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ALKALOIDS OF SOME OF THE PLANTS OF THE COMPOSITAE

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Compositae Giseke (nom. altern. *Asteraceae* Link), is one of the largest families of flowering plants, comprising about 900 genera, with over 13,000 species — more than 10% of the total. They are distributed over the greater part of the earth. Although so large a family they are well marked in their characters and cannot be confounded with any other.

Living in almost every conceivable situation (though rare in tropical rain forests), they present great variety in vegetative habitat, often within a single genus, e.g. *Senecio* (q.v.). The enormous majority are herbaceous plants; trees and shrubs are completely rare (about 1½%).

We have surveyed the literature on 105 genera of the *Compositae* family to record the alkaloids isolated from these plants. Only 17 genera were found to contain alkaloids. The alkaloids found in these genera are reported alongwith their physical data in Table 1. The chemical structures, where known, are given in Tables 2 and 3. The information reported in this paper will provide an easy reference for natural product chemists and pharmacognosists in particular, and to others in general.

TABLE 1

No.	Alkaloid name	M.p.	Molecular formula	Alpha	Solvent	Miscellaneous properties	Plant name	Ref.
1	Abrotine		$C_{21}H_{28}NO_2$				*Artemisia* sp.	1
2	(+)-Acanthoidine, dihydrochloride (acantoidine, dihydrochloride; ruscopine) - 39a	250	$C_{16}H_{26}N_4O_2 \cdot 2HCl$	6·8±1·5 7·3±1·2 7	(c 0·4, H_2O) (c 0·4, H_2O) (HCl)	λ_{max} 230, 284nm (log ε 4·5, 4·2)	*Carduus acanthoides* L.	1–4
3	(+)-Acanthione, dihydrochloride (acantoine, dihydrochloride) - 38	192–3	$C_{16}H_{22}N_2O_2 \cdot 2HCl$ $C_{16}H_{24}N_2O_2$	7·1±1·2 7	(c 0·4, H_2O) (HCl)	λ_{max} 238, 312nm (log ε 4·5, 3·3) IR : 1655 and 1682 cm^{-1} (two formimidino groups)	*Carduus acanthoides* L.	2,4
4	Achiceine		$C_{11}H_{17}NO_4$				*Achillea millefolium* L.	62
5	Achilleine	247–8	$C_{14}H_{26}N_2O_6$	—14·3			*Achillea millefolium* L.	1,121
6	Achilletin						*Achillea millefolium* L.	1

(continued)

(Table 1 continued)

7	Agmatine, salt - 54	231	$C_5H_{14}N_4 \cdot H_2SO_4$				*Ambrosia artemisifolia*	1
	—aurichloride	223						
	—picrate	240						
8	Alcamine	179–80	$C_7H_{13}NO_2$				*Senecio doria*	25
9	Alkaloid I (see under *Senecio* base)							
10	Alkaloid II (see under *Senecio* base)							
11	Angularine–1	200–1	$C_{18}H_{25}NO_6$	—98	(EtOH)		*Senecio* sp.	77
12	Aquaticine	220db	$C_{18}H_{25}NO_5$	—83	($CHCl_3$)		*Senecio aquaticus* Hill.	1,112
13	Artemisia base–I		$C_{31}H_{59}NO_5$				*Artemisia* sp.	79
14	Artemisia base–II	189–90	$C_{22}H_{31}NO_8$				*Artemisia* sp.	79
15	Aureine (see under senecionine)							
16	Betonicine, L-40	252d	$C_7H_{13}NO_3$	—37	(H_2O)		*Achillea millefolium* L.	1
	—hydrochloride	224d		—24	(H_2O)		*A. moschata* Jacq.	
	—aurichloride	230–2d						
	—chloroplatinate	225–6d						
	—hydrate	249		36·26	(H_2O)			
	—reinakate	180–90						
17	Brasilinecine	169–71		—68·2	($CHCl_3$)	Possibly a mixture of seneciphylline and jacobine	*Senecio brasiliensis* D.C.	1,10
18	Brevicepsine	198–9	$C_{26}H_{39}NO_9$	111·7	(c 0·73, H_2O)		*Centaurea breviceps* Iljin.	8,9
19	Brevicepsin, reduced	160–2	$C_{26}H_{39}NO_8$	105·7	(c 0·95, EtOH)		*Centaurea breviceps* Iljin.	9
	—salicylate	190–2						
	—benzoate	186–7						
	—oxalate	245–5						
	—picrate	224–6d						
	—picrolonate	279–81d						
20	Caffearine (see under trigonelline)							
21	Campestrine	93	$C_{13}H_{19}NO_3$				*Senecio campestris* D.C. var. maritimus	1

(continued)

(Table 1 continued)

22	Carduus base						*Carduus acanthoides*	2
23	Carthamoidine	220–1	$C_{18}H_{23}NO_5$	—109	$(CHCl_3)$	Mixture of senecionine and seneciphylline	*Senecio carthamoides* Greene	114, 115
24	Centaurea base	102–3					*Centaurea arenaria*	80
25	Centaurea base	129–31d					*Centaurea arenaria*	6
26	Choline, chloride–41		$C_5H_{14}NOCl$				*Achillea millefolium* L.	1
							Bidens bipinata	1,5
							Senecio aizoides Schultz-Bip.	1
27	Clivorine		$C_{21}H_{27}NO_7$				*Chrysanthemum cinerariaefolium* Bocc.	1, 54
28	Condoline		$C_{18}H_{25}NO_5$				*Senecio* sp.	62, 81
29	Cruentine-A	218–20	$C_{18}H_{25}NO_5$	—94	$(CHCl_3)$		*Senecio cruentus*	43
	—picrate	185–7						
	—aurichloride	134–6						
	—methiodide	228–31						
30	Cruentine-B	200–2	$C_{18}H_{25}NO_6$	—63	$(CHCl_3)$		*Senecio cruentus*	43
31	Delartine (see under lycaconitine, methyl)							
32	Delsemidine (see under lycaconitine, methyl)							
33	Delsine (see under lycoctonine)							
34	Douglasiine	206–9				Mixture of senecionine, seneciphylline, retrosine and ridelline	*Senecio douglasii*	1, 114, 115, 116
35	Echinatine - 2		$C_{15}H_{25}NO_5$	15	(EtOH)		*Eupatorium maculatum* L.	82
	—methopicrate	153–5				IR 1720 cm^{-1} (ester carbonyl)		
						NMR $—CH(CH_3)_2$ two doublets corresponding to six protons centered at δ 0·9; and $—CH(OH)CH_3$ (1·27; *J* 7c/sec) groups and one olefinic proton.		
	—picrolonate	212–4						

(continued)

(Table 1 continued)

36	Echinine		$C_{11}H_{13}NO_2$	0		*Echinops ritro* L.	56
37	Echinops base	311–4d	$C_{10}H_{10}N_2$			*Echinops ritro* L.	83
38	Echinops base-X	297–8				*Echinops ritro* L.	84
39	Echinops-fluorescine					*Echinops ritro* L.	1
40	Echinopseine					*Echinops ritro* L.	1
41	Echinopsine - 42	152	$C_{10}H_9NO$	0		*Echinops ritro* L.	1, 83
	—aurichloride	168–70					
	—chloroplatinate	210–12					
	—mercurichloride	204					
	—mercuriiodide	178					
	—monohydrate	90					
	—periodate	135					
	—picrate	223–4					
42	Echinopsine, beta–43	135	$C_{10}H_9NO$			*Echinops ritro* L.	1
43	Echinorine, perchlorate–244	251–3	$C_{11}H_{12}NO$			*Echinops ritro* L.	58
						E. sphaerocephalus	
44	Emiline					*Emilia flammea*	71
45	Equinopsidin					*Echnops* sp.	59
46	Eremophilline	217–8d			Mixture of senecionine, seneciphylline and retrosine.	*Senecio eremophilus* Richards.	1, 114, 115, 116
47	Eupatorine					*Eupatorium* sp.	1
48	Eupatorium base-C		$C_9H_{13}NO_3$			*Eupatorium maculatum* L.	82
	—picrate	194–5					
49	Eupatorium base-D		$C_8H_{13}NO$			*Eupatorium maculatum* L.	82
	—picrate	165–7					
50	Franchetine	124–5				*Senecio* sp.	85
51	Fuchsisenecionine, —hydrochloride	225–7	$C_{13}H_{21}NO_4$ $C_{12}H_{21}NO_3$			*Senecio fuchsii* Gmel.	1, 106
52	Gaillardia base	147–8	$C_{10}H_{19}N_3O_{11}$			*Gaillardia pulchella*	107

(continued)

(Table 1 continued)

53	Graminifoline	236	$C_{18}H_{23}NO_5$				*Senecio graminifolius* Jacqs.	1
54	Gynesine (see under trigonelline)							
55	Heliotridine (see under retronecine)							
56	Heliotridine, O-angeloyl -4	116–7	$C_{13}H_{19}NO_3$	19	(EtOH)		*Senecio* sp.	86
57	Hieracifoline	172–3		4·3	($CHCl_3$)	Mixture of senecionine and seneciphylline	*Senecio* sp.	113
58	Histamine - 45	86	$C_5H_9N_3$				*Helianthus annuus*	1, 87
	—dihydrochloride	244–6						
	—dipicrate	241						
	—dipicrolonate	262–4						
	—monopicrate	160–2						
59	Hygrophylline - 5	174	$C_{18}H_{21}NO_4$	—67	(EtOH)		*Senecio hygrophyllus* Dyer. and Sn.	1, 47
60	Integerrimine (squallidine) - 6	168–70	$C_{18}H_{25}NO_5$	—29 —22·1 4	($CHCl_3$) (c 5·12, $CHCl_3$) (MeOH)		*Senecio antieuphorbium* *S. erraticus* sp. *barbareaefolius* K. *S. integerrimus* Nutt.	69 16
							S. kleinia Schultz-Bip	1
							S. magnificus	33
							S. squalidus	1
				—19·2	(c 2·6, $CHCl_3$)		*S. viscosus*	39
	—methiodide	256–6d		—23	(MeOH)			
	—nitrate	203–4						
	—picrate	212–3						
61	Inula base	134–5	$C_{25}H_{41}NO_7$	51	(EtOH)		*Inula royleana* D.C.	88
62	Inula base	120–1	$C_{21}H_{38}NO_6$	42·5			*Inula royleana* D.C.	1
	—aurichloride	142						
63	Inula base	152–3	$C_{11}H_{11}NO_2$			IR 3247 cm^{-1} (—NH—); 2927 (—CH_2—); 2610 (—COOH); 1680(—C=O of acid); 1604 (—C=C— of aromatic); 1583 (aromatic ring); 1526 (—NH—CO—R); 1472 and 1484 (—CH_2—); 1411 cm^{-1} (—C—C—)	*Inula royleana* D.C.	89

(continued)

(Table 1 continued)

	—anilide	211	$C_{23}H_{21}N_3O_3$					
	—*p*-toluidide	255	$C_{25}H_{26}N_3O_3$					
64	Inuline (see under lycoctonine, anthranoyl)							
65	Isatidine (retrosine, *N*-oxide)—7	138–45	$C_{18}H_{25}NO_7$	—8	(H_2O)		*Senecio isatidius* D.C.	1
							S. retrorsus Benth.	
							S. sceleratus	
66	Jacobine - 8	222	$C_{18}H_{26}NO_6$	—38	($CHCl_3$)		*Senecio borysthenicus*	51
		232–6		—46·3	($CHCl_3$)		*S. brasiliensis*	1, 10
							S. cineraria D.C.	
							S. jacobea L.	13, 49, 51
							S. kleinia Schultz-Bip	1
							S. paludosus	21, 24
							S. paucifolius	
							S. schuetzovii	
							S. vulgaris	
67	Jacobine, *N*-oxide - 9						*Senecio jacobea* L.	75
68	Jacodine (see under seneciphylline)							
69	Jacoline - 10	217–9	$C_{18}H_{27}NO_7$	48	($CHCl_3$)		*Senecio jacobea* L.	1, 13, 21, 24
70	Jaconine - 11	149	$C_{18}H_{26}NO_6$ $C_{18}H_{25}NO_8$	30	(EtOH)		*Senecio jacobea* L.	1, 21, 24
71	Jacozine-12	228	$C_{18}H_{23}NO_6$	—140	($CHCl_3$)	IR 1749 (Nujol) 1722, 1735, 1751 cm^{-1} ($CHCl_3$) NMR δ1·55 (CH_3—C—OH) 1·27 d, 3·07 q, [O] (CH_3—CH—C) 6·28 m, (olefinic protons of pyrrolizidine ring), 5·08 m, (CH—O—CO—C), 5·50, 4·10, *J* 12c/sec., (CH_2—O—CO—C), 5.58, 5·41, *J* 2c/sec, (C=CH_2) UV λ_{max} 233 μ (λ_{max} 1731)	*Senecio jacobea* L.	1, 13, 38
72	Khastanine						*Senecio borysthenicus*	51

(continued)

(Table 1 continued)

						S. cineraria	
						S. jacobea L.	
						S. paludosus	
						S. paucifolius	
						S. schuetzovii	
						S. vernalis	
						S. vulgaris	
73	Lanigerosine					*Senecio paucicalyculatus* Platt.	1, 117
						S. retrosus Benth.	
74	Lasiocarpine - 13	97	$C_{21}H_{33}NO_7$	—4	(EtOH)	*Senecio* sp.	76
75	Leonucardine (see under stachydrine)						
76	Lindelofine - 14	102–3	$C_{15}H_{27}NO_4$			*Eupatorium stoechadosmum*	63
	—picrate	188–9					
77	Longilobine, alpha- (see under seneciphylline)						
78	Longilobine, beta- (see under retrosine)						
79	Lupanidine (see under matrine)						
80	Lycaconitine, methyl (delatine, delsemidine, mellictine) - 47	130	$C_{37}H_{50}N_2O_{10}$	49	(EtOH)	*Inula* sp.	1
	—perchlorate	235					
81	Lycoctonine (delsine, royline)	151–3	$C_{25}H_{41}NO_7$	51	($CHCl_3$)	*Inula royleana*	1, 89
	—acetate	133					
	—aurichloride	115					
	—hydrochloride	152					
	—hydrobromide	190					
	—hydroiodide	175					
	—methiodide	187					
	—picrate	161					
	—perchlorate	215					

(continued)

(Table 1 continued)

82	Lycoctonine, anthranoyl (inuline) - 46	165	$C_{32}H_{46}N_2O_8$	51	($CHCl_3$/EtOH)		*Inula* sp.	1
	—*N*,acetyl (ajacine)	154						
	—aurichloride	159						
	—hydrobromide	185						
	—hydrochloride	182						
	—hydroiodide	183						
	—picrate	160						
	—perchlorate	207						
83	Macrophylline	42–4	$C_{13}H_{21}NO_3$	34·5	(EtOH)	Macronecine ($C_8H_{15}NO_2$) found as the angelic ester in macrophylline	*Senecio borysthenicus*	1, 49, 51
							S. cineraria	
							S. jacobea L.	
							S. macrophyllus	
							S. paludosus	
							S. schuetzovii	
							S. vernallis	
							S. vulgaris	
84	Matrine (Lupanidine, sophocarpidine) - 48	87	$C_{15}H_{24}N_2O$	10			*Senecio* sp.	1
		75–6		41	(H_2O)			
		223						
		84						
	—aurichloride	199–200						
	—hydrobromide	272–5						
	—methiodide	254d						
		304						
	—methylmethiodide	219	$C_{17}H_{30}N_2O_2CH_3I$					
	—perchlorate	214–6						
	—platinichloride	229–30						
	—picrate	167–9						
85	Melictine (see under lycaconitine, methyl)							

(continued)

(Table 1 continued)

86	Mikanecine (platynecine)	148–9	$C_8H_{15}NO_2$	—55·7	($CHC1_3$)	*Senecio mikanoides* (Walp) Otto.	1, 12, 19
	—dichloro	63–4					
	—methiodide	207					
	—monobenzoyl	119–20		—88·6	(EtOH)		
	—picrate	184–5					
87	Mikanoidine, hydrochloride - 15		$C_{18}H_{23}NO_4$ $C_{21}H_{29}NO_6$			*Senecio mikanoides* (Walp) Otto.	1, 12
						S. kaempferi D.C.	
88	Moscatine		$C_{21}H_{27}NO_7$			*Achillea* sp.	1
89	Otonecine - 16	232–3	$C_9H_{15}NO_3$	15±2	(c 1·02, $CHC1_3$)	*Senecio erraticus* sp.	1, 23
						Barbareaefolius K.	
						S. othonae Bieb.	
	—hydrochloride	146–8		—18·5	(EtOH)		
90	Othosenine (see under otosenine)						
91	Otosenine (othosonine)-17	232	$C_{19}H_{27}NO_7$	14	(c 1·0, $CHC1_3$)	*Senecio erraticus* ssp. *barbareaefolius* K.	16, 61
		21–9d		20·8	($CHC1_3$)	*S. othonnae* Bieb.	1
						S. tomentosus	15
	—picrate	251d					
92	Parthenine					*Parthenium* sp.	1
93	Paucicaline	184	$C_{18}H_{27}NO_8$			*Senecio* sp.	1
94	Platynecine (see under mikanecine)						
95	Platyphylline - 18	127–9	$C_{18}H_{27}NO_2$	—59	(EtOH)	*Ambrosia* sp.	67
				—56·4	(c 0·7, $CHC1_3$)	*Nardosomia laevigata* D.C. (*Petasites leavigatus* Reich)	1
						Senecio adantus D.C.	
						S. carthamoides	44
						S. grandifolia	1, 17
						S. hygrophyllus Dyer. and Sm.	66

(continued)

(Table 1 continued)

							S. kubensis	
							S. platyphyllus D.C.	
							S. platyphylloides	72
96	Platyphylline, *N*-hydroxy						*Senecio grandifolia*	17
97	Platyphylline, *N*-oxide	180–4	$C_{18}H_{27}NO_5$	—59	(H_2O)		*Senecio hygrophillus* Dyer. and Sm.	118
							S. platyphyllus D.C.	1, 18
98	Platyphylline, bitartarate	199	$C_{18}H_{27}NO_5 \cdot C_4H_6O_6$	—4	(c 2, H_2O)		*Senecio hygrophillus* Dyer. and Sm.	52
99	Platyphylline, neo - 19	131–3	$C_{18}H_{27}NO_5$	2			*Senecio hygrophillus* Dyer. and Sm.	1, 25
100	Pluchine	243–4d		—29·51	(EtOH)	IR (Nujol) 3·75, 3·85, 3·95, 4·06, 4·17, 4·25, 4·8, 5·0, 5·36, 5·67, 5·8s, 6·75s, 7·05, 7·15, 10·75s, 11·1s, 11·35s, and 12·88s.	*Pluchea laneolata*	54
101	Pterophine	227–8	$C_{18}H_{23}NO_5$	—88·5	($CHCl_3$)	Mixture of senecionine and seneciphyllline	*Senecio ilicifolius* Thumb.	119, 120
							S. pterphorus	1
102	Pulchellidine - 53	185–6	$C_{20}H_{33}NO_4$	—22·5	(c 1·33, EtOH)	IR 3350 (OH), 1774 cm^{-1} (γ-lactone) NMR δ 0·80s (—C—CH_3), 1·25d, 6(—CH—CH_3), 3·65d, 5(—*CH*—OH), 4·15m, (—*CH*—CH and C—C—CO—O—*CH*—) MS (M+, 351·243) UV end absorption	*Gaillardia pulchella* Foug.	6
	—dehydro	117–9	$C_{20}H_{31}NO_4$	28·8	(c 0·87, EtOH)	IR 3400 (OH), 1770 (γ-lactone), and 1739 cm^{-1} (cyclopentanone)		
	—diacetate	135–6	$C_{24}H_{37}NO_6 \cdot \frac{1}{2}H_2O$	—24	(c 1·0, $CHCl_3$)	NMR δ 0·98s (—C—CH_3), 1·01d, 6 (—CH—CH_3), 4·13t, (—C—C—CO—O—*CH*—), 4·65d, 5 (*CH*—OAc), 4.93t, 9(—CH—OAc) MS (M+, 435·259)		

(continued)

(Table 1 continued)

	—hydrobromide	208–10						
	—hydrochloride	205–8				IR 3490, 1765 and 1734 cm-1		
	—methiodide	136–7						
	—tetrol	103–5	$C_{20}H_{37}NO_4$	—9·6	(c 1·0, EtOH)	NMR δ 0·70s (—C—CH_3), 1·19d, 6(—CH—CH_3), 1·26—2·31 (16H), 2·31—2·91m N(CH_2—)$_3$, 3·48m, (—CH—OH and —CH_2—OH), 4·01m, (2X—CH—OH), 4·57s, (3X—CHOH and —CH_2—OH; disappeared by addition of D_2O		
	—tetrol acetate			8	(c 0·7, EtOH)			
103	Renardine (senkirkine) - 20	193–4	$C_{19}H_{27}NO_6$	—2·12	(c 2·6, $CHCl_3$)	Renardine gave otonecine and anhydrootonecine ($C_9H_{13}NO_2$) isolated as its hydrochloride, m.p. 203–5.	*Nordosomia laevigata* D.C. (*Petasites laevigatus* Reich)	1
							Senecio antieuphorbium	69
							S. kirkii Hook.	48
							S. kleinia	70
	—perchlorate	202–4					*S. renardi* Winkl.	102
	—picrate	223–6						
	—tartarate	202–3						
104	Renardine, *O*-acetyl						*Senecio kirkii* Hook.	48
105	Retronecanol - 21	98–9		—96	($CHCl_3$)		*Senecio* sp.	90
				—91·1	(EtOH)			
	—hydrochloride	210						
	—methiodide	184–5						
	—picrate	210						
	—picrolonate	184–5						
106	Retronecine (heliotridine, trichodesmidine) - 22,3	121–2	$C_8H_{13}NO_2$	51·4	(EtOH)		*Senecio erraticus* ssp. *barbareaefolius* K.	1, 23
				31	($CHCl_3$)		*S. pampeanus*	22
							Eupatorium maculatum L.	82
	—diacetylpicrate	129–30		30·4	(c 2·5, EtOH)	NMR 7·8 and 7·79 two acetyl groups		
	—hydrochloride	159–60		—8·7	(c 1·59, EtOH)			
	—picrate	104–5						

(continued)

(Table 1 continued)

107	Retrosine (longilobine, beta-) - 23	207–8	$C_{18}H_{25}NO_6$	—53·5	(c 0·0551 g/2 ml, $CHCl_3$)	*Senecio ambrosiodes*	10
						S. ampullaceus Hook.	1
				—18	(EtOH)	*S. bupleuroides* D.C.	
						S. discolor	91
						S. douglasii D.C.	
						S. eremophilus Richards.	
						S. glaberrimus D.C.	
						S. graminifolius Jacq.	
						S. ilicifolius	
						S. isatideus	
						S. longilobus Benth.	
						S. paucicalyculatus Platt.	
						S. pterophorus	
						S. retrorsus	116
						S. ridellii T. and G. var. Parksii Cory.	
						S. ruderalis	
						S. sceleratus Schweikerdt	
						S. swaziensis	74
						S. venosus Harv.	
						S. vulgaris	35
108	Retrosine, *N*-oxide (see under isatidine)						
109	Riddelliine - 24	195–6	$C_{18}H_{23}NO_6$	—110	($CHCl_3$)	*Senecio douglasii* D.C.	1
						S. eremophilus Richards.	
						S. longilobus Benth.	
						S. riddellii Torr. and Gray.	
110	Rinderine - 25	100–1	$C_{15}H_{25}NO_5$	25	(EtOH)	*Eupatorium sertinum*	55
111	Rivularine	115–7	$C_{13}H_{19}NO_3$	—19	($CHCl_3$)	*Senecio rivularis*	33
				17	(EtOH)		

(continued)

(Table 1 continued)

	—methiodide	139–41		4	(EtOH)		
	—picrate	146–8					
112	Rosmerinecine - 26	171–2	$C_8H_{15}NO_3$	—119	(MeOH)	*Senecio rosmarinifolius*	1
	—methiodide	195					
	—picrate	175					
113	Rosmarinine - 27	209	$C_{18}H_{27}NO_6$	—94	(EtOH)	*Senecio adnatus* D.C.	1
						S. brachypodus D.C.	
						S. hygrophillus Dyer and Sm.	
						S. pauciligulatus Dyer and Sm.	
						S. rosmarinifolius	
114	Rosmarinine, *N*-oxide —28	169	$C_{18}H_{27}NO_7$			*Senecio adantus* D.C.	1, 92
						S. brachypodus D.C.	
						S. hygrophillus Dyer and Sm.	
115	Royline (see under lycoctonine)						
116	Ruscopiene, dihydro-chloride	192–3		6·8±1·1	(c 0·4, H_2O)	*Carduus acanthoides* L.	2,3
117	Ruscopine, dihydrochloride (see under (+)-acanthoi-dine, dihydrochloride)						
118	Ruwenine	176–9	$C_{18}H_{27}NO_6$			*Senecio ruwenzoriensis* S. Moore	1, 93
119	Ruzorine	161–3	$C_{18}H_{27}NO_8$			*Senecio* sp.	1
120	Sarracine - 29	48–50	$C_{15}H_{25}NO_5$	—121	(c 1·09, EtOH)	*Ambrosia* sp.	67
		51–2	$C_{18}H_{27}NO_5$	—130	(EtOH)	*Senecio mikanioides* Otto.	29
						S. platyphyllus	37, 44, 94
						S. platyphylloides	72
						S. rhombifolius	
	—bitartarate	182–3		—71	(c 1·98, H_2O)	*S. sarracenius* L.	1
	—picrate	114–5					
		141–2					
	—picrolonate	158–9					

(continued)

(Table 1 continued)

121	Sarracine, *N*-oxide - 30	140–1	$C_{18}H_{27}NO_6$	—82	(H_2O)	*Senecio mikanioides* Otto.	1, 29
		123–4				*S. sarracenicus* L.	
	—hydrate	125–6		—94	(c 2·01, EtOH)		
				—73	(c 2·14, H_2O)		
	—picrate	108–9					
122	Saussurine					*Sausaurea* sp.	1
123	Sceleratine	178	$C_{18}H_{27}NO_7$	—54	(EtOH)	*Senecio sceleratus* Schweikerdt.	14, 95
124	Sceleratine, chloro-hydroxy - 31	196	$C_{18}H_{26}NO_6$	32		*Senecio* sp.	96
125	Senecifolidine	212	$C_{18}H_{25}NO_7$	—14	(EtOH)	*Senecio latifolius* D. C.	62
126	Senecifoline	194–5	$C_{18}H_{27}NO_8$	28	(EtOH)	*Senecio latifolius* D. C.	62
127	Senecine					*Senecio vulgaris* L.	1, 114
128	Senecio amide	130–2	$C_6H_{11}NO$	0		*Senecio* sp.	86
129	Senecio base		C_5H_9NO			*Senecio serracenicus* L.	108
130	Senecio base	179–80	$C_7H_{13}NO_2$			*Senecio* sp.	26
131	Senecio base		$C_8H_{13}NO$			*Senecio serracenicus* L.	108
132	Senecio base		$C_9H_{15}NO_2$			*Senecio fuchsii*	109
133	Senecio base		$C_{13}H_{21}NO_3$			*Senecio sarracenicus* L.	108
134	Senecio base, S–F	228–30	$C_{15}H_{21}NO_3$	—148	($CHCl_3$)	*Senecio viscosus*	33
135	Senecio base	195 d	$C_{18}H_{23}NO_5$			*Senecio borysthenicus*	20
136	Senecio base, S–C	193–5	$C_{18}H_{23}NO_6$	—108±3	(c 1·02, $CHCl_3$)	*Senecio erraticus* ssp. *barbareaefolius* K.	16, 23
		226–8	$C_{18}H_{25}NO_6$	—134±2	(c 0·52, $CHCl_3$)		
						S. erucifolius	32, 43
137	Senecio base	232–4	$C_{18}H_{25}NO_5$			*Senecio brasiliensis*	110
138	Senecio base		$C_{18}H_{25}NO_5$	—73·2	(c 0·984, $CHCl_3$)	*Senecio cronopifolius*	46
	—aurichloride	160–2					
	—picrate	168–70					
139	Senecio base, S–D	166–8	$C_{18}H_{25}NO_5$	—32	(c 1·299, $CHCl_3$)	*Senecio erraticus* ssp. *barbareaefolius* K.	23
	—methiodide	254–6		—27±3	(c 0·819, EtOH)		
	—picrate	203–6					

(continued)

(Table 1 continued)

140	Senecio base	200–2	$C_{18}H_{25}NO_6$	—63·4	($CHCl_3$)		*Senecio cruentus*	43
	—picrate	170–2						
141	Senecio base	222	$C_{18}H_{27}NO_5$				*Senecio erucifolius* L.	108
142	Senecio base	122–3	$C_{18}H_{27}NO_5$				*Senecio* sp.	98
143	Senecio base	169	$C_{18}H_{27}NO_5$				*Senecio palustris* Hook.	108
144	Senecio base		$C_{18}H_{27}NO_5$				*Senecio platyphyllus*	25
145	Senecio base	175–6	$C_{18}H_{27}NO_6$	—62·4	(MeOH)		*Senecio hygrophillus* Dyer. and Sm.	111
146	Senecio base	190–1	$C_{19}H_{27}NO_6$	2			*Senecio* sp.	99
147	Senecio base		$C_{19}H_{27}NO_7$				*Senecio tomentosus*	15
148	Senecio base	213–5d		—103	($CHCl_3$)	IR 3650 (OH), 1710 (C=O) 1380, 1360 and 1150 cm^{-1} (isopropyl)	*Senecio nuducoilis*	40
	—methiodide	226–8d						
	—nitrate	205–7						
	—perchlorate	240–2d						
149	Senecio base						*Senecio* sp.	100
150	Senecio base (alkaloid-I)						*Senecio ambrosioides*	10
							S. fremonti	
151	Senecio base (alkaloid-II)						*Senecio ambrosioides*	10
							S. fremonti	
152	Senecio base	245		—54·8	(c 3·5, $CHCl_3$)		*Senecio tomentosus*	15
153	Senecio base					A glassy material	*Senecio tomentosus*	15
	—picrate	245–6						
154	Senecio base	229–32		19·5±5	(c 0·471, $CHCl_3$)		*Senecio erraticus* ssp. *barbareaefolius* K.	23
155	Senecio base	133–7		—90±10	(c 0·473, $CHCl_3$)		*Senecio vulgaris*	35
156	Senecio base	217–8d					*Senecio coronopifolius*	46
157	Senecionine (aureine) - 32	239d 249	$C_{18}H_{25}NO_5$	—51 —67·8±2	(c 2·02, $CHCl_3$) (c 1·009, $CHCl_3$)	UV λ_{max} 221 nm (log ε=6592)	*Nardosomia laevigata* D. C. (*Petasites laevigatus* Reich)	1

(continued)

(Table 1 continued)

Senecio ambrosiodes	22, 53
S. ampullaceus Hook.	
S. aureus L.	
S. borysthenicus	51
S. brasiliensis D. C.	10
S. carthamoides	
S. cineraria	
S. discolor	91
S. erraticus ssp. *barbareaefolius* K.	1, 16, 23, 61
S. eremophilus Richards.	
S. erucifolius	32, 75
S. fremonti Torr. and Gray.	
S. glabellus D. C.	
S. ilicifolius Thumb.	
S. integerrimus	
S. jacobea L.	13, 49, 51, 61
S. kleinia Schultz-Bip	1
S. magnificus	34
S. paludosus	1
S. paucifolius	
S. pseudoarnica Less.	
S. pterophorus D. C.	
S. schuetzovii	
S. squalidus L.	
S. subalpinus	41
S. tomentosus	15
S. triangularis	22, 53
S. vernalis	

(continued)

(Table 1 continued)

							S. viscosus L.	33
							S. vulgaris L.	35, 71, 78
	—aurichloride	186						
	—iodomethylate	243		—43·4	(MeOH)			
	—methiodide	245–7d		—44±2	(c 1·218, MeOH)			
	—picrate	184–5						
158	Senecionine, *N*-oxide —33		$C_{18}H_{25}NO_6$				*Senecio triangularis*	53
159	Seneciphylline (longilobine, alpha-; jacodine)	217–8	$C_{18}H_{23}NO_5$	—119±2 —70±3	(c 1·11, $CHCl_3$) (c 0·60, H_2O)	IR 3424 (OH), 1739 (ester), 1716 (C=O), 1640 (C=C)$_1$ 1443, 1225 and 1150 cm	*Ambrosia* sp.	67
							Senecio ambrosioides	1
							S. adonidifolius	75
							S. ampullaceus Hook.	
							S. aquaticus Hill.	
							S. borysthenicus	30, 45, 51
							S. brasiliensis	10
							S. cannabifolius	
							S. carthamoides Green.	
							S. chrysanthemoides	42
							S. cineraria D. C.	31
							S. cineraria maritima	
							S. eremophilus Richards	
							S. erucifolius L.	1
							S. fremonti Torr. and Gray.	
							S. grandifolia	17
							S. ilicifolius Thunb.	
							S. jacobea L.	13, 49
							S. longilobus Benth.	115
							S. paludosus L.	
							S. palmatus	36

(continued)

(Table 1 continued)

					S. partioides Torr. and Gray.	
					S. paucifolius	
					S. platyphyllus D. C.	
					S. pterophorus D. C.	
					S. racemosus	27, 28
					S. renardi Winkl.	
					S. schuetzovii	
					S. subalpinus	41
					S. tomentosus	15
					S. triangularis	53
					S. vernalis L.	
					S. vulgaris	35, 75
					Senecio sp.	61
	—aurichloride	163–4				
		186				
	—methiodide	242–4				
	—nitrate	220 d				
	—picrolonate	192–3				
160	Seneciphylline, *N*-oxide	120	$C_{18}H_{23}NO_6$		*Senecio kubensis*	75
					S. platyphyllus D. C.	18
					S. propinquus	65
					S. rhombifolius	66
					S. vulgaris	101
161	Seneciphylline, tetra-hydro				*Senecio platyphyllus*	18
162	Senkirkine (see under renardine)					
163	Senkirkine, *O*-acetyl - 34		$C_{21}H_{29}NO_7$		*Senecio renardi* Winkl.	102
164	Senkirkine, chloro-platinate			Differs from senkirkine in absence of a methylene group	*Senecio kirkii*	50

(continued)

(Table 1 continued)

165	Silvasenecine		$C_{12}H_{21}NO_4$				*Senecio sylvaticus* L.	1, 103
166	Sophocarpidine (see under matrine)							
167	Spartioidine - 35	178	$C_{18}H_{23}NO_5$	—84		UV λ_{max} 215, 10170 nm	*Senecio spartioides* Torr. and Gray.	1, 11
				—1·44	(EtOH)	IR broad band at 1655 cm^{-1}		
168	Stachydrine (leonucardine) - 49	235	$C_7H_{13}NO_2$	—40	(H_2O)		*Achillea millefolium* L. *Chrysanthemum cinerariafolium* Bocc. *C. sinense* Sabina.	1
	—aurichloride	225						
	—chloroplatinate	210–20						
	—hydrochloride	235		—26·5	(H_2O)			
	—oxalate	105–6						
	—picrate	195–6						
169	Stachydrine, homo - 50		$C_{18}H_{15}NO_2$	—13	(EtOH)		*Achillea millefolium* L.	104
170	Stizolophine	122–3	$C_{15}H_{23}NO_5$				*Centaurea* sp.	105
171	Supinine - 36	142–4	$C_{12}H_{25}NO_4$	—12	(EtOH)		*Eupatorium retrinum*	55
							E. stoechadosmum	63
172	Swazine						*Senecio swaziensis*	64, 74
173	Tomentosine (see under otosenine)							
174	Trachelanthamidine - 37		$C_8H_{15}NO$	—13·8	(c 1·28, EtOH)		*Eupatorium maculatum* L.	1, 82
	—hydrochloride	114–5						
	—picrate	178–9						
	—picrolonate	182–3						
175	Trichodesmidine (see under retronecine)							
176	Trigonelline (gynesine, caffearine) - 51	218	$C_7H_7NO_2$				*Achillea* sp.	1

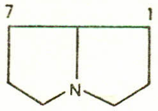
(continued)

(Table 1 continued)

—aurichloride	198			
—hydrochloride	258–9			
—picrate	204–5			
177 Tyramine - 52	164	$C_8H_{11}NO$	*Silybum* sp.	1
—dibenzoate	206			
—hydrochloride	175–8			
—oxalate	203–4			
—picrate	206			

a, Structure number in Tables 2 and 3 ; b, decomposed.

TABLE 2. PYRROLIZIDINE ALKALOIDS.



I

Structure I : Substituents at 1 and/or 7 of the following types :

A. $—CH_2OCO—C(OH)(Me)CHMe$

B. $—CH_2—C—COO—$ (with CHMe on C)

C. $—CH_2—C—COO—$ (with CHMe on C)

D. $—CH_2—C(OH)—COO—$ (with CH(OH)Me on C)

E. $—CH_2OCO—C(OH)Me—C(=CH_2)—$

F. $—CH_2OCO—C(OH)—CHMe—$ (with CH_2OH on C)

G. $—CH_2—C(OH)—COO—$ (with CH(Cl)Me on C)

J. $—CH_2OCO—C(OH)—C=CH_2—$ (with CH_2OH on C)

K. $—CH_2OCO—C(=CH_2)—CHMe—$

L. $—CH(OH)—C—COO—$ (with CHMe on C)

M. $—CH_2OCOC=CMe—$ (with CH_2OH on CMe)

N. $—OCO—CMe=CHMe$

O. $—CH_2OCO—C(OH)—CHOH—Me$ (with $CHMe_2$ on C)

P. $—CH_2OCOC(OH)—CHOH—Me$ (with *i*-Pr on C)

Q. $—CH_2OCOC(OH)—CHMe—$ (with CH_2Cl on C)

R. $—OCO—C=CHMe$ (with Me on C)

S. $—CH_2OCO—C(OH)CHMe_2$ (with $C(OH)Me_2$ on C)

Structure number	1	7	Δ	
1	E	B	—	
2	P	OH	1	
3	CH_2OH	OH	1	
4	CH_2OH	N	1	
5	A	L	—	
6	A	B	—	
7	F	B	1	N→O
8	A	C	1	
9	A	C	1	N→O

(continued)

(Table 2 continued)

10	A	D	1	
11	A	G	1	
12	E	C	1	
13	S	R	1	
14	O	H	—	
15	K	B	—	
16	CH_2OH	OH	1	NMe^+; 8=O
17	A	C	1	N→O
18	A	B	—	
19	A	B	—	
20	A	B	1	NMe^+; 8—O—
21	Me	OH	—	
22	CH_2OH	OH	1	
23	F	B	1	
24	J	B	1	
25	P	OH	1	
26	CH_2OH	OH	—	2—OH
27	A	B	—	2—OH
28	A	B	—	2—OH; N→O
29	M	N	—	
30	M	N	—	N→O
31	Q	R	1	
32	A	B	1	
33	A	B	1	N→O
34	A—OAc	B	1	NMe^+; 8—O—
35	E	B	1	
36	P	H	1	
37	CH_2OH	H	1	

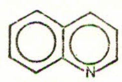
TABLE 3. MISCELLANEOUS STRUCTURES.

II (a)

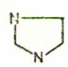
$(CH_3)_3\overset{\oplus}{N}CH_2CH_2OH\ \overset{\ominus}{Cl}$

II (b)

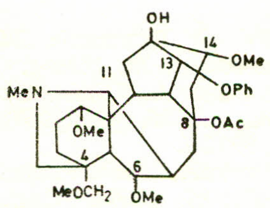
II (c)



II (d)

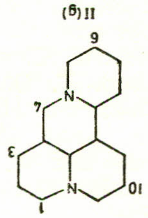


II (e)



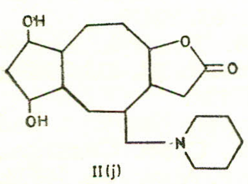
II (f)

II (g)



II (h)

II (i)



II (j)

$H_2N\overset{\overset{NH}{\|}}{C}NH(CH_2)_4NH_2$

II (k)

38 II(a): 3,4—OMe_2 ; 1—CH=CHCH(NHCHNH)-CH=$CHCH_2$NHCHNH

39 II(a): 3,4—OMe_2;1—$(CH_2)_2$CH(NHCHNH) $(CH_2)_3$-NHCHNH

40 II(c): NMe_2^+; 2—COO—; 4—OH

41 II(b):

42 II(d): NMe; 4=O; dihydro

43 II(d): NMe; 4=O; dihydro

44 II(d): NMe^+; 4—OMe

45 II(e): 4—$(CH_2)_2NH_2$

46 II(f): N—Et; 6,15—$(OMe)_2$; 7, 8, 16—$(OH)_3$; 4—CH_2OH

47 II(f): 6,15—$(OMe)_2$; 7,8,16—$(OH)_3$; N—Et; 4—$CH_2OCOC_6H_4$—*O*—N<CO—CH_2 / CO—CH_2> (succinimido)

48 II(g): 5—oxo

49 II(c): NMe_2^+; 2—COO—; 4—H

50 II(h): NMe_2^+; 2—COO—

51 II(i): NMe^+; 3—COO—

52 II(a): 4—OH ; 1—$(CH_2)_2NH_2$

53 II(j):

54 II(k):

The numbering used in these ring systems is merely a guide to the placement of the substituents indicated in the structure tables and does not necessarily correspond to Ring Index, Chemical Abstracts or other 'official' numbering.

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