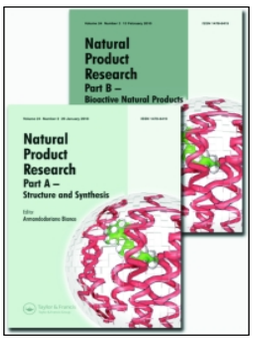

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SHORT COMMUNICATION

Phytochemical components and biological activities of *Silene arenarioides* Desf.

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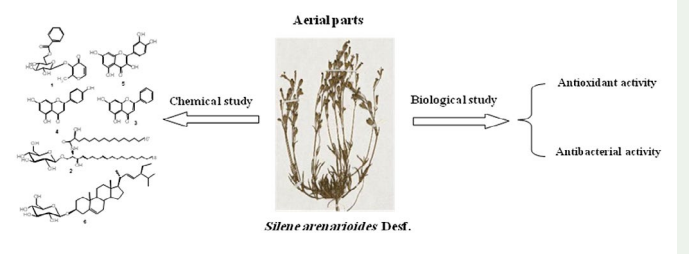
ABSTRACT

In this study, six known compounds **1**–**6** were isolated from the aerial parts of *Silene arenarioides* Desf. using different chromatographic methods. The structures of these compounds were identified as maltol glycoside (**1**), soyacerebroside I (**2**), chrysin (**3**), apigenin (**4**), quercetin (**5**) and stigmasterol glucoside (**6**). The compounds (**1**) and (**2**) are reported for the first time from this genus. The isolated compounds were determined using NMR techniques (^{1}H NMR, ^{13}C NMR, COSY, HSQC and HMBC) and mass spectroscopy (ESI-MS). The antibacterial and antioxidant activities of extracts and of compound (**1**) have been evaluated. The antioxidant activity was performed by DPPH radical scavenging method, which showed that methanol extract possesses a good antioxidant activity with value of IC_{50} = 8.064 ± 0.005 µg/mL.



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KEYWORDS
Silene arenarioides Desf.; soyacerebroside; maltol; antibacterial activity; antioxidant activity

1. Introduction

Caryophyllaceae species are known for their rich content in bioactive metabolites, such as triterpene saponins (Jia et al. 1998; Mamadalieva et al. 2014), flavonoids (Atta et al. 2013), phytoecdysteroids (Simon et al. 2004) and oligosaccharides (Simon et al. 2010). The *Silene* genus (Caryophyllaceae) comprises more than 700 species widely distributed in temperate zones of the world. In Algeria, this genus is represented by ten species (Quezel & Santa 1963).

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Numerous phytochemical studies were performed on *Silene* species, particularly revealing the isolation and identification of ecdysteroids (Meng et al. 2001; Mamadalieva et al. 2003), saponins (Lacaille-Dubois et al. 1995) and essential oils (Azadi & Sohrabi 2015).

The present paper deals with the isolation and structure elucidation of six known metabolites (Figure 1) from the methanol extract of aerial parts of *Silene arenarioides* Desf. Since several isolated compounds were described as possessing an interesting antioxidant activity, we found it pertinent to evaluate the antioxidant activity of the methanol extract.

In addition, the antibacterial activity of extracts of *S. arenarioides* and of the major compound (**1**) of the methanol extract were evaluated. The antibacterial activity of maltol and its glucoside was previously documented (Kiran 2014; Adams et al. 2015), but to the best of our knowledge, no antibacterial activity has been reported for the maltol 3-*O*-[6-*O*-benzoyl]-β-D-glucopyranoside (**1**).

Thus, this work constitutes the first phytochemical and biological study of *S. arenarioides*.

2. Results and discussion

2.1. Chemical composition

After a stepwise extraction of the aerial parts of *S. arenarioides* with solvents of increasing polarity, the methanol extract was fractionated to allow the isolation and purification of six known compounds. Their structures were established from analysis of NMR and ESI-MS spectral techniques and by comparison of data with those reported in the literature, as maltol 3-*O*-[6-*O*-benzoyl]-β-D-glucopyranoside (**1**) (0.36%) (Nakato et al. 2011), soyacerebroside I (**2**) (0.26%) (Voutquenne et al. 1999), chrysin (**3**) (0.06%) (Shen et al. 1993), apigenin (**4**) (0.09%) (Chaturvedula & Prakash 2013), quercetin (**5**) (0.08%) (Choi et al. 2006) and stigmasterol glucoside (**6**) (0.22%) (El-Askary 2005) (Figure 1). Among them, compounds **1** and **2** were found in the genus *Silene* for the first time and compound **2** was isolated here for the

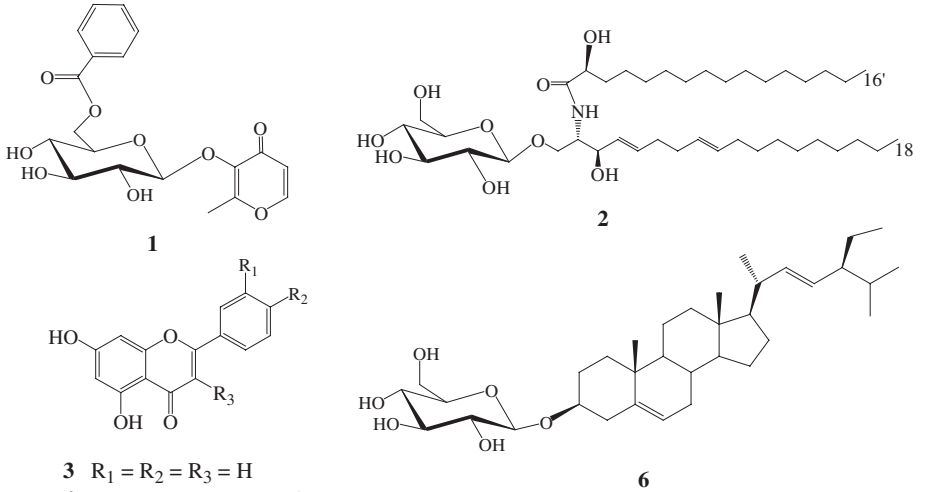

Figure 1. Structures of compounds **1–6** isolated from *S. arenarioides*.

second time from Caryophyllaceae family. Along this process, a mixture of inseparable saponins has been isolated during the separation procedures.

2.2. Evaluation of antioxidant activity

The antioxidant activity of methanol extract of *S. arenarioides* was determined by the radical scavenging method using DPPH free radical. The methanol extract of the aerial parts of *S. arenarioides* showed a very good antioxidant activity with value of $IC_{50} = 8.064 \pm 0.005$ µg/mL close to the standard ascorbic acid (Supplementary material, Figures S1 and S2). This result indicates that the level of antioxidant activity of the methanol extract was indeed correlated with the presence of highly antioxidant compounds such as flavonoids (Tchinda et al. 2014), saponins (Pande et al. 2014) and glycolipids (Kitamoto et al. 2002), known to possess a strong antiradical activity.

2.3. Evaluation of antibacterial activity

The petroleum ether, ethyl acetate and methanol extracts, and maltol benzoylglucoside (**1**) were tested against three standard bacterial strains for the determination of their antibacterial activity. The results given in Table S1 showed that methanol extract possessed a good antibacterial activity against tested bacterial strains with inhibition diameters ranging from 18 to 23 mm at 100 µg/mL. The ethyl acetate extract was only active against *S. aureus* and *E. coli*, and the petroleum ether extract showed no antibacterial activity. Compound **1** exhibited a moderate activity against *E. coli* and *P. aeruginosa*. The higher antibacterial activity found for methanol extract in comparison with compound **1**, could be due to the concomitant presence of soyacerebroside I (**2**), chrysin (**3**), apigenin (**4**) and quercetin (**5**) already known as antibacterial agents (Cateni et al. 2003; Cushnie et al. 2003; Ramos et al. 2006; Nina et al. 2015).

3. Conclusion

On the basis of this study, it is concluded that methanol extract of *S. arenarioides* possesses significant antibacterial and antioxidant activities. These findings are due to the presence of active compounds like flavonoids, maltol derivatives and saponins. This study allowed the identification of six known secondary metabolites **1**–**6** and a mixture of saponins, which, so far, represent the major chemical components of this species. Furthermore, it seems important to perform further phytochemical investigation on extracts of *S. arenarioides* to especially isolate and identify triterpene saponins and ecdysteroids considered as characteristic constituents of *Silene* species.

Supplementary material

General experimental methods and supporting NMR information are available online.

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