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REVIEW

OCCURRENCE AND DISTRIBUTION OF FREE FLAVONOID AGLYCONES IN PLANTS

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Key Word Index—Flavonoids; free aglycones; distribution; correlation with secretory structures.

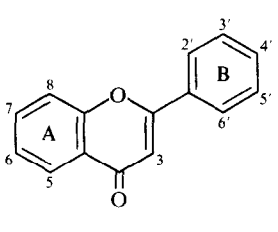
Abstract—Flavonoids are widely present in plants as water-soluble glycosides but the lipophilic free aglycones are far less abundant. The 462 flavonoids reported so far to be present in the free state and their plant sources are listed. Evaluation of these data reveals a correlation in most cases between the occurrence of flavonoid aglycones, the presence of secretory structures and the production of other lipophilic plant products. Their accumulation in some plant organs and in certain taxa is discussed. Special attention is given to their occurrence in materials deposited externally on leaves and buds.

More than 2000 flavonoids are known at present [1], and new ones are reported every month. They are present mainly as glycosides, which being water-soluble are located in the cell sap. Free aglycones have also been found in various plants in increasing numbers. However, little attention has been paid as to whether they are genuinely present in the free state, and even less to the fact that their occurrence may be associated with secretory structures or else that they are deposited externally. We began to work in this field with studies on bud excretions in *Populus*, in *Aesculus* and in Betulaceae, as well as on the 'farina' of *Primula* species. As it turned out, a wide array of more or less lipophilic aglycones are present in such materials, in much greater profusion than the earlier literature suggested. All literature reports on flavonoid aglycones occurring in the free state have now been collected together and are presented here for the benefit of other workers.

The present data relate to the flavones, flavonols, flavanones, dihydroflavonols, chalcones and dihydrochalcones, i.e. six of the eight major classes of flavonoids. Isoflavonoids and biflavonoids have been omitted because the available data are very incomplete. The same is true for chromenoflavonoids, neoflavonoids, furano- and pyrano-flavonoids and for methylenedioxy- and prenylated compounds. Only aglycones that have been reported to occur in the free state are included. Whenever this could not be elucidated with certainty, the plant name is marked with an asterisk; e.g. the presence of free baicalein in roots and leaves of *Scutellaria* is somewhat dubious, since this plant is known to have a very active glucuronidase and it is possible that enzymatic hydrolysis of the 7-glucuronide present may occur during extraction (J. B. Harborne, personal communication). We are sceptical also in the case of some reports of free taxifolin (unless in wood) and free quercetagetin; these compounds usually occur in glycosidic composition.

In the first column of Table 1, the flavonoids are listed according to the number of hydroxyl groups of their basic substitution patterns; the respective methyl derivatives are indented. We use the preferred convention of listing A-ring substituents in ascending order before B-ring substituents, e.g. we use 3,5,7,2′,4′-OH flavone rather than 2′,3,4′,5,7-OH flavone. In the second column we list the trivial names whenever such names have been given. An alphabetical list of all trivial names used here is presented in Table 3. In the third column of Table 1 the plant species follow, listed alphabetically within the families, which in turn are arranged alphabetically within the groups of angiosperms, gymnosperms and cryptogams. Families are indicated by abbreviations but full names are given in Table 3. Only two species of a given genus are normally noted; if there are up to five species, this is stated; for more (or when the number is unknown) 'spp.' is used. In the next column the part of plant is indicated, wherever possible. In instructions to authors of this journal for 1980 the following statement is highlighted: "It is essential to state the organ of the plant from which the substance is obtained" [2]. This is still not always given. Whenever possible, we cite the original literature, and mostly the first mention of a particular compound. However, if the first report of a substance from a species has been confirmed by a later report of the same substance from several species of that genus, we cite the latter reference only, since the earlier reference is usually available therein.

To avoid confusion in the numbering of positions, we give here the two systems in use for flavones, flavonols, flavanones and dihydroflavonols (**1**) on the one hand, and for chalcones and dihydrochalcones (**2**) on the other hand (single bond/double bond in ring C is neglected).



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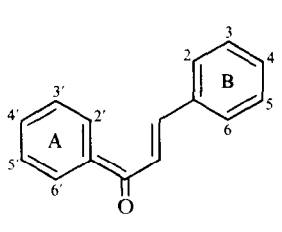

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Table 1. Flavonoid aglycones found to occur in the free state (Where presence as the free aglycone is not beyond all doubt, the compound is marked with ×. External occurrence is indicated by ● throughout this table. OMe = *O*-methyl ether. Plant family names abbreviated here are given in full in Table 2)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
1.1 FLAVONES				
	Flavone	*Dionysia* 3 sp. (Prim.)	21	Farinose exudate on leaves and inflorescence
		Primula spp.● (Prim.)	28	Farinose exudate on aerial parts
5-OH	Primuletin	*Primula* spp.● (Prim.)	28	Farinose exudate on aerial parts
2′-OH 5,6-OH		*Primula* spp. (Prim.)	28	Farinose exudate on aerial parts
6-OMe		*Primula sinensis*● (Prim.)	29	Farinose exudate on aerial parts
5,6-OMe		*Casimiroa edulis* (Rut.)	30	Bark
		Sargentia greggi (Rut.)	31	Fruit, stem, leaf
5,7-OH	Chrysin	*Pinus* subg. *Haploxylon* (Pin.)	32	Heartwood
		Flourensia resinosa● (Ast.)	33	Leaf
		Oroxylum indicum (Bign.)	34	Stem bark
		Prunus spp. (Ros.)	35	Wood
		Populus spp.● (Salica.)	36	Bud excretion
7-OMe	Tectochrysin	*Pinus* subg. *Haploxylon* (Pin.)	32	Leaf, bud, heartwood
		Andrographis serpyllifolia (Acanth.)	37	Leaf
		Flourensia resinosa● (Ast.)	33	Leaf
		Prunus spp. (Ros.)	35	Heartwood
		Populus spp.● (Salica.)	36	Bud excretion
5,7-OMe		*Helichrysum herbaceum* (Ast.)	38	Aerial parts
5,8-OH	Primetin	*Primula* spp.● (Prim.)	28	Farinose exudate on aerial parts
5,2′-OH		*Primula* spp.● (Prim.)	28	Farinose exudate on aerial parts
7,4′-OH		*Medicago sativa* (Leg.)	39	Leaf, wood
		Trifolium repens (Leg.)	39	Leaf, wood
3′,4′-OH		*Primula* spp.● (Prim.)	28	Farinose exudate on aerial parts
5,6,7-OH	Baicalein	*Oroxylum indicum* (Bignon.)	8	Root, seed
		Scutellaria baicalensis (Lam.)	8	Root, leaf
6-OMe	Oroxylon (oroxylin A)	*Oroxylum indicum* (Bignon.)	8	Bark
6,7-OMe		*Popowia cauliflora* (Annon.)	40	Stem
5,6,7-OMe		*Popowia cauliflora* (Annon.)	40	Stem

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Zeyhera tuberculosa (Bignon.)	41	Leaf
		Colebrookia oppositifolia (Lam.)	42	Leaf
		Kickxia lanigera (*Scroph.*)	43	Whole plant
		Callicarpa japonica (Verb.)	44	Leaf
5,7,8-OH	Norwogonin			
8-OMe	Wogonin	*Anodendron affine* (Apocyn.)	45	Stem
		Scutellaria baicalensis (Lam.)	8	Root
7,8-OMe		*Andrographis paniculata* (Acanth.)	46	Tissue culture
		Gnaphalium pellitum (Ast.)	47	Inflorescence
5,7,8-OMe		*Helichrysum mundii* (Ast.)	48	Aerial parts
		Actinodaphne madraspatana (Laura.)	49	Heartwood
5,6,2′-OH 5,6,2′-OMe		*Casimiroa edulis* (Rut.)	50	Fruit peel
5,6,3′-OH 5,6,3′-OMe		*Casimiroa edulis* (Rut.)	51	Seed
5,7,2′-OH 7-OMe	Echioidinin	*Andrographis echioides* (Acanth.)	52	Whole plant
		Andrographis wightiana (Acanth.)	52	Whole plant
5,7,4′-OH	Apigenin	*Barleria christata* (Acant.)	53	Flower
		Chrysanthemium cinerariaefolium (Ast.)	54	Stem, leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Garcinia multiflora (Hyper.)	56	Heartwood
		Coleus amboinicus (Lam.)	57	Leaf
		Salvia glutinosa● (Lam.)	58	Exudate on aerial parts
		Acacia ixiophylla (Leg.)	59	Leaf
		Crudia amazonia× (Leg.)	60	Wood
		Prosopis spp. (Leg.)	61	Leaf
		Elaegia utilis (Rub.)	14	Bud excretion
		Populus spp.● (Salica.)	36	Bud excretion
		Antirrhinum spp. (Scroph.)	8	Flower
		Larrea divaricata● (Zygo.)	22	Resin on leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Larrea tridentata● (Zygo.)	22	Resin on leaf
		Cheilanthes spp.● (Polypod.)	62	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
5-OMe	Thevetiaflavone	*Thevetia peruviana* (Apo.)	63	Seed
7-OMe	Genkwanin	*Artemisia capillaris* (Ast.)	64	Aerial parts
		Eupatorium capillifolium (Ast.)	65	Aerial parts
		Eupatorium perfoliatum (Ast.)	65	Aerial parts
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Beyeria spp. (Euphorb.)	66	Whole plant
		Rosmarinus officinalis (Lam.)	67	Leaf
		Salvia glutinosa● (Lam.)	58	Exudate on aerial parts
		Salvia officinalis (Lam.)	68	Leaf
		Populus tremuloides (Salica.)	36	Bud excretion
		Daphne genkwa (Thymae.)	8	Flower
		Larrea divaricata● (Zygo.)	22	Resin on leaf
		Larrea tridentata● (Zygo.)	22	Resin on leaf
		Cheilanthes farinosa● ("*longissima*") (Polypod.)	17	Farinose exudate on fronds
		Cheilanthes spp.● (Polypod.)	69	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	69	Farinose exudate on fronds
		Pityrogramma tartarea● (Polypod.)	70	Farinose exudate on fronds
4′-OMe	Acacetin	*Artemisia pygmaea* (Ast.)	71	Stem, leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya japonica● (Bet.)	55	Bud excretion
		Robinia pseudacacia (Leg.)	8	
		Populus spp.● (Salica.)	36	Bud excretion
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
7,4′-OMe		*Andrographis serpyllifolia* (Acanth.)	37	Leaf
		Andrographis paniculata (Acanth.)	72	Root
		Baccharis crispa (Ast.)	73	Aerial parts
		Alnus japonica● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Betula rhomboidalis (Bet.)	74	Leaf
		Beyeria spp. (Euphorb.)	66	Leaf, terminal branches
		Sideritis gomerae (Lam.)	75	Aerial parts
		Piper peepuloides (Piper.)	76	Fruit
		Acacia ixiophylla (Leg.)	59	Leaf
		Elaegia utilis● (Rub.)	14	Bud excretion
		Cheilanthes spp.● (Polypod.)	69	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	69	Farinose exudate on fronds
		Pityrogramma tartarea● (Polypod.)	77	Farinose exudate on fronds
5,8,2′-OH		*Primula* spp.● (Prim.)	28	Farinose exudates on aerial parts
7,3′,4′-OH		*Trifolium repens* (Leg.)	8	Leaf
		Trifolium subterraneum (Leg.)	78	Leaf
		Salvertia convallariodora (Vochys.)	79	Leaf
		Vochysia cinnamonea (Vochys.)	79	Leaf
		Vochysia tucanorum (Vochys.)	79	Leaf
		Juncus trifidus (Junca.)	80	Stem, leaf
		Luzula purpurea (Junca.)	80	Stem, leaf
3′-OMe	Geraldone	*Trifolium subterraneum* (Leg.)	81	Leaf
		Salvertia convallariodora (Vochys.)	79	Leaf
		Vochysia cinnamonea (Vochys.)	79	Leaf
7,4′-OMe	Tithonin	*Tithonia tubaeformis* (Ast.)	82	
5,6,7,8-OH, 6,7-OMe		*Helichrysum herbaceum* (Ast.)	38	Aerial parts
5,6,7-OMe		*Helichrysum herbaceum* (Ast.)	38	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
6,7,8-OMe	Alnetin	*Alnus sieboldiana* ● (Bet.)	83	Male flower
5,6,7,8-OMe		*Helichrysum herbaceum* (Ast.)	38	Aerial parts
		Zeyhera tuberculosa (Bignon.)	41	Leaf
		Lindera lucida (Laura.)	84	Root
5,6,7,4'-OH	Scutellarein	*Oroxylum indicum* (Bign.)	34	Leaf
		Scutellaria spp. (Lam.)	8	Leaf
		Scoparia dulcis (Sroph.)	85	Leaf
		Clerodendron phlomides (Verb.)	86	Leaf
		Duranta repens (Verb.)	86	Leaf
6-OMe	Hispidulin, dinatin	*Ambrosia dumosa* (Ast.)	87	Leaf
		Ambrosia hispida (Ast.)	88	Whole plant
		Centaurea arguta (Ast.)	89	Leaf
		Flourensia viscosum var. *bracteatum* (Ast.)	90	Whole plant
		Gaillardia spp. (Ast.)	87	Leaf
		Helenium spp. (Ast.)	87	Leaf
		Hymenoxis spp. (Ast.)	87	Leaf
		Iva frutescens spp. *oraria* (Ast.)	81	Aerial parts
		Iva hayesiana (Ast.)	92	Aerial parts
		Iva nevadensis (Ast.)	93	Whole plant
		Plummera ambigens (Ast.)	87	Leaf
		Plummera floribunda (Ast.)	87	Leaf
		Ratibida columnaris (Ast.)	87	Leaf
		Betula verrucosa ● (Bet.)	94	Bud excretion
		Salvia officinalis (Lam.)	68	Leaf
		Digitalis ferruginea (Scroph.)	95	Leaf
		Digitalis schischkinii (Scroph.)	96	Leaf
7-OMe	Sorbifolin	*Anvillea garcini* (Ast.)	97	Leaf
		Pleocarphus revolutus (Ast.)	98	Leaf, stem

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Sorbaria stellipila (Ros.)	99	Leaf, stem
		Scoparia dulcis[×] (Scroph.)	85	Leaf
4′-OMe		*Clerodendron inerme* (Verb.)	100	Leaf
6,7-OMe	Cirsimaritin, scrophulein	*Betula nigra*[●] (Bet.)	101	Bud excretion
		Artemisia capillaris (Ast.)	64	Aerial parts
		Brickellia californica (Ast.)	102	Leaf
		Helenium spp. (Ast.)	103	
		Helichrysum viscosum var. *bracteatum* (Ast.)	104	Whole plant
		Flourensia cernua (Ast.)	90	Plant heads
		Coleus amboinicus (Lam.)	57	Leaf
		Coleus aromaticus (Lam.)	105	Leaf
		Salvia officinalis (Lam.)	68	Leaf
		Salvia tomentosa (Lam.)	106	Leaf
		Sideritis dasygnaphala (Lam.)	75	Aerial parts
		Teucrium pelium (Lam.)	106	Aerial parts
6,4′-OMe	Pectolinarigenin	*Brickellia californica* (Ast.)	102	Leaf
		Brickellia dentata (Ast.)	108	Leaf
		Cirsium oleraceum (Ast.)	8	Leaf
		Hymenoxys rusbyi (Ast.)	109	Aerial parts
		Iva frutescens (Ast.)	91	Aerial parts
		Iva nevadensis (Ast.)	93	Whole plant
		Plummera floribunda (Ast.)	110	Aerial parts
		Plummera ambigua (Ast.)	110	Aerial parts
		Alnus spp.[●] (Bet.)	55	Bud excretion
		Betula spp.[●] (Bet.)	55	Bud excretion
		Sideritis dasygnaphala[●] (Lam.)	75	Aerial parts
		Cassia reniger (Leg.)	111	Stem, bark
		Digitalis schischkinii (Scroph.)	96	Leaf
		Linaria japonica (Scroph.)	8	Leaf, flower

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Clerodendron inerme (Verb.)	100	Leaf
		Clerodendron phlomides (Verb.)	86	Leaf
		Duranta repens (Verb.)	86	
7,4′-OMe		*Catalpa bignonioides* (Bignon.)	112	Seed
		Nepeta hindustana× (Lam.)	113	Aerial parts
6,7,4′-OMe	Salvigenin, psathyrotin	*Ageratina gilbertii* (Ast.)	114	Aerial parts
		Brickellia dentata (Ast.)	108	Leaf
		Eupatorium odoratum (Ast.)	115	Whole plant
		Mikania cordata (Ast.)	8	Leaf
		Psathyrothes annua (Ast.)	116	Leaf
		Alnus 4 sp.● (Bet.)	55	Bud excretion
		Betula nigra● (Bet.)	55	Bud excretion
		Phyllarthron madagascariensis (Bignon.)	117	Leaf
		Salvia aethiopia (Lam.)	118	Whole plant
		Coleus amboinicus (Lam.)	57	Leaf
		Salvia triloba (Lam.)	119	Leaf, stem
		Sideritis dasygnaphala (Lam.)	75	Aerial parts
5,6,7,4′-OMe		*Chromolaena odorata* (Ast.)	120	Aerial parts
		Citrus aurantium var. *amara* (Rut.)	121	Fruit peel
		Citrus sinensis (Rut.)	122	Fruit peel
		Citrus cult. "calamondin" (Rut.)	123	Fruit peel
		Kickxia lanigera (Scroph.)	43	Whole plant
		Callicarpa japonica (Verb.)	44	Leaf
		Colebrookia oppositifolia (Verb.)	42	Leaf
		Marrubium peregrinum (Lam.)	503	
5,7,8,2′-OH		*Scutellaria litwinowii*× (Lam.)	124	Root
7,8-OMe	Skullcapflavone I	*Scutellaria baicalensis* (Lam.)	125	Root
		Andrographis paniculata (Acanth.)	46	Tissue culture

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
7,8,2′-OMe		*Andrographis paniculata* (Acanth.)	46	Tissue culture
5,7,8,4′-OH	Isoscutellarein	*Pinguicula vulgaris* (Lentibul.)	126	Leaf
7-OMe	Salvitin	*Salvia plebeja* (Lam.)	127	Flowers
8-OMe		*Gardenia lucida* (Rub.)	128	Dikamali gum
		Gardenia gummifera (Rub.)	128	Dikamali gum
8,4′-OMe	Cirsitakaogenin	*Cirsium japonicum* var. *takaoense* (Ast.)	129	Leaf
5,7,8,4′-OMe		*Citrus aurantinum* var. *amara* (Rut.)	121	Fruit peel
		Citrus paradisi × *reticulata* (Rut.)	130	Fruit peel
		Citrus sinensis (Rut.)	130	Fruit peel
		Citrus cult. "calamondin" (Rut.)	123	Fruit peel
5,6,2′,6′-OH				
6,2′,6′-OMe	Zapotinin	*Casimiroa edulis* (Rut.)	131	Fruit, bark
5,6,2′,6′-OMe	Zapotin	*Casimiroa edulis* (Rut.)	131	Fruit, bark
5,6,3′,5′-OH				
5,6,3′,5′-OMe	Cerrosillin	*Casimiroa edulis* (Rut.)	51	Seed
		Sargentia greggi (Rut.)	31	Fruit, stem, leaf
5,7,2′,4′-OH	Norartocarpetin	*Artocarpus* spp. (Mora.)	132	Heartwood
7-OMe	Artocarpetin	*Artocarpus heterophyllus* (Mora.)	133	Heartwood
		Artocarpus hirsutus (Mora.)	133	Heartwood
5,7,2′,4′-OMe		*Terminalia arjuna* (Combret.)	134	Fruit
5,7,3′,4′-OH	Luteolin	*Vernonia pectoralis* (Ast.)	135	Aerial parts
		Ceratodon purpureus (Ditricha.)	136	Sporophyte
		Coleus amboinicus (Lam.)	57	Leaf
		Salvia officinalis (Lam.)	68	Leaf
		Crotalaria striata (Lcg.)	137	Seeds
		Prosopsis spp. (Leg.)	61	Leaf
		Reseda luteola (Reseda.)	8	Whole plant
		Notholaena californica● (Polypod.)	138	Farinose exudate on fronds

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
5-OMe		*Juncus* spp. (Junca.)	80	Leaf, stem
		Luzula spp. (Junca.)	80	Leaf, stem
7-OMe		*Sorghum darra* (Poa.)	139	Glume
		Notholaena californica● (Polypod.)	138	Farinose exudate on fronds
3′-OMe	Chrysoeriol	*Coleus amboinicus* (Lam.)	57	Leaf
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
4′-OMe	Diosmetin	*Brickellia laciniata* (Ast.)	140	Leaf
		Stemodia viscosa× (Scroph.)	85	Leaf
7,3′-OMe	Velutin	*Vernonia flexuosa* (Ast.)	141	Aerial parts
		Ceanothus velutinus (Rhamna.)	142	Leaf, bark, root
		Larrea divaricata● (Zygophyll.)	22	Resin on leaf
		Larrea tridentata● (Zygophyll.)	22	Resin on leaf
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7,4′-OMe	Pilloin	*Baccharis crispa* (Ast.)	73	Aerial parts
		Lychnophora affinis (Ast.)	143	Leaf, stem
		Alnus japonica (Bet.)	144	Bud excretion
		Ovidia pillo-pillo (Commelin.)	145	Leaf, branches
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7,3′4′-OMe		*Lychnophora affinis* (Ast.)	143	Leaf, stem
		Betula nigra● (Bet.)	33	Bud excretion
		Salvia aethiopis (Lam.)	118	Whole plant
		Piper peepuloides (Piper.)	76	Whole plant
		Turnera diffusa (Turner.)	146	Aerial parts
5,7,3′,4′-OMe		*Merillia caloxylon* (Rut.)	147	Fruit
5,6,7,8,4′-OH 6,8-OMe	Desmethoxy-sudachitin	*Hymenoxis scaposa* (Ast.)	148	Leaf
		Gardenia gummifera (Rub.)	128	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
		Citrus sudachi (Rut.)	149	Fruit
6,7,8-OMe	Xanthomicrol	*Sideritis dasygnaphala* (Lam.)	75	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Citrus reticulata (Rut.)	150	Leaf
6,8,4′-OMe	Nevadensin	*Helianthus pumilis* (Ast.)	151	Whole plant
		Iva nevadensis (Ast.)	93	Aerial parts
		Gardenia lucida (Rub.)	152	Dikamali gum
		Gardenia gummifera (Rub.)	152	Dikamali gum
5,6,8,4′-OMe		*Helichrysum herbaceum* (Ast.)	38	Aerial parts
6,7,8,4′-OMe	Gardenin B, desmethyl-tangeritin	*Brickellia squarrosa* (Ast.)	153	
		Gardenia lucida (Rub.)	152	Dikamali gum
		Gardenia gummifera (Rub.)	152	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
		Citrus jambhiri (Rut.)	154	Fruit peel
		Citrus cult. (Rut.)	130	Fruit peel, juice
5,6,7,8,4′-OMe	Tangeritin	*Citrus* spp. (Rut.)	8	Fruit peel
		Citrus reticulata (Rut.)	150	Fruit peel
		Citrus cult. "calamondin" (Rut.)	130	Fruit peel
5,6,7,3′,4′-OH 6-OMe	Nepetin, eupafolin	*Anvillea garcini* (Ast.)	97	Leaf
		Brickellia californica (Ast.)	102	Leaf
		Brickellia dentata (Ast.)	108	Leaf
		Digitalis schischkinii (Scroph.)	96	Leaf
		Eupatorium cuneifolium (Ast.)	155	Leaf, stem, flower
		Eupatorium subhastatum (Ast.)	156	Aerial parts
		Helenium spp. (Ast.)	103	?
		Nepeta hindustana[×] (Lam.)	113	Aerial parts
		Salvia officinalis[●] (Lam.)	68	Leaf
7-OMe	Pedalitin	*Eupatorium inulaefolium* var. *suaveolens* (Ast.)	157	Aerial parts
3′-OMe	Nodifloretin, batatifolin	*Mikania batatifolia* (Ast.)	158	Aerial parts
		Neurolaena oaxacana (Ast.)	159	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Lippia nodiflora (Verb.)	160	Leaf
6,7-OMe	Cirsiliol	*Brickellia californica* (Ast.)	102	Leaf
		Brickellia dentata (Ast.)	108	Leaf
		Salvia officinalis (Lam.)	68	Leaf
6,3′-OMe	Jaceosidin	*Artemisia dracunculoides* (Ast.)	161	Aerial parts
		Centaurea arguta (Ast.)	89	Leaf
		Helenium alternifolium (Ast.)	162	Aerial parts
		Helichrysum viscosum var. *bracteatum* (Ast.)	104	Aerial parts
		Plummera floribunda (Ast.)	110	?
		Plummera ambigens (Ast.)	110	?
		Salvia tomentosa (Lam.)	106	Leaf
		Digitalis lanata (Scroph.)	163	Leaf
6,4′-OMe	Desmethoxy-centaureidin	*Brickellia californica* (Ast.)	102	Leaf
		Brickellia laciniata (Ast.)	140	Leaf
		Centaurea nigrescens (Ast.)	164	Aerial parts
		Centaurea phrygia (Ast.)	164	Aerial parts
7,4′-OMe		*Eupatorium inulaefolium* var. *suaveolans* (Ast.)	157	Aerial parts (?)
6,7,3′-OMe	Cirsilineol fastigenin, anisomelin	*Ajania fastigiata*[×] (Ast.)	165	
		Artemisia capillaris[×] (Ast.)	64	
		Artemisia herba-alba (Ast.)	166	Aerial parts
		Anisomeles malabarica (Lam.)	167	Aerial parts
		Salvia tomentosa (Lam.)	106	Aerial parts
		Sideritis mugronensis (Lam.)	168	Aerial parts
6,7,4′-OMe	Eupatorin	*Centaurea pseudomaculosa* (Ast.)	169	Aerial parts
		Eupatorium altissimum (Ast.)	170	Aerial parts
		Eupatorium semiserratum (Ast.)	170	Aerial parts
		Brickellia laciniata (Ast.)	140	Leaf
		Brickellia dentata (Ast.)	140	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Orthosyphon stamineus (Lam.)	171	Aerial parts
		Otostegia limbata (Lam.)	172	Stem
		Salvia lavanduloides (Lam.)	153	?
6,3′,4′-OMe	Eupalitin	*Eupatorium semiserratum* (Ast.)	169	Aerial parts
		Sideritis gomerae (Lam.)	75	Aerial parts
5,6,7,4′-OMe		*Orthosyphon stamineus* (Lam.)	171	
6,7,3′,4′-OMe		*Centaurea pseudomaculosa* (Ast.)	169	Aerial parts
		Eupatorium altissimum (Ast.)	170	Whole plant
		Otostegia limbata (Ast.)	172	Stem
		Salvia lavanduloides (Lam.)	153	Whole plant
		Salvia tomentosa (Lam.)	106	Leaf
		Sideritis mugronensis (Lam.)	168	Aerial parts
		Sideritis gomerae (Lam.)	75	Aerial parts
		Merillia caloxylon (Rut.)	25	Root
5,6,7,3′,4′-OMe	Sinensetin	*Chromolaena odorata* (Ast.)	120	Aerial parts
		Orthosyphon stamineus (Lam.)	171	
		Citrus aurantium (Rut.)	121	Fruit peel
		Citrus cult. "calamondin" (Rut.)	123	Fruit peel
		Citrus sinensis (Rut.)	173	Fruit peel
5,7,8,2′,3′-OH	Norwightin			
7,8,2′-OMe	Wightin	*Andrographis wightiana* (Acanth.)	174	Stem, root
7,8,2′,3′-OMe		*Andrographis wightiana* (Acanth.)	174	Stem, root
5,7,8,3′,4′-OH	Hypolaetin			
8-OMe	Onopordin	*Gardenia gummifera* (Rub.)	175	Dikamali gum
		Gardenia lucida (Rub.)	175	Dikamali gum
7,3′-OMe		*Solanum grayi* (Solan.)	176	Aerial parts
8,3′-OMe		*Ambrosia dumosa* (Ast.)	177	Leaf
7,8,3′,4′-OMe		*Lychnophora affinis* (Ast.)	143	Leaf, stem
		Citrus bergamia (Rut.)	178	Bergamot oil
5,7,8,3′,4′-OMe	Isosinensetin	*Citrus aurantium* (Rut.)	121	Fruit peel

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Citrus cult. "calamondin" (Rut.)	123	Fruit peel
		Citrus paradisi (Rut.)	123	Fruit peel
		Citrus sinensis (Rut.)	130	Fruit peel
		Fortunella japonica (Rut.)	179	Leaf, branches
6,7,8,2′,6′-OH				
7,8,6′-OMe	Rivularin	*Scutellaria rivularis* (Scroph.)	510	Root
5,7,3′,4′,5′-OH	Tricetin			
3′,5′-OMe	Tricin	*Avena sativa* (Poa.)	180	Aerial parts
		Schefflera roxburgii (Aralia.)	181	Root
		Eperna bijuga (Leg.)	60	Flower
3′,4′,5′-OMe		*Bromus pauciflorus* (Poa.)	182	Stem, leaf
		Hordeum vulgare var. *hexastichon* (Poa.)	182	Stem, leaf
7,3′,4′,5′-OMe	Corymbosin	*Webera corymbosa* (Rub.)	513	
5,7,3′,4′,5′-OMe		*Merillia caloxylon* (Rut.)	25	Root
6,7,3′,4′,5′-OH				
6,7,3′,4′,5′-OMe	Prosogerin C	*Prosopis spicigera* (Leg.)	183	Seed
5,6,7,8,2′,6′-OH				
6,7,8,6′-OMe	Scullcapflavone II	*Scutellaria baicalensis* (Lam.)	185	?
5,6,7,8,3′,4′-OH				
6,8-OMe		*Gardenia gummifera* (Rub.)	184	Dikamali gum
		Gardenia lucida (Rub.)	184	Dikamali gum
3′,4′-OMe		*Citrus aurantium* (Rut.)	186	Fruit peel
6,7,8-OMe		*Sideritis leucantha* (Lam.)	187	Whole plant
6,8,3′-OMe	Sudachitin	*Citrus sudachi* (Rut.)	188	Whole plant
		Majorana hortensis (Lam.)	189	Leaf
6,8,4′-OMe	Acerosin	*Iva acerosa* (Ast.)	190	Aerial parts
		Gardenia gummifera (Rub.)	128	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
6,7,8,3′-OMe		*Sideritis leucantha* (Lam.)	187	Whole plant
		Sideritis mugronensis (Lam.)	168	Aerial parts
		Citrus reticulata (Rut.)	191	Leaf
6,7,8,4′-OMe	Gardenin D	*Sideritis mugronensis* (Lam.)	168	Aerial parts
		Gardenia lucida (Rub.)	192	Gum exudate

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
6,8,3′,4′-OMe	Hymenoxin	*Helianthus angustifolium* (Ast.)	193	Aerial parts?
		Hymenoxis linearifolia (Ast.)	109	Aerial parts
		Hymenoxis scaposa (Ast.)	194	Leaf
6,7,8,3′,4′-OMe	5-Desmethoxy-nobiletin	*Sideritis mugronensis* (Lam.)	168	
		Citrus cult. "calamondin" (Rut.)	130	Fruit peel
		Citrus reticulata (Rut.)	150	Leaf
5,6,7,8,3′,4′-OMe	Nobiletin	*Citrus* spp. (Rut.)	24	Fruit peel
		Citrus aurantium (Rut.)	121	
		Citrus cult. "calamondin" (Rut.)	123	Fruit peel
		Citrus reticulata (Rut.)	150	Fruit peel
5,6,7,2′,4′,5′-OH 6,2′,4′,5′-OMe	Tabularin	*Chukrasia tabularis* (Melia.)	195	Leaf
5,6,7,3′,4′,5′-OH 6,7,3′,4′,5′-OMe		*Merillia caloxylon* (Rut.)	25	Fruit
5,7,8,2′,3′,4′-OH 7,8,2′,3′,4′-OMe	Serpyllin	*Andrographis serpyllifolia* (Acantha.)	37	Stem, root
5,7,8,3′,4′,5′-OH 8-OMe		*Gardenia lucida* (Rub.)	175	Dikamali gum
		Gardenia gummifera (Rub.)	175	Dikamali gum
8,4′-OMe		*Gardenia gummifera* (Rub.)	196	Dikamali gum
		Gardenia lucida (Rub.)	196	Dikamali gum
8,3′,4′-OMe		*Gardenia gummifera* (Rub.)	152	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
7,8,4′,5′-OMe		*Lychnophora affinis* (Ast.)	143	Leaf, stem
8,3′,4′,5′-OMe		*Gardenia gummifera* (Rub.)	152	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
5,6,7,8,3′,4′,5′-OH 6,7,8,4′-OMe	Gardenin E	*Gardenia lucida* (Rub.)	192	Dikamali gum
		Gardenia lucida (Rub.)	128	Dikamali gum
		Gardenia gummifera (Rub.)	128	Dikamali gum
6,8,3′,4′-OMe	Scaposin	*Hymnoxys scaposa* (Ast.)	194	Leaf
6,7,8,4′,5′-OMe	Gardenin C	*Gardenia lucida* (Rub.)	192	Dikamali gum
6,7,8,3′,4′,5′-OMe	Gardenin A	*Gardenia gummifera* (Ast.)	128	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Gardenia lucida (Ast.)	128	Aerial parts
5,6,7,8,3',4',5'-OMe		*Eupatorium coelestinum* (Ast.)	197	Aerial parts
		Ageratum conyzoides (Ast.)	198	Aerial parts
1.2 FLAVONOLS				
3,7-OH		*Platymiscium praecox* (Leg.)	199	Wood
3,5,7-OH	Galangin	*Helichrysum arenarium* (Ast.)	201	Seeds
		Pinus griffithii (Pin.)	186	Wood
		Alnus pendula● (Bet.)	200	Male flowers
		Alnus viridis● (Bet.)	55	Bud excretion
		Comptonia peregrina× (Myr.)	202	Leaf
		Populus spp.● (Salic.)	36	Bud excretion
		Alpinia officinarum (Zingib.)	203	Rhizome
		Adiantum sulphureum● (Polypod.)	204	Farinose exudate on fronds
		Cheilanthes kaulfussii● (Polypod.)	204	Farinose exudate on fronds
		Pellea longimucronata● (Polypod.)	204	Farinose exudate on fronds
		Pityrogramma chrysoconia● (Polypod.)	205	Farinose exudate on fronds
		Pityrogramma triangularis● var. *triangularis* (Polypod.)	77	Farinose exudate on fronds
3-OMe		*Pinus griffithii* (Pin.)	206	Wood
		Ericameria diffusa (Ast.)	207	Leaf (external ?)
		Eremophila alternifolia (Acanth.)	208	Leaf, branches
		Eremophila ramossissima (Acanth.)	208	Leaf, branches
		Populus spp.● (Salic.)	36	Bud excretion
		Alpinia officinarum (Zingib.)	203	Rhizome
		Cheilanthes kaulfussii● (Polypod.)	204	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	204	Farinose exudate on fronds
7-OMe	Izalpinin	*Pinus excelsa* (Pin.)	206	Heartwood
		Pinus griffithii (Pin.)	186	Wood
		Olearia nummularifolia (Ast.)	209	Leaf
		Alnus sieboldiana (Bet.)	83	Male flower

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Aniba riparia (Laura.)	210	Trunk wood
		Populus spp.● (Salic.)	36	Bud excretion
		Alpinia chinensis (Zingib.)	186	Seed
		Alpinia japonica (Zingib.)	186	Rhizome
		Pityrogramma chrysoconia● (Polypod.)	205	Farinose exudate on fronds
		Adiantum sulphureum● (Polypod.)	69	Farinose exudate on fronds
3,7-OMe		*Cheilanthes kaulfussii*● (Polypod.)	204	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	204	Farinose exudate on fronds
3,5,7-OMe		*Aniba riparia* (Laura.)	211	Wood
3,7,4′-OH	5-Deoxy-kaempferol	*Rhus javanica* (Anacard.)	212	Heartwood
		Schinopsis spp. (Anacard.)	213	Heartwood
		Cicer arietinum (Leg.)	214	Seeds
		Platymiscium praecox (Leg.)	199	Heartwood, sapwood
3,5,6,7-OH 6-OMe	Alnusin	*Alnus sieboldiana*● (Bet.)	83	Male flower
3,6-OMe		*Helichrysum heterolasium* (Ast.)	215	Aerial parts
		Helichrysum chrysargyrum (Ast.)	215	Aerial parts
3,7-OMe		*Helichrysum chrysargyrum* (Ast.)	38	Aerial parts
		Gnaphalium wrightii (Ast.)	216	Aerial parts
3,6,7-OMe	Alnustin	*Alnus sieboldiana* (Bet.)	83	Male flowers
3,5,7,8-OH 7-OMe	8-OH-Galangin	*Notholaena galapagensis*● (as ester with butyric acid) (Polypod.)	217	Farinose exudate on fronds
3,7-OMe	Isognaphaliin	*Achyrocline satureoides* (Ast.)	219	?
3,8-OMe	Gnaphaliin	*Gnaphalium obtusifolium* (Ast.)	219	Whole plant
		Helichrysum italicum (Ast.)	220	Flowers
7,8-OMe		*Gnaphalium obtusifolium* (Ast.)	216	Aerial parts
3,7,8-OMe	Methylgnaphaliin	*Gnaphalium obtusifolium* (Ast.)	218	Aerial parts
3,5,7,2′-OH	Datiscetin	*Datisca cannabina*× (Datisc.)	221	
7-OMe	Datin	*Datisca cannabina*× (Datisc.)	222	
3,5,7,4′-OH	Kaempferol	*Betula* spp.● (Bet.)	55	Bud excretion

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Alluaudia ascendens● (Didier.)	223	Aerial parts
		Acrotema uniflora (Dillen.)	224	
		Aesculus spp.● (Hippo.)	225	Bud excretion
		Prunus spp.● (Ros.)	226	Bud excretion
		Populus spp.● (Salic.)	36	Bud excretion
		Pterospermum acerifolium (Sterculia.)	227	Flower
		Alpinia officinarum (Zingib.)	203	Rhizome
		Larrea nitida (Zygo.)	228	Leaf
		Larrea tridentata	229	Leaf
		Cheilanthes spp.● (Polypod.)	230	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	230	Farinose exudate on fronds
		Pityrogramma spp.● (Polypod.)	230	Farinose exudate on fronds
3-OMe	Isokaempferide	*Centaurea arbutifolia* (Ast.)	89	Leaf
		Centaurea arguta (Ast.)	89	Leaf
		Centaurea nigrescens (Ast.)	164	Aerial parts
		Centaurea phrygia (Ast.)	164	Aerial parts
		Cirsium arvense× (Ast.)	231	Flower
		Cirsium oleraceum× (Ast.)	232	Flower
		Chrysothamnus viscidiflorus (Ast.)	233	Leaf
		Ericameria diffusa (Ast.)	207	Leaf (external)
		Flourensia ilicifolia (Ast.)	234	Leaf
		Tetragonotheca ludoviciana (Ast.)	235	Leaf
		Tetragonotheca texana (Ast.)	235	Leaf
		Betula nigra● (Bet.)	101	Bed excretion
		Geranium macrorrhizum× (Geran.)	236	Aerial parts
		Aesculus spp.● (Hippo.)	225	Bud excretion
		Prosopis spp. (Leg.)	61	Leaf
		Populus spp.● (Salic.)	36	Bud exudate
		Chryosplenum valdivicum (Saxifrag.)	237	Leaf (?)
		Larrea cuneifolia (Zygo.)	238	Leaf (external?)

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Cheilanthes spp.● (Polypod.)	62	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
		Didierea trollii (Didier.)	239	Aerial parts
		Didierea madagascariensis (Didier.)	239	Aerial parts, bark
5-OMe		*Erica vagans* (Eric.)	240	Leaf
		Gaultheria veitchiana (Eric.)	240	Leaf
		Kalmiopsis leachiana (Eric.)	240	Leaf
		Rhodothamnus chamaecistus (Eric.)	240	Leaf
7-OMe	Rhamnocitrin	*Alnus* spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Aesculus 4 spp.● (Hippo.)	225	Bud excretion
		Rhamnus dahurica● (Rham.)	226	Bud excretion
		Rhamnus erythroxylon● (Rham.)	226	Bud excretion
		Rhamnus frangula● (Rham.)	226	Bud excretion
		Populus spp.● (Salic.)	36	Bud excretion
		Alpinia japonica (Zingi.)	241	Seed
		Alpinia kumatake (Zingi.)	242	Seed
		Larrea tridentata● (Zygo.)	22	Leaf
		Larrea nitida● (Zygo.)	228	Leaf
		Cheilanthes spp.● (Polypod.)	69	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	69	Farinose exudate on fronds
		Pityrogramma tartarea● (Polypod.)	70	Farinose exudate on fronds
4′-OMe	Kaempferide	*Alnus* spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Dillenia indica (Dillen.)	224	Pericarp
		Prunus mume (Ros.)	243	Wood
		Prunus spp.● (Ros.)	226	Bud excretion

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Populus spp.● (Salic.)	36	Bud excretion
		Tamarix dioica (Tamaric.)	244	Leaf
		Alpinia officinarum (Zingi.)	203	Root (rhizome)
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
		Pityrogramma triangularis● (Polypod.)	245	Farinose exudate on fronds
3,7-OMe	Kumatakenin, jaranol	*Ambrosia eriocentra* (Ast.)	246	Aerial parts
		Ericameria diffusa● (Ast.)	207	Leaf
		Flourensia cernua● (Ast.)	234	Leaf
		Flourensia retinophylla● (Ast.)	234	Leaf
		Alnus 3 spp.● (Bet.)	55	Bud excretion
		Ostrya 2 spp.● (Bet.)	55	Bud excretion
		Cistus ladaniferus (Cist.)	247	Resin
		Beyeria sp. (Euphorb.)	248	Aerial parts
		Aesculus carnea● (Hippo.)	225	Bud excretion
		Aesculus turbinata● (Hippo.)	225	Bud excretion
		Salvia glutinosa● (Lam.)	58	Aerial parts
		Alpinia japonica (Zingi.)	242	Seeds
		Alpinia kumataka (Zingi.)	241	Seeds
		Larrea cuneifolia● (Zygo.)	238	Leaf
		Larrea nitida● (Zygo.)	228	Leaf
		Cheilanthes farinosa● (Polypod.)	16	Farinose exudate on fronds
		Cheilanthes farinosa● ("*longissima*") (Polypod.)	17	Farinose exudate on fronds
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
3,4′-OMe	Ermanin	*Ericameria diffusa*● (Ast.)	207	Leaf
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Cordia boissieri× (Borag.)	249	Flower

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Geranium macrorrhizum (Geran.)	250	Whole plant
		Angelonia grandiflora (Scroph.)	251	Leaf
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
7,4′-OMe		*Betula* spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Aesculus 4 spp.● (Hippo.)	225	Bud excretion
		Populus spp.● (Salic.)	36	Bud excretion
		Angelonia grandiflora (Scroph.)	251	Leaf
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	62	Farinose exudate on fronds
		Pityrogramma triangularis● (Polypod.)	245	Farinose exudate on fronds
3,5,7-OMe		*Ericameria diffusa*● (Ast.)	207	Leaf
3,7,4′-OMe		*Betula nigra*● (Bet.)	55	Bud excretion
		Ostrya virginiana● (Bet.)	55	Bud excretion
		Aesculus turbinata● (Hippo.)	225	Bud excretion
		Sideritis bolleana (Lam.)	75	Aerial parts
		Sideritis dasygnaphala (Lam.)	75	Aerial parts
		Aframomum giganteum (Zingi.)	253	Stem
		Cheilanthes farinosa● (Polypod.)	254	Farinose exudate on fronds
		Cheilanthes farinosa● ("*longissima*") (Polypod.)	17	Farinose exudate on fronds
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7,8,4′-OH		*Acacia* spp. (Leg.)	252	Heartwood
3-OMe		*Acacia* spp. (Leg.)	252	Heartwood
7,3′,4′-OH	Fisetin	*Mangifera indica* (Anacard.)	255	Bark
		Pistacia chinensis (Anacard.)	256	Heartwood
		Rhus javanica (Anacard.)	212	Heartwood
		Schinopsis spp. (Anacard.)	213	Heartwood

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Acacia mearnsii (Leg.)	257	Bark
		Robinia pseudacacia (Leg.)	258	Heartwood
		Gleditsia triacanthos (Leg.)	259	Wood
3-OMe		*Acacia mearnsii* (Leg.)	260	Wood
4′-OMe		*Schinopsis lorentsii* (Anacard.)	213	Aerial parts
3,7,3′,4′-OMe		*Pongamia glabra* (Leg.)	261	Stem, bark
3,5,6,7,8-OH				
6,8-OMe		*Gnaphalium obtusifolium* (Ast.)	262	Whole plant
3,6,8-OMe	Araneol	*Amphalis araneosa* (Ast.)	263	Flowering part
6,7,8-OMe		*Artemisia ludoviciana* (Ast.)	264	Stem
		Helichrysum arenarium (Ast.)	201	Seed, flower
		Helichrysum graveolens (Ast.)	265	Aerial parts
3,5,6,7,4′-OH				
5-OMe	Vogoletin	*Neurolaena lobata* (Ast.)	266	Leaf
6-OMe		*Artemisia arbuscula* (Ast.)	71	Whole plant
		Flourensia ilicifolia● (Ast.)	234	Leaf
		Prunus avium● var. *juliana* (Ros.)	226	Bud excretion
4′-OMe		*Ostrya japonica*● (Bet.)	55	Bud excretion
3,6-OMe		*Acanthospermum glabratum*● (Ast.)	267	Bud excretion
		Centaurea jacea (Ast.)	268	Flower
		Flourensia ilicifolia● (Ast.)	234	Leaf
		Alnus 3 spp.● (Bet.)	55	Bud excretion
		Ostrya carpinifolia● (Bet.)	55	Bud excretion
		Didieria trollii (Didier.)	239	Aerial parts
		Prunus avium● var. *juliana* (Ros.)	226	Bud excretion
		Prunus cerasus● (Ros.)	33	Bud excretion
3,7-OMe		*Inula grandis* (Ast.)	269	Leaf
		Parthenium hysterophorus (Ast.)	271	Leaf
		Neurolaena lobata (Ast.)	266	Leaf
6,7-OMe	Eupalitin	*Ostrya japonica*● (Bet.)	55	Bud excretion

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Cheilanthes argentea● (Polypod.)	33	Farinose exudate on fronds
6,4′-OMe	Betuletol	*Alnus* spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Alluaudia ascendens (Didier.)	223	Aerial parts
		Alluaudia procera (Didier.)	270	Aerial parts
		Decarya madagascariensis (Didier.)	270	Bud excretion
		Prunus cerasus● (Ros.)	33	Bud excretion
3,6,7-OMe	Penduletin	*Betula nigra* (Bet.)	33	Aerial parts
		Artemisia 3 spp. (Ast.)	71	Whole plants
		Parthenium vollinsianum (Ast.)	271	Leaf
		Prunus avium● (Rosa.)	33	Bud excretion
		Cyanostegia microphylla (Verb.)	272	Leaf
3,6,4′-OMe	Santin 3-methylbetuletol	*Chrysanthemum parthenium* (Ast.)	153	Leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Alluaudia ascendens (Didier.)	223	Aerial parts
		Alluaudia procera (Didier.)	270	
		Decarya madagascariensis (Didier.)	270	
6,7,4′-OMe	Mikanin	*Mikania cordata* (Ast.)	274	Root
3,6,7,4′-OMe		*Achillea millefolium* (Ast.)	275	Flower
		Perityle vasegi (Ast.)	276	Leaf
		Sideritis gomerae (Lam.)	75	Aerial parts
		Dodonea lobulata (Sapin.)	66	Leaf, branchlets
3,5,7,8,4′-OH 7-OMe	Herbacetin, pollenitin	*Camellia sinensis*× (Thea.)	277	Pollen
		Notholaena standleyi● (Polypod.)	33	Farinose exudate on fronds
		Notholaena aschenborniana● (as ester with butyric acid) (Polypod.)	217	Farinose exudate on fronds
3,7-OMe		*Larrea divaricata*● (Zygo.)	229	Leaf, resin
		Larrea tridentata● (Zygo.)	229	Leaf, resin

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
3,8-OMe		*Cyanostegia angustifolia* (Verba.)	272	Aerial parts
7,4′-OMe		*Notholaena standleyi* ● (Polypod.)	33	Farinose exudate on fronds
		Notholaena affinis ● (as ester with butyric acid) (Polypod.)	217	Farinose exudate on fronds
8,4′-OMe	Prudomestin	*Prunus domestica* (Rosa.)		Heartwood
3,7,8-OMe		*Ricinocarpus stylosus* (Euphorb.)	278	?
		Cyanostegia angustifolia (Verb.)	272	Aerial parts
3,8,3′-OMe		*Cyanostegia angustifolia* (Verb.)	272	Aerial parts
3,8,4′-OMe		*Conzya stricta* (Ast.)	279	Whole plant
		Beyeria sp. (Euphorb.)	66	Leaf, branches
7,8,4′-OMe	Tambulin	*Zanthoxylum acanthopodium* (Rut.)	280	Fruit
3,6,7,8,4′-OH				
3,6,7,8,4′-OMe	Auranetin	*Citrus aurantium* (Rut.)	186	Fruit peel
3,5,7,2′,4′-OH	Morin	*Lannea coromandelica* (Anacard.)	281	
		Chlorophora tinctoria (Mor.)	186	Wood
		Morus spp. (Mor.)	186	Wood
		Treculia africana (Morac.)	282	
3,5,7,2′,5′-OH				
3,5,2′-OMe		*Inula cappa* (Ast.)	283	Aerial parts
3,5,7,3′,4′-OH	Quercetin	*Acrotema uniflorum* (Dill.)	224	Plant bark
		Wormia triquetra (Dill.)	224	Plant bark
		Nothofagus 4 spp. (Fag.)	284	Wood
		Crotalaria retusa (Leg.)	137	Seeds
		Soymidia febrifuga (Mel.)	285	Heartwood
		Populus spp. ● (Salic.)	36	Bud excretion
		Alpinia officinarium (Zingib.)	203	
		Cheilanthes spp. ●	33	Farinose exudate on fronds
		Notholaena spp. ●	33	Farinose exudate on fronds
		Pityrogramma spp. ●	33	Farinose exudate on fronds
3-OMe		*Centaurea arbutifolia* (Ast.)	286	Leaf
		Chrysothamnus viscidiflorus (Ast.)	233	Leaf
		Ericameria diffusa ● (Ast.)	207	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Eupatorium capillifolium (Ast.)	65	Aerial parts
		Eupatorium perfoliatum (Ast.)	65	Aerial parts
		Haplopappus beilahuen (Ast.)	287	Aerial parts
		Inula viscosa (Ast.)	288	Flower
		Neurolaena oaxacana (Ast.)	159	Leaf
		Vernonia cineraria (Ast.)	289	Aerial parts
		Vernonia patens (Ast.)	289	Aerial parts
		Vernonia pectoralis (Ast.)	135	Aerial parts
		Betula nigra● (Bet.)	101	Bud excretion
		Aeonium manriquorum (Crass.)	290	Leaf
		Didiera madagascariensis (Did.)	239	Aerial parts
		Goodenia strophiolata (Good.)	291	Whole plant
		Prosopis spp. (Leg.)	61	Leaf
		Tamarix dioica (Tamaric.)	244	Leaf
		Alpinia officinalis (Zingib.)	203	Rhizome
		Larrea tridentata● (Zygoph.)	292	Leaf resin
		Larrea nitida● (Zygoph.)	228	Leaf resin
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7-OMe	Rhamnetin	*Alnus maritima*● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Acacia ixiophylla (Leg.)	59	Leaf
		Rhamnus 4 spp.● (Rhamn.)	226	Bud excretion
		Populus spp.● (Salic.)	36	Bud excretion
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
3′-OMe	Isorhamnetin	*Ericameria diffusa*● (Ast.)	207	Leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Dillenia indica (Dill.)	224	Bark
		Aesculus spp.● (Hippo.)	225	Bud excretion
		Rhamnus spp.● (Rhamn.)	226	Bud excretion

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Larrea divaricata● (Zyg.)	22	Leaf resin
		Larrea tridentata● (Zyg.)	22	Leaf resin
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
4′-OMe	Tamarixetin	*Tamarix dioica* (Tamari.)	244	Leaf
		Tamarix troupii (Tamari.)	293	Leaf
3,5-OMe	Caryatin	*Eucryphia cordifolia* (Eucryph.)	294	Leaf
		Carya pecan (Jugland.)	295	Bark
3,7-OMe		*Ericameria diffusa* (Ast.)	207	Leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Aeonium manriquorum (Crass.)	290	Leaf wax?
		Populus spp.● (Salic.)	36	Bud excretion
		Angelonia grandiflora (Scroph.)	251	Leaf
		Larrea cuneifolia● (Zygo.)	22	Leaf
		Larrea divaricata● (Zygo.)	22	Leaf
		Larrea tridentata● (Zygo.)	22	Leaf
3,3′-OMe		*Chrysothamnus viscidiflorus* (Ast.)	233	Leaf
		Hymenoxis acaulis (Ast.)	109	Aerial parts
		Parthenium vollinsianum (Ast.)	296	Aerial parts
		Betula nigra● (Bet.)	101	Bud excretion
		Didierea madagascariensis (Didier.)	239	Aerial parts
		Aesculus hyppocastanum● (Hippo.)	297	Bud excretion
		Melicope perspicuinervia (Rut.)	298	Leaf
		Populus spp.● (Salic.)	36	Bud excretion
		Nicotiana tabacum (Solan.)	299	Flower
		Larrea cuneifolia● (Zygoph.)	238	Leaf
		Larrea divaricata● (Zygoph.)	22	Leaf
		Larrea nitida● (Zygoph.)	228	Leaf
		Larrea tridentata● (Zygoph.)	22	Leaf
3,4′-OMe		*Baccharis sarothroides* (Ast.)	300	Leaf, branches

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Ericameria diffusa (Ast.)	207	Leaf
		Angelonia grandiflora (Scroph.)	251	Leaf
7,3′-OMe	Rhamnazin	*Artemisia pygmaea* (Ast.)	71	Aerial parts
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula 5 spp.● (Bet.)	55	Bud excretion
		Aesculus 4 spp.● (Hippo.)	225	Bud excretion
		Polygonum hydropiper× (Polygon.)	186	
		Rhamnus 4 spp.● (Rhamn.)	226	Bud excretion
		Populus spp.● (Salic.)	36	Bud excretion
		Larrea cuneifolia● (Zygoph.)	238	Leaf
		Larrea divaricata● (Zygoph.)	22	Leaf
		Larrea tridentata● (Zygoph.)	22	Leaf
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7,4′-OMe	Ombuin	*Ostrya japonica*● (Bet.)	55	Bud excretion
		Cassia laevigata (Leg.)	301	Leaf
		Angelonia grandiflora (Scroph.)	251	Leaf
3′,4′-OMe	Dillenetin	*Dillenia indica* (Dill.)	224	Pericarp.
3,7,3′-OMe	Pachypodol	*Pachipodanthium confine* (Annon.)	302	Root
		Betula nigra● (Bet.)	55	Bud excretion
		Euodia glabra (Rut.)	303	Bark
		Larrea cuneifolia● (Zygoph.)	238	Leaf
		Larrea divaricata● (Zygoph.)	22	Leaf
		Larrea tridentata● (Zygoph.)	304	Leaf
3,7,4′-OMe	Ayanin	*Ericameria diffusa* (Ast.)	207	Leaf
		Alnus spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Salvia glutinosa● (Lam.)	58	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Apuleia leiocarpa (Leg.)	305	Wood
		Disthemonanthus benthamianus (Leg.)	306	Heartwood
		Physalis angulata (Solan.)	307	Whole plant
		Aframomum giganteum (Zing.)	253	Stem
		Cheilanthes spp.● (Polypod.)	33	Farinose exudate on fronds
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
3,3′,4′-OMe		*Ericameria diffusa* (Ast.)	207	
		Betula nigra● (Bet.)	101	Bud excretion
7,3′,4′-OMe		*Alnus* spp.● (Bet.)	55	Bud excretion
		Betula spp.● (Bet.)	55	Bud excretion
		Ostrya spp.● (Bet.)	55	Bud excretion
		Diospyros melanoxylon (Ebena.)	308	Leaf
		Aesculus spp.● (Hippo.)	225	Bud excretion
		Larrea cuneifolia● (Zygoph.)	238	Leaf
		Larrea divaricata● (Zygoph.)	22	Leaf
		Larrea nitida● (Zygoph.)	228	Leaf
		Larrea tridentata● (Zygoph.)	22	Leaf
3,5,7,4′-OMe		*Gossypium hirsutum* (Malv.)	309	
3,5,3′,4′-OMe		*Gossypium hirsutum* (Malv.)	309	
3,7,3′,4′-OMe	Retusin	*Betula nigra*● (Bet.)	55	Bud excretion
		Ariocarpus retusus (Cact.)	310	Whole plant
		Geranium macrorrhizum (Geran.)	311	
		Salvia glutinosa● (Lam.)	58	Aerial parts
		Aframomum giganteum (Zing.)	235	Stem
		Larrea cuneifolia● (Zygoph.)	238	Leaf
		Larrea divaricata● (Zygoph.)	22	Leaf
		Larrea tridentata● (Zygoph.)	22	Leaf
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
3,7,8,3′,4′-OH	Melanoxetin	*Acacia* 3 spp. (Leg.)	312	Heartwood

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Albizia lebbeck (Leg.)	313	Wood
		Albizia adianthifolia (Leg.)	314	Wood
3-OMe	Transilitin	*Artemisia transiliensis*[×] (Ast.)	315	Wood
		Acacia 3 spp. (Leg.)	312	Heartwood
8-OMe		*Acacia kempeana* (Leg.)	312	Heartwood
3,8-OMe		*Acacia kempeana* (Leg.)	312	Heartwood
3,7,3′,4′,5′-OH	Robinetin	*Schinopsis* spp. (Anacard.)	213	Aerial parts
		Acacia mearnsii (Leg.)	257	Bark
		Butea sp. (Leg.)	8	
		Gleditsia monosperma (Mimos.)	186	
		Millettia stuhlmannii (Leg.)	316	Heartwood
		Robinia pseudacacia (Leg.)	258	Heartwood
3,5,6,7,8,3′-OH 3,6,7,8,3′-OMe	Emmaosunin	*Gymnosperma glutinosum* (Ast.)	317	Aerial parts
3,5,6,7,8,4′-OH 3,6,7,8-OMe	(Calicopterin) Thapsin	*Calicopteris floribundus* (Combr.)	318	Leaf
		Digitalis thapsi (Scroph.)	186	Leaf
5,6,7,4′-OMe	Eriostemin	*Eriostemon buxifolius* spp. *buxifolius* (Rut.)	319	Leaf
		Eriostemon hispidulus (Rut.)	319	Leaf
3,6,8,4′-OMe	Araneosol	*Ambrosia grayi* (Ast.)	320	Aerial parts
		Anaphalis araneosa (Ast.)	263	Flowering plant
3,6,7,8,4′-OMe		*Calycopteris floribunda* (Combr.)	318	Leaf
		Citrus aurantium (Rut.)	321	Fruit peel
3,5,6,7,3′,4′-OH 6-OMe	Quercetagetin Patuletin	*Tagetes patula* (Ast.)	186	
		Tetragonotheca 3 spp. (Ast.)	235	Leaf
		Brickellia chlorolepsis (Ast.)	108	Leaf
		Brickellia cylindraceae (Ast.)	322	Leaf
		Brickellia laciniata (Ast.)	140	Leaf
3,6-OMe	Axillarin	*Artemisia* spp. (Ast.)	71	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Chrysothamnus cinerariaefolium (Ast.)	54	Leaf, stem
		Chrysothamnus viscidiflorus (Ast.)	233	Leaf
		Flourensia illicifolia	234	Aerial parts
		Iva axillaris (Ast.)	323	Leaf
		Iva hayesiana (Ast.)	92	Aerial parts
		Tetragonotheca helianthoides (Ast.)	235	Leaf
		Xanthium pennsylvanicum (Ast.)	324	Leaf
		Didierea madagascariensis (Didier.)	239	Aerial parts
		Didierea trolli (Didier.)	270	Aerial parts
		Neurolaena oaxacana (Ast.)	159	Leaf
3,7-OMe		*Parthenium hysterophorus* (Ast.)	271	Leaf
		Neurolaena oaxacana (Ast.)	159	Leaf
3,3′-OMe		*Parthenium hysterophorus* (Ast.)	296	Leaf
		Parthenium tomentosum (Ast.)	325	Leaf
6,7-OMe	Eupatolitin	*Brickellia dentata* (Ast.)	108	Leaf
		Brickellia laciniata (Ast.)	140	Leaf
		Brickellia veronicaefolia (Ast.)	326	Leaf
6,3′-OMe	Spinacetin	*Brickellia californica* (Ast.)	102	Leaf
		Brickellia laciniata (Arst.)	140	Leaf
		Chrysothamnus viscidiflorus (Ast.)	233	Leaf
6,4′-OMe	Laciniatin	*Brickellia laciniata* (Ast.)	140	Leaf
3,6,7-OMe	Chrysosplenol-D	*Artemisia* 3 spp. (Ast.)	71	Aerial parts
		Brickellia veronicaefolia (Ast.)	326	Aerial parts
		Blumea lacera (Ast.)	327	Leaf
		Parthenium rollinsianum (Ast.)	271	Leaf
3,6,3′-OMe	Jaceidin	*Centaurea salicifolia* (Ast.)	169	Aerial parts
		Chrysothamnus viscidiflorus (Ast.)	233	Aerial parts
		Flourensia illicifolia (Ast.)	234	Aerial parts
		Didierea madagascariensis (Didier.)	239	Aerial parts
		Didierea trolli (Didier.)	270	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Prunus avium var. *juliana*● (Rut.)	226	Bud excretion
		Prunus cerasus ● (Rut.)	33	Bud excretion
3,6,4′-OMe	Centaureidin	*Chrysanthemum cinerariifolium* (Ast.)	54	Leaf, stem
		Iva frutescens subsp. *frutescens* (Ast.)	91	Aerial parts
		Tetragonotheca rependa (Ast.)	235	Leaf
		Alnus 4 spp.● (Bet.)	55	Bud excretion
		Brickellia lacinata (Ast.)	140	Leaf
		Brickellia cylindracea (Ast.)	322	Leaf
3,7,3′-OMe	Chrysosplenol-C	*Parthenium bipinnatifidum* (Ast.)	296	Aerial parts
		Parthenium glomeratum (Ast.)	296	Aerial parts
3,7,4′-OMe	Oxyayanin B	*Pulicaria dysenterica* (Ast.)	328	Flower heads
		Distemonanthus benthamianus (Leg.)	186	
		Apuleia leiocarpa (Leg.)	305	Wood
		Chrysosplenium alternifolium (Saxi.)	329	Aerial parts
		Chrysosplenium oppositifolium (Saxi.)	329	Aerial parts
6,7,4′-OMe	Eupatin	*Brickellia californica* (Ast.)	102	Leaf
		Brickellia dentata (Ast.)	108	Leaf
		Brickellia lacinata (Ast.)	140	Leaf
		Brickellia veronicaefolia (Ast.)	326	Leaf
		Eupatorium semiserratum (Ast.)	330	Leaf
3,5,6,3′-OMe		*Chrysothamnus viscidiflorus* (Ast.)	233	Leaf
3,6,7,3′-OMe	Chrysosplenetin	*Artemisia cana* (Ast.)	504	Leaf
		Lepidophyllum quadrangulare× (Ast.)	505	Leaf
		Matricaria chamomilla (Ast.)	506	Leaf
		Parthenium 3 spp. (Ast.)	296	Leaf
		Plectranthus marrubioides (Lam.)	507	Aerial parts
3,6,7,4′-OMe	Casticin, vitexicarpin	*Achillea millefolium* (Ast.)	275	Flower heads
		Parthenium 3 spp. (Ast.)	296	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Brickellia chlorolepsis (Ast.)	140	Leaf
		Brickellia laciniata (Ast.)	108	Leaf
		Brickellia veronicaefolia (Ast.)	326	Leaf
		Vitex spp. (Verb.)	331	Seeds
5,6,7,4′-OMe	Eupatoretin	*Eupatorium semiserratum* (Ast.)	330	Aerial parts
3,6,3′,4′-OMe	Bonanzin	*Bahia oppositifolia* (Ast.)	333	Whole plant
		Parthenium ligulatum (Ast.)	296	Leaf
		Vitex trifoliata (Verb.)	332	Whole plant
3,6,7,3′,4′-OMe	Artemetin, artemisetin, erianthin	*Achillea millefolia* (Ast.)	275	Flower heads
		Artemisia absinthium (Ast.)	186	
		Artemisia arborescens (Ast.)	186	
		Blumea erianthea (Ast.)	334	
		Blumea lacera (Ast.)	327	Leaf
		Brickellia chlorolepsis (Ast.)	108	Leaf
		Brickellia cylindraceae (Ast.)	322	Leaf
		Brickellia veronicifolia (Ast.)	326	Leaf
		Kuhnia eupatorides (Ast.)	335	Aerial parts
		Parthenium rollinsianum (Ast.)	296	Leaf
		Sideritis gomerae (Lam.)	75	Aerial parts
		Vitex negundo (Verb.)	336	Leaf
		Vitex trifolia (Verb.)	333	Leaf
3,5,6,7,3′,4′-OMe		*Citrus mitis* (Rut.)	337	Fruit peel
		Citrus sinensis (Rut.)	130	Fruit peel
3,5,7,8,2′,4′-OH 3,7,8,2′-OMe		*Notholaena affinis*● (Polypod.)	509	Farinose exudate on fronds
3,7,8,2′,4′-OMe		*Notholaena affinis*● (Polypod.)	509	Farinose exudate on fronds
3,5,7,8,3′,4′-OH 3,7-OMe	Gossypetin	*Larrea divaricata*● (Zygoph.)	22	Resin on leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Larrea tridentata● (Zygoph.)	22	Resin on leaf
3,8-OMe		*Ricinocarpus muricatus* (Euphorb.)	338	Aerial parts
		Cyanostegia angustifolia (Verb.)	272	Leaf
7,4′-OMe	Tambuletin	*Xanthoxylum acanthopodium* (Rut.)	339	
		Notholaena affinis● (as ester with butyric acid) (Polypod.)	217	Farinose exudate on fronds
8,3′-OMe	Limocitrin	*Citrus limon* (Rut.)	186	
3,7,8-OMe		*Ricinocarpus muricatus* (Euphorb.)	338	
		Cyanostegia angustifolia (Verb.)	272	Leaf
3,7,3′OMe		*Larrea tridentata*● (Zygoph.)	22	Leaf
3,8,3′-OMe		*Cyanostegia angustifolia* (Verb.)	272	Leaf
7,8,3′-OMe		*Heteromma simplicifolia* (Ast.)	340	
3,7,8,3′-OMe	Ternatin	*Melicope mantellii* (Rut.)	186	Bark
		Melicope simplex (Rut.)	186	
3,7,8,4′-OMe		*Ricinocarpus muricatus* (Euphorb.)	342	Aerial parts
		Ricinocarpus stylosus (Euphorb.)	338	Aerial parts
3,7,3′,4′-OMe		*Citrus* spp. (Rut.)	341	Fruit peel
7,8,3′,4′-OMe		*Heteromma simplicifolia* (Ast.)	340	
3,7,8,3′,4′-OMe		*Ricinocarpus stylosus* (Euphorb.)	342	Aerial parts
		Citrus sinensis (Rut.)	130	Fruit peel
3,5,7,8,3′,4′-OMe		*Citrus sinensis* (Rut.)	130	Fruit peel
3,5,7,2′,3′,4′-OH				
3,7,4′-OMe	Apuleidin	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,7,2′,4′,5′-OH	5′-OH-Morin	*Geranium macrorrhizum* (Geran.)	236	Aerial parts
3,7,4′-OMe	Oxyayanin A	*Apuleia leiocarpa* (Leg.)	305	Heartwood
		Distemonanthus benthamianus (Leg.)	186	Heartwood
3,6,7,2′,4′,5′-OH				
3,6,7,4′-OMe	5-Demethylapulein	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,7,3′,4′,5′-OH	Myricetin	*Soymida febrifuga* (Mel.)	285	Heartwood
4′-OMe	Mearnsetin	*Liatris pauciflora* (Ast.)	343	Aerial parts
		Alluaudia 6 spp. (Didier.)	270	Stem, bark

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Elaeocarpus lanceofolius (Elaeocarp.)	344	Leaf
		Elaeocarpus floribundus (Elaeocarp.)	345	Leaf
3,4′-OMe		*Alluaudia ascendens* (Didier.)	223	Aerial parts
		Alluaudia procera (Didier.)	270	Aerial parts
3,5′-OMe		*Artemisia monosperma* (Ast.)	273	Flower heads
3′,5′-OMe	Syringetin	*Heuchera micrantha* var. *diversifolia* (Saxif.)	346	Flower heads
		Soymida febrifuga (Mel.)	347	Root, heartwood
3,7,4′-OMe		*Ricinocarpus stylosus* (Euphorb.)	342	Aerial parts
3,3′,4′-OMe		*Decaryia madagascariensis* (Didier.)	270	Aerial parts
7,3′,4′-OMe		*Aesculus* spp.● (Hippo.)	297	Bud excretion
3,7,3′,4′-OMe		*Cistus monspeliensis* (Cist.)	348	Leaf
		Doliocarpus amazonicus (Dillen.)	349	Leaf
3,7,3′,4′,5′-OMe	Combretol	*Betula nigra*● (Bet.)	350	Bud excretion
		Combretum quadrangulare (Erica.)	351	Seed
		Notholaena candida var. *candida*● (Polypod.)	69	Farinose exudate on fronds
3,5,6,7,8,2′,4′-OH				
3,6,7,8-OMe		*Notholaena affinis*● (Polypod.)	352	Farinose exudate on fronds
3,6,7,8,2′-OMe		*Notholaena affinis*● (Polypod.)	352	Farinose exudate on fronds
3,6,7,8,4′-OMe		*Notholaena affinis*● (Polypod.)	352	Farinose exudate on fronds
3,6,7,8,2′,4′-OMe		*Notholaena affinis*● (Polypod.)	352	Farinose exudate on fronds
3,5,6,7,8,3′,4′-OH				
3,6,8-OMe		*Pluchea sagittalis* (Ast.)	353	
6,8,3′-OMe	Limocitrol	*Citrus limon* (Rut.)	354	Fruit peel
6,8,4′-OMe	Isolimocitrol	*Citrus limon* (Rut.)	354	Fruit peel
3,6,8,3′-OMe		*Chrysothamnus viscidiflorus* (Ast.)	233	Leaf
3,6,7,8,3′-OMe		*Calycopteris floribundus* (Combr.)	355	Leaf
3,6,7,8,3′,4′-OMe		*Citrus sinensis* (Rut.)	130	Fruit peel
5,6,7,8,3′,4′-OMe	Natsudadain	*Citrus natsudaidai* (Rut.)	356	Fruit peel
3,5,6,7,8,3′,4′-OMe		*Citrus* 4 spp. (Rut.)	24	Fruit peel
		Citrus cult. (Rut.)	123	Fruit peel

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
3,5,6,7,2′,3′,4′-OH 3,7,4′-OMe	Apuleisin	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,6,7,2′,4′,5′-OH 3,5,6,7,4′-OMe	Apulein	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,6,7,3′,4′,5′-OH 3,6-OMe		*Alluaudia ascendens* (Didier.)	223	Bark
3,4′-OMe		*Alluaudia ascendens* (Didier.)	223	Bark
6,4′-OMe		*Alluaudia ascendens* (Didier.)	223	Bark
3,6,3′-OMe		*Decarya madagascariensis*	270	Bark
3,6,4′-OMe		*Alluaudia ascendens* (Didier.)	223	Bark
3,6,5′-OMe		*Decarya madagascariensis* (Didier.)	270	Aerial parts
3,6,7,4′-OMe		*Eremophila fraseri* (Myopor.)	208	Aerial parts
3,6,3′,4′-OMe		*Decarya madagascariensis* (Didier.)	270	Aerial parts
3,6,3′,5′-OMe		*Tillandsia usneoides* (Brom.)	357	Stem, leaf
5,6,3′,5′-OMe		*Casimiroa edulis* (Rut.)	51	Seed
3,7,3′,4′-OMe	Apuleitrin	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,7,3′,5′-OMe	Apuleirin	*Apuleia leiocarpa* (Leg.)	305	Heartwood
3,5,6,7,3′,4′,5′-OMe		*Murraya exotica* (Rut.)	358	Leaf, fruit
		Murraya paniculata (Rut.)	359	Leaf, fruit
3,5,7,8,3′,4′,5′-OH 3,7,4′-OMe	Hibiscetin	*Solanum* spp. (Solan.)	176	
3,7,8,4′-OMe		*Solanum* spp. (Solan.)	176	
3,8,4′,5′-OMe		*Beyeria brevifolia*● (Euphorb.)	360	Resin on leaf
3,8,3′,4′,5′-OMe	Conyzatin	*Conzya stricta* (Ast.)	279	Whole plant
7,8,3′,4′,5′-OMe		*Heteromma simplicifolia* (Ast.)	340	
3,5,7,8,3′,4′,5′-OMe		*Murraya exotica* (Rut.)	361	Leaf
3,5,6,7,8,3′,4′,5′-OH 3,6,7,8,4′,5′-OMe	Digicitrin	*Digitalis purpurea* (Scroph.)	362	Leaf
3,5,6,7,3′,4′,5′-OMe		*Murraya exotica* (Rut.)	358	Fruit
3,5,6,7,8,3′,4′,5′-OMe	Exoticin	*Murraya exotica* (Rut.)	363	Fruit

Table 1. *(continued)*

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
1.3 FLAVANONES				
7-OH		*Flourensia oolepis* (Ast.)	364	Leaf, stem
		Flemingia chappar (Leg.)	365	Root
		Larrea nitida (Zygoph.)	366	Aerial parts
7-OMe		*Flourensia heterolepsis* (Ast.)	367	Aerial parts
5,7-OH	Pinocembrin	*Baccharis glutinosa* (Ast.)	368	
		Chrysothamnus nausensus (Ast.)	369	Aerial parts
		Flourensia spp. (Ast.)	234	Leaf
		Hymenoclea monogyra (Ast.)	368	
		Alnus spp.● (Bet.)	200	Bud excretion
		Aniba rosaeodora (Laura.)	370	Wood
		Eucalyptus spp.× (Myrt.)	371	Leaf
		Prunus spp. (Rosa.)	35	Wood
		Populus spp.● (Salic.)	36	Bud excretion
		Pinus excelsa (Pin.)	206	Heartwood
		Pinus krempfii (Pin.)	372	Wood
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
5-OMe	Alpinetin	*Chrysothamnus nausensis* (Ast.)	38	Aerial parts
		Helichrysum herbaceum (Ast.)	38	Aerial parts
		Alnus sieboldiana● (Bet.)	373	Male flower
		Alnus pendula● (Bet.)	200	Male flower
		Eucalyptus spp.● (Myrt.)	371	Leaf
		Piper spp. (Piper.)	374	
		Alpinia katsumadai (Zingib.)	375	Seed
		Alpinia speciosa (Zingib.)	376	Seed
		Kaempferia pandurata (Zingib.)	377	Rhizome
7-OMe	Pinostrobin	*Alnus sieboldiana*● (Bet.)	373	Male flower
		Alnus pendula● (Bet.)	200	Male flower
		Aniba riparia (Laura.)	210	Trunk wood
		Agonis spathulata (Myrt.)	378	Leaf, twigs

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Prunus cerasus (Ros.)	379	Heartwood
		Populus spp. ● (Salic.)	36	Bud excretion
		Kaempferia pandurata (Zingib.)	377	Rhizome
		Larix dahurica (Pin.)	380	Heartwood
		Pinus clausa (Pin.)	381	Heartwood
		Pinus krempfii (Pin.)	372	Wood
5,7-OMe		*Aniba riparia* (Laura.)	210	Trunk wood
		Eucalyptus sieberi (Myrt.)	371	Leaf
7,8-OH				
8-OMe	Isolarrein	*Larrea nitida* (Zygoph.)	366	Aerial parts
7,8-OMe		*Tetragonia expansa* (Aizoa.)	382	Leaf
7,4′-OH	Liquiritigenin	*Cicer* (Leg.)	214	Seedling
		Diplotropis purpurea (Leg.)	60	Wood
		Glycyrrhiza glabra (Leg.)	383	Root
		Platymiscium praecox (Leg.)	199	Heartwood, sapwood
		Dalbergia sericea (Leg.)	384	Bark
4′-OMe		*Dalbergia retusa* (Leg.)	385	Heartwood
2,5,7-OH				
7-OMe		*Populus* spp. (Salic.)	36	Bud excretion
5,6,7-OH				
6-OMe	Dihydroöroxylin	*Chrysothamnus nauseusus* (Ast.)	369	Aerial parts
6,7-OMe		*Piper* (Piper.)	374	
5,7,8-OH				
8-OMe	Dihydrowogonin	*Prunus avium* (Ros.)	386	Heartwood
		Prunus avium ● (Ros.)	226	Bud excretion
		Prunus cerasus (Ros.)	379	Heartwood
		Prunus cerasus ● (Ros.)	33	Bud excretion
		Prunus maackii ● (Ros.)	33	Bud excretion
5,7,8-OMe		*Popowia cauliflora* (Annon.)	40	Stem
5,7,4′-OH	Naringenin	*Barleria christata* (Acanth.)	53	Flowers
		Centaurea arguta (Ast.)	387	Leaf

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Helichrysum viscosum var. *bracteatum* (Ast.)	104	Whole plant
		Helichrysum arenarium (Ast.)	201	Seed, leaf
		Nothofagus 4 spp. (Fag.)	284	Wood
		Ferreira spectabilis (Leg.)	388	Heartwood
		Intsia bijuga (Leg.)	389	Heartwood, sapwood
		Soymida febrifuga (Mel.)	285	Heartwood
		Prunus spp. (Ros.)	35	Wood
		Prunus sargentii ● (Ros.)	33	Bud excretion
		Larix dahurica (Pin.)	380	Heartwood
7-OMe	Sakuranetin	*Betula* 4 spp.● (Bet.)	55	Bud excretion
		Eupatorium havanense (Ast.)	500	
		Polymnia sp. (Ast.)	390	
		Juglans regia (Jugland.)	391	Bark
		Poecilanthe parviflora (Leg.)	392	
		Eucalyptus calophylla ● (Myrt.)	393	'Kino' resin
		Prunus spp. (Ros.)	35	Wood
		Prunus sargentii ● (Ros.)	33	Bud excretion
		Populus tremula ● (Salic.)	33	Bud excretion
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
4′-OMe	Isosakuranetin	*Eupatorium odoratum* (Ast.)	394	Leaf
		Betula 3 spp.● (Bet.)	55	Bud excretion
		Eucalyptus maculata (Myrt.)	502	Stem, bark
		Prunus 3 spp. (Ros.)	35	Wood
		Notholaena spp.● (Polypod.)	33	Farinose exudate on fronds
7,4′-OMe		*Dahlia tenuicaulis* (Ast.)	395	Flower
		Eupatorium odoratum (Ast.)	396	Aerial parts
		Betula 4 spp.● (Bet.)	55	Bud excretion
		Prunus sargentii ● (Ros.)	33	Bud excretion
		Pityrogramma spp.● (Polypod.)	77	Farinose exudate on fronds

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
5,7,4′-OMe		*Dahlia tenuicaulis* (Ast.)	395	Leaf
7,8,4′-OH		*Acacia rhodoxylon* (Leg.)	312	Wood
7,3′,4′-OH	Butin	*Mangifera indica* (Anacard.)	255	
		Acacia spp. (Leg.)	397	Heartwood, bark
		Butea frondosa (Leg.)	398	Flower
		Gliricidia sepium (Leg.)	399	Heartwood
		Robinia pseudacacia (Leg.)	258	Heartwood
5,6,7,8-OH				
5,6,8-OMe	Didymocarpin	*Didymocarpus pedicellata*● (Gesn.)	20	Leaf exudate
5,7,8-OMe	Isopedicin	*Didymocarpus pedicellata*● (Gesn.)	400	Leaf exudate
5,6,7,8-OMe	Kanakugin	*Popowia cauliflora* (Annon.)	401	Fruit
		Lindera erythrocarpa (Laura.)	402	Fruit
5,6,7,4′-OH				
6,7-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
5,6,7-OMe		*Chromolaena odorata* (Ast.)	120	Aerial parts
6,7,4′-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
5,7,8,4′-OH				
7,8-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
7,8,4′-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
5,7,2′,4′-OH	Neoartocarpanon, steppogenin	*Euphorbia stepposa* (Euphorb.)	404	
		Morus rubra (Mora.)	405	Heartwood
7-OMe	Artocarpanon	*Artocarpus integrifolia* (Mora.)	133	Heartwood
5,2′,4′-OMe	Cerasinone	*Prunus cerasus* (Ros.)	379	Heartwood
5,7,2′,4′-OMe	Arjunone	*Terminalia arjuna* (Comb.)	134	Fruits
5,7,2′,5′-OH		*Inula cappa* (Ast.)	283	Aerial parts
5,7,3′,4′-OH	Eriodictyol	*Eupatorium subhastatum* (Ast.)	156	Aerial parts
		Helichrysum viscosum var. *bracteatum* (Ast.)	104	Whole plant
		Lophophytum leandri (Balano.)	406	
		Sedum altissimum (Crass.)	407	Whole plant
		Eucryphia sp. (Eucryph.)	408	
		Eriodictyon (Hydroph.)	409	

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Coleus amboinicus (Lam.)	57	Leaf
		Prunus spp. (Ros.)	35	Wood
3′-OMe		*Helichrysum viscosum* var. *bracteatum* (Ast.)	104	Whole plant
4′-OMe	Hesperetin	*Citrus* spp. (Rut.)	410	Fruit peel
7,3′-OMe		*Eupatorium odoratum* (Ast.)	396	Aerial parts
		Melicope sarcocolla (Rut.)		Bark
7,4′-OMe	Persicogenin	*Prunus persica* (Ros.)	411	Bark
		Notholaena spp.● (Polypod.)	403	Farinose exudate on fronds
7,3′,4′-OMe		*Notholaena* spp.● (Polypod.)	403	Farinose exudate on fronds
6,7,3′,4′-OH	Plathymenin	*Plathymenia reticulata* (Leg.)	412	Heartwood
7,8,3′,4′-OH	Isoökanin	*Acacia* 4 spp. (Leg.)	312	Heartwood
8-OMe	Methoxy-butin	*Coreopsis* sp. (Ast.)	413	
7,3′,4′,5′-OH	Robtin	*Robinia pseudacacia* (Leg.)	258	Heartwood
5,6,7,8,4′-OH				
6,7,8-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
7,8,4′-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
6,7,8,4′-OMe		*Cheilanthes argentea*● (Polypod.)	403	Farinose exudate on fronds
5,7,3′,4′,5′-OH				
7,3′,4′,5′-OMe		*Notholaena lemonnii*● var. *lemonii* (Polypod.)	403	Farinose exudate on fronds
1.4 DIHYDROFLAVONOLS				
3,7-OH		*Platymiscium praecox* (Leg.)	199	Wood
3,5,7-OH	Pinobanksin, dihydrogalangin	*Eremophila alternifolia* (Myopor.)	208	Leaf, branch
		Eremophila ramosissima (Myopor.)	208	Leaf, branch
		Platanus vulgaris (Platan.)	414	Bark, heartwood
		Tilia platiphylla (Tilia.)	414	Wood
		Larix dahurica (Pin.)	380	Heartwood
		Pinus spp. (Pin.)	32	Bark
3-acetate		*Populus* spp.● (Salic.)	36	Bud excretion

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
7-OMe	Alpinone	*Alpinia* (Zingib.)	415	
		Pinus excelsa (Pin.)	206	Heartwood
		Pinus clausa (Pin.)	381	Heartwood
		Pinus strobus (Pin.)	414	Heartwood
5,7-OMe 3,6,7-OH		*Aniba riparia*	210	Wood
6-OMe		*Dalbergia ecastophyllum* (Leg.)	416	Wood
3,7,4′-OH	Garbanzol	*Toxicodendron succedaneum* (Anacard.)	417	Heartwood
		Cicer arietinum (Leg.)	214	Seedlings
3,5,6,7-OH 6-OMe	Alnustinol	*Alnus sieboldiana* ● (Bet.)	83	Male flower
3,5,7,4′-OH	Aromadendrin	*Nothofagus* 4 spp. (Faga.)	284	Wood
		Afzelia spp. (Leg.)	418	Heartwood
		Chlorophora tinctora (Mora.)	419	
		Morus alba (Mora.)	419	
		Eucalyptus (Myrt.)	420	'Kino' resin
		Larix decidua (Pin.)	421	Heartwood
		Pinus spp. (Pin.)	414	Bark
		Platanus vulgaris (Platan.)	414	Wood
		Prunus persica (Ros.)	411	Bark
		Prunus cerasus (Ros.)	411	Heartwood
		Tilia platiphyllos (Tilia.)	414	Wood
7-OMe		*Eupatorium capillifolium* (Ast.)	65	Aerial parts
		Eupatorium perfoliatum (Ast.)	65	Aerial parts
		Glycyrrhiza spp. (Leg.)	422	
		Eucalyptus (Myrt.)	423	'Kino'
		Prunus avium (Ros.)	424	Heartwood
4′-OMe	Dihydrokaempferide	*Prunus domestica* (Ros.)	278	Heartwood
5,7-OMe		*Eupatorium capillifolium* (Ast.)	65	Aerial parts
		Eupatorium perfoliatum (Ast.)	65	Aerial parts
7,4′-OMe		*Cephalanthus spathelliferus* (Rub.)	425	Bark

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
3,5,7,2′,5′-OH 5′-OMe		*Inula cappa* (Ast.)	283	Aerial parts
7,5′-OMe		*Inula cappa* (Ast.)	283	Aerial parts
3,7,3′,4′-OH	Fustin, dihydrofisetin	*Pistacia chinensis* (Anacard.)	256	
		Schinopsis spp. (Anacard.)	426	Heartwood
		Rhus javanica (Anacard.)	212	Heartwood
		Acacia mollissima (Leg.)	423	Heartwood
		Mimosa pudica (Leg.)	414	Heartwood
		Robinia pseudacacia (Leg.)	414	Heartwood
		Gleditsia triacanthos (Leg.)	259	Wood
3,5,7,3′,4′-OH	Taxifolin, (distylin), dihydroquercetin	*Melanorrhea* spp. (Anacard.)	428	Heartwood
		Pistacia chinensis (Anacard.)	256	Heartwood
		Rhus javanica (Anacard.)	212	Heartwood
		Lophophytum (Balano.)	406	Rhizome
		Rhododendron grande (Erica.)	429	Bark
		Nothofagus 4 spp. (Faga.)	284	Aerial parts
		Distylium racemosum (Hamamel.)	430	Heartwood
		Liquidambar styraciflua (Hamamel.)	431	Sapwood
		Coleus amboinicus (Lam.)	57	Leaf
		Machilus (Laura.)	432	
		Ocotea usambarensis (Laura.)	428	Wood
		Cytisus sp. (Leg.)	414	Branches
		Platanus spp. (Platan.)	414	Heartwood
		Prunus spp. (Ros.)	414	Wood
		Mimusops elengi (Sapo.)	433	Seed coat
		Mimusops manilkara (Sapo.)	433	Seed coat
		Sequoia gigantea (Taxo.)	414	Seed. bark
		Tilia platiphyllos (Tilia.)	414	Bark
		Cedrus libani (Pin.)	414	Wood
		Larix dahurica (Pin.)	380	Heartwood

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Larix decidua (Pin.)	421	Heartwood
		Pinus montana (Pin.)	414	Wood, bark
		Pinus strobus (Pin.)	414	Wood, bark
7-OMe	Padmatin	*Prunus puddum* (Ros.)	434	Heartwood
7,3′-OMe		*Artemisia pygmea* (Ast.)	71	Aerial parts
3,7,8,3′,4′-OH	Dihydromelanoxetin	*Acacia kempeana* (Leg.)	435	Wood
		Albizia adianthifolia (Leg.)	314	Heartwood
8-OMe		*Acacia kempeana* (Leg.)	312	
3,7,3′,4′,5′-OH	Dihydrorobinetin	*Schinopsis* spp. (Anacard.)	213	Heartwood
		Gleditsia triacanthos (Leg.)	414	
		Mimosa pudica (Leg.)	414	Heartwood
		Robinia pseudacacia (Leg.)	414	Heartwood
		Wisteria sinensis (Leg.)	414	Wood
		Sequoia gigantea (Taxo.)	412	Heartwood
4′-Me	Sepinol	*Gliricidia sepium* (Leg.)	512	Heartwood
3,5,7,8,3′,4′-OH		*Acacia nigrescens* (Leg.)	436	Heartwood
3,5,7,3′,4′,5′-OH	Ampelopsin, dihydromyricetin	*Cercidiphyllum* (Cercid.)	437	
		Adenanthera pavonina (Leg.)	438	Wood
		Soymidia febrifuga (Mel.)	285	Heartwood
		Leptharrhena pyrolifolia (Saxi.)	439	Aerial parts
		Pinus contorta (Pin.)	440	Wood, bark
		Pinus montana (Pin.)	414	Wood, bark
3′,5′-OMe	Dihydrosyringetin	*Soymidia febrifuga* (Mel.)	285	Heartwood
		Larrea tridentata (Zygoph.)	22	Leaf
1.5 CHALCONES				
4′-OH				
4′-OMe		*Citrus limon* (Rut.)	410	Fruit peel
2,4-OH		*Flourensia oolepsis* (Ast.)	364	Leaf, stem
		Flemingia chappar (Leg.)	441	Whole plant
		Larrea nitida (Zygoph.)	366	Aerial parts
2′,3′,4′-OH				
3′-OMe	Larrein	*Larrea nitida* (Zygoph.)	366	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
2′,4′,5′-OH 5′-OMe	Flemichapparin	*Flemingia chappar* (Leg.)	442	Whole plant
2′,4′6′-OH		*Populus* 4 spp.● (Salic.)	36	Bud excretion
		Adiantum sulphureum● (Polypod.)	204	Farinose exudate on fronds
4′-OMe		*Helichrysum cymosum* var. *calvum* (Ast.)	443	Aerial parts
		Helichrysum temiculum (Ast.)	443	Aerial parts, root
		Lindera umbellata (Laura.)	444	Leaf
		Piper sp. (Piper.)	445	Root
		Populus 4 spp.● (Salic.)	36	Bud excretion
		Adiantum sulphureum● (Polypod.)	204	Farinose exudate on fronds
		Cheilanthes 4 spp.● (Polypod.)	446	Farinose exudate on fronds
		Notholaena 2 spp.● (Polypod.)	446	Farinose exudate on fronds
		Onychium siliculosum● (Polypod.)	18	Farinose exudate on fronds
		Pityrogramma spp.●	77	Farinose exudate on fronds
6′-OMe	Cardamonin	*Alnus viridis*● (Bet.)	446	Bud excretion
		Daemonorops draco● (Palm.)	448	Resin
		Piper sp. (Piper.)	445	Root
		Alpinia katsumadai (Zingi.)	375	Seeds
		Alpinia speciosa (Zingi.)	376	Seeds
4′,6′-OMe	Flavokawin B	*Piper methysticum* (Piper.)	499	Root
		Aniba riparia (Laura.)	210	Trunk wood
2′,4′,4-OH	Isoliquiritigenin	*Dahlia tenuicaulis* (Ast.)	395	Flower
		Acacia spp. (Leg.)	397	Heartwood
		Cicer arietinum (Leg.)	214	Seedlings
		Cyclobium sp. (Leg.)	450	Heartwood
		Dalbergia retusa (Leg.)	385	Heartwood
		Dalbergia sericea (Leg.)	384	Bark
		Diplotropis purpurea (Leg.)	60	Heartwood
		Flemingia chappar (Leg.)	451	Whole plant
		Machaerium spp. (Leg.)	452	Heartwood

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Platymiscium praecox (Leg.)	450	Wood
		Robinia pseudacacia (Leg.)	258	Heartwood
4′-OMe		*Xanthorrhea* spp. (Xantho.)	453	Resin
2′,5′,4-OH				
4-OMe		*Cassia javanica*[×] (Leg.)	454	*Root*
4′,2,4-OH	Echinatin	*Glycyrrhiza echinata* (Leg.)	455	Tissue culture
2,4,6-OH				
6-OMe		*Daemonopsis draco* (Palm.)	448	Resin 'dragons blood'
4,6-OMe		*Pinus excelsa* (Pin.)	206	Heartwood
2′,3′,4′,6′-OH				
3′,6′-OMe		*Polygonum senegalensis* (Polygon.)	456	Seed, leaf
2′,3′,4′-OMe	Heliandin B	*Helichrysum sutherlandii* (Ast.)	48	Aerial parts
3′,4′,6′-OMe		*Popowia cauliflora* (Annon.)	40	Stem
2′,3′,4′,6′-OMe		*Popowia cauliflora* (Annon.)	40	Stem
2′,4′,5′,6′-OH				
4′,5′-OMe	Pashanone	*Didymocarpus pedicellata* (Gesn.)	457	Root
		Onychium siliculosum● (Polypod.)	18	Farinose exudate on fronds
2′,3′,4′,4-OH				
3′-OMe		*Acacia* 2 spp. (Leg.)	312	Heartwood
2′,4′,6′,4-OH	Isosalipurpol	*Nothofagus antarctica* (Faga.)	458	Pollen
		Tulipa spp. (Lilia.)	459	Anthers
4′-OMe	Neosakuranetin	*Pityrogramma calomelanos* var. *aureoflava*● (Polypod.)	33	Farinose exudate on fronds
		Pityrogramma tartarea● var. *aurata* (Polypod.)	77	Farinose exudate on fronds
6′-OMe		*Helichrysum heterolasium* (Ast.)	215	Aerial parts
4′,4-OMe		*Pityrogramma* spp.● (Polypod.)	77	Farinose exudate on fronds
		Pterozonium brevifrons● (Polypod.)	204	Farinose exudate on fronds
		Pterozonium scopulinum● (Polypod.)	204	Farinose exudate on fronds
4′,6′,4-OMe		*Dahlia tenuicaulis* (Ast.)		Flowers
		Piper methysticum (Piper.)	449	Rhizome
2′,4′,3,4-OH	Butein	*Rhus javanica* (Anacard.)	212	Heartwood
		Cosmos bipinnatus (Ast.)	460	Flowers

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Acacia spp. (Leg.)	312	Heartwood
		Adenanthera pavonia (Leg.)	438	Wood
		Butea frondosa (Leg.)	398	Flowers
		Cyclopia sp. (Leg.)	461	
		Machaerium mucronulatum (Leg.)	462	Trunk wood
		Machaerium villosum (Leg.)	452	
		Robinia pseudacacia (Leg.)	258	Heartwood
2′,4′,3,4-OH	Homobutein	*Acacia* (Leg.)	312	Heartwood
4-OMe		*Dahlia tenuicaulis* (Ast.)	395	Leaf
6,4′,4,5-OH				
6-OMe	Licochalcone	*Glycyrrhiza glabra* (Ast.)	460	Root
2′,3′,4′,5′,6′-OH				
3′,5′,6′-OMe	Isodidymocarpin	*Didymocarpus pedicellata*● (Gesn.)	463	Leaf
3′,4′,5′,6′-OMe	Pedicin	*Didymocarpus pedicellata*● (Gesn.)	464	Leaf
	Kanakugiol	*Popowia cauliflora* (Annon.)	401	Fruit
2′,3′,4′,5′,6′-OMe	Pedicellin	*Didymocarpus pedicellata*● (Gesn.)	464	Leaf
2′,3′,4′,6′,4-OH				
3′,4′,6′-OMe		*Popowia cauliflora* (Annon.)	401	Whole stems
		Chromolaena odorata (Ast.)	120	Aerial parts
2′,4′,5′,6′,4-OH		*Eupatorium odoratum* (Ast.)	394	Aerial parts
4′,5′,6′,4-OMe	Odoratin	*Eupatorium odoratum* (Ast.)	394	Aerial parts
2′,3′,4′,3,4-OH	Okanin	*Acacia* 3 spp. (Leg.)	312	Heartwood
		Albizia adiantifolius (Leg.)	314	Wood
		Albizia lebbeck (Leg.)	313	Heartwood
		Cylicodis cus gabuensis (Leg.)	465	Heartwood
3′-OMe	Lanceoletin	*Coreopsis bigelovii* (Ast.)	466	Flowers
2′,4′,6′,2,4-OH				
6′,2,4-OMe	Cerasin	*Prunus cerasus* (Ros.)	379	Flowers
4′,6′,2,4-OMe	Cerasidin	*Prunus cerasus* (Ros.)	379	Flowers
2′,4′,6′,3,4-OH				
4′,6′,4-OMe		*Merillia caloxylon* (Rut.)	147	Fruit
4′,6′,3,4-OMe		*Merillia caloxylon* (Rut.)	147	Fruit

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
3′,4′,2,4,5-OH	Neoplathymenin	*Plathymenia reticulata* (Leg.)	412	Heartwood
2′,4′,3,4,5-OH	Robtein	*Robinia pseudacacia* (Leg.)	258	Heartwood
2′,3′,4′,5′,6′,4-OH				
2′,4′,5′,4-OMe		*Flemingia strobilifera* (Leg.)	467	Root
2′,4′,5′,6′,3,4-OH				
4′,5′,6′,3,4-OMe		*Eupatorium odoratum* (Ast.)	120	Aerial parts
2′,4′,6′,2,4,5-OH				
4′,6′,2,4,5-OMe	Rubone	*Derris robusta* (Leg.)	468	Seed shells
2′,4′,6′,3,4,5-OH				
4′,6′,3,4,5-OMe		*Merillia caloxylon* (Rut.)	147	Fruit peel
1.6 DIHYDROCHALCONES				
	Dihydrochalcone	*Phallus impudicus* (Phall.)	469	Gleba
2′,4′,4-OH	Davidigenin	*Viburnum davidii* (Caprifol.)	470	Leaf
4-OMe		*Viburnum davidii* (Caprifol.)	470	Leaf
2′,4′,6′-OH				
4′-OMe		*Rhododendron* 3 spp. (Erica.)	471	Leaf
		Populus spp.● (Sali.)	36	Bud excretion
		Pityrogramma spp.● (Polypod.)	77	Farinose exudate on fronds
		Cheilanthes welwitschii● (Polypod.)	446	Farinose exudate on fronds
		Notholaena sulphurea● (Polypod.)	446	Farinose exudate on fronds
2′,4′,6′,4-OH	Phloretin			
4′-OMe	Lyonogenin, asebogenin	*Rhododendron* 3 spp. (Eric.)	501	Leaf
4′,4-OMe		*Notholaena sulphurea*● (Polypod.)	446	Farinose exudate on fronds
		Pityrogramma spp.● (Polypod.)	77	Farinose exudate on fronds
1.7 *C*-METHYLATED FLAVONOIDS				
Flavones				
5,7-OH				
6-Me	Strobochrysin 6-methylchrysin	*Pinus strobus* (Pin.)	472	Heartwood
5,7,4′-OH				
7,4′-OMe				
6-Me		*Eucalyptus*● *torreliana* (Myrt.)	473	Leaf wax
7-OMe				
6,8-Me	Sideroxylin	*Eucalyptus sideroxylon*● (Myrt.)	474	Leaf wax
		Eucalyptus torreliana● (Myrt.)	473	Leaf wax

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
7,4′-OMe				
6,8-Me	Eucalyptin	*Eucalyptus* spp. (Myrt.)	475	Leaf
		Eugenia biflora (Myrt.)	476	Leaf
		Angophora lanceolata ● (Myrt.)	473	Leaf wax
		Angophora subvelutina ● (Myrt.)	473	Leaf wax
		Myrcia citrifolia (Myrt.)	476	Leaf
Flavonols				
3,5,7-OH				
3-OMe				
6,8-Me		*Pityrogramma triangularis* ● var. *triangularis* (Polypod.)	477	Farinose exudate on fronds
3,5,7,8-OH				
7-OMe				
6-Me	Pityrogrammin	*Pityrogramma triangularis* ● var. *triangularis* (Polypod.)	245	Farinose exudate on fronds
3,5,7,4′-OH				
3-OMe				
6-Me		*Alluaudia dumosa* (Didier.)	478	Aerial parts
6,8-Me		*Alluaudia dumosa* (Didier.)	270	Aerial parts
		Alluaudia humbertii (Didier.)	270	Aerial parts
		Didierea madagascariensis (Didier.)	479	Aerial parts
3,5,6,4′-OH				
3-OMe				
8-Me	Sylpin	*Pinus silvestris* (Pin.)	480	Needles
3,5,7,3′,4′-OH				
6-Me	Pinoquercetin	*Pinus ponderosa* (Pin.)	481	Bark
6,8-Me		*Allaudia humbertii* (Didier.)	270	Aerial parts
3,3′-OMe				
6-Me		*Alluaudia humbertii* (Didier.)	270	Aerial parts
3,5,7,3′,4′,5′-OH				
6-Me		*Pinus ponderosa* (Pin.)	481	Bark
3-OMe				
6-Me		*Alluaudia dumosa* (Dider.)	482	Bark
		Alluaudia humbertii (Didier.)	270	Bark
3-OMe				
6,8-Me		*Alluaudia humbertii* (Didier.)	270	Aerial parts
4′-OMe				
6-Me	Dumosol	*Alluaudia dumosa* (Didier.)	483	Aerial parts

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
		Alluaudia humbertii (Didier.)	270	Aerial parts
4'-OMe 6,8-Me		*Alluaudia humbertii* (Didier.)	484	Aerial parts
3,4'-OMe 6-Me		*Alluaudia dumosa* (Didier.)	483	Aerial parts
		Alluaudia humbertii (Didier.)	484	Aerial parts
3,4'-OMe 6,8-Me		*Alluaudia dumosa* (Didier.)	483	Aerial parts
		Alluaudia humbertii (Didier.)	483	Aerial parts
Flavanones				
5,7-OH 6-Me	Strobopinin	*Agonis spathulata* (Myrt.)	378	Leaf twigs
		Pinus spp. subg. *haploxylon* (Pin.)	32	Heartwood
		Pityrogramma triangularis● var. *pallida* (Polypod.)	485	Farinose exudate on fronds
7-OMe 6-Me		*Pityrogramma triangularis*● var. *triangularis* (Polypod.)	485	Farinose exudate on fronds
8-Me	Cryptostrobin	*Agonis spathulata* (Myrt.)	378	Leaf twigs
		Pinus spp. subg. *haploxylon* (Pin.)	32	Heartwood
		Pityrogramma triangularis● var. *pallida* (Polypod.)	485	Farinose exudate on fronds
6,8-Me	Desmethoxy-matteucinol	*Unona lawii* (Annon.)	486	Stem
		Dalea polyadenia (Leg.)	487	Aerial parts
		Eugenia javanica (Myrt.)	488	Flowers
		Agonis spathulata (Myrt.)	378	Leaf twigs
		Pinus krempfii (Pin.)	372	Heartwood
		Pityrogramma triangularis● var. *pallida* (Polypod.)	485	Farinose exudate on fronds
7-OMe 6,8-Me		*Unona lawii* (Annon.)	486	Stem
5,7,4'-OH 6-Me	Poriol	*Leucothoe keiskei* (Erica.)	489	Whole plant
		Pseudotsuga spp. (Pin.)	490	Roots
6,8-Me	Farrerol, cyrtopterinetin	*Angophora lanceolata* (Myrt.)	491	'Kino' resin

Table 1. (*continued*)

Substitution pattern	Trivial name	Plant source (family)	Reference	Part of plant
7-OMe				
6,8-Me	Angophorol	*Angophora lanceolata* (Myrt.)	491	'Kino' resin
5,7,3',4',5'-OH				
4'-OMe				
8-Me		*Alluaudia ascendens* (Didier.)	270	
		Alluaudia procera (Didier.)	270	
5,7,3',4',5'-OH				
3',5'-OMe				
6,8-Me		*Alluaudiopsis marnieriana* (Didier.)	270	
5,7,1'-OH				
4'-OMe				
6,8-Me	Protofarrerol	*Leptorumora miqueliana* (Polypod.)	492	Fronds
Dihydroflavonols				
3,5,7-OH				
6-Me	Strobobanksin	*Pinus* spp. subg. *haploxylon* (Pin.)	32	Heartwood
3,5,7,3',4'-OH				
6-Me	6-*C*-Dihydro-quercetin	*Populus deltoides* (Sal.)	443	Bark
	Deodarin	*Cedrus deodora* (Pin.)	511	Bark
Chalcones				
2',4',6'-OH				
6'-OMe				
5'-Me		*Daemonorops draco* (Palmae)	448	'Dragon's blood' resin
4'-OMe				
3'-Me	Triangularin	*Pityrogramma triangularis*● var. *triangularis* (Polypod.)	494	Farinose exudate on fronds
4',6'-OMe				
3'-Me	Aurentiacin	*Didymocarpus aurantiaca* (Gesn.)	495	Whole plant
6'-OMe				
3',5'-Me		*Myrica gale* (Myric.)	496	Leaf
4'-OMe				
3'-diMe	Ceroptin	*Pityrogramma triangularis*● var. *triangularis* (Polypod.)	497	Farinose exudate on fronds
Dihydrochalcones				
2',4',6'-OH				
4'-OMe				
3',5'-Me		*Myrica gale*● (Myric.)	498	Fruit
4',6'-OMe				
3'-Me		*Myrica gale*● (Myric.)	496	Fruit
2',4',6',4-OMe				
4'-OMe				
3'-Me		*Pityrogramma triangularis*● var. *viscosa* (Polypod.)	499	Farinose exudate on fronds

There are comparatively few flavonoids that have as yet been found *only* in glycosidic combination. It is surprising to find that among these there are several tri- and tetramethyl derivatives which would be expected to occur as free aglycones. In all, some six flavones, 19 flavonols, four flavanones, two dihydroflavonols, three chalcones and two *C*-methylflavanones have been described as occurring only in glucosidic form.

Without doubt, the water-soluble *O*-glycosides are the form in which flavonoids are ubiquitous in plants. With respect to aglycones, Swain [3] writes: "... although their presence has often been reported in non-woody tissues, it is probable that in most cases they are formed as artefacts during the course of extraction, since most living tissues contain very active glycosidases which work even in the presence of high concentrations of organic solvents". The above tables show unequivocally that a large number of free aglycones are known—some 462 at present (121 flavones, 175 flavonols, 46 flavanones, 26 dihydroflavonols, 47 chalcones and 6 dihydrochalcones; in addition 39 *C*-methylated compounds). The total number of known aglycones—free or not—in 1975 was 335 [4]! It can also be seen that they are most common in certain taxa, and we will shortly discuss the reasons for such accumulations. Flavonoids with up to, say, five hydroxyl groups are scarcely soluble in water, and also those with more substituents become more and more lipophilic with increasing methylation. Derivatives of the 'usual' flavonols with two and more methyl groups can be assumed to occur in most cases without sugar attachment in lipid-soluble fractions, whereas monomethyl ethers like isorhamnetin are often present in glycosidic combination (c.f. [1]). On the other hand, kaempferol and isorhamnetin are very widely distributed as aglycones. Their lipophilic nature does not allow accumulation of these compounds in the cell sap, which leads to extracellular accumulation, e.g. in the oil glands of *Citrus* peel, in bud excretions of *Populus*, as farina on *Primula* (glandulotropic and epidermal excretion, according to [5]). In consequence there must be a correlation between the presence of free aglycones and certain plant structures.

Hänsel probably was the first to draw attention to such a correlation [6]. As he pointed out, some plants in connection with certain metabolic activities develop specialized anatomical structures in which certain products (rich in energy) can be secreted, and he mentioned especially plants producing essential oils and possessing the relevant storage structures: oil cells, oil cavities, oil ducts, glandular trichomes. The special physiological characters of essential oil plants find their expression also in the 'Endausgestaltung' (final elaboration) of secondary plant products belonging neither to the terpenoids nor to the phenylpropanes and which due to their common properties, i.e. lipid solubility, may be deposited together with the 'normal' constituents of essential oils. Hänsel's conclusions were as follows. Hydroxyflavonoids with glycosidic moieties (type A) can be expected in all plants as vacuolar constituents. Free hydroxyflavonoids (type B) are abundant in woody plants, occurring together with type A compounds. Lipophilic flavonoids with a low number of OH groups and/or a higher number of methoxy groups (type C) are encountered especially in plants with excretion cells or cavities and as constituents of waxy layers [7]. The tables presented here for compounds belonging to the B- and C-types corroborate these assumptions to a great extent.

Table 2. Distribution of flavonoid aglycones in plant families

	Flavones	Flavonols	Flavanones	Dihydroflavonols	Chalcones	Dihydrochalcones	*C*-Methylated flavonoids
Asteraceae	46	63	16	4	12		
Leguminosae	18	25		11	13		1
Polypodiaceae	9	31	6		4	2	13
Rutaceae	23	25	2		4		
Betulaceae	9	34	6	1	1		
Lamiaceae	34	7		1			
Rosaceae	2	8	9	4	2		
Didieraceae		13					11
Zygophyllaceae	3	14	2	1	1		
Pinaceae	2	3	2	4	1		8
Salicaceae		13	4	1	1	1	
Rubiaceae	18			1			
Scrophulariaceae	11	7					
Myrtaceae			5	2			9
Acanthaceae	11	1	1				
Verbenaceae	6	7					
Zingiberaceae		9	2	1	1		
Hippocastanaceae		11					
Anacardiaceae		4	1	4	1		
Euphorbiaceae		8	1				
Bignoniaceae	8						
Primulaceae	8						
Annonaceae	2	1			2		2
Fagaceae		3	1	2	1		
Piperaceae	1		2		5		
Dilleniaceae		6					
Ericaceae		2		1		2	1
Gesneriaceae			2		3		1
Geraniaceae		5					
Moraceae	2			1	2		
Rhamnaceae	1	4					
Combretaceae	1	3					
Lauraceae	1	2		1			
Myricaceae		1					3
Saxifragaceae		3		1			
Solanaceae		4					
Tamaricaceae		4					
Crassulaceae		2	1				
Juncaceae		3					
Meliaceae	1	1		1			
Palmae					2		1
Platanaceae				3			
Tiliaceae				3			
Apocynaceae	2						
Balanophoraceae			1	1			
Caprifoliaceae						2	
Cistaceae		2					
Eucryphiaceae		1	1				
Poaceae	2						
Hypericaceae	1	1					
Juglandaceae		1	1				
Malvaceae		2					
Polygonaceae		1			1		

Table 2. (*continued*)

	Flavones	Flavonols	Flavanones	Dihydroflavonols	Chalcones	Dihydrochalcones	C-Methylated flavonoids
Sapindaceae		1			1		
Taxodiaceae				2			
Vochysiaceae	2						
Aizoaceae			1				
Boraginaceae		1					
Brassicaceae				1			
Bromeliaceae		1					
Cactaceae		1					
Ceridiphyllaceae				1			
Datiscaceae		1					
Ebenaceae		1					
Elaeocarpanaceae		1					
Goodeniaceae		1					
Hamamelidaceae				1			
Hydrophyllaceae			1				
Lentibulariaceae	1						
Liliaceae					1		
Mimosaceae		1					
Myoporaceae				1			
Resedaceae	1						
Sapotaceae				1			
Sterculiaceae		1					
Thymelaeaceae	1						
Turneraceae	1						
Theaceae		1					
Xanthorrheaceae							1

With regard to the accumulation of free aglycones in certain families and/or genera, it must be remembered that plants are often analysed for their pharmaceutical interest and that plants of only certain geographical areas have been analysed in detail. In Table 2 we have listed all the relevant plant families according to decreasing number of flavonoid aglycones reported, and the numbers of aglycones are recorded according to their class. It must be stressed that only the number of *different* flavonoids found per family is given.

Asteraceae is at the top of our list; most free aglycones have been reported so far from this one family. Flavones and flavonols are widely present often with additional substituents in the 6- and/or 8-positions. In spite of the large number of flavonoids found, only one 5-deoxy compound has been reported and no dihydrochalcone is known; furthermore the 12 chalcones are restricted to only six genera. It is striking that all reports of free flavonoids in Asteraceae refer to members of the tribe Tubuliflorae. Only in this tribe are glandular hairs, schizogenous oil ducts and resin ducts or single latex cells present. They produce essential oils, balsams and latices.

In Leguminosae most of the free aglycones are flavonols, many of them being 5-deoxy compounds and 6- or 8-substituted. (We here use the term Leguminosae to include the three subfamilies which are now treated by some as separate families, i.e. the Mimosaceae, Caesalpinaceae and Fabaceae.) It can be assumed that many of the isoflavonoids, which are known to be almost confined to this family, also occur as free aglycones. In the Leguminosae secretory structures occur only exceptionally. Although certain woody representatives produce balsams, the family as a whole does not typically form lipophilic secondary products. Thus it is surprising that they occupy the second place in this table.

Rutaceae produce flavones and flavonols in abundance, most of them being substituted in positions 6 and/or 8. The number of highly methylated flavonoids in this family is striking. We may cite Harborne here: "The Rutaceae, as a family, is extremely versatile in its synthetic capacity and produces a wide range of unusual, highly substituted flavonoid constituents... characterised by a high degree of methylation by extra groups in the 6-, 8- or 2′-position, by presence of methylenedioxy groups and by attachment of isoprenoid side-chains" [8]. It is a typical anatomical character of the Rutaceae that they possess lysigenous oil cavities. Besides essential oils based mainly on mono- and sesquiterpenes and on phenylpropanes, they also produce diterpenes and triterpenes.

In the Betulaceae all aglycones reported hitherto have been found in bud excretions of *Alnus*, *Betula* and *Ostrya* species. Most of them are methylated 'normal' flavones and flavonols, compounds of the latter class being more abundant. They are exuded together with terpenoid-rich material (not essential oils) by peltate squamiform trichomes (colleteres) on the inner side of the bud scales and on young leaves. The accumulation of triterpenes is characteristic for the Betulaceae.

Flavones predominate in the Lamiaceae, the majority of them being substituted in 6- and/or 8-position. The Lamiaceae bear secretory glands which are typical for the family. They are rich in the production of essential oils, composed of various classes of terpenoids.

In Rosaceae most free flavonoids have been found in woods or in bud excretions of *Prunus* species. It may be mentioned too that trace amounts of aglycones have been found also in buds of *Sorbus* species (unpublished results). Plants of this family sometimes bear glandular trichomes; they occasionally accumulate triterpenes and only rarely essential oils.

All data for Zygophyllaceae are due to one single genus again, namely *Larrea*, in which methyl ethers of 'normal' flavonols are dominant. Zygophyllaceae generally bear glandular trichomes. They accumulate essential oils, mostly sesquiterpenes, in parenchyma. The leaves of *Larrea* species are covered with a resin which is well-known for its large nordihydroguaretic acid content.

The occurrence of flavonoids in Salicaceae is obvfously restricted to bud excretions of various *Populus* species. They all show the 'normal' substitution pattern. The resinous excretions and essential oils consist of phenylpropanes. They are secreted by a glandular epithelium on the inner side of the bud scales.

For Rubiaceae only flavones have been reported, mostly substituted in 6- and 8-positions, and they are almost restricted to *Gardenia* (dikamali gum). The family exhibits schizogenous cavities; resinous materials, containing triterpenes and sterols, accumulate.

For other families, individual discussion is not warranted since the numbers of aglycones present are too scanty. It should be mentioned though that the reports of

'normal' flavonols for Hippocastanaceae only comprise those found in bud excretions of *Aesculus*, and Primulaceae reports almost exclusively are due to *Primula* farinas, which consist of an unsubstituted flavone itself and of mono- and dihydroxylated flavones and trace amounts of alkanes.

From the Tables 1 and 2 and the discussion of several families it becomes evident that the distribution of sugar-free, ±lipophilic flavonoids in the plant kingdom in most cases is clearly correlated with the presence of secretory structures, essential oils and similar lipophilic secondary products. This is most convincingly observed in the Asteraceae, the Rutaceae, the Betulaceae and the Lamiaceae. It applies to members of a series of additional families discussed above or contained only in Table 3. Examples are the Myrtaceae (mainly *Eucalyptus* leaf wax), the Acanthaceae (mainly *Andrographis*), the Verbenaceae (six genera), the Juglandaceae (3 genera), the Anacardiaceae (six genera) and the Euphorbiaceae (*Beyeria, Ricinocarpus* and *Euphorbia*). A good example of an excellent correlation of characters had been reported by Hänsel [9]. Casticin, a tetramethyl derivative of quercetagetin, is encountered within *Vitex* only in those species which possess glandular hairs and produce essential oils. In *Aesculus* the buds of only those species producing a resin contain the methylated flavonols.

The Brassicaceae are a good negative example; they do not normally possess any secretory structures, nor do they produce lipophilic materials belonging to the terpenoids or phenylpropanes—and there are no free aglycones reported. The production of fats and fatty oils and their storage in seeds are abundant in this family, but these are obviously not correlated with occurrence of flavonoid aglycones. Also for Hamamelidaceae and for the whole order Ranunculales it can be stated that secretory structures as well as free flavonoids are lacking.

The Apiaceae are characterized by secretory ducts and oil cavities; they produce essential oils in abundance but no free flavonoids have been encountered apart from 4'-prenyloxynaringenin from *Angelica archangelica* [10]. Coumarins, on the other hand, have been found as aglycones (cf. [11]). Flavonoid glycosides are commonly present in the Apiaceae. Not so striking, but nevertheless remarkable, is the lack of free flavonoids in Magnoliaceae. The Liliceae are another large family with practically no free aglycones (only one chalcone from anthers of *Tulipa*). Also for the important family Poaceae only three aglycones have been reported to occur in some grasses.

Still another category is represented by the Didieriaceae. They do not have secretory structures [12] or lipophilic products, but they have been found recently to contain free flavonoids, especially *C*-methylated derivatives, in spines and in cortex.

For a number of angiosperm families we found reports only for a single genus, or even for a single species. This is clear in some rare exotic families and in those which comprise only a few genera, for example, the Ebenaceae (7 genera), the Eucryphiaceae (2), the Myoporaceae (5) and the Turneraceae (6). It is striking, however, that there are only a few records of some families containing a good number of genera, like the Sapindaceae (120 genera), the Sapotaceae (35), and the Thymelaeaceae (38), or some of those common in temperate regions, as for example the Fagaceae. At least in the latter this is probably due to the true absence of free flavonoids, and not merely to the lack of relevant investigations.

Going through the column 'plant organs' in our lists 1.1–1.7 (Table 1), it becomes evident that, in woody plants, heartwoods are a rich source of flavonoid aglycones. The best examples are *Pinus* (many dihydroflavonols and *C*-methylated compounds), *Prunus* (flavanones and chalcones), and especially Leguminosae like *Acacia* (flavonols, chalcones), *Apuleia* (flavonols only), *Robinia* and others. The accumulation of aglycones in heartwood of Leguminosae would be still greater if isoflavonoids and prenylated compounds were taken into account. To a lesser extent also accumulation in the bark is observed: in some Rutaceae and Leguminosae and conspicuously in *Pinus* (dihydroflavonols, *C*-methylflavonoids).

A further remarkable source of lipophilic flavonoids is the bud excretions of *Populus* species (Salicaceae), of Betulaceae (*Alnus* and *Betula* in tribe Betuleae; only *Ostrya* in tribe Coryleae), and of some *Aesculus* species (Hippocastanaceae). In *Populus* they are secreted by a secretory epithelium on the inner surface of the bud scales; in *Alnus, Betula* and *Aesculus* there are stalked glandular trichomes with multicellular heads (colleters). We do not know if there are similar structures in the buds of *Prunus* (Rosaceae) and of *Rhamnus* (Rhamnaceae), where we also found free flavonols. Also *Platanus* (Platanaceae) produces a lipophilic bud exudate, from which a prenylated flavonol (platanetin) has been identified [13], and recently it has been mentioned that buds of *Elaegia utilis* (Rubiaceae) produce a resin that contains, besides phytosterols, free apigenin [14]. It has been stressed already by Charrière and Tissut [15] that there is no correlation observed between those woody plants which accumulate aglycones in the heartwood and those which produce aglycones in their buds. We now know *Prunus* to be the one exception.

Flavonoid aglycones are also deposited externally on plant leaves, sometimes in considerable amounts, although this is often not obvious from the relevant publications. For example, dried and powdered fronds of farinose *Cheilanthes* species [16, 17] and of *Onychium auratum* (=*O. siliculosum*) [18] were analysed but the authors failed to make it clear in their papers that the flavonoid aglycones they found in the petrol extracts were the constituents of the farina. Only those familiar with these ferns would realise this when reading such reports. For *Didymocarpus pedicellata* (Gesneriaceae) it is well known that the benzoquinoid chalcones pedicin and pedicellin and the related flavanones are the constituents of a highly coloured dust on the under-surface of the leaf [19]. External occurrence can thus be assumed for the flavanone didymocarpin, reported more recently [20] as isolated from powdered leaves of the same species.

Now let us summarize the data on those families or genera in which external occurrence of flavonoids is certain. From our own work we can cite the farina of Gymnogrammoid ferns, especially those belonging to the genera *Cheilanthes, Notholaena* and *Pityrogramma*, and the farina of many *Primula* species. On the ferns, as well as on primroses, the farinose deposit consists almost exclusively of flavonoid aglycones; in both cases it is excreted as quasi-crystalline matter on the capitate cells of stalked glandular trichomes. Earlier reports of the occurrence of external aglycones on *Dionysia* species [21] (also Primulaceae) could be confirmed, although we could not yet detect unsubstituted flavone itself (E. Wollenweber, unpublished results). On *Salvia glutinosa* (Lamiaceae) methylated flavonols have been found as

constituents of an exudate and *Salvia tomentosa* also exhibits some external flavonoids (A. Ulubelen, personal communication). In this context *Larrea* (Zygophyllaceae) must be mentioned again. Here it has been noted also in the literature [22] that the aglycones are constituents of a 'resin' that covers the leaves and twigs. Components of epicuticular layers flavonoids are observed also in the leaf wax of *Eucalyptus* species (Myrtaceae). A similar case occurs in the fern *Pellaea*, where there is a thin waxy layer on the leaflets, causing a glaucous appearance, which rather unexpectedly contains trace amounts, at least, of free flavonoids. Our preliminary observations in other plants suggest that there may be many instances when flavonoids are deposited externally in leaf waxes.

Since phenolic substances generally have significant antimicrobial activity, it has been assumed that their function in tissues where they accumulate might be to provide chemical barriers to invading micro-organisms [23]. Swain postulated (personal communication) that the methylated, lipophilic flavonoids are especially suitable as protection against micro-organisms because of their ease in penetrating membranes. Because of the very limited occurrence of flavonoid-containing bud excretions or flavonoid farina in plants, we were originally sceptical about this suggestion. Our recent discovery that external flavonoids occur at least in trace amounts, as constituents of epicuticular layers in a variety of other plants is in favour of Swain's hypothesis.

The co-occurrence of lipophilic flavonoids with terpenoids has been demonstrated very clearly in the Rutaceae, which are well known to produce very highly methylated flavonoids. Walther *et al.* [24] showed in 1966 that these are located in the oil glands of the rind of *Citrus* fruits, by analysis of the essential oil sucked with a capillary from such oil cavities. No doubt, the same is true for the fruits of *Merillia caloxylon*, another rutaceous plant, where numerous oil glands and highly methylated flavones and chalcones are found in the fruit rind [25]. Also the resinous exudate of *Gardenia lucida* (dikamali gum) contains, besides terpenoid constituents, highly methylated flavones [26]. It is clear that the Rutaceae possess 'an active methylating mechanism' [27]. They are also distinguished by their capacity for the biosynthesis of flavonoid molecules with additional substituents. An 'active methylating mechanism' for flavonoids can be assumed also for *Populus*, *Betula*, *Aesculus*, *Pityrogramma*, and all the other taxa described above which produce methylated aglycones. Gottlieb [4] has pointed out that within a given plant the relative amounts of flavonol glycosides compared with aglycones present would not only depend on increasing *O*-methylation, but also "depends additionally on the stage of growth and the plant organ analysed". From all these observations it is evident that the occurrence of non-polar, polymethylated or minimally hydroxylated flavonoids (Hänsel's type C) is naturally correlated with the plants' ability to accumulate lipophilic secondary products, especially terpenoids, either within specialized structures (often a character of a distinct plant organ) or externally.

Although the number of known structures has greatly increased since Harborne [8] wrote the first book on the comparative biochemistry of flavonoids, most of his assumptions on the occurrence and abundance of certain substitution patterns are still valid. It has long been known that glycosides of kaempferol, quercetin, and, to a lesser extent, of myricetin, are almost universally distributed in leaves of angiosperms. It is now our opinion that the methylated derivatives of kaempferol and quercetin are very often present in those plants which contain free aglycones. This is not obvious from our tables since a generic name often represents occurrences in many different species, and because we have not included *all* reports on such widely distributed compounds as isorhamnetin, rhamnocitrin, etc.

With regard to the methylated flavonols found free as aglycone (Table 1.2), the frequency of finding particular hydroxyl groups with methyl substitutions follows already established trends [4, 28]. Four of seven possible methyl ethers of galangin are known, 10 of 15 in the case of kampferol, 19 of 31 in the case of quercetin. In the case of myricetin, only 11 methyl ethers have been found as yet (7 as free aglycones), while 63 are possible theoretically, and 31 if position 5 is free. This contrasts with the more usual situation where flavonoids with a large number of hydroxyls tend to occur in highly methylated forms. Thus the highest numbers of hydroxyls are found in the flavone series with tetra- to heptamethyl ethers of 5,6,7,8,3',4',5'-heptahydroxyflavone, and in the flavonol series with tri- to heptamethyl ethers of 3,5,7,8,3',4',5'-heptahydroxyflavone and hexa- to octamethyl ethers of 3,5,6,7,8,3',4',5'-octahydroxyflavone. The parent polyhydroxy compounds of these methyl ethers are not known to occur as such. This might be "due to the high reactivity of polyhydroxyflavonols, which means they are difficult to isolate" [4]. In our opinion, it is also a consequence of the ability of the relevant plants to accumulate lipophilic secondary products.

Among the flavones (Table 1.1), the substitution patterns of apigenin and scutellarein seem to be the most abundant, whereas derivatives of luteolin, which occupy the second place in abundance as glycosides, appear to occupy the third place in this connection.

Flavones and flavonols with extra substituents in the 6- or 8-positions are the most important group among the rarer structures. In a considerable number of cases the extra hydroxyls are methylated (cf. [1]). Most of the 6- and/or 8-substituted compounds are reported from the Asteraceae, followed by the Rutaceae, Lamiaceae, and Leguminosae. When considering such findings it must be remembered however, that the greatest number of plants analysed so far belong to the Asteraceae.

2'-Substituted flavones and flavonols are rare and their occurrence in plants is scattered. Very rarely 2'-substitution is combined with 6- or 8-substitution. 5-Deoxyflavonoids are mostly flavonols. They are encountered above all in Leguminosae, to a lesser extent in Anacardiaceae, and there are single reports from members of three further families (one flavonol in *Alnus*, one in *Gleditsia*, one chalcone in *Larrea*).

Flavanones are of erratic distribution in plants. Although found variously in all parts of the plant, there is a tendency for accumulation in wood. Free flavanones are sometimes reported to occur together with the chalcones of the corresponding substitution patterns. For example, 7-hydroxyflavanone and 2',4'-dihydroxychalcone have been isolated together from *Flourensia oolepis*, *Flemingia chappar*, and *Larrea nitida*. Such findings need to be carefully checked, since it is always possible that the flavanones are artefacts, formed from the less stable chalcones during the isolation procedures.

Free dihydroflavonols (Table 1.4) have a scattered distribution in the plant kingdom and do not occur with

Table 3. Alphabetical key to the trivial names of flavonoid aglycones (See Addendum for further trivial names)

Acacetin	5,7-OH, 4′-OMe-flavone
Acerosin	5,7,3′-OH, 6,8,4′-OMe-flavone
Alnetin	5-OH, 6,7,8-OMe-flavone
Alnusin	3,5,7-OH, 6-OMe-flavone
Alnustin	5-OH, 3,6,7-OMe-flavone
Alnustinol	3,5,8-OH, 6-OMe-flavanone
Alpinetin	7-OH, 5-OMe-flavanone
Alpinone	3,5-OH, 7-OMe-flavanone
Ampelopsin	3,5,7,3′,4′,5′-OH-flavanone
Angophorol	5,4′-OH, 7-OMe-flavanone
Annulatin	5,7,3′,4′,5′-OH, 3-OMe-flavone
Apigenin	5,7,4′-OH-flavone
Apuleidin	5,2′,3′-OH, 3,7,4′-OMe-flavone
Apulein	2′,5′-OH, 3,5,6,7,4′-OMe-flavone
Apuleirin	6,3′-OH, 3,5,7,4′,5′-OMe-flavone
Apuleisin	5,6,2′,3′-OH, 3,7,4′-OMe-flavone
Apuleitrin	5,6,5′-OH, 3,7,3′,4′-OMe-flavone
Arjunone	5,7,2′,4′-OMe-flavanone
Aromadendrin	3,5,7,4′-OH-flavanone
Artemetin	5-OH, 3,6,7,3′,4′-OMe-flavone
Artemisetin = artemetin	
Artocarpanone	5,2′,4′-OH, 7-OMe-flavanone
Artocarpetin	5,2′,4′-OH, 7-OMe-flavone
Asebotin = lyonogenin	
Auranetin	3,6,7,8,4′-OMe-flavone
Aurentiacin	2′-OH, 6-OMe, 3′-Me-chalcone
Axillarin	5,7,3′,4′-OH, 3,6-OMe-flavone
Ayanin	5,6,3′-OH, 3,7,4′-OMe-flavone
Azaleatin	3,7,3′,4′-OH, 5-OMe-flavone
Batatifolin = nodifloretin	
Beicalein	5,6,7-OH-flavone
Betuletol	3,5,7-OH, 6.4′-OMe-flavone
Buddleoflavonol = acacetin	
Butein	2′,4′,3,4-OH-chalcone
Butin	7,3′,4′-OH-flavanone
Calycopterin	3,4′-OH, 3,6,7,8-OMe-flavone
Cardamonin	2′,4′-OH, 6′-OMe-chalcone
Carthamidin	5,7,8,4′-OH-flavanone
Caryatin	7,3,4′-OH, 3,5-OMe-flavone
Casticin	5,3′-OH, 3,6,7,4′-OMe-flavone
Centaureidin	5,7,3′-OH, 3,6,4′-OMe-flavone
Cerasinone	7-OH, 5,2′,4′OMe-flavanone
Cerrosilin	5,6,3′,5′-OMe-flavone
Chrysin	5,7-OH-flavone
Chrysoeriol	5,7,4′-OH, 3-OMe-flavone
Chrysosplenol	5,3′,4′-OH, 3,6,7-OMe-flavone
Chysosplenetin	5,4′-OH, 3,6,7,3′-OMe-flavone
Chrysosplenol C	5,6,4′-OH, 3,7,3′-OMe-flavone
Chrysosplin	5,4′-OH, 3,6,7,2′-OMe-flavone
Cirsilineol	5,4′-OH, 6,7,3′-OMe-flavone
Cirsiliol	5,3′,4′-OH, 6,7-OMe-flavone
Cirsimaritin	5,4′-OH, 6,7-OMe-flavone
Citrifoliol = isosakuranetin	
Citromitin	5,6,7,8,3′,4′-OMe-flavanone
Citronetin	5,7-OH, 2′-OMe-flavanone
Combretol	5-OH, 3,7,3′,4′,5′-OMe-flavone
Conyzatin	5,7-OH, 3,8,3′,4′,5′-OMe-flavone
Corniculatusin	3,5,7,3′,4′-OH, 8-OMe-flavone
Corymbosin	5-OH, 7,3′,4′,5′-OMe-flavone
Cryptostrobin	5,7-OH, 8-Me-flavanone
Cyrtominetin	5,7,3′,4′-OH, 6,8-Me-flavanone
Cyrtoperinetin = farrerol	
Datin	3,5,2′-OH, 7-OMe-flavone
Datiscetin	3,5,7,2′-OH-flavone
Davidigenin	2′,4′,4-OH-dihydrochalcone
Desmethoxymatteueinol	5,7-OH, 6,8-Me-flavanone
Digicitrin	5-OH, 3,6,7,8,4′,5′-OMe-flavone
Digitoflavone = luteolin	
Dihydroöroxylin	5,7-OH, 6-OMe-flavanone
Dihydrowogonin	5,7-OH, 8-OMe-flavanone
Dillenetin	3,5,7-OH, 3′,4′-OMe-flavone
Dinatin = hispidulin	
Diosmetin	5,7,3′-OH, 4′-OMe-flavone
Distylin = taxifolin	
Dumosol	3,5,7,3′,5′-OH, 4′-OMe, 6-Me-flavone
Echinatin	4′,4-OH, 2-OMe-chalcone
Echioidin	5,2′-OH, 7-OMe-flavone
Emmaosumin	5-OH, 3,6,7,8,3′-OMe-flavone
Erianthin	5-OH, 3,6,7,3′,4′-OMe-flavone
Eriodictyol	5,7,3′,4′-flavanone
Eriostemin	3,8-OH, 5,6,7,4′-OMe-flavone
Ermanin	5,7-OH, 3,4′-OMe-flavone
Eucalyptin	5-OH, 7,4′-OMe, 6,8-Me-flavone
Eupafolin = nepetin	
Eupalitin	3,5,4′-OH, 6,7-OMe-flavone
Eupatilin	5,7-OH, 6,3′,4′-OMe-flavone
Eupatin	3,5,3′-OH, 6,7,4′-OMe-flavone
Eupatolitin	3,5,3′,4′-OH, 6,7-OMe-flavone
Eupatoretin	3,3′-OH, 5,6,7,4′-OMe-flavone
Eupatorin	5,3′-OH, 6,7,4′-OMe-flavone
Europetin	3,5,3′,4′,5′-OH, 7-OMe-flavone
Exoticin	3,5,6,7,8,3′,4′,5′-OMe-flavone
Farrerol	5,7,4′-OH, 6,8-Me-flavanone
Fastigenin = cirsilineol	
Fisetin	3,7,3′,4′-OH-flavone
Flavokawin B	2′-OH, 4′,6′-OMe-chalcone
Flavonol	3-OH-flavone
Flemichapparin	2′,4′-OH, 5′-OMe-chalcone
Flindulatin	5-OH, 3,7,8,4′-OMe-flavone
Fustin	3,7,3′,4′-OH-flavanone
Galangin	3,5,7-OH-flavone
Galetin	3,5,6,7,4′-OH-flavone
Garbanzol	3,7,4′-OH-flavanone
Gardenin A	5-OH, 6,7,8,3′,4′,5′-OMe-flavone
Gardenin B	5-OH, 6,7,8,4′-OMe-flavone
Gardenin C	5,3′-OH, 6,7,8,4′,5′-OMe-flavone
Gardenin D	5,3′-OH, 6,7,8,4′-OMe-flavone
Gardenin E	5,3′,5′-OH, 6,7,8,4′-OMe-flavone
Genkwanin	5,4′-OH, 7-OMe-flavone
Geraldol	3,7,4′-OH, 3′-OMe-flavone
Geraldone	7,4′-OH, 3′-OMe-flavone
Gnaphaliin	5,7-OH, 3,8-OMe-flavone
Gonzalithosin F	7-OH, 5,3′,4′-OMe-flavone
Gossypetin	3,5,7,8,3′,4′-OH-flavone
Herbacetin	3,5,7,8,4′-OH-flavone
Hesperetin	5,7,3′-OH, 4′-OMe-flavanone
Hibiscetin	3,5,7,8,3′,4′,5′-OH-flavone
Hieracin	5,7-OH, 3′,4′,6′-OMe-flavone
Hispidulin	5,7,4′-OH, 6-OMe-flavone
Homobutein	2′,4′,4-OH, 3-OMe-chalcone
Homoeriodictyol	5,7,4′-OH, 3′-OMe-flavanone
Hymenoxin	5,7-OH, 6,8,3′,4′-OMe-flavone
Hypolaetin	5,7,8,3′,4′-OH-flavone
Isocarthamidin	5,6,7,4′-OH-flavanone
Isognaphaliin	5,8-OH, 3,7-OMe-flavone

Table 3. (*continued*)

Isokaempferide	5,7,4′-OH, 3-OMe-flavone
Isolimocitrol	3,5,7,3′-OH, 6,8,4′-OMe-flavone
Isoliquiritigenin	2′,4′,4-OH-chalcone
Isoökanin	7,8,3′,4′-OH-flavanone
Isorhamnetin	3,5,7,4′-OH, 3′-OMe-flavone
Isosakuranetin	5,7-OH, 4′-OMe-flavanone
Isosalipurpol	2′,4′,6′,4-OH-chalcone
Isoscutellarein	5,7,8,4′-OH-flavone
Isosinensetin	5,7,8,3′,4′-OMe-flavone
Izalpinin	3,5-OH, 7-OMe-flavone
Jaceidein	5,7,4′-OH, 3,6,3′-OMe-flavone
Jaceosidin	5,7,4′-OH, 6,3′-OMe-flavone
Jaranol = kumatakenin	
Kanakugin	5,6,7,8-OMe-flavanone
Kanakugiol	2′,3′,4′,5′,6′-OH-chalcone
Kaempferide	3,5,7-OH, 4′-OMe-flavone
Kaempferol	3,5,7,4′-OH-flavone
Kikokunetin = isosakuranetin	
Kumatakenin	5,4′-OH, 3,7-OMe-flavone
Lanceoletin	2′,4′,3,4-OH, 3′-OMe-chalcone
Laricitrin	3,5,7,4′,5′-OH, 3′-OMe-flavone
Licochalcone B	4′,4,5-OH, 6-OMe-chalcone
Limocitrin	3,5,7,4′-OH, 8,3′-OMe-flavone
Limocitrol	3,5,7,4′-OH, 6,8,3′-OMe-flavone
Linarigenin = acacetin	
Linderoflavone A	5,7-OH, 6,8-OMe-flavone
Liquiritigenin	7,4′-OH-flavanone
Lucidin = linderoflavone A	
Luteolin	5,7,3′,4′-OH-flavone
Lyonogenin	2′,6′,4-OH, 4′-OMe-dihydrochalcone
Methoxybutin	7,3′,4′-OH, 8-OMe-flavanone
Matteucinol	5,7-OH, 4′-OMe, 6,8-Me-flavanone
Mearnsetin	3,5,7,3′,5′-OH, 4′-OMe-flavone
Melanoxetin	3,7,8,3′,4′-OH-flavone
Mikanin	3,5-OH, 6,7,4′-OMe-flavone
Morin	3,5,7,2′,4′-OH-flavone
Myricetin	3,5,7,3′,4′,5′-OH-flavone
Naringenin	5,7,4′-OH-flavanone
Natsudaidain	3-OH, 5,6,7,8,3′,4′-OMe-flavone
Negletein	5,6-OH, 7-OMe-flavone
Neoartocarpanone	5,7,2′,4′-OH-flavanone
Neoplathymenin	2′,4′,5′,3,4-OH-chalcone
Nepetin	5,7,3′,4′-OH, 6-OMe-flavone
Nevadensin	5,7-OH,6,8,4′-OMe-flavone
Nimbicetin = kaempferol	
Nobiletin	5,6,7,8,3′,4′-OMe-flavone
Nodifloretin	5,6,7,4′-OH, 3′-OMe-flavone
Norartocarpetin	5,7,2′,4′-OH-flavone
Norwogonin	5,7,8-OH-flavone
Odoratin	2′-OH, 4′,5′,6′,4-OMe-chalcone
Okanin	2′,3′,4′,3,4-OH-chalcone
Ombuin	3,5,3′-OH, 7,4′-OMe-flavone
Onopordin	5,7,3′,4′OH, 8-OMe-flavone
Oroxylon	5,7-OH, 6-OMe-flavone
Oxyayanin A	5,2′,5′-OH, 3,7,4′-OMe-flavone
Oxyayanin B	5,6,3′-OH, 3,7,4′-OMe-flavone
Pachypodol	5,4′-OH, 3,7,3′-OMe-flavone
Padmatin	3,5,3′,4′-OH, 7-OMe-flavanone
Parshanone	2′,6′-OH, 4′,5′-OMe-chalcone
Patuletin	3,5,7,3′,4′-OH, 6-OMe-flavone
Pectolinarigenin	5,7-OH, 6,4′-OMe-flavone
Pedalitin	5,6,3′,4′-OH, 7-OMe-flavone
Pedicellin	2′,3′,4′,5′,6′-OMe-chalcone
Pedicin	2′-OH, 3′,4′,5′,6′-OMe-chalcone
Penduletin	5,4′-OH, 3,6,7-OMe-flavone
Persicogenin	5,3′-OH, 7,4′-OMe-flavanone
Phloretin	2′,4′,6′,4-OH-dihydrochalcone
Pilloin	5,3′-OH, 7,4′-OMe-flavone
Pinocembrin	5,7-OH-flavanone
Pinostrobin	5-OH, 7-OMe-flavanone
Pityrogrammin	3,5,8-OH, 7-OMe, 6-Me-flavone
Plathymenin	6,7,3′,4′-OH-flavanone
Pollenitin	3,5,8,4′-OH, 7-OMe-flavone
Polycladin = chrysosplenetin	
Ponkanetin = tangeritin	
Populnetin = kaempferol	
Poriol	5,7,4′-OH, 6-Me-flavanone
Pratoletin	3,5,8,4′-OH-flavone
Primetin	5,8-OH-flavone
Primuletin	5-OH-flavone
Protofarrerol	5,7,1′-OH, 4′=O, 6,8-Me-flavanone
Prudomestin	3,5,7-OH, 8,4′-OMe-flavone
Prunusetin = prunetin	
Psathyrotin = salvigenin	
Ptaeroxylon	3,5,7-OH, 2′-OMe-flavone
Quercetagetin	3,5,6,7,3′,4′-OH-flavone
Quercetin	3,5,7,3′,4′-OH-flavone
Ranupenin	3,5,8,3′,4′-OH, 7-OMe-flavone
Retusin	5-OH, 3,7,3′,4′-OMe-flavone
Rhamnazin	3,5,4′-OH, 7,3′-OMe-flavone
Rhamnetin	3,5,3′,4′-OH, 7-OMe-flavone
Rhamnocitrin	3,5,4′-OH, 7-OMe-flavone
Rhamnolutin = kaempferol	
Robigenin = kaempferol	
Robinetin	3,7,3′,4′,5′-OH-flavone
Sakuranetin	5,4′-OH, 7-OMe-flavanone
Salvigenin	5-OH, 6,7,4′-OMe-flavone
Salvitin	7-OH, 5,8,4′-OMe-flavone
Santin	5,7-OH, 3,6,4′-OMe-flavone
Scaposin	5,7-OH, 6,8,3′,4′-OMe-flavone
Scoparol	5,7,3′,4′-OH, 3-OMe-flavone
Scrophulein = cirsimaritin	
Scutellarein	5,6,7,4′-OH-flavone
Serpyllin	5-OH, 7,8,2′,3′,4′-OMe-flavone
Sexangularetin	3,5,7,4′-OH, 8-OMe-flavone
Sideroxylin	5,4′-OH, 7-OMe, 6,8-Me-flavone
Sinensetin	5,6,7,3′,4′-OMe-flavone
Skullcapflavone I	5,2′-OH, 7,8-OMe-flavone
Scullcapflavone II	5,2′-OH, 6,7,8,6′-OMe-flavone
Scutellarein	5,6,7,4′-OH-flavone
Sorbifolin	5,6,4′-OH, 7-OMe-flavone
Spinacetin	3,5,7,4′-OH, 6,3′-OMe-flavone
Steppogenin = neoartocarpanon	
Stillopsidin = neoplathymenin	
Strobobanksin	3,5,7-OH, 6-Me-flavanone
Strobochrysin	5,7-OH, 6-Me-flavone
Stropopinin	5,7-OH, 6-Me-flavanone
Sudachitin	5,7,4′-OH, 6,8,3′-OMe-flavone
Swartziol = kaempferol	
Sylvin	5,6,4′-OH, 3-OMe, 8-Me-flavone
Syringetin	3,5,7,4′-OH, 3′,5′-OMe-flavone
Tamarixetin	3,5,7,3′-OH, 4′-OMe-flavone
Tambuletin	3,5,8,3′-OH, 7,4′-OMe-flavone
Tambulin	3,5-OH, 7,8,4′-OMe-flavone
Tangeritin	5,6,7,8,4′-OMe-flavone
Taxifolin	3,5,7,3′,4′-OH-flavanone

Table 3. (*continued*)

Tectochrysin	5-OH, 7-OMe-flavone	Trifolitin = kaempferol	
Ternatin	5,4′-OH, 3,7,8,3′-OMe-flavone	Velutin	5,4′-OH, 7,3′-OMe-flavone
Thapsin = calicopterin		Vitexicarpin = casticin	
Thevetiaflavon	7,4′-OH, 5-OMe-flavone	Vogelitin	3,6,7,4′-OH, 5-OMe-flavone
Tithonine	3′-OH, 7,4′-OMe-flavone	Wightin	5,3′-OH, 7,8,2′-OMe-flavone
Tomentin	5,6,3′,4′-OH, 3,7-OMe-flavone	Wogonin	5,7-OH, 8-OMe-flavone
Transilitin	7,8,3′,4′-OH, 3-OMe-flavone	Xanthomicrol	5,4′-OH, 6,7,8-OMe-flavone
Triangularin	2′,6′-OH, 4′-OMe, 3′-Me-chalcone	Zapotin	5,6,2′,6′-OMe-flavone
Tricetin	5,7,3′,4′,5′-OH-flavone	Zapotinin	5-OH, 6,2′,6′-flavone
Tricin	5,7,4′-OH, 3,5-OMe-flavone		

particular frequency in any particular families. There is, however, a tendency for accumulation in (heart-) woods and to a lesser extent in barks. Since chalcones are biogenetically amongst the simplest flavonoids their occurrence in ferns has been used to support the view that they are primitive characters in plants. A variety of free chalcones are known especially from Leguminosae and Asteraceae. Their distribution in other angiosperm families is erratic. Rich production of some chalcones is encountered in farina of gymnogrammoid ferns. Dihydrochalcones are also produced in large amounts as farina constituents of several gymnogrammoid ferns. However, only six compounds in all have been found hitherto as free aglycones and there are only five reports of free dihydrochalcones from angiosperms. Together with those occurring as glycosides the number of known dihydrochalcones is still less than ten.

It is striking that *C*-methylation has been observed hitherto exclusively in 6- and/or 8-positions. Free aglycones of this type are found in Myrtaceae, in fern farinas (*Pit. triangularis*), and only recently a significant number have been reported from Didieraceae (though this family comprises 11 species only). Most *C*-methylated flavonoids belong to the flavanone and flavonol classes.

IUPAC nomenclature recommendations emphasize that trivial names "should preferably be considered as ephemeral and replaced for chemical purposes by systematic names". Experience shows, however, that for every-day use trivial names are more convenient; e.g. it is easier to speak of combretol than of 5-hydroxy-3,7,3′,4′,5′-pentamethoxyflavone or of the 3,7,3′,4′,5′-pentamethyl ether of myricetin. In the flavonoid series, some trivial names are very confusing, e.g. eupatin, eupatorin, eupatilin, eupatoletin, etc., or apulein, apuleidin, apuleisin, apuleirin, apuleitrin. Such nomenclature should definitively be avoided in the future. We hope that the citation of trivial names in Table 1 as well as the alphabetical list in Table 3 will be welcome to many workers in this field.

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ADDENDUM TO TABLE 3

Alluaudiol	5,7,3′,4′,5′-OH, 3-OMe, 6-Me-flavone
Anisomelin = cirsilineol	
Arancol	5,7-OH, 3,6,8-OMe-flavone
Araneosol	5,7-OH, 3,6,8,4′-OMe-flavone
Bonanzin	5,7-OH, 3,6,3′,4′-OMe-flavone
Cerasidin	6′-OH, 2′,4′,2,4-OMe-chalcone
Cerasin	4,4′,6′-OH, 2′,2,4-OMe-chalcone
Cirsitagaogenin	5,7-OH, 8,4′-OMe-flavone
Deodarin	3,5,7,3′,4′-OH, 6-Me-flavone
Isodidymocarpin	2′,4′-OH, 3′,5′,6′-OMe-chalcone
Isolarrein	7-OH, 8-OMe-flavanone
Laciniatin	3,5,7,3′-OH,6,4′-OMe-flavone
Larrein	2′,4′-OH, 3′-OMe-chalcone
Norwightin	5,7,8,2′,3′-OH-flavone
Pinoquercetin	3,5,7,3′,4′-OH,6-Me-flavone
Prosogerin C	6,7,3′,4′,5′-OMe-flavone
Rivularin	5,2′-OH, 7,8,6′-OMe-flavone
Sepinol	3,7,3′,5′-OH, 4′-OMe-flavanone
Tabularin	5.7-OH,6,2′,4′,5-OMe-flavone