection control or for the preservation of food [9].

As far as this literature review could ascertain, few *Allium* species had been taken into account, except for *A. sativum* (garlic) and *A. cepa* (onion), for the assessment of their possible biological activities [18,19].

Since no information is available on the antibacterial activities of the *A. roseum* var. *odoratissimum*, in the present study the chemical composition of the essential oil and its antibacterial activity were investigated for the first time. The antibacterial effects of the aqueous and the organic extracts and the total oligomer flavonoids (TOF) of this species were also studied.

2. Materials and methods

2.1. Plant material

A. roseum var. *odoratissimum* (Desf.) Coss (syn. *A. roseum*) was collected from the south-east of Tunisia (Bengardane, latitude 33° 86′ 46″ N, longitude 10° 52′ 48″ E, with an arid climate characterized by a mean rainfall of 150 mm/year) at two periods in 2006, in relation to both different stages of the plant