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Short communication

SHORT COMMUNICATION

An isoflavane and saponins from *Astragalus depressus* L.

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Abstract: In this study, nine known secondary metabolites were isolated from ethyl acetate and *n*-butanol extracts of *Astragalus depressus* L. (Fabaceae family), including one isoflavane, namely pendulone (**1**) and eight saponins, namely cyclogaleginoside A (**2**), astrasieversianin II (**3**), astrasieversianin IV (**4**), astrasieversianin VIII (**5**), astrasieversianin VI (**6**), astrasieversianin XIV (**7**), dehydrosoyasaponin I (**8**) and soyasaponin I (**9**). The structures of compounds **1**–**9** were elucidated by spectroscopic methods, including 1D and 2D NMR, ESI mass spectrometry and comparison with literature data.

Keywords: Fabaceae; *Astragalus depressus*; saponins; pendulone; NMR; ESI.

INTRODUCTION

Astragalus depressus L. belongs to the genus *Astragalus* L.,[1] which is the largest genus in the Leguminosae (Fabaceae) family.[2] This Mediterranean species that is grazed by livestock is a perennial herb that grows in the rocks of the high mountains of Algeria.[1]

Astragalus, a member of the tribe Galegeae under the subfamily Papilionoideae (or Faboideae),[3] is found mainly in the temperate and arid regions of the world. Several *Astragalus* species are used worldwide in traditional medicine as antiperspirants, diuretics, tonics, in the treatment of nephritis, diabetes, leukemia and uterine cancer.[4,5]

In the course of previous investigations on Algerian Fabaceae plants, oleanane-type triterpene glycosides and flavonoids were isolated from *Astragalus cruciatus* Link[3] and *Lotus pusillus* Medik.[6] Saponins, cycloartane-type glycosides particularly, are the major class of chemical compounds that were isolated

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previously from *Astragalus* species. Saponin compounds are known to possess immunostimulating,[7] cytotoxic[8] and antiviral activities.[9]

Hitherto, there have been no literature reports on the chemical constituents of *A. depressus*. A phytochemical investigation of the ethyl acetate and *n*-butanol extracts of this species was undertaken in order to determine its major components, such as saponins, which could be helpful for the chemotaxonomic profile of this species and *Astragalus* genus for further investigations.

EXPERIMENTAL

General

UV spectra were recorded on a Beckman DU-600 spectrometer. Positive and negative ion mode mass spectra were obtained on a Bruker Esquire Ion trap spectrometer. 1D and 2D NMR spectra (COSY, HSQC, HMBC, TOCSY, NOESY and ROESY) were obtained on a Bruker Avance spectrometer (^{1}H, 600 MHz, ^{13}C, 150 MHz). Optical rotations were measured on a Perkin-Elmer 241 polarimeter. CC was performed on silica gel 60 (320–400 mesh) and Sephadex LH-20. Analytical and preparative (1 mm thickness) TLCs were run on silica gel (Kieselgel 60 F254, Merck).

Plant material

The plant material (aerial parts and roots) was collected in May 2011 nearby Khenchela (Algeria) and was identified by Prof. Bachir Oudjehih, Agronomic Institute of the University of Batna, where a voucher specimen was deposited, with the identification number 659/LCCE.

Extraction and isolation

The air-dried and powdered whole plant of *Astragalus depressus* (800 g) was macerated with EtOH–H_2O (70:30 *V*/*V*, 8 L×2) for 3 days at room temperature. After filtration and evaporation of the aqueous alcoholic solution, the aqueous residue (0.5 L) was extracted successively with petroleum ether, EtOAc and *n*-butanol (each solvent, 0.5 L×3). The solvents were removed under vacuum to yield the following extracts: petroleum ether (3 g), ethyl acetate (8 g) and *n*-butanol (40 g). The details related to isolation are given in the Supplementary material to this paper.

RESULTS AND DISCUSSION

Nine known compounds were isolated from the ethyl acetate and *n*-butanol extracts of *A. depressus*, including eight saponins and one isoflavan. The structures of the compounds (Fig. 1) were identified clearly by comparison of ^{1}H- and ^{13}C-NMR data, ESI mass spectra and values of optical rotation with published data. The isolated compounds were identified as pendulone (**1**),[10,11] cycloglaeginoside A (**2**),[12] astrasieversianin II (**3**),[13] astrasieversianin IV (**4**),[13] astrasieversianin VIII (**5**),[13] astrasieversianin VI (**6**),[13] astrasieversianin XIV (**7**),[13] dehydrosoyasaponin I (**8**)[14] and soyasaponin I (**9**).[15]

Pendulone (**1**) was previously found in *Millettia pendula*,[16] *Oxytropis falcata*[17] and *Astragalus membranaceus*[18] that belong to the Fabaceae family. This is the second report of the occurrence of pendulone in the *Astragalus* genus. This

isoflavan has potent leishmanicidal activity[10] and showed potent anti-tumor-promoting activity.[19]

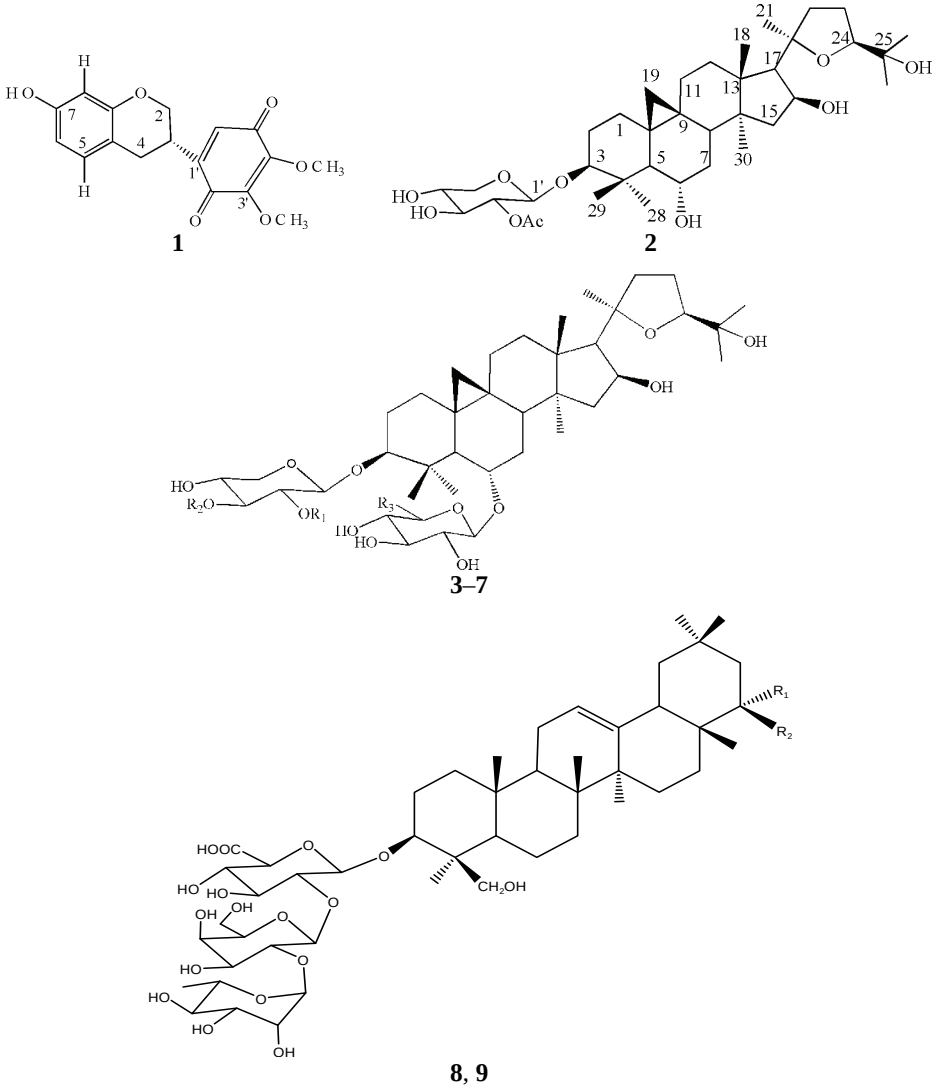

Fig. 1. Structures of compounds **1**–**9**; **3** – $R_1 = R_2 = Ac$, $R_3 = H$; **4** – $R_1 = R_2 = Ac$, $R_3 = CH_2OH$; **5** – $R_1 = Ac$, $R_2 = H$, $R_3 = CH_2OH$; **6** – $R_1 = Ac$, $R_2 = R_3 = H$; **7** – $R_1 = R_2 = H$, $R_3 = CH_2OH$; **8** – R_1, $R_2 = O$; **9** – $R_1 = \alpha H$, $R_2 = \beta OH$.

The cycloartane-type triterpene glycosides **2**–**7** isolated previously from several *Astragalus* species are considered as common saponins for the genus *Astragalus*.[12,13,20–26]

Dehydrosoyasaponin I (**8**) was found in many genera of the Fabaceae family, such as *Medicago sativa*[27] and *Pisum sativum* L.[28] This study reports its first identification in the *Astragalus* genus. Soyasaponin I (**9**) was identified previously from several *Astragalus* species, such as *A. crysopterus*,[29] *A. shikokianus*[30] and *A. trimestris*[31] besides some other Fabaceae genus, such as *Pisum*,[28] *Hedysarum*[32] and *Melilotus*.[33]

CONCLUSIONS

This is the first report on the chemical composition of *Astragalus depressus*. This work, which is in full agreement with the previous studies performed on the *Astragalus* genus, confirmed the importance of saponins as major compounds of this genus. Soyasaponin I (**9**), largely distributed in Fabaceae plants, is used as a chemotaxonomic marker for the family Fabaceae and *Astragalus* genus.[34]

To the best of our knowledge, the full ^{1}H- and ^{13}C-NMR data of pendulone (**1**) and cyclogaleginoside A (**2**) are given here for the first time.

SUPPLEMENTARY MATERIAL

The experimental details about isolation of the fractions, as well as the characterization data for pendulone (**1**) and cyclogaleginoside A (**2**) are available electronically from http://www.shd.org.rs/JSCS/, or from the corresponding author on request.

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ИЗВОД

ИЗОФЛАВОНИ И САПОНИНИ ИЗОЛОВАНИ ИЗ *Astragalus depressus* L.

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Током овог истраживања изоловано је девет познатих секундарних метаболита из етил-ацетатног екстракта и *n*-бутанолног екстракта *Astragalus depressus* L. (Fabaceae фамилија), и то пендулон (**1**) и осам сапонина, циклогалегинозид A (**2**), астрасиверсијанин II (**3**), астрасиверсијанин IV (**4**), астрасиверсијанин VIII (**5**), астрасиверсијанин VI (**6**), астрасиверсијанин XIV (**7**), дехидросојасапонин I (**8**) и сојасапонин I (**9**). Структуре једињења **1**–**9** утврђене су спектроскопским методама које подразумевају 1D и 2D NMR спектроскопију и ESI масену спектрометрију и поређене са подацима из литературе.

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