

Flavonoids as chemosystematic markers of *Astragalus bombycinus* Boiss. and *Astragalus peregrinus* Vahl growing in Egypt

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The genus *Astragalus* is represented by 2500 species, which are widespread in temperate and tropical regions. *Astragalus* species contain mainly flavonoids (isoflavones) and triterpenes, whereas phenolic acids and polysaccharides are of less distribution. The biological activities such as hepatoprotective, antioxidant, antiviral, anti-inflammatory, and cardiovascular activities have been reported for numerous species of the genus. On the basis of various botanical characteristics, two *Astragalus* spp. (*Astragalus bombycinus* Boiss. and *Astragalus peregrinus* Vahl), native to Egypt, are very closely related species. Their flavonoid constituents were surveyed to find the interrelationships between them. The flavonoids were reported as six flavones, three flavonols, one C-glycosyl flavonoid, and three isoflavones. The flavonoid profile supports the placement of the two species together in one section (*Platyglottis*) but as two distinct species.

Keywords:

Astragalus bombycinus, *Astragalus peregrinus*, chemosystematics, flavonoids

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Introduction

Astragalus L. is the largest genus in the family Fabaceae (Leguminosae) belonging to subfamily Papilionideae (tribe Galegeae). It comprises 2500 species distributed mainly in the northern temperate regions and tropical African mountains. It is represented by 32 species indigenous to Egypt [1]. Various *Astragalus* species roots were represented as well-known drugs in traditional medicine for the treatment of nephritis, diabetes, leukemia, uterine cancer, and as diuretic [2,3]. Some *Astragalus* species showed interesting pharmacological properties including hepatoprotective, immune stimulant, antiviral activities, anti-inflammatory, analgesic, sedative, and cardiovascular activities [4–7]. *Astragalus bombycinus* Boiss. and *Astragalus peregrinus* Vahl are the only two *Astragalus* spp. in section *Platyglottis* [8]. They were arranged in one group based on their similarity in pollen grain characteristics; peregrines type [9], and chromosomal number; $2n=16$ [10], which agrees with similarities among them in morphological characteristics. Macromorphological characters such as stem prostrate, branched from the base, stipule acuminate, broadly triangular, leaves imparipinnate, leaflet petiolate, elliptic to obovate and pod pedicellate, curved, hairy with acute apices [1,11]. Micromorphological pod characters such as tangentially elongated epidermal cells, the occurrence of two types of sclerenchyma and fused ventral bundles [12]. In addition, their similarities in spermoderm characteristics and seed protein electrophoretic profile [13]. So all points suggested that the two species are very closely related

species. From this point of view, the aim of the present review is to highlight the typical flavonoid contents of these two *Astragalus* species to evaluate the interrelationships between them.

Flavonoids and chemosystematics

A previous phytochemical investigation revealed the isolation of six flavonoids from *A. peregrinus* [14] and 10 flavonoids from *A. bombycinus* [3,15] (Table 1, Fig. 1). From the flavonoid profile of both species, 13 flavonoids were isolated and identified. They represented three classes of flavonoids and occurred as six flavones, three flavonols, one C-glycosyl flavone, and three isoflavones. The flavones presented as apigenin and luteolin and their 7-O-glycosides, whereas the flavonols are represented as the 3,7-di-O-β-glycosides of quercetin. Only single C-glycosyl flavone (5, 2',4'-trihydroxyflavone-8-C-α-arabinopyranosyl-7-O-β-glucopyranoside) was reported for *A. bombycinus*. The isoflavones are reported as daidzein in the two species and genistein and 7-hydroxy-3',5'-dimethoxy isoflavones in *A. peregrinus* only.

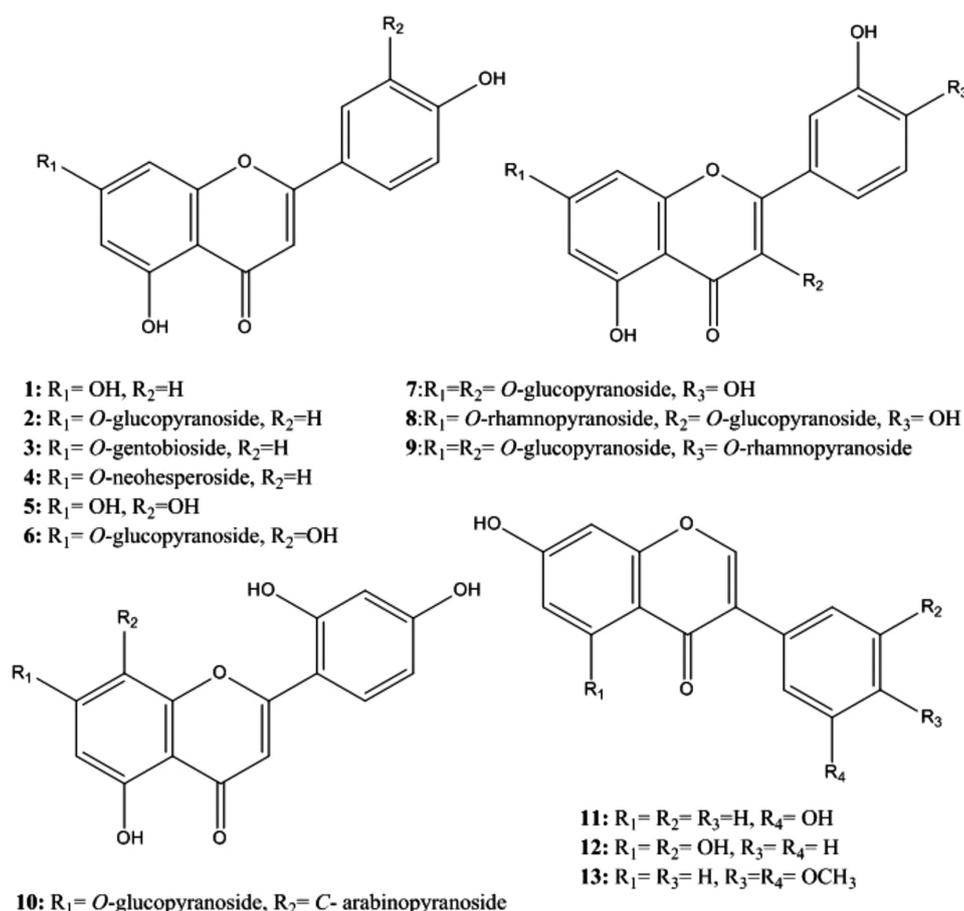
The two species are shared in flavone and isoflavone nuclei (Table 1), which confirmed their classification together in one section (*Platyglottis*) [8] and agrees

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Table 1 Distribution of flavonoids in *A. bombycinus* and *A. peregrinus*

Compounds	<i>Astragalus bombycinus</i>	<i>Astragalus peregrinus</i>
Flavones		
Apigenin (1)	+	+
Apigenin 7-O- β -glucopyranoside (2)	+	-
Apigenin 7-O- β -gentiobioside (3)	+	-
Apigenin 7-O- β -neohesperidoside (4)	-	+
Luteolin (5)	+	+
Luteolin 7-O- β -glucopyranoside (6)	+	-
Flavanols		
Quercetin 3,7-di-O- β -glucopyranoside (7)	+	-
Quercetin 3-O- β -glucopyranoside 7-O- α -rhamnopyranoside (8)	+	-
Quercetin 3,7-di-O- β -glucopyranoside-4'-O- α -rhamnopyranoside (9)	+	-
C-glycosyl flavonoids		
5, 2',4'-Trihydroxyflavone-8-C- α -arabinopyranosyl-7-O- β -glucopyranoside (10)	+	-
Isoflavones		
Daidzein (11)	+	+
Genistein (12)	-	+
7-Hydroxy-3',5'-dimethoxyisoflavone (13)	-	+

+, present; -, absent.

Figure 1Flavonoid structures of flavonoids reported for *A. bombycinus* and *A. peregrinus*.

with the other studies which grouped the two species together according to their pollen grain characteristics [9], chromosomal numbers [10,16,17], morphological characteristics [1,18], a combination of morphological and anatomical characteristics [11], seed protein

electrophoretic criteria [13] as well as fruit morphology [14]. *A. bombycinus* differs by its capability to synthesize flavonol glycosides and C-glycosyl flavones. The presence of such compounds in *A. bombycinus* without *A. peregrinus* supported their

classification as two distinct species, where *A. bombycinus* contains flavones, flavonols, C-glycosyl flavones, and isoflavones, whereas *A. peregrinus* contains flavones and isoflavones only.

Conclusion

The flavonoid profile of *A. bombycinus* and *A. peregrinus* shows a difference exists between both species, supporting their classification as two distinct species, which is in disparity with the previous data extracted from the macromorphological and micromorphological as well as protein and chromosomal characteristics which concluded that they are very closely related to each other.

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Conflicts of interest

There are no conflicts of interest.

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