Phytochemistry, Vol. 28, No. 2, pp. 665–667, 1989.
Printed in Great Britain.

0031–9422/89 $3.00 + 0.00

FLAVONOID AGLYCONES FROM *JASONIA MONTANA*

AHMED A. AHMED, ASHRAF A. ALI and TOM J. MABRY*

Department of Chemistry, Faculty of Science, El-Minia University, El-Minia, Egypt, *The Department of Botany, The University of Texas at Austin, Austin, Texas 78713 U.S.A.

(*Received in revised form* 20 *June* 1988)

Key Word Index—*Jasonia montana*; Compositae; Inuleae; polymethoxylated flavonoids; 4′-hydroxy-3,5,6,7,3′-pentamethoxyflavone.

Abstract—Thirteen flavonoid aglycones were identified from aerial parts of *Jasonia montana*. They include eight methyl ethers of quercetagetin, one methyl ether of 6-hydroxykaempferol, and three methyl ethers of quercetin. Quercetagetin 3,5,6,7,3′-pentamethyl ether is a new natural product.

INTRODUCTION

Jasonia (Compositae, tribe Inuleae, subtribe Inulinae) is a small genus with *ca* five species and a chromosome number of $n=9$, which occurs in the Mediterranean and adjacent areas [1]. On the basis of pollen fine structure, Leins [2] divided the subtribe Inulinae into two sections and placed the genus *Jasonia* in that group which is characterized by a simple baculate sexine. In his revision Merxmuller split the Inulinae into three and included *Jasonia* in the Inula group.

Three species of *Jasonia*, *J. glutinosa*, *J. tuberosa* and *J. montana*, afforded sesquiterpenes with highly oxygenated eudesmane skeletons, which are rare in Inuleae and seem to be characteristic for the genus [3–5]. We report here on the flavonoids of *Jasonia montana* (Vahl) Botsch. as part of a continuing chemical study of this genus.

RESULTS AND DISCUSSION

The aerial parts of *Jasonia montana* yielded 13 flavonoids, which are listed in Table 1, including the new compound 4′-hydroxy-3,5,6,7,3′-pentamethoxyflavone (quercetagetin 3,5,6,7,3′-pentamethyl ether) (**1**). Nine 6-methoxylated flavonoids, 3,5,6,7,3′,4′-hexamethoxyflavone (quercetagetin hexamethyl ether) (**2**) [6, 7], 5-hydroxy-3,6,7,3′,4′-pentamethoxyflavone (artemetin) (**3**), 5,3′-dihydroxy-3,6,7,4′-tetramethoxyflavone (casticin) (**4**), 5,4′-dihydroxy-3,6,7,3′-tetramethoxyflavone (chrysosplenetin) (**5**), 5,4′-dihydroxy-3,6,7-trimethoxyflavone (penduletin) (**6**), 5,7,3′-trihydroxy-3,6,4′-trimethoxyflavone (centaureidin) (**7**), 5,7,4′-trihydroxy-3,6,3′-trimethoxyflavone (jaceidin) (**8**), 5,3′,4′-trihydroxy-3,6,7,-trimethoxyflavone (**9**), 3,5,7,3′,4′-pentahydroxy-6-methoxyflavone (patuletin) (**10**), and three non 6-methoxy-

Table 1. MS data of flavonoids EIMS (probe 70 eV, *m/z* (rel. int.)

Flavonoids		$[M]^+$	$[M-15]^+$	$[M-43]^+$	$[A_1-15]^+$	$[B_2]^+$
(**1**)	3,5,6,7,3′,4′-OMe	402	387	359	195	165
		(75)	(100)	(5)	(10)	(15)
(**2**)	3,5,6,7,3′-OMe	388	373	345	195	151
	4′-OH	(70)	(100)	(4)	(11)	(19)
(**3**)	3,6,7,3′,4′-OMe	388	373	345	181	165
	5-OH	(65)	(100)	(7)	(13)	(20)
(**4**)	3,6,7,4′-OMe	374	359	331	181	151
	5,3′-OH	(69)	(100)	(8)	(10)	(14)
(**5**)	3,6,7,3′-OMe	374	359	331	181	151
	5,4′-OH	(80)	(100)	(9)	(11)	(14)
(**6**)	3,6,7-OMe	344	329	301	181	121
	5,4′-OH	(100)	(75)	(20)	(9)	(9)
(**7**)	3,6,4′-OMe	360	345	317	167	151
	5,7,3′-OH	(100)	(80)	(22)	(8)	(16)
(**8**)	3,6,3′-OMe	360	345	317	167	151
	7,4′-OH	(100)	(75)	(20)	(6)	(14)
(**9**)	3,6,7-OMe	360	345	317	181	137
	3′,4′-OH	(100)	(70)	(15)	(5)	(10)
(**10**)	3,5,7,3′,4′-OH	332	314	289	167	137
	6-OMe	(100)	(40)	(90)	(6)	(20)

lated-flavonoids, 5,4′-dihydroxy-3,7,3′-trimethoxyflavone (pachypodol) (**11**), 5,7,3′-trihydroxy-3,4′-dimethoxyflavone (**12**), and 5,7,4′-trihydroxy-3,3′-dimethoxyflavone (**13**).

The ^{1}H NMR spectrum of (**1**) in $CDCl_3$ showed one proton doublet at δ 7.7 (J = 2.5 Hz) for H-2′, one proton double-doublet at δ 7.6 (J = 2.5 Hz and 9 Hz) for H-6′, an *ortho*-coupled doublet at δ 7.05 (J = 9 Hz) for H-5′ and a singlet at 6.7 for H-8. The presence of an H-2′ signal downfield from that of H-6′, indicated a methoxyl group at the 3′-position with a free 4′-hydroxyl group. The remaining signals in the ^{1}H NMR spectrum were in accord with five methyl groups. The chemical shift of the 5-methoxyl, which appeared at δ4.02, was typical for a 3,5,6-trimethoxylated system [8, 9]. The ^{1}H NMR spectrum in C_6D_6 showed a pronounced shift for the methoxyl groups as indicated in the literature [10, 11], Table 2. In contrast to the upfield shift of signals for the 3-, 6-, 7- and 3′-methoxyls, the 5-methoxyl signal exhibited a downfield shift to δ 4.1 ppm (Δ −0.08). Since polymethoxylated flavonoids with a methoxyl group at the 5-position are rare in nature [12], no models for this unusual downfield shift are available. The MS of **1**, Table 1, exhibited a molecular ion peak at *m/z* 388 (70%), indicating an aglycone containing five methoxyl groups and one hydroxyl group. The peak at *m/z* 373, which appeared as a base peak, was in accord with the loss of methyl group from the 6-position, which was confirmed by the fragment $[A-15]^+$ at *m/z* 195 (13%). Compound **1** appeared as a white spot on paper under UV light that changed to yellowish-green with ammonia and NA, suggesting 3,5-disubstitution and a free 4′-hydroxyl group. This conclusion was supported by UV spectra, which on addition of NaOMe exhibited a bathochromic shift of Band I, relative to Band I in MeOH, with an increase in intensity, while no shifts were observed with $AlCl_3$, $AlCl_3$/HCl, NaOAc or NaOAc/H_3BO_3. Furthermore, the identity of **1** has been confirmed by co-chromatography and mixed melting point with a synthetic authentic sample. Therefore, compound **1** was identified as 4′-hydroxy-3,5,6,7,3′-pentamethoxyflavone, a novel flavonoid.

MS of compound **2** showed a molecular ion peak at *m/z* 402, indicating a flavonoid with six methoxyl groups. The $[M-15]^+$ fragment which appeared at *m/z* 387 due to the loss of a methyl group from the 6-methoxyl and the $[A-15]^+$ fragment at *m/z* 195 confirmed the methoxyl group at the 6-position and an A-ring with three methoxyl groups. On the other hand, a $[B_2]^+$ fragment at *m/z* 165 supported a B-ring with two methoxyl groups. Compound **2** appeared fluorescent light blue under UV light and did not change with ammonia or NA. ^{1}H NMR showed a quercetin skeleton with six methoxyl groups at δ4.02–3.88 ppm, and the sharp signal at δ 4.02 was typical for a 3,5,6-trimethoxylated flavonoid. Thus, **2** was identified as 3,5,6,7,3′,4′-hexamethoxyflavone (quercetagetin hexamethyl ether). While quercetagetin hexamethyl ether has been reported from *Citrus mitis* and *C. sinensis* (Rutaceae) [6, 7], this is the first report from the Compositae.

EXPERIMENTAL

Plant material. Jasonia montana (Vahl) Botsch. was collected on 15 August 1985 from North of Sinia, Egypt. Voucher specimens, identified by Professor Dr El-Hadidi (Department of Botany, Cairo University) are deposited in the Department of Botany, El-Minia University.

Table 2. Solvent shifts for methoxyl groups in compounds **1** and **2**

	1		**2**	
C	$CDCl_3$	C_6D_6	$CDCl_3$	C_6D_6
3	3.98	3.80	3.98	3.80
5	4.02	4.10	4.02	4.10
6	3.98	3.82	3.98	3.88
7	3.92	3.32	3.92	3.26
3′	3.86	3.50	3.88	3.42
4′	—	—	3.98	3.60

Isolation of flavonoids. Air-dried aerial parts of *Jasonia montana* (1 kg) were extracted with CH_2Cl_2–Et_2O–MeOH (1:1:1) and the concd extract (15 g crude syrup) was applied to a silica gel (300 g) column and eluted with a CH_2Cl_2–MeOH gradient. The bands on the column were monitored with UV light. Fractions were finally separated either by prep. TLC or subcolumn. Purification of each compound for spectral analysis was carried out using aq. MeOH over Sephadex LH-20. All UV data were recorded using standard procedures [13]. ^{1}H NMR spectra of the TMSi ether of these flavonoids were recorded in $CDCl_3$ at 200 MHz and are reported as δ-values (ppm) relative to TMS as int. standard. MS data were recorded by direct probe EIMS at 70 eV.

Data for quercetagetin 3,5,6,7,3′-*pentamethyl ether* (**1**). Colour: UV, white; UV/NH_3, yellowish-green; NA (Naturstoffreagenz A in MeOH) yellowish-green. R_f values: TBA, 91; 15% HOAc, 50. UV, λ_{max}^{MeOH} nm: 254sh, 267sh, 335; NaOMe, 255, 281sh, 400, with increase in intensity; $AlCl_3$, 154sh, 267sh, 337; $AlCl_3$–HCl, 254sh, 267sh, 337; NaOAc, 256sh, 264sh, 337, 406sh; NaOAc–H_3BO_3, 256sh, 264sh, 337. MS: *m/z* (rel. int.), 388 $(M)^+$ (70%), 373 $[M-15]^+$, (100%), 151 $(B_2)^+$ (25%). ^{1}H NMR (200 MHz, in $CDCl_3$, TMS): δ 7.7 (1H, *d*, H-2′), 7.6 (1H, *dd*, H-6′), 7.0 (1H, *d*, H-5′), 6.8 (1 H, *s*, H-8), 4.02 (3H, *s*, 5-OMe), 3.98 (6 H, *s*, 3-OMe and 6-OMe), 3.92 (3H, *s*, 7-OMe) and 3.86 (3H, *s*, 3′-OMe). ^{1}H NMR (200 MHz, in C_6D_6, TMS), δ4.1 (3H, *s*, 5-OMe, Δ −0.08 ppm), 3.82 (3H, *s*, 6-OMe, Δ +0.16 ppm), 3.8 (3H, *s*, 3-OMe, Δ +0.18 ppm), 3.50 (3 H, *s*, 3′-OMe, Δ +0.36 ppm), and 3.32 (3 H, *s*, 7-OMe, Δ +0.60 ppm).

Data for quercetagetin 3,5,6,7,3′,4′-*hexamethyl ether* (**2**). Colour: UV, fluorescent light blue; UV/NH_3 fluorescent light blue; NA, fluorescent light blue. R_f values: TBA, 98; 15% HOAc, 45. UV, λ_{max}^{MeOH} nm, 245, 255sh, 265sh, 335; NaOMe, 255sh, 265sh, 335; $AlCl_3$, 250sh, 265sh, 330; $AlCl_3$/HCl, 255sh, 265sh, 330; NaOAc, 250sh, 265sh, 335; NaOAc/H_3BO_3, 250sh, 265sh, 335. MS: *m/z* (rel. int.), 402 $(M)^+$ (75%), 387 $[M-15]^+$ (100%), 195 $[A-15]^+$ (10%), 165 $(B_2)^+$ (15%). ^{1}H NMR (200 MHz, in $CDCl_3$, TMS): δ 7.7 (2 H, *m*, H-6′ and H-2′), 7.0 (1 H, *d*, H-5′), 6.8 (1 H, *s*, H-8), 4.02 (3 H, *s*, 5-OMe), 3.98 (9 H, *s*, 3-OMe, 6-OMe and 4′-OMe), 3.92 (3 H, *s*, 7-OMe) and 3.88 (3 H, *s*, 3′-OMe). ^{1}H NMR (200 MHz, in C_6D_6, TMS): δ4.1 (3 H, *s*, 5-OMe, Δ −0.08 ppm), 3.88 (3 H, *s*, 6-OMe, Δ +0.10 ppm), 3.80 (3 H, *s*, 3-OMe, Δ +0.18 ppm), 3.60 (3 H, *s*, 4′-OMe, Δ +0.18 ppm), 3.42 (3 H, *s*, 3′-OMe, Δ +0.46 ppm), and 3.26 (3 H, *s*, 7-OMe, Δ +0.66 ppm).

Acknowledgements—The work in Egypt was supported by the Faculty of Science, El-Minia University. T. J. M. wishes to acknowledge support from the National Institutes of Health (GM-35710) and the Robert A. Welch Foundation (F-130). The authors thank Dr M. Iinuma (Gifu University, Japan) for the synthetic sample of 4′-hydroxy-3,5,6,7,3′-pentamethoxyflavone.

REFERENCES

1. Merxmuller, H., Leins, P. and Roesseler, H. (1977) in *The Biology and Chemistry of Compositae* (Heywood, J. B., Harborne, J. B. and Turner, B. L., eds). pp. 590. Academic Press, New York.
2. Leins, P. (1971) *Bot. Jahrb.* **91**, 91.
3. Pascual, Teresa, J., Barrero, A. F., San Feliciano, A., Grande, M., and Medarde, M. (1978) *Tetrahedron Letters* **43**, 4141.
4. Pascual Teresa, J., Barrero, A. F., San Feliciano, A. and Medarde, M. (1980) *Phytochemistry* **19**, 2155.
5. Ahmed, A. A., Jakupovic, J., Eid, F. and Ali, A. A. (1989) *Phytochemistry* (in press).
6. Tatum, J. H. and Berry, R. E. (1972) *Phytochemistry* **11**, 2283.
7. Row, L. R. and Sastry, G. (1963) *Indian J. Chem.* **1**, 207.
8. Joseph-Nathan, P., Abramo-Bruno and Torres Ma. M. (1981), *Phytochemistry* **20**, 313.
9. Buschi, C. A., Pomilio, A. B. and Gros, E. G. (1981) *Phytochemistry* **20**, 1179.
10. Rodrigues, E., Carman, N. J. and Mabry, T. J. (1972) *Phytochemistry* **11**, 409.
11. Rodrigues, E., Carman, N. J., Velde, G. V., McReynols, J. H., Mabry, T. J., Irwin, M. A. and Geissman, T. A. (1972) *Phytochemistry* **11**, 3509.
12. Harborne, J. B. and Mabry, T. J. (1982) *The Flavonoids, Advances in Research*. Chapman & Hall, London.
13. Mabry, T. J., Markham, K. R. and Thomas, N. B. (1970) *The Systematic Identification of Flavonoids*. Springer, New York.

Phytochemistry, Vol. 28, No. 2, pp. 667–670, 1989.
Printed in Great Britain.

0031–9422/89 $3.00 + 0.00

ALKALOIDS OF *ALSTONIA CORIACEA*

ABDALLAH CHERIF, GEORGES MASSIOT, LOUISETTE LE MEN-OLIVIER, JACQUES PUSSET and STÉPHANE LABARRE

Faculte de Pharmacie (U.A. au C.N.R.S. N° 492), 51 rue Cognacq-jay, 51096 Reims Cedex, France;† Laboratoire des Plantes Medicinales du C.N.R.S. B.P. 643, Noumea, New Caledonia, France; Institut de Chimie des Substances Naturelles du CNRS 91198 Gif sur Yvette-Cedex, France

(*Received in revised form* 8 *June* 1988)

Key Word Index— *Alstonia coriacea*; Apocynaceae; indole alkaloids; quinoline alkaloids; ^{1}H and ^{13}C NMR.

Abstract—Seven alkaloids have been identified from the stem bark of *Alstonia coriacea* from New Caledonia. They are gentianine, 10-methoxy deplancheine, vincamajine, desmethylquaternine, 10-methoxy-3-*epi*-α-yohimbine, corialstonine and cabucraline. Corialstonine is a novel member of the little represented quinoline alkaloid series.

INTRODUCTION

Alstonia coriacea Pancher ex S. Moore is a shrub from New Caledonia, which sometimes is mistaken for *A. lenormandii* [1]. After studying the alkaloid content of this latter species [2], we herein report our results on the alkaloids of the stem bark of *A. coriacea* collected by two of us (J. P. and S. L.) in the southern part of the island. Alkaloids were extracted in the standard fashion and from 3.3 kg of dried milled stem bark, there was obtained 17 g of alkaloids (yield 5.2 g/kg); some alkaloids were also isolated from the leaves but their low yield discouraged us from pursuing investigation.

RESULTS AND DISCUSSION

From the crude alkaloid mixture, seven alkaloids were isolated in a pure state and identified. They are gentianine, **1** (0.6% of alkaloid mixture (AM)), 10-methoxy deplancheine, **2** (1.5% AM), vincamajine, **3** (6.5% AM), desmethylquaternine **4** (56% AM), 10-methoxy-3-*epi*-α-yohimbine **5** (0.9% AM), corialstonine **6** (0.5% AM) and cabucraline, **7** (0.8% AM). Among these, alkaloids **1–3** and **7** are known compounds, available for direct comparison from the study of other *Alstonia* species. Alkaloid **4**, previously isolated from *A. legouixae*, was identified here by comparison of spectra [3]. To the best of our knowledge, alkaloids **5** and **6** are new; the structural elucidation of **6** has been reported in a preliminary note [4] and will not be detailed here. The novel isolation of **2–4** and **7** has provided the opportunity of obtaining complete ^{1}H and ^{13}C NMR assignments by means of 2D NMR experiments.

Deplancheine and 10-methoxydeplancheine 2 are rare alkaloids, isolated from *A. deplanchei* [5], *A. undulata* [6] and *A. lanceolifera* [7]. Previous structural assignment of **2** was based on comparison of the ^{1}H NMR spectra of **2** and of the corresponding fully synthetic 19,20-dihydro derivative. This is now done using ^{13}C NMR, to establish the gross structure of **2** and to settle the aromatic substitution, and ^{1}H NMR. Both spectra were assigned using δ–δ correlation experiments and the chemical shifts of the aromatic carbons were found to be close to the values reported for 10-methoxy indoles by Verpoorte *et al.* [8]. Ring junction H-3 was observed as a broad

† Part 125 in the series 'Plants from New Caledonia'. For part 124, see Ettouati, L., Ahond, A., Convert, O., Poupat. C. and Potier, P. (1988) *Bull. Soc. Chim. Fr.*, (in press).