Phytochemistry, 1979, Vol. 18, pp. 711–724. © Pergamon Press Ltd. Printed in England. 0031-9422/79/0501-0711 $05.00/0

REVIEW

FRIEDELIN AND ASSOCIATED TRITERPENOIDS*

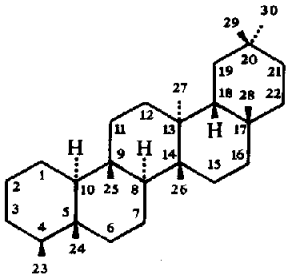
R. FRANK CHANDLER† and SHIRLEY N. HOOPER

College of Pharmacy, Dalhousie University, Halifax, Nova Scotia, Canada, B3H 3J5

(*Received* 3 *October* 1978)

Key Word Index—D: A-friedelooleanane; friedelan-3-one; friedelin; friedelane; friedelanols; pentacyclic triterpenes; occurrence; properties.

Abstract—The literature is reviewed for the natural occurrence of the pentacyclic triterpenes, friedelin and the epimeric 3-friedelanols. A summary of the literature relating to the structure elucidation, physical properties, synthesis and biosynthesis of these friedelane derivatives is presented. Compounds possessing the same carbon skeleton (D: A-friedelooleanane) and occurring with at least one of the above friedelane derivatives are also tabulated.



1 Friedelane (D: A-Friedooleanane)

Fig. 1. Skeleton and numbering of the friedelanes.

The scientific literature on friedelin, the 3-keto-derivative of the hydrocarbon, friedelane (Fig. 1), and related compounds (Table 1) is widely scattered; only limited information is available in the various general reviews on pentacyclic triterpenes.

White [1] summarized the data on structure determination of friedelin and some of its derivatives. Extensive tables of melting points§, derivatives, and some indication of plant source are available in the review by Halsall and Alpin [2]. Elsevier [3] covers all aspects until 1946 and structures until 1952. Kulshreshtha *et al.* [4] present a survey of the occurrence and structures of triterpenoids for the period 1963–70. However there are few listings for friedelin-related compounds. The only comprehensive review with friedelin as the focus is provided by Sainsbury [5]. Although his article lists only 73 sources of friedelin, it also documents the associated occurrence of the epemeric 3-friedelanols and other triterpenes.

Friedel [6], according to Karrer [7], first isolated friedelin; however, a much earlier reference is provided by Elsevier [3] to Chevreul [8] who obtained a substance from cork which he called 'cerine'. In 1899 Istrati and Ostrogovich [9] showed that cerine was composed of two substances, one they named friedelin in honor of their friend Friedel and the other cerin.

By 1935, Drake and Jacobsen [10] had repeated the isolation of friedelin and cerin, determined their molecular weights and empirical formulae and proven a common skeleton. Drake, working with Shrader [11] and Haskins [12], presented evidence that friedelin contained a ketone and that cerin was a hydroxyketone. The ensuing years saw numerous reports on studies of friedelin, with chemists preparing derivatives, attempting to trace biosynthetic intermediates and trying to synthesize friedelin.

Efforts to elucidate the structure and conformation were based initially on the preparation of derivatives and their comparison with known compounds [13–15]. Most modern physical methods were yet to be developed, but Drake and Wolfe [16] investigated the surface films formed by friedelin and cerin, and Lander and Svirbely [17] studied the structure of friedelin using the dipole moments of cerin, friedelin and various isomers. The

* This review covers all articles listed in *Chem. Abstr.* up to and including Vol. 88, No. 22, 1978.

† To whom inquiries should be directed.

§ For the more common physical properties the reader is also referred to standard works such as: (1965 *et seq.*) *Dictionary of Organic Compounds*, 4th edn. and supplements, Eyre and Spottiswoode, London; Devon, T. K. and Scott, A. I. (1972) *Handbook of Naturally Occurring Compounds*, Vol. II, Academic Press, New York; Newman, A. A. (ed.) (1972) *Chemistry of Terpenes and Terpenoids*, Academic Press, London or (1976) *The Merck Index*, Merck, Rahway.

Table 1. Names and structures of friedelanes*

No.	Name†	Type and location of functional groups on friedelane‡ C=C	OH	C=O	CHO	CO_2H	—O—	Seco
1	Friedelane							
2	Friedelin			3				
3	Friedelan-3α-ol		3α					
4	Friedelan-3β-ol		3β					
5	Canophyllal		3β		28			
6	Canophyllic acid		3β			28		
7	Canophyllol		3β, 28					
8	Cerin		2α	3				
9	3,21-Dihydroxyfriedelan-25-oic acid		3ξ, 21ξ			25		
10	3,4-Epoxyfriedelane						3α, 4α	
11	Friedelan-1,3-dion-24-al			1, 3	24			
12	Friedelan-3,21-dion-25-al			3, 21	25			
13	Friedelan-1,3-dione			1, 3				
14	Friedelan-2,3-dione			2, 3				
15	Friedelan-3,21-dione			3, 21				
16	Friedelan-1,3-dion-24-oic acid			1, 3		24		
17	Friedelan-1,3-dion-24-ol		24	1, 3				
18	Friedelan-3-on-25-al			3	25			
19	Friedel-2-ene	2						
20	Friedel-3-ene	3						
21	Friedel-1-en-3-one	1		3				
22	7α-Hydroxyfriedelan-1,3-dione		7α	1, 3				
23	25-Hydroxyfriedelan-3,21-dione		25	3, 21				
24	21β-Hydroxyfriedelan-3-on-25-al		21β	3	25			
25	21α-Hydroxyfriedelan-3-one		21α	3				
26	21β-Hydroxyfriedelan-3-one		21β	3				
27	25-Hydroxyfriedelan-3-one		25	3				
28	21α-Hydroxyfriedel-4(23)-en-3-one	4(23)	21α	3				
29	Octandrolal		3α		29			
30	Octandrolic acid		3α			29		
31	Octandrolol		3α, 29					
32	Octandronal			3	29			
33	Octandronic acid			3		29		
34	Octandronol		29	3				
35	25,26-Oxido-friedel-1,3-dione			1, 3			25β, 26β	
36	Pachysandiol A		2α, 3β					
37	Pachysandiol B		3β, 16ξ					
38	Pachysantriol		2α, 3β, 16ξ					
39	Pachysonol		16ξ	3				
40	Putranjic acid		2			3		3,4
41	Putranjivadione			3, 7				
42	Putranjivic acid	4(23)				3		3, 4
43	Roxburgholone		3α	7				
44	Roxburghonic acid			3		25		
45	Trichadenal		3β		26			
46	Trichadenic acid A		3α			26		
47	Trichadenic acid B		3β			26		
48	Trichodonic acid			3		26		

* See Table 2 for occurrence and citations.
† Names used are those of the literature.
‡ See Fig. 1 for basic structure and numbering system.

latter paper contains an early reference to friedelan-3α-ol.

In 1944 and 1949 Ruzicka and co-workers [18, 19] published the results of their attempts to derive the structure of friedelin by chemical means. However, it was not until 1955 that two groups (Dutler, Jeger and Ruzicka [20], and Corey and Ursprung [21, 22]), working independently, arrived at the accepted structure as a result of dehydrogenation studies and the isomerization of friedel-3-ene to olean-13(18)-ene. The structure was confirmed independently by Brownlie and co-workers [23–25] and Ourisson and co-workers [26]. Further studies of the friedelin–oleanene rearrangement continued with attempts to isolate the intermediate compounds [27–31].

After the structure of friedelin was established, studies were done, notably by Djerassi and co-workers [32, 33], to determine the configuration using optical rotary dispersion. A crystallographic study of friedelin was

carried out by Rogers and Thomas [34] who reported that the unit cell contained four molecules, the formula indicated was $C_{30}H_{50}O$ and the crystals were orthorhombic. Further studies concluded that there were two possible conformations, the quasi-all-chair and the chair:chair:chair:boat:boat [35]. More recently, the crystal structure and conformation of friedelan-3β-ol have been reported and confirmed the latter conformation [36].

Isolation procedures have been refined with the development of chromatography and its application to natural products. Stevenson and Kane [37, 38] reported a convenient isolation procedure for obtaining friedelin and related compounds from cork-board by-products.

Further details on column chromatography in the isolation and purification of triterpenes, including friedelin and related compounds, have been reported by Cambie and Parnell [39] and Sengupta and Mukherjee [40].

Several publications deal with TLC of pentacylic triterpenes. Information regarding solvent systems, detection reagents and R_f values is available [41–43]. Increased efficiency in separating compounds of a given class is obtained on plates impregnated with silver nitrate as described by Fisher and Hertel [44] and by Barua *et al.* [45].

GLC of pentacylic triterpenes utilizing a variety of column packing materials has been reported. Thus, Ikan and Gottlieb [46] obtained good results with the trimethylsilyl derivatives of triterpenes on a nitrile silicone phase, XE-60. Fokina and Belova [47] reported the use of SE-30, while Ikekawa *et al.* [48] compared results on a variety of columns.

Spectroscopic methods have also been applied to the study of triterpenes. Ourisson and Takahashi [49] published the IR spectrum of friedelin and Cole *et al.* [50] reported the spectrum of friedelan-3α-ol. Solvent effects in IR spectroscopy were reported by Oganesyan *et al.* [51] and Brooks *et al.* [52].

The development of NMR spectroscopy and mass spectrometry (MS) resulted in a series of papers reporting, first, the spectra obtained with known compounds, and then, the attempts to correlate this knowledge with the spectra of compounds of undetermined structures. Djerassi and co-workers [53–55] were responsible for much of the general application of MS to triterpenes, including friedelin, while Courtney *et al.* [56, 57], Hunech and Tummler [58], and Hirota *et al.* [59] considered the problem of friedelin-related derivatives.

Shamma *et al.* [60] published NMR spectra of a series of triterpenoid derivatives with correlations between spectra and structure as did Djerassi [54]. The value of NMR in structure elucidation was increased with the application of solvent induced shifts [61] and the development of shift reagents [62, 63], the use of ^{13}C NMR [64–66], and the application of homonuclear INDOR spectroscopy [67, 68].

The utility of combining NMR spectroscopy and MS in the determination of friedelin-related compounds is well demonstrated by two series of papers. Kikuchi and co-workers [69–72] isolated friedelin-type components from *Pachysandras terminalis* and formulated the structures based on the spectroscopic evidence of the compounds and their derivatives. The other series, by Courtney and co-workers, dealt with a number of carbonyl, hydroxycarbonyl and polyhydroxy friedelanes isolated from *Siphonodon australe* [28, 29, 73–76].

A series of papers by Stevenson and his co-workers [77–79] explored the reactions of friedelin and friedelane with bromine and with *n*-bromosuccinimide. Takyuki *et al.* [80] and Shoppe and Johnson [81] provided interesting comments on yields in these preparations. Stevenson and co-workers [82–84] went on to investigate the effects of ultraviolet light on reactions involving friedelin and its derivatives.

Many Japanese workers were involved in the preparation of a wide variety of compounds using friedelin as the starting material [85], and varying the reaction conditions [86, 87] and/or employing irradiation [88–91]. Thus, 2-oxo-3-oxa-friedelane [92], epoxyfriedelane [93, 94], friedelan-3-on-24-al [95], 5α-ethyl-10β-(carbomethoxymethyl)-des-A-friedelone [96], 3β-friedelanol, 3α-friedelanol [97, 98], 3,4-seco-3-norfriedelan-2-al [99], 4-epifriedelin, 4-epishione [100, 101], and some nitrogen-containing friedelanes [102] were prepared. A one step synthesis of putranjivic acid from friedelin by photochemical oxidation in benzene under oxygen was also accomplished [103].

In addition, other workers employed a wide variety of techniques and reactions to explore the structure and reactivity of friedelin and related compounds. Among these were the reduction of cerin oxime [104]; the preparation of epimeric 3-amino friedelanes [105]; the acid catalysed rearrangement of the 3-friedelene into 13(18)-oleanene [31]; conformation studies of oxo-triterpenes using circular dichroism [106, 107]; and surveys of the possible rearrangements leading to friedelin-type compounds [108, 109].

The biosynthesis of triterpenes has been reviewed by Rees and Goodwin [110] and discussed by Sengupta [111].

The chemical synthesis of friedelin starts with a more available triterpene such as amyrin [112] or with a readily available tetracyclic triterpene [113], or attacks the problem through the stereo-specific synthesis of intermediates [114, 115]. A total synthesis of friedelin was reported in 31 steps and 0.3% yield [116].

Finally, the use of friedelin or friedelin-type compounds has been considered for treatment of cancer of the bladder [117], convulsions, inflammation [118], topical ulcers, rheumatic inflammation, fever and dysentry [119]. Friedelin has also been found to have an 'anti-feedant' activity upon some insects [120].

The natural occurrence of friedelin and the 3-friedelanols is extensive. Friedelin has been reported in many of the higher plants and in algae [121, 122], lichens [123, 124], mosses [125, 126], peat [42, 43, 46, 127, 128], coal [129–134], and mineral wax [135]. It has also been reported in swine [136] and epifriedelinol has been found in microorganisms [137]. Finally, a word of caution, the finding of friedelin in a study of polyhydroxylated neutral aglucons [138] was attributed to the cork stoppers used in the extraction!

Acknowledgements—Thanks are extended to Mrs. E. Foy, Librarian, College of Pharmacy, for her interest and assistance in the preparation of this manuscript. The authors thank the Medical Research Council of Canada for financial assistance (Grant MA-6448).

Table 2. Occurrence of friedelin, the friedelanols and associated friedelanes*

Plant	Part used	Friedelanes identified† 2‡	3§	4‖	Others	References
Abroma augusta	bark, roots	+				146, 147
Acer amoenum	leaves	+				148
Acokanthera spectabilis	various parts	+				120, 149, 150
Actinodaphne augustifolia	leaves	+				151
Aesculus hippocastanum	seed oil	+				152
Ageratum conyzoides	plant material	+				153
Ageratum houstonianum	plant material	+		+		153
Alangium lamarckii	leaves	+				154
Albizzia lebbeck	bark	+				155
Alectoria ochroleuca	whole plant	+				123
Alectryon excelsum	bark	+		E		156
Aleurites montana	bark	+				157
Antidesma bunius	leaves, stems	+				158
Antirrhoea chinensis	leaves	+		+		159
Aporoosa chinensis	leaves, stems	+		+		160
Argyreia speciosa	leaves			E		161
Argyreia populifolia	fruit	+		+		162
Arundinaria chino	rhizomes	+				163
Arundinarieae¶	whole plant	+		E		164
Arundinella hirta	herb	+				163
Arundo donax	leaves	+				165
Asclepias tuberosa	leaves	+				166
Aster baccharoides	leaves	+				167
Aster baccharoides	stems	+		+		167
Aster scaber	roots	+		+		168
Aster tataricus	roots	+		E		5, 169
Atalantia monophylla	leaves	+		E		170
Athrixia pinifolia	roots	+		E		171
Avicennia officinalis	aerial parts	+				172
Baccaurea sapida	bark	+		E		173
Baccharis salicifolia	whole plant	+		+		174
Balanops australiana	bark	+	+	+	8	175, 176
Bischofia javanica	bark	+		E**		177
Bischofia trifoliata	leaves, stems	+	+	+		178
Bridelia micrantha	bark	+		E		179
Bridelia monoica	leaves, stems	+		+		180
Bridelia stipularis	bark	+				181
Bromus rigidus	culms, blades	+				163
Brosimum¶ (Takini bark)	bark	+				182
Byrsonima verbascifolia	bark	+				183
Cacalia bulbifera	whole plant	+				184
Calophyllum apetalum	bark	+				185
Calophyllum brasiliense	not stated††	+				186
Calophyllum cordato-oblongum	bark, wood	+				187
Calophyllum cuneifolium	bark	+				188
Calophyllum inophyllum	bark	+		+		185, 189
Calophyllum inophyllum	leaves	+			5–7	190
Calophyllum thwaitesii	bark	+				191
Calophyllum tomentosum	bark	+		+		185
Cannabis sativa	root	+		E		192, 193
Canscora decussata	aerial parts	+		+		194
Canscora decussata	roots	+		E		195
Caraipa densiflora	wood	+				196
Carapa obovata	bark, leaves	+				197
Caryocar brasiliense	leaves	+	+			198
Castanopus concinna	leaves, stems	+		+	7	199, 200
Castanopus cuspidata	leaves	+	+**	+		199, 200
Castanopus cuspidata	stems	+	+**	+**		200
Castanopus cuspidata var. *sieboldii*	bark	+				5, 201
Castanopis eyrei	leaves, stems	+		+		199, 200, 202
Castanopis fabri	leaves	+		+		199, 200
Castanopis fabri	stems	+		+	14	200
Castanopis fissa	leaves, stems	+		+		199, 200
Castanopis hickelii	leaves, stems	+		+		199, 200
Castanopis lamontii	leaves	+		+		203
Castanopis lamontii	stems	+		+	7, 10	203

Table 2.—*continued*

Plant	Part used	Friedelanes identified† 2‡	3§	4‖	Others	References
Ceratopetalum apetalum	bark	+		E		204
Cetruria crispa	whole plant	+				123
Cetruria cuculatta	whole plant	+				123
Cetruria delisei	whole plant	+				123
Cetruria islandica	whole plant	+				123
Cetruria nivalis	whole plant	+		E	8	123, 124
Choisya ternata	leaves	+				205
Citrus aurantium var. *sinensis*	oil from peel	+				206
Citrus paradisi	oil from peel	+				207
Cladonia alpestris	whole plant	+				123
Claoxylon polot	leaves	+				208
Clerodendron trichotomum	bark	+				201
Clusia rosea	plant material	+	+	+		209
Coix lacryma-jobi	herb	+				163
Colletia hystrix	not stated††	+				210
Colletia spinosa	not stated††	+				210
Conocephalum conicum	not stated††	+				211
Cuphea balsamona	not stated††	+				212
Cynanchum vincetoxicum	not stated††	+				213
Cynodon dactylon	herb	+				163
Dalbergia volubilis	wood chips	+				214
Dichrostachys cinerea	bark, roots	+		+		215, 216
Diospyros buxifolia	leaves, stems	+		E		217
Diospyros kaki	flowers	+				218
Elaeocarpus hookerianus	wood	+				39
Elephantopus scaber	plant material			E		219
Erica arborea	not stated††	+				220
Erythrospermum zeylanicum	bark	+				221
Eugenia fructicosa	bark	+		E		222
Eugenia jambolana	stem bark	+		E		223, 224
Eugenia wallichii	bark	+		E		222
Euonymus alata	leaves	+		E		225
Euonymus japonica	leaves	+	+	E		226
Euonymus radicans	leaves		+			226
Euphorbia antiquorum	stems		+	+		227–229
Euphorbia azureum	leaves, stems			E		230
Euphorbia hirta	plant material	+				231
Euphorbia hirta	stems	+				232
Euphorbia longana	leaves			E		233
Euphorbia neriifolia	leaves		+	+		234
Euphorbia neriifolia	stems		+			234
Festuca parvigluma	herb	+				163
Ficus bengalensis	leaves	+				235
Ficus nitida	leaves	+		E		236
Flotowia dicanthoides	not stated††	+	+			237
Fluggea microcarpa	bark	+	+			238
Fluggea virosa	leaves	+	+			208
Fluggea virosa	stems	+		+		208
Frullania tamarisci	not stated††	+				239
Fucus evanescens	whole plant	+				122
Grewia asiatica	stem bark	+				240
Glochidion macrophyllun	leaves, stems	+		+		241
Glochidion puberum	leaves, stems	−		+		242
Glycosmis mauritiana	leaves, stems	+				151
Gauzuma tomentosa	bark	+				243
Guazuma tomentosa	leaves		+**	+		244
Gymnocolea inflata‡‡	whole plant		+	+		126
Gymnosporia wallichiana	whole plant	+				246
Haplopappus angustifolius	not stated††	+		E		247
Haplopappus foliosus	not stated††	+		E		247
Haplopappus heterophyllus§§	not stated††	+	+			248
Hemarthria sibirica	herb	+				163
Hemerocallis longituba	roots	+				249
Heterophragma adenophyllum	fruit	+				250
Holcus lanatus	herb	+				163
Holoptelea integrifolia	leaves	+		+		251
Hydnocarpus octandra	fruit, wood	+				252

Table 2.—*continued*

Plant	Part used	Friedelanes identified† 2‡	3§	4‖	Others	References
Hydnocarpus octandra	bark	+	+	+	29–34, 46, 47**	252
Hypserpa nitida	leaves	+				253
Imperata cylindrica	culms, blades	+				163, 254
Inula helenium	oil from root	+				255
Iresine pringlei	ground stem, leaves	+				256
Kalanchoe spathulata	flowers	+				257
Kielmeyera rosea	branches	+				258
Legnephora moorei	whole plant	+				259
Lithocarpus attenuata	leaves	+		+	36	260
Lithocarpus attenuata	stems	+		−		260
Lithocarpus cornea	leaves, stems	+		−		260, 261
Lithocarpus elizabethae	leaves, stems	+		−		260
Lithocarpus glabra	leaves, stems	+		+		260, 261
Lithocarpus haipinii	leaves	+		+	7	260
Lithocarpus haipinii	stems	+		+		260
Lithocarpus hancei	leaves	+		+		260, 261
Lithocarpus hancei	stems	+		+	36	260
Lithocarpus harlandi	leaves	+		+	36	260, 261
Lithocarpus harlandi	stems	+		+		260, 261
Lithocarpus irwinii	leaves	+		+	14, 36	260, 262
Lithocarpus irwinii	stems	−		+		260, 262
Lithocarpus litchioides	leaves	+		+	36	260, 262
Lithocarpus litchioides	stems	+				260, 262
Lithocarpus polystachya	leaves, stems	+		+		260, 261, 263
Lophatherum gracile	culms, blades	+				163
Lophoperalum rigidum	bark	+				264
Macaranga tanarius	stems	+		+	20	265
Madhuca butyracea	bark	+				266
Madhuca neriifolia	bark, wood	+				267
Mallotus paniculatus	leaves	+		+		160
Mangifera indica	roots	+				268
Maytenus heterophylla	bark	+		E		269
Melaleuca leucadendron	leaves, stems	+				270
Melanolepis multiglandulosa	not stated††	+				271
Microstegium vimineum	herb	+				163
Mikania cordata	roots	+		E		272, 273
Millettia dielsiana	leaves	+		+		274
Millettia nitida	leaves	+		+		274
Millettia pachycarpa	leaves	−		+		274
Mimosa rubicaulis	roots	+				275
Miscanthus sacchariflorus	culms, blades	+				163
Miscanthus sinensis	culms, blades	+				163
Monostroma nitidum	whole plant	+				121
Nephelium litchi	bark	+				276
Notonia grandiflora	leaves	+				277
Olearia paniculata	bark, roots	−		E		39, 278
Olearia paniculata	leaves	+				39
Ophiorrhiza japonica	whole plant	+				279
Oplismensus undulatifolius	herb	+				163
Opuntia vulgaris	whole plant		+			280
Orixa japonica	leaves	+				281
Pachysandra terminalis	not stated*†	+		E	36–39	35, 69–72, 282–285
Paederia foetida	not stated††	+				286
Pedilantus calcaratus	whole plant	+				231
Pedilanthus tehuacanus	whole plant	+				231
Pedilanthus tithymaloides	not stated†*	+		− **		287
Phacelurus latifolius	culms, blades	+				163
Photina glabra	leaves			E		288
Phyllanthus reticulatus	leaves	+				289
Phyllanthus reticulatus	stems	+		+	25, 28	289
Phyllostachys heteroecycla	culms, wax	+				163
Pinus roxburghi	bark	+				290
Pinus serotina	bark	+		E		291
Piper aurantiacum	seeds	+		E		292
Pleurostylia africana	leaves	+		E		269
Poa annua	herb		+			163

Table 2.—*continued*

Plant	Part used	Friedelanes identified† 2‡	3§	4‖	Others	References
Poa sphondylodes	herb	+				163
Polygonum plebejum	flowers			E		293
Prunus lusitanica	leaves	+				294
Prunus nepalensis	bark	+				295
Prunus turfosa	bark	+		E		5
Pterospermum acerifolium	flowers		+	+		296
Punica granatum	bark	+				297
Putranjiva roxburghii	bark	+	+		40, 41, 43	40, 298–303
Putranjiva roxburghii	leaves				42, 44	299, 302, 304–306
Putranjiva roxburghii	root bark	+			41–43	307
Pyrus communis	bark	+		E		308
Pyrus lanata	leaves, bark	+				309
Pyrus malus	bark	+		E		310
Pyrus pashia	bark, leaves	+				311
Pyrus pashia	stems	+				151
Pyrus sikkimensis	whole plant	+				312
Quercus¶	bark	+	+			313, 314
Quercus acuta	leaves	+	+			315
Quercus acutissima	pollen	+				316
Quercus bambusaefolia	leaves	+	+	+		317
Quercus bambusaefolia	stems	+		+		318
Quercus championi	leaves	+	+	E		319
Quercus championi	stems	+		+		318
Quercus gilva	leaves	+	+**	+		315
Quercus glauca	leaves	+		+		267, 315, 320, 321
Quercus ilex	heart wood	+				322
Quercus incana	stem bark	+				323
Quercus lanceaefolia	stem bark	+			5, 7	324
Quercus myrsinaefolia	leaves	+	+	+		315, 317
Quercus myrsinaefolia	stems	+		+		318
Quercus pachyphylla	plant material	+			7	325
Quercus petraea	bark	+	+			326
Quercus phillyracoides	leaves	+	+			315
Quercus robur	bark	+	+			323, 327
Quercus semicarpifolia	bark	+				328
Quercus sessilifolia	leaves	+	+			315
Quercus stenophylla	leaves, branches	+	+	E		315, 329, 330
Quercus suber	cork wax	+			8	331
Quercus suber	see also 'cork'					—
Raupellia grata	whole plant	+		E		332
Rhododendron adamsii	defoliated shoots	+				333
Rhododendron arboreum	leaves	+				334
Rhododendron aureum	defoliated shoots	+				333
Rhododendron barbatum	leaves			E		334
Rhododendron campanulatum	leaves	+		E		334, 335
Rhododendron championae	leaves			E		336
Rhododendron cinnamomeum	leaves	+		E		337
Rhododendron colletianum	not stated††	+				338
Rhododendron cucasicum	stems, leaves	+		E		47
Rhododendron dahuricum	defoliated shoots	+				333
Rhododendron decipiens	leaves	+				339
Rhododendron degronianum	leaves	+		E		340
Rhododendron falconeri	leaves	+				334
Rhododendron ferrugineum	not stated††	+		E		341
Rhododendron grande	bark, leaves	+				342, 343
Rhododendron hodgsonii	not stated††	+				344
Rhododendron kotschyi	defoliated shoots	+				333
Rhododendron luteum	defoliated shoots	+				333
Rhododendron metternichii	leaves	+		E		345
Rhododendron mucronulatum	defoliated shoots	+				333
Rhododendron nilagiricum	leaves			E		346
Rhododendron niveum	leaves	+		E		151, 347
Rhododendron ponticum	leaves	+				348, 349
Rhododendron reticulatum	leaves	+		E		350
Rhododendron schlippenbachii	defoliated shoots	+				333
Rhododendron westlandii	not stated††	+		E		143, 351
Rhodomyrtus tomentosa	not stated††	+				352

Table 2.—*continued*

Plant	Part used	Friedelanes identified† 2‡	3§	4‖	Others	References
Saccharum spontaneum	culms, blades	+				163
Salacia fruticosa	root bark	+			21, 32, 34	353
Salacia prinoides	root bark	+			11, 13, 16, 17, 21, 22, 35	354–359
Salix japonica	bark	+		E		201, 360
Salvia glutinosa	gum exudate	+				361
Sapium sebiferum	leaves	+				362
Sarcostemma viminale	whole plant	+				363, 364
Saussurea lappa	root oil	+				365
Scolapia crenata	not stated††	+				366
Scolapia schieberi	bark, wood	+				221
Secamone afzelii	roots	+				367
Setaria chondrachne	grains	+				163
Severinia buxifolia	leaves	+				368
Siphonodon australe	bark	+			9, 12, 15, 18, 23–27	28, 29, 57, 73–76, 107
Sorghum japonicum	grains	+				163
Spatholobus roxburghii	beans	+				369
Spireae formosana	not stated††	+				370
Stachytarpheta indica	leaves	+				119
Stereocaulon paschale	whole plant	+				123
Syzygium cordatum	bark, sapwood	+		E		371
Talguena quinquenervis	not stated††	+				210
Tillandsia usneoides	whole plant	+				125
Trevoa trinervis	not stated††	+				210
Trichadenia zeylanica	bark, wood		+**		45**, 46, 47**, 48	372, 373
Tripetaleia paniculata	leaves, flowers			E		374, 375
Tripetaleia paniculata	wood	+		E		375, 376
Ulmus campestris	bark	+				377
Undaria pinnatifida	not stated††	+				378
Vaccinium bracteatum	flowers	+				379
Vaccinium bracteatum	leaves	+		E		380
Vaccinium membranaceum	roots				20	381
Vaccinium membranaceum	cork	+			15, 19, 20	382
Vaccinium uliginosum	leaves	+				383
Vanillosmopsis erythropappa	not stated††	+	+			384
Vincetoxicum¶	herb	+				363
Viola odorata	leaves	+				385
Viola odorata	wax	+		+		386
Vitex trifolia	leaves	+				387
Vittadinia australis	whole plant	+		E		388
Zea mays	herb	+				163
Zelkowa serrata	bark	+				201
Zoysia tenuifolia	herb	+	+			163
Coal		+	+	+		129–132, 134
Cork [presumably *Quercus suber* (389)]		+			8, 14 19, 20	3, 6, 8–10, 25, 37, 105, 138, 382
Mineral wax		+		+		135
Peat		+		+, E		43, 127, 128, 133

* This includes only those friedelane derivatives that were reported in association with friedelin and/or one or both of the epimeric 3-friedelanols. Additional D:A-friedelooleanane derivatives are known [e.g. 107, 139–141] but these have not been reported in the presence of friedelin or the 3-friedelanols. Similarly, there are additional sources for some of the compounds found in Tables 1 and 2 which are devoid of friedelin and the 3-friedelanols [e.g. 142–145].

† The numbers refer to the structures illustrated in Fig. 1 and Table 1.

‡ Friedelin (friedelan-3-one).

§ Friedelan-3α-ol (friedelinol, friedelanol).

‖ Friedelan-3β-ol (epifreidelinol, epifriedelanol). As there is some confusion in the literature regarding the usage of the prefix 'epi-', we have chosen to distinguish between the reported occurrence of 'epifriedelanol' (**E**) and 'friedelan-3β-ol' (+).

¶ Further details regarding the genus and species are not provided in the literature cited.

** Reported present as the alcohol and/or the acetates.

†† 'Not stated' indicates that the plant part used was not stated in the literature cited.

‡‡ Friedelin has been identified in additional liverworts, but the plants were not specified in the available literature [245].

§§ Also known as *Isocoma wrightii*.

REFERENCES

1. White, D. E. (1956) *Rev. Pure Appl. Chem.* **6**, 191.
2. Halsall, T. G. and Aplin, R. T. (1954) *Fortschr. Chem. Org. Naturst.* **22**, 153.
3. (1940) *Elsevier's Encyclopedia of Organic Chemistry*, Vol. 14, p. 588; (1952) suppl. Vol. 14S, p. 825. Elsevier, New York.
4. Kulshreshtha, M. J., Kulshreshtha, D. K. and Rastogi, R. P. (1972) *Phytochemistry* **11**, 2369.
5. Sainsbury, M. (1970) *Phytochemistry* **9**, 2209.
6. Friedel, C. (1892) *Bull. Soc. Chim. Fr.* **7**, 164.
7. Karrer, W. (1958) *Konstitution und Vorkommen der Organischen Pflanzenstoffe*. Birkhäuser, Basel.
8. Chevreul, M. (1815) *Ann. Chim.* **96**, 141.
9. Istrati, C. and Ostrogovich, A. (1899) *C. R.* **128**, 1581.
10. Drake, N. L. and Jacobsen, R. P. (1935) *J. Am. Chem. Soc.* **57**, 1570.
11. Drake, N. L. and Shrader, S. A. (1935) *J. Am. Chem. Soc.* **57**, 1854.
12. Drake, N. L. and Haskins, W. T. (1936) *J. Am. Chem. Soc.* **58**, 1684.
13. Drake, N. L. and Campbell, W. P. (1936) *J. Am. Chem. Soc.* **58**, 1681.
14. Drake, N. L. and Wolfe, J. K. (1939) *J. Am. Chem. Soc.* **61**, 3074.
15. Seoane, E. (1957) *Rev. Cienc. Apl.* **11**, 393 (*Chem. Abstr.* **52**, 9039b).
16. Drake, N. L. and Wolfe, J. K. (1940) *J. Am. Chem. Soc.* **62**, 3018.
17. Lander, J. J. and Svirbely, W. J. (1944) *J. Am. Chem. Soc.* **66**, 235.
18. Ruzicka, L., Jeger, O. and Ringnes, P. (1944) *Helv. Chim. Acta* **27**, 972.
19. Perold, G. W., Meyerhans, K., Jeger, O. and Ruzicka, L. (1949) *Helv. Chim. Acta* **32**, 1246.
20. Dutler, H., Jeger, O. and Ruzicka, L. (1955) *Helv. Chim. Acta* **38**, 1268.
21. Corey, E. J. and Ursprung, J. J. (1955) *J. Am. Chem. Soc.* **77**, 3668.
22. Corey, E. J. and Upsprung, J. J. (1956) *J. Am. Chem. Soc.* **78**, 5041.
23. Brownlie, G., Spring, F. S., Stevenson, R. and Strachan, W. S. (1956) *Chem. Ind. (London)* 686.
24. Brownlie, G., Spring, F. S., Stevenson, R. and Strachan, W. S. (1955) *Chem. Ind. (London)* 1156.
25. Brownlie, G., Spring, F. S., Stevenson, R. and Strachan, W. S. (1956) *J. Chem. Soc.* 2419.
26. Takahashi, T. and Ourisson, G. (1956) *Bull. Soc. Chim. Fr.* 353.
27. Coates, R. M. (1967) *Tetrahedron Letters* 4143.
28. Courtney, J. L. and Gascoigne, R. M. (1956) *J. Chem. Soc.* 2115.
29. Courtney, J. L., Gascoigne, R. M. and Szumer, A. Z. (1956) *J. Chem. Soc.* 2119.
30. Courtney, J. L., Gascoigne, R. M. and Szumer, A. Z. (1956) *Chem. Ind. (London)* 1479.
31. Courtney, J. L., Gascoigne, R. M. and Szumer, A. Z. (1958) *J. Chem. Soc.* 881.
32. Djerassi, C., Riniker, R. and Riniker, B. (1956) *J. Am. Chem. Soc.* **78**, 6362.
33. Djerassi, C. and Klyne, W. (1957) *J. Am. Chem. Soc.* **79**, 1506.
34. Rogers, D. and Thomas, D. V. (1956) *Bull. Soc. Chim. Fr.* 361.
35. Masaki, N., Niwa, M. and Kikuchi, T. (1975) *J. Chem. Soc. Perkin Trans.* 2, 610.
36. Laing, M., Burke-Laing, M. E., Bartho, R. and Weeks, C. M. (1977) *Tetrahedron Letters* 3839.
37. Stevenson, R. (1961) *J. Org. Chem.* **26**, 2142.
38. Kane, V. V. and Stevenson, R. (1960) *J. Org. Chem.* **25**, 1394.
39. Cambie, R. C. and Parnell, J. C. (1969) *N. Z. J. Sci.* **12**, 453.
40. Sengupta, P. and Mukherjee, J. (1968) *Tetrahedron* **24**, 6259.
41. Murakami, T., Itokawa, H., Uzuki, F. and Sawada, N. (1965) *Chem. Pharm. Bull.* **13**, 1346.
42. Ikan, R., Kashman, J. and Bergmann, E. D. (1964) *J. Chromatogr.* **14**, 275.
43. Kaganovich, F. L., Bel'kevich, P. I. and Dolidovich, E. F. (1972) *Vestsi Akad. Navuk B. SSR, Khim. Navuk* 110 (*Chem. Abstr.* **78**, 6393m).
44. Fischer, F. and Hertel, R. (1968) *J. Chromatogr.* **38**, 274.
45. Barua, A. K., Dutta, S. P. and Pal, S. K. (1967) *J. Chromatogr.* **31**, 569.
46. Ikan, R. and Gottlieb, R. (1970) *Isr. J. Chem.* **8**, 685.
47. Fokina, G. A. and Belova, N. V. (1971) *Khim. Prir. Soedin.* **7**, 30 (*Chem. Abstr.* **74**, 11225t).
48. Ikekawa, N., Natori, S., Itokawa, H., Tobinaga, S. and Matsui, M. (1965) *Chem. Pharm. Bull.* **13**, 316.
49. Ourisson, G. and Takahashi, T. (1955) *Chem. Ind. (London)* 1155.
50. Cole, A. R. H., Muller, G. T. A., Thornton, D. W. and Willix, R. L. S. (1959) *J. Chem. Soc.* 1218.
51. Oganesyan, E. T., Shinkarenka, A. L. and Bandyukova, V. A. (1968) *Khim. Prir. Soedin.* **4**, 212 (*Chem. Abstr.* **70**, 58056j).
52. Brooks, C. J. W., Eglinton, G. and Hanaineh, L. (1966) *Spectrochim. Acta* **22**, 131.
53. Djerassi, C., Budzikiewicz, H. and Wilson, J. M. (1962) *Tetrahedron Letters* 263.
54. Budzikiewicz, H., Wilson, J. M. and Djerassi, C. (1963) *J. Am. Chem. Soc.* **85**, 3688.
55. Budzikiewicz, H., Brauman, J. I. and Djerassi, C. (1965) *Tetrahedron* **21**, 1855.
56. Courtney, J. L. and Shannon, J. S. (1963) *Tetrahedron Letters* 13.
57. Shannon, J. S., Macdonald, C. G. and Courtney, J. L. (1963) *Tetrahedron Letters* 173.
58. Huneck, S. and Tummler, R. (1968) *J. Prakt. Chem.* **38**, 233.
59. Hirota, H., Moriyama, Y., Tsuyuki, T., Tanahashi, Y., Takahashi, T., Katoh, Y. and Satoh, H. (1975) *Bull. Chem. Soc. Jpn* **48**, 1884.
60. Shamma, M., Glick, R. E. and Mumma, R. O. (1962) *J. Org. Chem.* **27**, 4512.
61. Wilson, R. G. and Williams, D. H. (1969) *Tetrahedron* **25**, 155.
62. Demarco, P. V., Elzey, T. K., Lewis, R. B. and Wenkert, E. (1970) *J. Am. Chem. Soc.* **92**, 5737.
63. Buckley, D. G., Green, G. H., Ritchie, E. and Taylor, W. C. (1971) *Chem. Ind. (London)* 298.
64. Wenkert, E., Clouse, A. O., Cochran, D. W. and Doddrell, D. (1969) *J. Am. Chem. Soc.* **91**, 6879.
65. Beierbeck, H. and Saunders, J. K. (1975) *Can. J. Chem.* **53**, 1307.
66. Beierbeck, H., Saunders, J. K. and ApSimon, J. W. (1977) *Can. J. Chem.* **55**, 2813.
67. Kikuchi, T., Shingu, T., Niwa, M. and Yokoi, T. (1973) *Chem. Pharm. Bull.* **21**, 1396.
68. Kikuchi, T., Niwa, M., Takayama, M., Yokoi, T. and Shingu, T. (1973) *Tetrahedron Letters* 1987.

69. Kikuchi, T. and Toyoda, T. (1967) *Tetrahedron Letters* 3181.
70. Kikuchi, T. and Toyoda, T. (1971) *Chem. Pharm. Bull.* **19**, 753.
71. Kikuchi, T., Takayama, M., Toyoda, T., Arimoto, M. and Niwa, M. (1971) *Tetrahedron Letters* 1535.
72. Kikuchi, T. and Niwa, M. (1971) *Tetrahedron Letters* 3807.
73. Courtney, J. L. and Stern, W. (1966) *Aust. J. Chem.* **19**, 1709.
74. Courtney, J. L. and Stern, W. (1965) *Tetrahedron Letters* 1607.
75. Courtney, J. L. and Stern, W. (1965) *Tetrahedron Letters* 3733.
76. Clarke, B. J., Courtney, J. L. and Stern, W. (1970) *Aust. J. Chem.* **23**, 1651.
77. Kane, V. V. and Stevenson, R. (1960) *Chem. Ind. (London)* 1243.
78. Kane, V. V. and Stevenson, R. (1961) *Tetrahedron* **15**, 223.
79. Kohen, F. and Stevenson, R. (1965) *J. Org. Chem.* **30**, 2479.
80. Tsuyuki, T., Tanahashi, Y., Sudo, Y., Nakamata, S. and Takahashi, T. (1966) *Bull. Chem. Soc. Jpn* **39**, 1610.
81. Shoppe, C. W. and Johnston, G. A. R. (1962) *J. Chem. Soc.* 1246.
82. Kohen, F. and Stevenson, R. (1966) *Chem. Ind. (London)* 1844.
83. Kohen, F., Samson, A. S. and Stevenson, R. (1969) *J. Org. Chem.* **34**, 1355.
84. Stevenson, R., Tsuyuki, T., Aoyagi, R. and Takahashi, T. (1971) *Bull. Chem. Soc. Jpn* **44**, 2567.
85. Torii, T., Tachibana, K., Yamada, S., Tsuyuki, T. and Takahashi, T. (1975) *Tetrahedron Letters* 2283.
86. Kakisawa, H., Horie, T. and Kusumi, T. (1975) *Bull. Chem. Soc. Jpn* **48**, 727.
87. Sengupta, P., Sen, M., Sengupta, S. and Das, K. G. (1974) *Tetrahedron Letters* 4197.
88. Shirasaki, H., Tsuyuki, T., Takahashi, T. and Stevenson, R. (1975) *Tetrahedron Letters* 2271.
89. Shirasaki, H., Aoyagi, R., Tsuyuki, T., Takahashi, T. and Stevenson, R. (1975) *Bull. Chem. Soc. Jpn* **48**, 1073.
90. Aoyagi, R., Tsuyuki, T., Takai, M. Takahashi, T., Kohen, F. and Stevenson, R. (1973) *Tetrahedron* **29**, 4331.
91. Shirasaki, H., Tsuyuki, T., Takahashi, T. and Stevenson, R. (1977) *Bull. Chem. Soc. Jpn* **50**, 921.
92. Nishihama, T. and Takahashi, T. (1966) *Bull. Chem. Soc. Jpn* **39**, 200.
93. Takahashi, T., Tsuyuki, T., Hoshino, T. and Ito, M. (1967) *Tetrahedron Letters* 2997.
94. Tsuyuki, T., Hoshino, T., Ito, M. and Takahashi, T. (1968) *Bull. Soc. Chim. Fr.* 2895.
95. Hoshino, T., Tsuyuki, T. and Takahashi, T. (1967) *Bull. Chem. Soc. Jpn* **40**, 389.
96. Taki, M., Aoyagi, R., Yamada, S., Tsuyuki, T. and Takahashi, T. (1970) *Bull. Chem. Soc. Jpn* **43**, 972.
97. Tsuyuki, T., Yamada, S. and Takahashi, T. (1968) *Bull. Chem. Soc. Jpn* **41**, 511.
98. Nasipuri, D., Mukherjee, P. R., Pakrashi, S. C., Datta, S. and Ghosh-Dastidar, P. P. (1976) *J. Chem. Soc. Perkin Trans.* 1, 321.
99. Aoyagi, R., Tsuyuki, T. and Takahashi, T. (1972) *Tetrahedron Letters* 3397.
100. Tsuyuki, T., Aoyagi, R., Yamada, S. and Takahashi, T. (1968) *Tetrahedron Letters* 5263.
101. Aoyagi, R., Yamada, S., Tsuyuki, T. and Takahashi, T. (1973) *Bull. Chem. Soc. Jpn* **46**, 959.
102. Yasue, M., Sakakibar, J. and Kaiya, T. (1974) *Yakugaku Zasshi* **94**, 461 (*Chem. Abstr.* **81**, 49878d).
103. Aoyagi, R., Tsuyuki, T. and Takahashi, T. (1973) *Bull. Chem. Soc. Jpn* **46**, 692.
104. Drefahl, G. and Huneck, S. (1962) *J. Prakt. Chem.* **19**, 14 (*Chem. Abstr.* **58**, 12607f).
105. Drefahl, G. and Huneck, S. (1960) *Chem. Ber.* **93**, 1961.
106. Witz, P., Herrmann, H., Lehn, J. M. and Ourisson, G. (1963) *Bull. Soc. Chim. Fr.* 1101.
107. Djerassi, C., Osiecki, J. and Closson, W. (1959) *J. Am. Chem. Soc.* **81**, 4587.
108. Sengupta, P., Mukherjee, J. and Sen, M. (1971) *Tetrahedron* **27**, 2473.
109. Stevenson, R. (1963) *J. Org. Chem.* **28**, 188.
110. Rees, H. W. and Goodwin, T. W. (1972) in *Biosynthesis* (Geissman, T. A., ed.) Vol. 1, p. 59. The Chemical Society, London.
111. Sengupta, P. (1968) *Bull. Natl. Inst. Sci. India* **37**, 1.
112. Agata, I., Corey, E. J., Hortmann, A. G., Klein, J., Proskow, S. and Ursprung, J. J. (1965) *J. Org. Chem.* **30**, 1698.
113. ApSimon, J. W., Baker, P., Buccini, J., Hooper, J. W. and Macaulay, S. (1972) *Can. J. Chem.* **50**, 1944.
114. Evans, D. A. (1968) *Diss. Abstr. B.* **29**, 936.
115. Kametani, T., Hirai, Y., Satoh, F. and Fukumoto, K. (1977) *J. Chem. Soc. Chem. Commun.* 16.
116. Ireland, R. E. and Walba, D. M. (1976) *Tetrahedron Letters* 1071.
117. Simon, H. C. (1976) *Ger. Offen.* 2,508,338 (C1.A61K) 19 Feb. 1976 (*Chem. Abstr.* **84**, 169664q).
118. Chaturvedi, A. K., Parmar, S. S., Bhatnagar, S. C., Mistra, G. and Nigam, S. K. (1974) *Res. Commun. Chem. Pathol. Pharmacol.* **9**, 11.
119. Subramanian, S. S., Nair, A. G. R. and Vedanthan, T. N. C. (1974) *Indian J. Pharm.* **36**, 15.
120. Abbassy, M. A., El-Shazli, A. and El-Gayar, F. (1977) *Z. Angew. Entomol.* **83**, 317 (*Chem. Abstr.* **87**, 147016q).
121. Tsuda, K. and Sakai, K. (1960) *Chem. Pharm. Bull* **8**, 554.
122. Ikekawa, N., Morisaki, M. and Hirayama, K. (1972) *Phytochemistry* **11**, 2317.
123. Bruun, T. (1954) *Acta Chem. Scand.* **8**, 71.
124. Bruun, T. (1969) *Acta Chem. Scand.* **23**, 3038.
125. Djerassi, C. and McCrindle, R. (1962) *J. Chem. Soc.* 4034.
126. Huneck, S. and Overton, K. H. (1971) *Phytochemistry* **10**, 3279.
127. Ikan, R. and Kashman, J. (1963) *Isr. J. Chem.* 1, 502.
128. McLean, J., Rettie, G. H. and Spring, F. S. (1958) *Chem. Ind. (London)* 1515.
129. Golovanov, N. G. (1969) *Priroda (Moscow)* 59 (*Chem. Abstr.* **72**, 5011a).
130. Jarolim, V., Streibl, M., Hejno, K. and Sorm, F. (1961) *Collect. Czech. Chem. Commun.* **26**, 451.
131. Jarolim, V., Streibl, M., Horak, M. and Sorm, F. (1958) *Chem. Ind. (London)* 1142.
132. Golovanov, N. G., Borisoglebskii, V. V., Kuz'menko, E. A. Mazyra, L. N. (1967) *Khim. Tverd. Topl.* 3 (*Chem. Abstr.* **68**, 14677s).
133. Ikan, R. and McLean, J. (1960) *J. Chem. Soc.* 893.
134. Golovanov, N. G., Borisoglebskii, V. V., Kuz'menko, E. A. and Mazyra, L. N. (1968) *Khim. Tverd. Topl.* 57 (*Chem. Abstr.* **69**, 37760y).
135. Golovanov, N. G., Borisoglebskii, V. V., Kuz'menko, E. A. and Mazyra, L. N. (1967) *Kul't. - Bytovye Izdeliya* 82 (*Chem. Abstr.* **69**, 98192m).
136. Ruzika, L. and Prelog, V. (1943) *Helv. Chim. Acta* **26**, 975.

137. Kamel, A., Akhtar, R. and Quereshi, A. H. (1971) *Pak. J. Sci. Ind. Res.* **14**, 71.
138. Meyer, A., Jeger, O. and Ruzicka, L. (1950) *Helv. Chim. Acta* **33**, 672.
139. Adesida, G. A., Girgis, P. and Taylor, D. A. H. (1972) *Phytochemisty* **11**, 851.
140. Bruun, T. (1954) *Acta Chem. Scand.* **8**, 76.
141. Chang, P. T. O., Cordell, G. A., Fong, H. H. S. and Farnsworth, N. R. (1977) *Phytochemistry* **16**, 1443.
142. Delle Monache, F., Francisco de Mello, J., Marini-Bettolo, G. B., Goncalves de Lima, O. and Leoncio d'Albuquerque, I. (1972) *Gazz. Chim. Ital.* **102**, 636.
143. Arthur, H. R., Lee, C. M. and Ma, C. N. (1956) *J. Chem. Soc.* 1481.
144. Pustil'nikova, S. D., Abryutina, N. A. and Petrov, A. A. (1975) *Keftekhimiya* **15**, 183 (*Chem. Abstr.* **84**, 5186j).
145. Kimble, B. J., Maxwell, J. R., Philp, R. P. and Eglington, G. (1974) *Chem. Geol.* **14**, 173.
146. Ali, S., Ahsan, A. M. and Hahn, G. (1958) *Pak. J. Sci. Ind. Res.* **1**, 305.
147. Mukherjee, K. S. and Badruddoja, S. (1977) *J. Indian Chem. Soc.* **54**, 647.
148. Kojima, H., Goshima, F., Ito, Y. and Kanamori, K. (1964) *Nippon Kagaku Zasshi* **85** (*Chem. Abstr.* **61**, 13630h).
149. Karawya, M. S., Abdel-Wahab, S. M. and Niazi, H. M. (1973) *Planta Med.* **24**, 234.
150. Kapadia, G. J., Kapadia, G. G. and Mosby, J. R. (1964) *Lloydia* **27**, 233.
151. Bhakuni, D. S., Gupta, N. C., Satish, S., Sharma, S. C., Shukla, Y. N. and Tandon, J. S. (1971) *Phytochemistry* **10**, 2247.
152. Allan, G. G., McLean, J. and Thomson, J. B. (1962) *Arch. Pharm. (Paris)* **295**, 865.
153. Hui, W. H. and Lee, W. K. (1971) *Phytochemistry* **10**, 899.
154. Gupta, N. C., Singh, B. and Bhakuni, D. S. (1969) *Phytochemistry* **8**, 791.
155. Tripathi, V. J. and Dasgupta, B. (1974) *Curr. Sci.* **43**, 46 (*Chem. Abstr.* **80**, 934149v).
156. Briggs, L. H., Cambie, R. C. and Couch, R. A. F. (1967) *N.Z.J. Sci.* **10**, 1076.
157. Misra, D. R. and Khastgir, H. N. (1970) *Tetrahedron* **26**, 3017.
158. Hui, W. H. and Sung, M. L. (1968) *Aust. J. Chem.* **21**, 2137.
159. Hui, W. H. and Szeto, S. K. (1967) *Phytochemistry* **6**, 443.
160. Hui, W. H., Chan, C. K., Chow, L. C., Ng, H. Y. and Siu, Y. K. (1969) *Phytochemistry* **8**, 519.
161. Sahu, N. P. and Chakravarti, R. N. (1971) *Phytochemistry* **10**, 1949.
162. Gunatilake, A. A. L. and Sultanbawa, M. U. S. (1973) *J. Chem. Soc. Perkin Trans.* 1, 1155.
163. Ohmoto, T., Ikuse, M. and Natori, S. (1970) *Phytochemistry* **9**, 2137.
164. Ohmoto, T., Uzawa, S. and Tanaka, R. (1974) *Shoyakugaku Zasshi* **28**, 1 (*Chem. Abstr.* **83**, 152246m).
165. Chaudhuri, R. K. and Ghosal, S. (1970) *Phytochemistry* **9**, 1895.
166. Pagani, F. (1975) *Boll. Chim. Farm.* **114**, 450 (*Chem. Abstr.* **84**, 56478p).
167. Hui, W. H., Lam, W. R. and Tye, S. M. (1971) *Phytochemistry* **10**, 903.
168. Tada, M., Takahashi, T. and Koyama, H. (1974) *Phytochemistry* **13**, 670.
169. Takahashi, M., Kamisako, W., Ishimasa, S. and Miyamura, K. (1959) *Yakugaku Zasshi* **79**, 1281 (*Chem. Abstr.* **54**, 4667g).
179. Talapartra, S. K., Bhattacharya, S. and Talapartra, B. (1970) *J. Indian Chem. Soc.* **47**, 600.
171. Bohlmann, F. and Zdero, C. (1977) *Phytochemistry* **16**, 1773.
172. Subramanian, S. S. and Vedantham, T. N. C. (1974) *Indian J. Pharm.* **36**, 105.
173. Misra, D. and Khastgir, H. N. (1967) *J. Indian Chem. Soc.* **44**, 728.
174. Dominguez, X. A., Sanchez, H., Merijanian, B. A. and Rojas, M. P. (1972) *Phytochemistry* **11**, 2628.
175. Samson, A. S., Stevenson, S. J. and Stevenson, R. (1968) *J. Chem. Soc. C* 2342.
176. Shoppe, C. W., Howden, M. E. H. and Johnston, G. A. R. (1962) *J. Chem. Soc.* 498.
177. Bose, S. N. and Khastgir, H. N. (1969) *J. Indian Chem. Soc.* **46**, 757.
178. Hui, W. H. and Ho, C. T. (1968) *Aust. J. Chem.* **21**, 1675.
179. Pegel, K. H. and Rogers, C. B. (1968) *Phytochemistry* **7**, 655.
180. Hui, W. H. and Fung, M. L. (1968) *Phytochemistry* **7**, 2069.
181. Sengupta, P. and Gosh, B. N. (1963) *J. Indian Chem. Soc.* **40**, 247.
182. Bick, I. R. C. and Clezy, P. S. (1958) *Chem. Ind. (London)* 631.
183. Gottlieb, O. R., Mendes, P. H. and Magalhaes, M. J. (1975) *Phytochemistry* **14**, 1456.
184. El-Emary, N. A., Kusano, G. and Takemoto, T. (1975) *Phytochemistry* **14**, 1660.
185. Nigam, S. K. and Mitra, C. R. (1969) *Phytochemistry* **8**, 323.
186. Silva Pereira, M. O., Gottlieb, O. R. and Magalhaes, M. T. (1966) *Ann. Acad. Bras. Cienc.* **38**, 425 (*Chem. Abstr.* **68**, 19513v).
187. Gunasekara, S. P. and Sultanbawa, M. U. S. (1975) *J. Chem. Soc. Perkin Trans.* 1, 2215.
188. Gunasekara, S. P., Jayatilake, G. S., Selliah, S. S. and Sultanbawa, M. U. S. (1977) *J. Chem. Soc. Perkin Trans* 1, 1505.
189. Kumar, V., Ramachandran, S. and Sultanbawa, M. U. S. (1976) *Phytochemistry* **15**, 2016.
190. Govindachari, T. R., Viswanathan, N., Pai, B. R., Rao, U. R. and Srinivasan, M. (1967) *Tetrahedron* **23**, 1901.
191. Dahanayake, M., Kitagawa, I., Somanathan, R. and Sultanbawa, M. U. S. (1974) *J. Chem. Soc. Perkin Trans.* 1, 2510.
192. Slatkin, D. J., Doorenbos, N. J., Harris, L. S., Masoud, A. N., Quimby, M. W. and Schiff, P. L., Jr. (1971) *J. Pharm. Sci.* **60**, 1891.
193. Sethi, V. K., Jain, M. P. and Thakur, R. S. (1967) *Planta Med.* **32**, 378.
194. Ghosal, S., Chaudhuri, R. K. and Nath, A. (1973) *Phytochemistry* **12**, 1763.
195. Ghosal, S., Chaudhuri, R. K. and Nath, A. (1971) *J. Indian Chem. Soc.* **48**, 589.
196. Alves de Lima, R., Gottlieb, O. R. and Mesquita, A. A. L. (1972) *Phytochemistry* **11**, 2307.
197. Majumdar, S. and Ghosh, P. G. (1976) *J. Indian Chem. Soc.* **53**, 947.
198. De Oliveira, M. M., Gilbert, B. and Mors, W. B. (1968) *Ann. Acad. Bras. Cienc.* **40**, 451 (*Chem. Abstr.* **71**, 58886a).
199. Arthur, H. R. and Ko, P. D. S. (1969) *Aust. J. Chem.* **22**, 597.
200. Hui, W. H. and Li, M. M. (1976) *Phytochemistry* **15**, 427.
201. Nonomura, S. (1955) *J. Pharm. Soc. Jpn* **75**, 80.

202. Arthur, H. R. and Ko, P. D. S. (1968) *Aust. J. Chem.* **21**, 2583.
203. Hui, W. H. and Li, M. M. (1976) *Phytochemistry* **15**, 1313.
204. Jeffries, P. R. (1954) *J. Chem. Soc.* 473.
205. Dreyer, D. L., Pickering, M. V. and Cohan, P. (1972) *Phytochemistry* **11**, 705.
206. Weizmann, A. and Mazur, Y. (1958) *J. Org. Chem.* **23**, 832.
207. Weizmann, A., Meisels, A. and Mazur, Y. (1955) *J. Org. Chem.* **20**, 1173.
208. Hui, W. H., Li, M. M. and Lee, Y. C. (1977) *Phytochemistry* **16**, 607.
209. Mathur, S. B. (1972) *Phytochemistry* **11**, 1513.
210. Sanchez, E. and Torres, R. (1971) *An. Assoc. Quim. Argent.* **59**, 343 (*Chem. Abstr.* **77**, 85620q).
211. Benesova, V., Herout, V. and Sorm, F. (1969) *Collect. Czech. Chem. Commun.* **34**, 1810.
212. Lin, S. J. (1976) *Hua Hsueh*, 45 (*Chem. Abstr.* **87**, 81231x).
213. Fehlhaber, H. W., Snatzke, G., Toth, L., Haznagy, A. and Makay, Z. (1969) *Planta Med.* **17**, 40.
214. Gottlieb, O. R., Bittencourt, A. M. and Magalhaes, M. T. (1962) *Anais Assoc. Bras. Quim.* **21** 33 (*Chem. Abstr.* **63**, 4655b).
215. Joshi, K. C. and Sharma, T. (1974) *Phytochemistry* **13**, 2010.
216. Joshi, K. C. and Sharma, T. (1977) *J. Indian Chem. Soc.* **54**, 649.
217. Bhakuni, D. S., Satish, S., Shukla, Y. N. and Tandon, J. S. (1971) *Phytochemistry* **10**, 2829.
218. Matsuura, S. and Iinuma, M. (1977) *Yakugaku Zasshi* **97**, 452 (*Chem. Abstr.* **87**, 2409k).
219. Sim, K. Y. and Lee. H. T. (1969) *Phytochemistry* **8**, 933.
220. Hassan, T. Y., Zorina, A. D., Matyukhina, L. G. and Saltykova, I. A. (1977) *Khim. Prir. Soedin.* 119 (*Chem. Abstr.* **87**, 65338g).
221. Gunasekera, S. P., Sultanbawa, M. U. S. and Balasubramaniam, S. (1977) *Phytochemistry* **16**, 788.
222. Majumdar, S. G. and Thakur, S. (1968) *J. Indian Chem. Soc.* **45**, 785.
223. Bhargava, K. K., Dayal, R. and Seshadri, T. R. (1974) *Curr. Sci.* **43**, 645 (*Chem. Abstr.* **82**, 28524r).
224. Sengupta, P. and Das, P. B. (1965) *J. Indian Chem. Soc.* **42**, 255.
225. Mazaki, T. and Aritomi, M. (1957) *Yakugaku Zasshi* **77**, 1353 (*Chem. Abstr.* **52**, 3930d).
226. Mazaki, T. and Aritomi, M. (1959) *Yakugaku Zasshi* **79**, 980. (*Chem. Abstr.* **53**, 22065e).
227. Anjaneyulu, V., Rao, D. N. and Row, L. R. (1964) *Curr. Sci.* **33**, 583 (*Chem. Abstr.* **61**, 15033q).
228. Anjaneyulu, V., Rao. D. N. and Row, L. R. (1967) *J. Indian Chem. Soc.* **44**, 123.
229. Sengupta, P. and Ghosh, S. (1964) *Indian J. Chem.* **2**, 298.
230. Dominguez, K. A., Rojas, P., Wiarco, M., Del, C. D. and Escarria, S. (1973) *Phytochemistry* **12**, 224.
231. Estrada, H. (1959) *Bol. Inst. Quim. Univ. Nac. Auton. Mex.* **11**, 151 (*Chem. Abstr.* **56**, 7706h).
232. Gupta, D. R. and Garg, S. K. (1966) *Bull. Chem. Soc. Jpn* **39**, 2532.
233. Mahato, S. B., Sahu, N. P. and Chakravarti, R. N. (1971) *Phytochemistry* **10**, 2847.
234. Anjaneyulu, V. and Row, L. R. (1965) *Curr. Sci.* **34** 608 (*Chem. Abstr.* **64**, 8639b).
235. Chatterjee, D. and Chakraborty, D. P. (1968) *J. Indian Chem. Soc.* **45**, 285.
236. Elgamal, M. H. A., El-Tawil, B. A. H. and Fayez, M. B. E. (1975) *Naturwissenschaften* **62**, 486.
237. Reyes, A., Vicuna, P. and Zarraga, A. (1977) *Rev. Latinoam. Quim.* **8**, 46 (*Chem. Abstr.* **86**, 117635c).
238. Ray, T. K., Misra, D. R. and Khastgir, H. N. (1975) *Phytochemistry* **14**, 1876.
239. Perold, G. W., Muller, J. C. and Ourisson, G. (1972) *Tetrahedron* **28**, 5797.
240. Chattopadhyay, S. and Pakrashi, S. C. (1975) *J. Indian Chem. Soc.* **52**, 553.
241. Hui, W. H., Lee, W. K., Ng, K. K. and Chan, C. K. (1970) *Phytochemistry* **9**, 1099.
242. Hui, W. H. and Li, M. M. (1978) *Phytochemistry* **17**, 156.
243. Anjaneyulu, A. S. R. and Murthy, V. S. (1977) *Planta Med.* **32**, 247.
244. Anjaneyulu, A. S. R. and Murthy, V. S. (1977) *Curr. Sci.* **46**, 776 (*Chem. Abstr.* **88**, 34526h).
245. Huneck, S. and Schreiber, K. (1975) *J. Hattori Bot. Lab.* **39**, 215 (*Chem. Abstr.* **84**, 118420z).
246. Kulshreshtha, D. K. (1977) *Phytochemistry* **16**, 1783.
247. Silva, M. and Sammes, P. G. (1973) *Phytochemistry* **12**, 1755.
248. Zalkow, L. H., Ekpo, B. A. and Burke, N. I. (1977) *Phytochemistry* **16**, 1610.
249. Takemoto, T. and Kusano, G. (1966) *Yakugaku Zasshi* **86**, 1116 (*Chem. Abstr.* **66**, 83101v).
250. Rizvi, S. A. I. and Sultana, T. (1973) *Planta Med.* **23**, 125.
251. Misra, G., Bhatnagar, S. C. and Nigam, S. K. (1974) *Planta Med.* **26**, 394.
252. Gunasekera, S. P. and Sultanbawa, M. U. S. (1977) *J. Chem. Soc. Perkin Trans.* 1, 418.
253. Arthur, H. R., Chan, R. P. K., Loo, S. N., Tam, S. W. and Tung, S. (1966) *Phytochemistry* **5**, 379.
254. Ohmoto, T. and Natori, S. (1969) *J. Chem. Soc. Chem. Commun.* 601.
255. Collin-Asselineau, C. and Asselineau, J. (1957) *Bull. Soc. Chim. Fr.* 1359.
256. Crabbé, P., Azpeitia, E. A. and Djerassi, C. (1961) *Bull. Soc. Chim. Belg.* **70**, 168 (*Chem. Abstr.* **55**, 23587f).
257. Gaind, K. N., Singla, A. K., Boar, R. B. and Copsey, D. B. (1976) *Phytochemistry* **15**, 1999.
258. Fonseeae Silva, L. G., Gottlieb, O. R. and Magalhaes, M. T. (1968) *Ann. Acad. Bras. Cienc.* **40**, 155 (*Chem. Abstr.* **70**, 35023g).
259. Flor, S. C., Doorenbos, N. J., Svoboda, G. H., Knapp, J. E. and Schiff, P. L., Jr. (1974) *J. Pharm. Sci.* **63**, 618.
260. Hui, W. H., Ko, P. D. S., Lee, Y. C., Li, M. M. and Arthur, H. R. (1975) *Phytochemistry* **14**, 1063.
261. Arthur, H. R., Ko, P. D. S. and Cheung, H. T. (1974) *Phytochemistry* **13**, 2551.
262. Hui, W. H., Li, M. M. and Lee, L. C. (1975) *J. Chem. Soc. Perkin Trans.* 1, 617.
263. Hui, W. H. and Li, M. M. (1977) *Phytochemistry* **16**, 111.
264. Sainsbury, M. and Webb, B. (1972) *Phytochemistry* **11**, 3541.
265. Hui, W. H., Li, M. M. and Ng, K. K. (1975) *Phytochemistry* **14**, 816.
266. Awasthi, Y. C. and Mitra, C. R. (1968) *Phytochemistry* **7**, 637.
267. Gunasekera, S. P., Kumar, V., Sultanbawa, M. U. S. and Balasubramaniam, S. (1977) *Phytochemistry* **16**, 923.
268. Nigam, S. K. and Mitra, C. R. (1964) *Indian J. Chem.* **2**, 378.
269. Wagner, H. and Burghart, J. (1977) *Planta Med.* **32A**, 9.
270. Hui, W. H. and Li, M. M. (1976) *Phytochemistry* **15**, 563.

271. Hsu, H. Y., Hong, M. and Chen, Y. P. (1972) *T'ai-wan Yao Hseuh Tsa Chih* **24**, 43 (*Chem. Abstr.* **81**, 23075q).
272. Kiang, A. K., Sim, K. Y. and Yoong, S. W. (1968) *Phytochemistry* **7**, 1035.
273. Kiang, A. K., Sim, K. Y. and Goh, J. (1965) *J. Chem. Soc.* 6371.
274. Hui, W. H., Chan, W. S. and Leung, H. K. (1973) *Phytochemistry* **12**, 474.
275. Kumar, P. and Sen, P. (1975) *Curr. Sci.* **44**, 889 (*Chem. Abstr.* **84**, 102317k).
276. Mukherjee, J. and Roy, B. (1970) *J. Indian Chem. Soc.* **47**, 176.
277. Kotaiah, Y., Lakshmi, N. K. M., Rao, E. V. and Rao, D. V. (1976) *Indian J. Pharm.* **38**, 130.
278. Corbett, R. E., Young, H. and Wilson, R. S. (1964) *Aust. J. Chem.* **17**, 712.
279. Fujita, E. and Sumi, A. (1967) *Yakugaku Zasshi* **87**, 1153 (*Chem. Abstr.* **68**, 10235y).
280. Chatterjee, A., Mukhopadhyay, S. and Chattopadhyay, K. (1976) *Tetrahedron* **32**, 3051.
281. Abe, H., Kawashima, T., Maruta, I., Kodama, M. and Ito, S. (1971) *Phytochemistry* **10**, 3330.
282. Kikuchi, T., Toyoda, T., Arimoto, M., Takayama, M. and Yamano, M. (1969) *Yakugaku Zasshi* **89**, 1358 (*Chem. Abstr.* **72**, 15713v).
283. Kikuchi, T., Niwa, M. and Masaki, N. (1972) *Tetrahedron Letters* 5249.
284. Kikuchi, T., Takayama, M., Toyoda, T., Arimoto, M. and Niwa, M. (1973) *Chem. Pharm. Bull.* **21**, 2243.
285. Kikuchi, T. and Niwa, M. (1973) *Yakugaku Zasshi* **93**, 1378 (*Chem. Abstr.* **80**. 27402w).
286. Tripathi, V. J. and Dasgupta, B. (1974) *J. Indian Chem. Soc.* **51**, 1057.
287. Misra, D. R. and Khastgir, H. N. (1969) *J. Indian Chem. Soc.* **46**, 843.
288. Takemoto, T., Yahagi, N. and Yamana, R. (1955) *J. Pharm. Soc. Jpn* **75**, 1164.
289. Hui, W. H., Li, M. M. and Wong, K. M. (1976) *Phytochemistry* **15**, 797.
290. Beri, R. M. (1970) *Indian J. Chem.* **8**, 469.
291. Takahashi, K., Tanabe, Y. and Hosoda, N. (1965) *Yakugaku Zasshi* **85**, 854 (*Chem. Abstr.* **64**, 1901f).
292. Banerji, A. and Das, R. (1977) *Indian J. Chem.* **15B**, 395.
293. Sen, P. and Kumar, P. (1976) *Planta Med.* **30**, 133.
294. Biessels, H. W. A., Van der Kerk-Van Hoof, A. C., Kettenes-Van den Bosch, J. J. and Salemink, C. A. (1974) *Phytochemistry* **13**, 203.
295. Barua, A. K. and Maiti, P. C. (1957) *Sci. Cult.* **23**, 155 (*Chem. Abstr.* **52**, 3049h).
296. Rizvi, S. A. I. and Sultana, T. (1972) *Phytochemistry* **11**, 856.
297. Fayez, M. B. E., Negm, S. A. R. and Sharaf, A. (1963) *Planta Med.* **11**, 439.
298. Garg, H. S. and Mitra, C. R. (1968) *Phytochemistry* **7**, 2053.
299. Sengupta, P. and Dey, A. K. (1972) *Tetrahedron* **28**, 1307.
300. Garg, H. S. and Mitra, C. R. (1971) *Planta Med.* **19**, 352.
301. Sengupta, P., Chakraborty, A. K., Duffield, A. M., Durham, L. J. and Djerassi, C. (1968) *Tetrahedron* **24**, 1205.
302. Chopra, G. R., Jain, A. C., Seshadri, T. R. and Sood, G. R. (1970) *Indian J. Chem.* **8**, 401.
303. Chopra, G. R., Jain, A. C. and Seshadri, T. R. (1969) *Curr. Sci.* **38**, 101 (*Chem. Abstr.* **70**. 106704t).
304. Garg, H. S. and Mitra, C. R. (1971) *Phytochemistry* **10**, 865.
305. Chopra, G. R., Jain, A. C. and Seshadri, T. R. (1968) *Curr. Sci.* **37**, 301 (*Chem. Abstr.* **69**, 93685q).
306. Chopra, G. R., Jain, A. C. and Seshadri, T. R. (1969) *Indian J. Chem.* **7**, 1179.
307. Chopra, G. R., Jain, A. C., Seshadri, T. R. and Sood, G. R. (1970) *Indian J. Chem.* **8**, 776.
308. Chakravarti, D., Chakravarti, N. and Samanta, S. (1964) *J. Indian Chem. Soc.* **41**, 859.
309. Chakravarti, N. N., Moitra, S. K., Ganguly, A. N. and Adhya, R. N. (1971) *Phytochemistry* **10**, 1403.
310. Chakravarti, D., Chakravarti, N. N. and Chakravarti, A. (1965) *J. Indian Chem. Soc.* **42**, 573.
311. Chakravarti, D., Roy, N. K. and Chakravarti, N. N. (1964) *J. Indian Chem. Soc.* **41**, 83.
312. Chakravarti, D., Bhattacharya, S. and Das, R. (1971) *J. Indian Chem. Soc.* **48**, 297.
313. Wrzeciono, U. (1962) *Rocz. Chem.* **36**, 1063 (*Chem. Abstr.* **59**, 7601a).
314. Wrzeciono, U. (1963) *Rozc. Chem.* **37**, 3 (*Chem. Abstr.* **59**, 6657c).
315. Kamano, Y., Tachi, Y., Otake, T., Sawada, J. and Tanaka, I. (1976) *Yakugaku Zasshi* **96**, 1202 (*Chem. Abstr.* **86**, 2379e).
316. Ohmoto, T., Nikaido, T. and Ikuse, M. (1972) *Shoyakugaku Zasshi* **26**, 36.
317. Arthur, H. R., Cheng, K. F., Lau, M. P. and Lie, K. J. (1965) *Phytochemistry* **4**, 969.
318. Hui, W. H. and Li, M. M. (1977) *J. Chem. Soc. Perkin Trans.* 1, 897.
319. Arthur, H. R., Hui, W. H., Lam, C. N. and Szeto, S. K. (1964) *Aust. J. Chem.* **17**, 697.
320. Hui, W. H., Ho, C. T. and Yee, C. W. (1964) *Aust. J. Chem.* **18**, 2043.
321. Suga, T. and Kondo, S. (1974) *Phytochemistry* **13**, 522.
322. Ribo, J. M. and Raventos, J. (1972) *Phytochemistry* **11**, 3089.
323. Kalra, V. K., Kukla, A. S. and Seshardi, T. R. (1966) *Curr. Sci.* **35**, 204 (*Chem. Abstr.* **65**, 2624f).
324. Kulshreshtha, D. K. and Rastogi, R. P. (1971) *Phytochemistry* **10**, 2831.
325. Jyoti, M. and Rastogi, R. P. (1970) *Indian J. Pharm.* **32**, 167.
326. Ryabinin, A. A. and Lopunova, V. F. (1961) *Zh. Obshch. Khim.* **31**, 3478 (*Chem. Abstr.* **57**, 873e).
327. Wrzeciono, U. (1963) *Rozc. Chem.* **37**, 1457 (*Chem. Abstr.* **60**, 8069g).
328. Mohan, H. (1975) *Nat. Appl. Sci. Bull.* **27**, 91 (*Chem. Abstr.* **86**, 185951c).
329. Onishi, Y. and Hanaoka, M. (1968) *Yakugaku Zasshi* **88**, 1244 (*Chem. Abstr.* **70**, 25749j).
330. Kamano, Y., Tachi, Y., Otake, T. and Komatsu, M. (1968) *Yakugaku Zasshi* **88**, 1246 (*Chem. Abstr.* **70**, 26403d).
331. Sorm, F. and Bazant, V. (1950) *Collect. Czech. Chem. Commun.* **15**, 73.
332. Das, S. and Bhattacharya, A. K. (1968) *J. Indian. Chem. Soc.* **45**, 995.
333. Belova, N. V. and Fokina, G. A. (1970) *Khim. Prir. Soedin.* **6**, 137 (*Chem. Abstr.* **73**, 73829u).
334. Maiti, P. C., Kanji, S. K. and Chatterjee, R. (1967) *J. Proc. Inst. Chem.* **39**, 165 (*Chem. Abstr.* **68**, 19539h).
335. Rangaswami, S. and Sambamurthy, K. (1961) *Proc. Indian Acad. Sci. Sect. A* **53**, 98.
336. Arthur, H. R., Tam, S. W. and Angsusingh, V. (1960) *Aust. J. Chem.* **13**, 506.
337. Rangaswami, S. and Sambamurthy, K. (1961) *Proc. Indian Acad. Sci. Sect. A* **54**, 99.

338. Mir, I., Ahmad, S. and Bachelor, F. W. (1973) *Pak. J. Sci. Ind. Res.* **16**, 224.
339. Rangaswami, S. and Sambamurthy, K. (1961) *J. Sci. Ind. Res.* **20B**, 610.
340. Kurihara, T., Kikuchi, M., Suzuki, S. and Toyoda, E. (1976) *Yakugaku Zasshi* **96**, 1407 (*Chem. Abstr.* **86**, 117585m).
341. Fokina, G. A., Belova, N. V. and Gorovoi, P. G. (1971) *Khim. Prir. Soedin.* **7**, 377 (*Chem. Abstr.* **75**, 115849z).
342. Sengupta, P., Ghosh, S. and Sen, M. (1969) *J. Indian Chem. Soc.* **46**, 379.
343. Rangaswami, S. and Venkateswarlu, P. (1965) *Proc. Indian Acad. Sci. Sect. A* **62**, 224.
344. Sengupta, P. and Dey, A. K. (1970) *J. Indian Chem. Soc.* **47**, 713.
345. Takemoto, T. and Yahagi, N. (1958) *Yakugaku Zasshi* **78**, 304 (*Chem. Abstr.* **52**, 12892f).
346. Rangaswami, S. and Sambamurthy, K. (1959) *Proc. Indian Acad. Sci. Sect. A.* **50**, 366.
347. Sharma, S. C., Skukla, Y. N. and Tandon, J. S. (1972) *Phytochemistry* **11**, 2621.
348. Auf dem Keller, S., Von Kuerten, S., Pachaly, P. and Zymalkowski, F. (1970) *Pharmazie* **25**, 621.
349. Sambamurthy, K. and Babu, M. R. (1970) *Curr. Sci.* **39**, 110 (*Chem. Abstr.* **73**, 22115a).
350. Koyama, S. and Kumazawa, Z., (1974) *Mie Daigaku Nogakubu Gakujutsu Hokoku* **47**, 325 (*Chem. Abstr.* **81**, 101857n).
351. Arthur, H. R. and Hui, W. H. (1961) *J. Chem. Soc.* 551.
352. Hui, W. H., Li, M. M. and Luk, K. (1975) *Phytochemistry* **14**, 833.
353. Reddy, G. C. S., Ayengar, K. N. N. and Rangaswami, S. (1975) *Indian J. Chem.* **13**, 342.
354. Rangaswami, S. and Tewari, N. C. (1971) *Curr. Sci.* **40**, 36 (*Chem. Abstr.* **75**, 1271z).
355. Joshi, R. S. and Viswanathan, N. (1974) *Indian J. Chem.* **12**, 894.
356. Tewari, N. C., Ayengar, K. N. N. and Rangaswami, S. (1971) *Curr. Sci.* **40**, 601 (*Chem. Abstr.* **76**, 34426c).
357. Rogers, D., Williams, D. J., Joshi, B. S., Kamat, V. N. and Viswanathan, N. (1974) *Tetrahedron Letters* 63.
358. Tewari, N. C., Ayengar, K. N. N. and Rangaswami, S. (1974) *J. Chem. Soc. Perkin Trans.* 1, 146.
359. Joshi, B. S., Kamat, V. N. and Viswanathan, N. (1973) *Tetrahedron* **29**, 1365.
360. Nonomura, S. (1955) *J. Pharm. Soc. Jpn* **75**, 3103 (*Chem. Abstr.* **50**, 8543f).
361. Taylor, D. A. **11**. (1967) *J. Chem. Soc. C* 490.
362. Hui, W. H., Fung, T. L. and Ng, K. K. (1969) *Phytochemistry* **8**, 331.
363. Toth, L., Haznagy, A. and Snatzke, G. (1969) *Herba Hung.* **8**, 145 (*Chem. Abstr.* **72**, 114841s).
364. Torrance, J. D. and Marais, J. L. C. (1963) *J. Pharm. Sci.* **52**, 439.
365. Mathur, S. B. (1972) *Phytochemistry* **11**, 449.
366. Kiang, P. C. (1923) *China Med. J.* **37**, 142. (via ref. [221]).
367. El Said, F., Sofowara, E. A., Salami, M. A. and Sainsbury, M. (1971) *Phytochemistry* **10**, 1940.
368. Tin-Wa, W. M., Scora, R. W. and Kumamoto, J. (1972) *Lloydia* **35**, 183.
369. Knaji, S. and Bhattacharya, A K., (1970) *J. Indian Chem. Soc.* **47**, 95.
370. Chou, C. J., Wang, C. B. and Lin, L. C. (1977) *J. Chin. Chem. Soc.* **24**, 195 (*Chem. Abstr.* **88**, 117815c).
371. Candy, H. A., McGarry, E. J. and Pegel, K. H. (1968) *Phytochemistry* **7**, 889.
372. Gunasekera, S. P. and Sultanbawa, M. U. S. (1973) *Tetrahedron Letters* 2837.
373. Gunasekera, S. P. and Sultanbawa, M. U. S. (1977) *J. Chem. Soc. Perkin Trans.* 1, 483.
374. Yasue, M., Sakakibara, J. and Ina, H. (1971) *Yakugaku Zasshi* **91**, 1252 (*Chem. Abstr.* **76**, 56610k).
375. Yasue, M., Sakakibara, J., Ina, H. and Yanagisawa, I. (1974) *Yakugaku Zasshi* **94**, 1634 (*Chem. Abstr.* **82**, 108822b).
376. Yasue, M., Sakakibara, J. and Ina, H. (1973) *Yakugaku Zasshi* **93**, 687 (*Chem. Abstr.* **79**, 63560j).
377. Walther, H., Hobert, H. and Wachtel, H. (1976) *Pharmazie* **31**, 578.
378. Takemoto, T. and Takeshita, Y. (1970) *Yakugaku Zasshi* **90**, 1057 (*Chem. Abstr.* **73**, 127786y).
379. Sakakibara, J., Kaiya, T. and Yasue, M. (1973) *Yakugaku Zasshi* **93**, 164 (*Chem. Abstr.* **78**, 145234z).
389. Yasue, M., Itaya, M., Oshima, H. and Funahashi, S. (1965) *Yakugaku Zasshi* **85**, 553 (*Chem. Abstr.* **63**, 6021b).
381. Sheth, K., Constantine, G. H., Jr., Williams, D. K. and Catalfomo, P. (1968) *Phytochemistry* **7**, 1379.
382. Ribas-Marques, I. and Fernandez-Salgado, J. (1974) *An. Quim.* **70**, 363 (*Chem. Abstr.* **81**, 117050e).
383. Nees, H., Pachaly, P. and Zymalkowski, F. (1973) *Planta Med.* **24**, 320.
384. Baker, P. M., Fortes, C. C., Fortes, E. G., Gazzinelli, G., Gilbert, B., Lopes, J. N. C., Pellegrino, J., Tomassini, T. C. B. and Vichnewski, W. (1972) *J. Pharm. Pharmacol.* **24**, 853.
385. Ladwa, P. H. and Dutta, N. L. (1969) *Indian J. Appl. Chem.* **32**, 399.
386. Biglino, G. (1968) *Corsi Semin. Chim.* **11**, 72 (*Chem. Abstr.* **72**, 14065y).
387. Vedantham, T. N. C. and Subramanian, S. S. (1976) *Indian J. Pharm.* **38**, 13.
388. Sarin, J. P. S., Garg, H. S., Khanna, N. M. and Dhar, M. M. (1975) *Indian J. Chem.* **13**, 199.
389. Trease, G. E. and Evans, W. C. (1971) *Pharmacognosy*, 10th edn. Williams and Wilkins, Baltimore.