Glycosides of *Astragalus* Species

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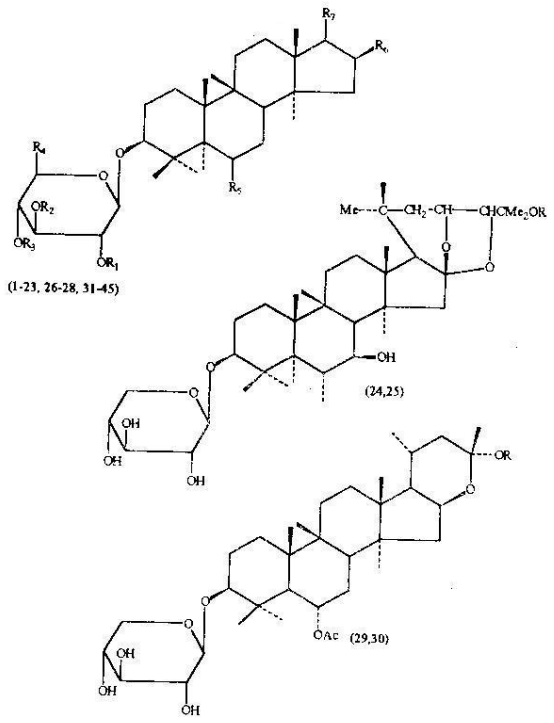
Summary: The review provides an account of the naturally occuring glycosides from *Astragalus* species which have been reported in the literature upto 1995.

Introduction

The genus *Astragalus* (Papilionaceae) is one of the largest Angiospermous genera with about 1600 species widely distributed all over the world. It is represented in Pakistan by 135 species [1]. The plants of the *Astragalus* species are rich source of glycosides and flavonoids which have great medicinal and economic importance. For example the roots of *Astragalus membranaceus* are used as a tonic to cure gastric and pulmonary diseases. *Astragalus tongolensis* and *Astragalus scaberrimus* have been considered good remedy for diarrhea, numbness of the muscles, poor circulation, weak lungs, asthma, nervousness, syphilis, scrofula and gall trouble [2]. The seeds of *Astragalus multiceps* and *Astragalus harmosus* are used for colic, leprosy, emollient and demulcent [3].



The sapogenins of *Astragalus glycyphyllos* possess anti-inflammatory activity against dextran-induced swelling of rat limbs and anabolic-promoting activity in mice [4]. The effects of different doses of *Astragalus* saponins on the experimental heart failure of rat models were

Table-: List of Glycosides isolated from *Astragalus* species

S.No.	Compound with Struc. No.	Physical data	Source	Parts used	Ref.No.
1.	Astrasieversianin-I (I) $C_{46}H_{72}O_{16}$ 1/2 H O_2 817	$[\alpha]_D^{12}$ + 5.3° (c 0.30; MeOH) M.P.:- 236-37°	A. Sieversianus	Roots	[9]
2.	Astrasieversianin - II (2) $C_{46}H_{70}O_{15}$ 839	$[\alpha]_D^{25}$ + 10.9° (c 0.39; MeOH) M.P.: 239 - 41°	"	"	"
3.	Astrasieversianin-III (3) $C_{44}H_{70}O_{15}$ 839	$[\alpha]_D^{24}$ + 15.7° (c 0.49; MeOH) M.P.: 250-54°	"	"	"
4.	Astrasieversianin -V (4) $C_{46}H_{72}O_{16}$ 880	$[\alpha]_D^{31}$ + 12.6° (c 0.10; MeOH) M.P.:- 233-34°	"	"	"
5.	Astrasieversianin-VI (5) $C_{46}H_{64}O_{14}$ $2H_2O$ 880	$[\alpha]_D^{31}$ + 30.4° (c 0.50; MeOH) M.P.: - 245-48°	"	"	"
6.	Astrasieversianin-X (6) $C_{40}H_{66}O_{13}$ 754	$[\alpha]_D^{12}$ + 26.7° (c 0.12; MeOH)	"	"	"

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S.No.	Compound with Struc. No.	Physical data	Source	Parts used	Ref.No.
7.	Astrasieversianin-IV (7) $C_{45}H_{72}O_{16}.2H_2O$ 904	$[\alpha]_D^{25}$ + 16.3° (c 0.38; MeOH) M.P.:- 245-48°	""	""	""
8.	Astrasieversianin-VII (8) $C_{43}H_{70}O_{15}.2H_2O$ 862	$[\alpha]_D^{12}$ + 11.3° (c 0.08; MeOH) M.P.:- 222-25°	""	""	""
9.	Astrasieversianin-VIII (9) $C_{43}H_{70}O_{15}.3H_2O$ 880	$[\alpha]_D^{31}$ + 30.4° (c 0.40; MeOH) M.P.: 249-50°	""	""	""
10.	Astrasieversianin-XIV (10) $C_{41}H_{68}O_{14}.2H_2O$ 820	$[\alpha]_D^{12}$ + 21.4° (c 0.20; MeOH) M.P.: 285-87°	""	""	""
11.	Astrasieversianin-XII (11) $C_{49}H_{80}O_{19}.H_2O$ 990	$[\alpha]_D^{12}$ - 4.0° (c 0.20; MeOH) M.P.:- 235-37°	""	""	""
12.	Astrasieversianin-XIII (12) $C_{49}H_{80}O_{19}.3/2\ H_2O$ 999	$[\alpha]_D^{12}$ - 6.3° (c 0.18; MeOH) M.P.: 223-25°	""	""	""
13.	Astrasieversianin-XVI (13) $C_{47}H_{76}O_{16}.2H_2O$ 964	$[\alpha]_D^{20}$ - 1.7° (c 0.24; MeOH) M.P.:- 257-60°	""	""	""
14.	Acetyl astragaloside-I (14) $C_{47}H_{74}O_{17}$ Na 933	$[\alpha]_D^{25}$ + 12.6° (c 0.56; MeOH) M.P.:- 279-81°	A. membranaceus	roots	[10]
15.	Astragaloside-I (15) $C_{45}H_{72}O_{16}.Na$ 891	$[\alpha]_D^{25}$ + 11.6° (c 0.36; MeOH) M.P.: 185-87°	""	""	""
16.	Astragaloside-III (16) $C_{41}H_{68}O_{14}.Na$ 807	$[\alpha]_D^{25}$ + 62.2° (c 0.13; MeOH) M.P.: - 247-48°	""	""	""
17.	Astragaloside-IV (17) $C_{41}H_{68}O_{14}.Na$ 807	$[\alpha]_D^{25}$ + 22° (c 0.92; MeOH) M.P.:- 299-300°	A.sievevsianus A. membranaceus	""	""
18.	Agro astragaloside-I (18) $C_{45}H_{74}O_{16}.Na$ 893	$[\alpha]_D^{25}$ + 17.3° (c 0.15; MeOH) M.P.:- 237-39°	A. sieversianus	""	""
19.	Agro astragaloside-II (19) $C_{43}H_{72}O_{15}.Na$ 851	$[\alpha]_D^{22}$ + 70° (c 0.22; MeOH) M.P.: 267-69°	""	""	""
20.	askenoside-A(20) $C_{42}H_{70}O_{14}$ 798	$[\alpha]_D$ M.P.:- 213-14°	A.laschkendicus	""	[11]
21.	Askenoside-B (21) $C_{47}H_{77}O_{17}$ 913	$[\alpha]_D$ + 30° (c 0.15; MeOH) M.P.: 255-57°	""	""	[12]
22.	Askenoside-C (22) $C_{41}H_{72}O_{13}$ 772	$[\alpha]_D$ - M.P.:- 219-20°	""	""	[13]
23.	Askenoside-D (23) $C_{46}H_{78}O_{17}$ 902	$[\alpha]_D$ - M.P.:- 230-32°	A.laschkendicus	roots	[14]
24.	Cyclo orbiscoside-A (24) $C_{36}H_{61}O_6$ 637	$[\alpha]_D^{15}$ + 70.9° (c 0.40; MeOH) M.P.:- 195-97°	A.orbiculatus	acrial parts	[15]
25.	Cyclo orbiscoside-G (25) $C_{40}H_{67}O_{14}$ 640	$[\alpha]_D$ - M.P.:- 227-30°	""	""	[16]
26.	Dactilin $C_{28}H_{32}O_{17}$ 640	$[\alpha]_D^{24}$ + 15°.7 (c 0.50; MeOH) M.P.: 178-80°	A. galegiformis	whole plant	[17]
27.	isorhamnetin-3,7-dighucoside $C_{28}H_{32}O_{17}$ 640	$[\alpha]_D$ - M.P.:- 165-68°	""	""	""
28.	Cyclocarposide (26) $C_{41}H_{65}O_{13}$ 765	$[\alpha]_D$ + 26° (c 0.30; MeOH) M.P.: 281-82°	A.colurteocarpus	aerial parts	[18]

Table-: List of Glycosides isolated from *Astragalus* species

S.No.	Compound with Struc. No.	Physical data	Source	Parts used	Ref.No.
29.	Astrachrysoside-A (27) $C_{39}H_{64}O_{15}$ 772	$[\alpha]_D$ - M.P.:- 265-68°	A.chrysopterus	roots	[19]
30.	Cycloaraloside-A (28) $C_{36}H_{58}O_6$ 634	$[\alpha]_D$ + 22° (c 0.30; MeOH) M.P.:-	A. amarus	"	[20]
31.	Tomentoside-I (29) $C_{34}H_{56}O_9$ 647	$[\alpha]_D^{25}$ - 18.7° (c 0.47; MeOH) M.P.:- 247-50°	A. tomentosus	aerial parts	[21]
32.	Tomentoside-II (30) $C_{32}H_{54}O_9$ 582	$[\alpha]_D$ - M.P.:- 258-60°	"	"	"
33.	Quercetin-3-O-α-L-rhamnoside $C_{21}H_{20}O_{12}$ 464	$[\alpha]_D$ - M.P.:- 170-80°	A. frigidux	"	[22,23]
34.	Quercetin-3-O-rutinoside $C_{27}H_{30}O_{18}$ 642	$[\alpha]_D$ M.P.: 190-92°	"	"	"
35.	isoquercitrin $C_{21}H_{20}O_{12}$ 464	$[\alpha]_D$ + 10° (c 0.10; MeOH) M.P.: 226-30°	"	"	"
36.	O-methyl astrasieversianin-XV $C_{56}H_{96}O_{17}$ 1040	$[\alpha]_D^{19}$ + 2.2° (c 0.50; MeOH) M.P.: 214-15°	A. sieversianus	roots	[25]
37.	Isoastragaloside-I (31) $C_{45}H_{72}O_{16}$. Na 891	$[\alpha]_D^{25}$ + 21.8° (c 1.82; MeOH) M.P.: 217-18°	A.membranaceus	"	[24]
38.	3-O-B-D-xylopyranosyl (32) $C_{35}H_{59}O$. Na. 518	$[\alpha]_D^{25}$ + 28°(c 0.32; MeOH) M.P.: 295-97°	"	"	"
39.	Astragaloside-II (33) $C_{43}H_{72}O_{15}$.Na 851	$[\alpha]_D^{25}$ + 31.3° (c 3.2; MeOH) M.P.: 251-53°	"	"	"
40.	Astrasieversianin-IX (34) $C_{48}H_{78}O_{18}$ 442	$[\alpha]_D^{12}$ + 6.5° (c 0.17; MeOH) M.P.: 208-209°	A.sieversianus	"	[25]
41.	Astrasieversianin-XI (35) $C_{48}H_{78}O_{18}$ 942	$[\alpha]_D^{12}$ + 9.0° (c 0.20; MeOH) M.P.: 192-193°	"	"	"
42.	Astrasieversianin-XV (36) $C_{46}H_{76}O_{17}$ 1/2 H_2O 942	$[\alpha]_D^{20}$ + 6.7° (c 0.14; MeOH) M.P.: 255-56°	"	"	"
43.	Alexandroside (37) $C_{36}H_{62}O_{10}$ 654	$[\alpha]_D^{10}$ + 4.32° (c 1.4; MeOH) M.P.: 288-90°	"	"	[26]
44.	Cyclosieversioside-A (38) $C_{44}H_{15}O_{15}$ 841	$[\alpha]_D$ - M.P.:	"	"	[27]
45.	Cyclosieversioside-E (39) $C_{41}H_{69}O_{14}$ 785	$[\alpha]_D$ - M.P.:- 209-11°	"	"	[28]
46.	Cyclosieversioside-F (40) $C_{40}H_{67}O_{14}$ 771	$[\alpha]_D$ - M.P.: - 189-90°	"	"	[29]
47.	Cyclosieversioside-G (41) $C_{46}H_{77}O_{17}$ 901	$[\alpha]_D^{24}$ + 21.2° (c 0.45; MeOH) M.P.:-	"	"	[30]
48.	Cyclosieversioside-H (42) $C_{46}H_{77}O_{17}$ 901	$[\alpha]_D$ + 30° (c 0.18; MeOH) M.P.:	A. milkvetch	"	[31]
49.	Cyclogaleginoside-A (43) $C_{37}H_{61}O_{16}$ 665	$[\alpha]_D^{24}$ + 4° (c 1.0; MeOH) M.P.: 224-26°	A.galegiformis	Whole plant	[32]
50.	Cyclogaleginoside-B (44) $C_{35}H_{59}HO_6$ 623	$[\alpha]_D$- M.P.:-	"	"	"
51.	6-Oxocycloartan-3β-16β-di-O-glucoside (45) $C_{42}H_{88}O_{13}$ 780	$[\alpha]_D$ + 25° (MeOH) M.P.: 214-15°	A.trigonus	aerial parts	[33]

S.No.	R_1	R_2	R_3	R_4	R_5	R_6	R_7
1.	Ac	Ac	Ac	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
2.	Ac	Ac	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
3.	Ac	H	Ac	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
4.	H	Ac	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
5.	Ac	H	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
6.	H	H	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
7.	Ac	Ac	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
8.	Ac	H	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
9.	H	Ac	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
10.	H	H	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
11.	H	Ac	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
12.	H	H	Ac	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
13.	H	H	Ac	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
14.	Ac	Ac	Ac	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
15.	Ac	Ac	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
16.	$C_6H_{11}O_5$	H	H	H	óH	óH	$C_8H_{15}O_2$
17.	H	H	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
18.	Ac	Ac	H	H	$C_6H_{11}O_6$	óH	$C_8H_{17}O_2$
19.	H	H	Ac	H	$C_6H_{11}O_6$	óH	$C_8H_{17}O_2$
20.	$C_5H_9O_4$	Ac	H	H	óH	óH	$C_8H_{17}O_2$
21.	$C_5H_9O_4$	Ac	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
22.	$C_5H_9O_4$	H	H	H	óH	óH	$C_8H_{17}O_2$
23.	$C_5H_9O_4$	H	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
26.	H	H	H	H	$C_5H_{10}O_5$	óH	$C_8H_{15}O_2$
27.	$C_6H_{10}O_4$	H	H	H	óH	óH	$C_8H_{15}O_2$
28.	H	H	H	CH_2OH	óH	CH_3	$C_7H_{13}O_2$
31.	Ac	óH	Ac	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
32.	H	óH	H	H	óH	óH	$C_8H_{15}O_2$
33.	Ac	óH	óH	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
34.	$C_6H_{10}O_5$	Ac	H	H	H	óH	$C_7H_{13}O_2$
35.	$C_6H_{10}O_5$	H	Ac	H	H	óH	$C_7H_{13}O_2$
36.	$C_6H_{10}O_5$	H	H	H	H	óH	$C_7H_{13}O_2$
37.	H	H	H	CH_2OH	óH	óH	$C_8H_{17}O_2$
38.	Ac	Ac	H	H	$C_5H_9O_5$	óH	$C_8H_{13}O_2$
39.	H	H	H	CH_2OH	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
40.	H	H	H	H	$C_6H_{11}O_6$	óH	$C_7H_{13}O_2$
41.	$C_6H_{10}O_4$	H	H	H	$C_5H_9O_5$	óH	$C_8H_{15}O_2$
42.	$C_6H_{10}O_4$	H	H	H	$C_6H_{11}O_6$	óH	$C_8H_{15}O_2$
43.	Ac	H	H	H	óH	óH	$C_8H_{15}O_2$
44.	H	H	H	H	óH	óH	$C_8H_{15}O_2$
45.	H	H	H	CH_2OH	= O	$C_6H_{11}O_7$	C_8H_{15}

Struct.	R
24.	óH
25.	$C_6H_{11}O_7$
29.	Et.
30.	H

studied by the homodynamic method. It was found that the saponins at low doses (2 mg) increased heart failure while in middle (4 mg) and high doses (8 mg) antagonized heart failure [5]. The root extracts of *Astragalus membranaceous* and *Astragalus glycyphyllos* are used as immunoenhancer, for preventation of cancer and infections and antitumour effects [6]. Astragan I and II isolated from *Astragalus mongholicus* increased the weight of cell number of mouse spleen and stimulated the phagocytic activity of peritioneal macrophages [7]. *Astragalus membranaceous* is widely used in chinese traditional medicine as an antiperspirant and diuretic. A positive inotropic constituent has been reported from the plant using modified Robert's method [8].

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