Flavonoidal Constituents from *Scutellaria* Species

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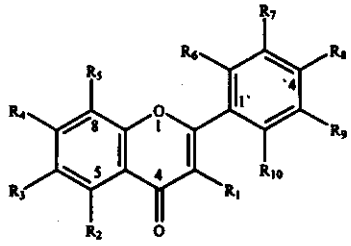
Summary: Naturally occurring flavonoidal constituents from *Scutellaria* species, which appeared in the literature upto 2001 have been reviewed.

Introduction

The genus *Scutellaria* belonging to family Labiatae has 350 species on the global level. Sixteen species are present in Pakistan, distributed from the Himalayan Peak to Sind plain [1]. The plant of the *Scutellaria* genus is a rich source of flavonoids. The extracts of a large number of *Scutellaria* species have long been used in folk medicines. For example in Indonesia, the roots of *Scutellaria indica* are regarded as febrifuge and also recommended for cutaneous diseases. In China, Poultice is applied to skin affected by fungus diseases. In addition to resolving blood clots, it is carminative and roborant. The fleshy rootstock or rhizome of *Scutellaria baicalensis* is widely used in the extreme orient. It is said by the Chinese to equalize the vital principles, to be tonic for the bladder and quieting to the pregnant uterus. It is also used as stimulant to the respiratory organs, astringent, anti-inflammatory, anti-pyretic, expectorant, diuretic, hypotensive and insecticidal. It is prescribed for various ailments of tuberculosis with fever, intermittent fever, digestive system (e.g. nausia, vomitting, diarrhea, juandice, stomachache) and cancer of the breast [2].

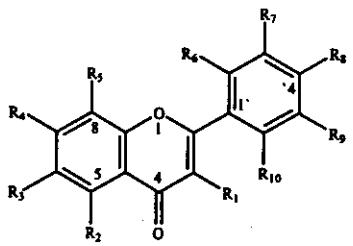
Baicalein, wogonin, oroxylin A, skullcapflavone-11 and chrysin, isolated from the roots of *Scutellaria baicalensis*, inhibited collagen-induced blood platelet aggregation [3]. The acetone extracts of the aerial parts of *Scutellaria galericulate* showed antifeedant activity [4]. Extracts of *Scutellaria barbata* is antitumor agent [5]. Baicalein, isolated from *Scutellaria rivularis* exhibited the hepatoprotective effect on CCl_4-induced liver injuries [6]. Polysaccharide, isolated from *Scutellaria barbata*, has definite inhibitory action on the cells of the implanted tumor sacroma 180 and ascites hepatoma [7]. The mixture of flavonoids and glycosides from *Scutellaria galericulata* had a dose-dependent anti-

Flavone



(1-2, 4-19, 22-24, 26-28, 31, 36-39, 45-61, 65-76, 79-93, 95-98, 100 -101)

Flavanone



(3, 20-21, 25, 29-30,32-35,40-44, 62-64, 77-78, 94-99)

histaminic effect both in *vivo* and *vitro*. The effect is comparable to that of promethazine [8]. Preliminary clinical test showed that carthamidine from *Scutellaria berbata* antagoni-zed the histamine-induced contraction of smooth muscle and exhibited anti-tussive and expectorant effects [9].

The increasing number of isolated flavonoids and to our current phytochemical research on the roots of *Scutellaria nuristanica*, prompted us to

Table 1. List of flavonoids isolated from *Scutellaria* species

S.No	Name of the compound Molecular formula Molecular weight	Physical data°C	Source	Parts used	Reference
1.	Chrysin $C_{15}H_{10}O_5$ 254	M.P. 285	*S. comosa*	roots	[10]
2.	Apigenin $C_{15}H_{10}O_5$ 270	M.P. 345-50	"	"	"
3.	2′, 5-Dihydroxy-6, 7, 6′-trimethoxy flavanone $C_{19}H_{18}O_6$ 342	$[\alpha]_D$ 79.0° ($CHCl_3$) M.P. 256-58	"	"	"
4.	2′, 5-Dihydroxy-6, 7, 8, 6′-tetramethoxy flavone $C_{20}H_{20}O_{10}$ 370		"	"	"
5.	Chrysin-7-*O*-methyl glucuronide $C_{22}H_{20}O_{10}$ 344		"	"	"
6.	Luteolin $C_{15}H_{10}O_6$ 286	M.P. 328-30	*S. albida*	aerial parts	[11]
7.	Hispidulin $C_{16}H_{12}O_6$ 300		"	"	"
8.	Vitexin $C_{21}H_{22}O_{10}$ 434	M.P. 260-62	"	"	"
9.	Acacetin $C_{16}H_{12}O_5$ 284	M.P. 263	"	"	"
10.	Baicalin $C_{21}H_{18}O_{11}$ 546	$[\alpha]_D$ -106° (MeOH) M.P. 222-24	*S. comosa*	roots	[12]
11.	Baicalein $C_{15}H_{10}O_5$ 270	M.P. 264	"	"	[12, 13]
12.	2-Hydroxy chrysin-7-*O*-glucuronide $C_{21}H_{18}O_{11}$ 446		"	"	"
13.	Oroxylin $C_{15}H_{12}O_5$ 272		S. iscanderi	roots and stems	[14]
14.	Apigenin-7-*O*-glucuronide $C_{21}H_{18}O_{11}$ 446		"	"	"
15.	Luteolin-7-*O*-glucuronide $C_{21}H_{18}O_{12}$ 462	M.P. 230-31	"	"	"
16.	2′-Methoxy chrysin $C_{15}H_{10}O_5$ 270		S. adenostagia	roots	[15]
17.	5, 2′, 6′-Trihydroxy-6,7,8-trimethoxy flavone $C_{18}H_{16}O_8$ 360		"	"	"
18.	5, 2′, 6′-Trihydroxy-7, 8-dimethoxy flavone $C_{17}H_{14}O_7$ 330		"	"	"
19.	5, 7, 2′, 6′-Tetrahydroxy flavone $C_{15}H_{10}O_6$ 286		*S. baicalensis* *S. glabrata*	"	[16]
20.	5, 7, 2′, 6′-Trentrahydroxy flavanone $C_{15}H_8O_6$ 284	M.P. 221-22	"	"	"

Table 1: continued

S.No	Name of the compound Molecular formula Molecular weight	Physical data°C	Source	Parts used	Reference
21.	3, 5, 7, 2′, 6′-Pentahydroxy flavanone $C_{15}H_8O_7$ 300		"	"	"
22.	5, 2′, 6-Tetrahydroxy –7,8-dimethoxy flavone $C_{17}H_{14}O_7$ 330		"	"	"
23.	Baicalein-7-*O*-glucoside $C_{21}H_{20}O_{10}$ 420	M.P. 213	"	"	"
24.	Chrysin-7-*O*-glucuronide $C_{21}H_{18}O_{10}$ 418		"	"	"
25.	5, 2′-Dihydroxy-6, 7, 8, 6′-tetramethoxy flavanone $C_{19}H_{20}O_8$ 376		*S. oxystegia*	whole plant	[17]
26.	5, 2′, 6′-Tetrahydroxy –6, 7, 8-trimethoxy flavone $C_{18}H_{16}O_8$ 360		*S. alpina L*	roots and leaves	[18]
27.	Flavone-1 $C_{19}H_{18}O_7$ 358		*S. grossa*	roots	[19,20]
28.	Flavone-11 $C_{17}H_{14}O_7$ 330		"	"	"
29.	Flavanone-111 $C_{19}H_{20}O_7$ 360		"	"	"
30.	Scuteamoenin $C_{16}H_{14}O_6$ 302	M.P. 210	*S. amoena*	"	[21]
31.	2′, 5, 7-Trihydroxy-6-methoxy flavone $C_{16}H_{12}O_6$ 300		"	"	"
32.	2′, 3, 5, 7-Tetrahydroxy flavanone $C_{15}H_{12}O_6$ 288		"	"	[22]
33.	5, 7, 8-Trihydroxy flavanone $C_{15}H_{12}O_5$ 272		"	"	"
34.	2′, 5, 6′, 7-Tetrahydroxy flavanone $C_{15}H_{12}O_6$ 288	M.P. 275-76	"	"	"
35.	2′, 3, 5, 6′, 7-Pentahydroxy flavanone $C_{15}H_{12}O_7$ 304		"	"	"
36.	2′, 5, 6, 7-Tetrahydroxy flavone $C_{15}H_{10}O_6$ 316		"	"	"
37.	5, 7-Dihydroxy-8, 2′-dimethoxy flavone $C_{16}H_{12}O_5$ 314		*S. discolor*	aerial parts	[23]
38.	5, 7, 4′-Trihydroxy-8-methoxy flavone $C_{16}H_{12}O_6$ 330		"	"	"
39.	5, 7-Dihydroxy-8, 2′, 6′-trimethoxy flavone $C_{17}H_{14}O_6$ 344		"	"	"
40.	5, 7, 2′-Trihydroxy-8-methoxy flavanone $C_{16}H_{14}O_6$ 332	M.P. 179	*S. indica*	roots	[24-26]

Table 1: continued

S.No	Name of the compound Molecular formula Molecular weight	Physical data°C	Source	Parts used	Reference
41.	5, 7, 2′-Trihydroxy flavanone $C_{15}H_{12}O_5$ 304	M.P. 202	"	"	"
42.	5, 2′, 5′-Trihydroxy-7, 8-dimethoxy flavone $C_{17}H_{16}O_7$ 362	M.P. 192	"	"	"
43.	5, 2′-Dihydroxy-8, 7, 6′-trimethoxy flavanone $C_{18}H_{18}O_7$ 376		"	"	"
44.	5, 2′-Dihydroxy-6, 7, 6′-trimethoxy flavanone $C_{18}H_{18}O_7$ 376		"	"	"
45.	5, 7-Dihydroxy-8, 2′-dimethoxy flavone $C_{17}H_{12}O_5$ 358		"	"	"
46.	Rivularin $C_{18}H_{16}O_7$ 374	M.P. 295	"	"	"
47.	5, 2′, 6′-Trihydroxy-7,8-dimethoxy flavone $C_{17}H_{14}O_7$ 360		"	"	"
48.	5, 7, 4′-Trihydroxy-8-methoxy flavone $C_{16}H_{14}O_6$ 326		"	"	"
49.	Tenaxin-II $C_{16}H_{12}O_6$ 324		*S. likiangensis*	"	[27]
50.	Rehderianin $C_{17}H_{14}O_7$ 354	M.P. 265	*S. rehderiana*	"	[28]
51.	Tiliarin $C_{22}H_{22}O_{10}$ 446		*S. polydon*	flowers	[29]
52.	Linarin $C_{28}H_{32}O_{14}$ 592	M.P. 267-69	"	"	"
53.	Pinocembrin $C_{15}H_{10}O_4$ 254	M.P. 195	*S. discolor*	roots	[30]
54.	7-Hydroxy-5, 8-dimethoxy flavone $C_{17}H_{14}O_5$ 289	M.P. 290	"	"	"
55.	5, 7, 4′-Trihydroxy-8, 6′-dimethoxy flavone $C_{17}H_{14}O_7$ 330	M.P. 280	"	"	"
56.	7-Hydroxy-5, 8, 2′-trimethoxy flavone $C_{18}H_{16}O_6$ 328		"	"	"
57.	5, 7-Dojudrpxu-8, 2′, 6′-trimethoxy flavone $C_{18}H_{16}O_7$ 344		"	"	"
58.	Viscidulin-1 $C_{15}H_{10}O_7$ 302		*S. viscidula*	"	[31]
59.	Viscidulin-11 $C_{17}H_{14}O_7$ 330			"	
60.	Uiscidulin-111 $C_{17}H_{14}O_8$ 346		*S. rehderiana*	"	[32]

Table 1: continued

S.No	Name of the compound Molecular formula Molecular weight	Physical data°C	Source	Parts used	Reference
61.	Ganhuangenin $C_{17}H_{14}O_8$ 346		*S. gamhuangenin*	"	[32-33]
62.	Naringenin $C_{15}H_{12}O_5$ 272	M.P. 251	*S. rivularis*	aerial parts	[34]
63.	4′, 5, 7-Trihydroxy-8-methoxy flavanone $C_{16}H_{14}O_6$ 302		"	"	"
64.	4′, 5, 7-Trihydroxy-6-methoxy flavanone $C_{16}H_{14}O_6$ 302		"	"	"
65.	4′-Hydroxy wogonin $C_{16}H_{12}O_6$ 300		"	"	"
66.	7-Hydroxy-5, 8-dimethoxy flavone $C_{17}H_{14}O_5$ 298		"	"	"
67.	Tenaxin-1 $C_{18}H_{16}O_7$ 344	M.P. 211-13	*S. tenax*	"	[35]
68.	5, 7, 2′-Trihydroxy-8, 6′-dimethoxy flavone $C_{17}H_{14}O_7$ 330		*S. baicalensis*	roots	[36]
69.	5, 7, 2′, 5′-Tetrahydroxy-8, 6′-dimethoxy flavone $C_{17}H_{14}O_8$ 346		"	"	"
70.	5, 2′, 5′-Trihydroxy-6, 7, 8-trimethoxy flavone $C_{18}H_{16}O_8$ 360		"	"	"
71.	5, 7, 2′-Trihydroxy flavone $C_{15}H_{10}O_5$ 270	M.P. 220-22	"	"	"
72.	Baicalein-7-*O*-glucopyranoside $C_{21}H_{20}O_{10}$ 432		"	"	"
73.	Ovatin $C_{21}H_{20}O_9$ 416		*S. ovata*	"	[37]
74.	6-Methoxy luteolin $C_{16}H_{12}O_7$ 316		"	"	"
75.	Wogonin $C_{16}H_{12}O_5$ 284	M.P. 203	*S. rivularis*	"	[38]
76.	7-*O*-Methyl wogonin $C_{17}H_{14}O_5$ 298		"	"	"
77.	Carthamidine $C_{15}H_{12}O_6$ 288		"	"	"
78.	Isocarthamidine $C_{15}H_{12}O_6$ 288		"	"	"
79.	Scutellarein $C_{15}H_{10}O_6$ 286	M.P. 300	*S. scordiifolia*	leaves and roots	[39]
80.	Chrysin-7-*O*-glucuronide $C_{21}H_{18}O_{10}$ 430		"	"	"

Table 1: continued

S.No	Name of the compound Molecular formula Molecular weight	Physical data°C	Source	Parts used	Reference
81.	Baicalein-7-*O*- glucuronide $C_{21}H_{18}O_{11}$ 346		"	"	"
82.	Apigenin-7-*O*-glucuronide $C_{21}H_{18}O_{11}$ 346		"	"	"
83.	Luteolin-7-*O*-glucuronide $C_{21}H_{18}O_{12}$ 362		"	"	"
84.	Altisin $C_{19}H_{18}O_7$ 358		*S. altissima*	roots	[40]
85.	Scullcapflavone-1 $C_{17}H_{14}O_6$ 314		*S. baicalensis*	"	[41]
86.	Scullcapflavone-11 $C_{18}H_{16}O_7$ 344		"	"	"
87.	7-Methoxy baicalein $C_{15}H_{12}O_5$ 272		"	"	[42]
88.	Wogonin-7-*O*-glucuronide $C_{22}H_{20}O_{11}$ 360	$[\alpha]_D$ -14° (MeOH) M.P. 194-96	"	"	[43]
89.	2′, 4′, 5-Trihydroxy-6, 8-dimethoxy flavone $C_{17}H_{14}O_7$ 330	M.P. 249-50	*S. rehderiana*	"	[32]
90.	2, 4′, 5′-Trihydroxy-6, 7-dimethoxy flavone $C_{17}H_{14}O_7$ 330	M.P. 264-66	"	"	"
91.	2, 4′, 5′-Trihydroxy-7, 8-dimethoxy flavone $C_{17}H_{14}O_7$ 330	M.P. 56-57	"	"	"
92.	3, 3′, 5, 7-Tetrahydroxy-2′, 4′-dimethoxy flavone $C_{17}H_{14}O_8$ 346	M.P. 216-18	"	"	"
93.	2′, 3, 3′, 5, 7-Pentahydroxy-4′-methoxy flavone $C_{16}H_{12}O_8$ 332	M.P. 272-73	"	"	"
94.	5, 7-Dihydroxy-8, 2′-dimethoxy flavanone $C_{17}H_{16}O_6$ 316	M.P. 208	*S. discolor*	"	[44]
95.	5, 7, 8, 2′-tetramethoxy flavanone $C_{19}H_{20}O_6$ 344	M.P. 174	"	"	"
96.	5-Hydroxy-7, 8, 2′-trimethoxy flavanone $C_{18}H_{18}O_6$ 330	M.P. 138	"	"	"
97.	7-Hydroxy-5, 8, 2′-trimethoxy flavanone $C_{18}H_{18}O_6$ 330	M.P. 214	"	"	"
98.	5, 2′-Dihydroxy-7, 8, 6′-trimethoxy flavanone $C_{18}H_{18}O_7$ 346	M.P. 202	"	"	"
99.	5, 2′-Dihydroxy-6, 7, 6′-trimethoxy flavanone $C_{18}H_{18}O_7$ 346	M.P. 221	"	"	"
100.	Luteolin-7-*O*-glucoside $C_{21}H_{20}O_{11}$ 448	M.P. 254-56	"	"	"
101.	Luteolin-7-*O*-glucospyranoside $C_{21}H_{20}O_{11}$ 448	M.P. 266-68	"	"	"

S.No.	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
1.	H	OH	H	OH	H	H	H	H	H	H
2.	H	OH	H	OH	H	H	H	OH	H	H
3.	H	OH	OMe	OMe	H	OH	H	H	H	OMe
4.	H	OH	OMe	OMe	OMe	OH	H	H	H	OMe
5.	H	OH	gluc	OMe	H	H	H	H	H	H
6.	H	OH	OH	OH	H	H	OH	OH	H	H
7.	H	OH	OH	OH	H	H	H	OH	H	H
8.	H	OH	OH	OH	glc	H	H	H	H	H
9.	H	OH	OH	OH	H	H	H	OMe	H	H
10.	H	OH	gluc	gluc	H	H	H	H	H	H
11.	H	OH	OH	OH	H	H	H	H	H	H
12.	H	OH	gluc	gluc	H	OH	H	H	H	H
13.	H	OH	OH	OH	H	H	H	H	H	H
14.	H	OH	gluc	gluc	H	H	H	OH	H	H
15.	H	OH	gluc	gluc	H	H	OH	OH	H	H
16.	H	OH	OH	OH	H	OMe	H	H	H	H
17.	H	OH	OMe	OMe	OMe	OH	H	H	H	OH
18.	H	OH	OMe	OMe	OMe	OH	H	H	H	H
19.	H	OH	OH	OH	H	OH	H	H	H	OH
20.	H	OH	OH	OH	H	OH	H	H	H	OH
21.	H	H	OH	OH	H	OH	H	H	H	OH
22.	H	OH	OMe	OMe	OMe	OH	H	H	H	H
23.	H	OH	glc	glc	H	H	H	H	H	H
24.	H	OH	gluc	gluc	H	H	H	H	H	H
25.	H	OH	OMe	OMe	OMe	OH	H	H	H	OMe
26.	H	OH	OMe	OMe	OMe	OH	H	H	H	OH
27.	H	OH	OMe	OMe	OMe	H	OMe	H	H	OMe
28.	H	OH	OMe	OMe	OMe	H	OH	H	H	H
29.	H	OH	OMe	OMe	OMe	OMe	H	H	H	OMe
30.	H	OH	OMe	OMe	H	OH	H	H	H	OH
31.	H	OH	OH	OH	H	OH	H	H	H	H
32.	OH	OH	OH	OH	H	OH	H	H	H	H
33.	H	OH	OH	OH	OH	H	H	H	H	H
34.	H	OH	OH	OH	H	OH	H	H	H	OH
35.	OH	OH	OH	OH	H	OH	H	H	H	OH
36.	H	OH	OH	OH	H	OH	H	H	H	OH
37.	H	OH	H	OH	OMe	OMe	H	H	H	H
38.	H	OH	H	OH	OMe	H	H	OH	H	H
39.	H	OH	H	OH	OMe	OMe	H	H	H	OMe
40.	H	OH	H	OH	OMe	OH	H	H	H	H
41.	H	OH	H	OH	H	OH	H	H	H	H
42.	H	OH	H	OMe	OMe	OH	H	H	OH	H
43.	H	OH	H	OMe	OMe	OH	H	H	H	OMe
44.	H	OH	OMe	OMe	H	OH	H	H	H	OMe
45.	H	OH	OMe	OH	OMe	OMe	H	H	H	H
46.	H	OH	H	OMe	OMe	OH	H	H	H	H
47.	H	OH	H	OMe	OMe	OH	H	H	H	H
48.	H	OH	H	OH	OMe	H	H	OH	H	H
49.	H	OH	OMe	OH	H	OH	H	H	H	H
50.	H	OH	H	OMe	OMe	OH	H	H	OH	H
51.	H	OH	H	g.pyr.	H	H	H	OMe	H	H
52.	H	0H	H	Rut	H	H	H	OMe	H	H
53.	H	OH	H	OH	H	H	H	H	H	H
54.	H	OMe	H	OH	OMe	H	H	H	H	H
55.	H	OH	H	OH	OMe	H	H	H	OH	OMe
56.	H	OMe	H	OH	OMe	OMe	H	H	H	H
57.	H	OH	H	OH	OMe	OMe	H	H	H	OMe
58.	OH	OH	H	OH	H	OH	H	H	H	OH
59.	H	OH	H	OMe	OMe	OH	H	H	H	OH
60.	H	OH	H	OH	OMe	OMe	OH	H	H	OH
61.	H	OH	H	OH	OMe	OMe	OH	H	H	OH
62.	H	OH	H	OH	H	H	H	OH	H	H
63.	H	OH	H	OH	OMe	H	H	OH	H	H
64.	H	OH	OMe	OH	H	H	H	OH	H	H

S.No.	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
65.	H	OMe	H	OH	OMe	H	H	H	H	H
66.	H	OMe	H	OH	OMe	H	H	H	H	H
67.	H	OH	OMe	OMe	OMe	OH	H	H	H	H
68.	H	OH	H	OH	OMe	OH	H	H	H	OMe
69.	H	OH	H	OH	OMe	OH	H	H	OH	OMe
70.	H	OH	OMe	OH	OMe	OH	H	H	OH	H
71.	H	OH	H	OH	H	OH	H	H	H	H
72.	H	OH	OH	g.pyr	H	H	H	H	H	H
73.	H	OMe	OMe	gluc	H	H	H	H	H	H
74.	H	OH	OMe	OH	H	H	OH	OH	H	H
75.	H	OH	H	OH	OMe	H	H	H	H	H
76.	H	OH	H	OMe	OMe	H	H	H	H	H
77.	H	OH	H	OH	OH	H	H	OH	H	H
78.	H	OH	OH	OH	H	H	H	OH	H	H
79.	H	OH	OH	OH	H	H	H	OH	H	H
80.	H	OH	H	gluc	H	H	H	H	H	H
81.	H	OH	OH	gluc	H	H	H	H	H	H
82.	H	OH	H	gluc	H	H	H	OH	H	H
83.	H	OH	H	gluc	H	H	OH	OH	H	H
84.	H	OH	H	OMe	OMe	OMe	H	H	H	H
85.	H	OH	OMe	H	OMe	OH	H	H	H	H
86.	H	OH	OMe	OMe	OMe	OH	H	H	H	H
87.	H	OH	OH	OMe	H	H	H	H	H	H
88.	H	OH	H	gluc	OMe	H	H	H	H	H
89.	H	OH	OMe	H	OMe	OH	H	OH	H	H
90.	H	OH	OMe	OMe	H	OH	H	OH	H	H
91.	H	OH	H	OMe	OMe	OH	H	OH	H	H
92.	OH	OH	H	OH	H	OMe	OH	OMe	H	H
93.	OH	OH	H	OH	H	OH	OH	OMe	H	H
94.	H	OH	H	OH	OMe	OMe	H	H	H	H
95.	H	OH	H	OH	OH	OH	H	H	H	H
96.	H	OH	H	OMe	OMe	OMe	H	H	H	H
97.	H	OMe	H	OH	OMe	OMe	H	H	H	H
98.	H	OH	H	OMe	OMe	OH	H	H	H	H
99.	H	OH	OMe	OMe	H	OH	H	H	H	H
100	H	OH	H	glc	H	H	OH	OH	H	H
101.	H	OH	H	g.pyr	H	H	OH	OH	H	H

S: Scutellaria, gluc = glucuronide, glc: glucoside, g. pyr = glucupyranoside

present an upto date review of the flavonoidal constituents of the genus *Scutellaria*. A concise account is hereby presented in Table 1 on flavonoids isolated upto the year 2001.

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