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FRIEDELIN AND EPIFRIEDELINOL FROM THE BARK OF *PRUNUS TURFOSA* AND A REVIEW OF THEIR NATURAL DISTRIBUTION

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Plant. Prunus turfosa Kalkman—Rosaceae.

Isolation of triterpenoids from bark. Extracted with light petroleum. Extract contains two compounds (TLC, Al_2O_3, 5% HOAc in C_6H_6, R_f 0·35 and 0·46). Separated by chromatography on Al_2O_3: Fraction A, C_6H_6. Fraction B, 5% C_6H_6 in $ChCl_3$.

Fraction A, *friedelin* (0·09%), m.p. 261–262° (lit.,[1] 261–264°), $[\alpha]_D^{21°} = -19°$ (benzene); identical with authentic sample. (Found: C, 84·4; H, 11·8. Calc. for $C_{30}H_{50}O$: C, 84·4; H, 11·8%.)

Fraction B, *epifriedelinol* (0·05%), m.p. 280–282° (lit.,[1] 280–282°), $[\alpha]_D^{21°} = +21°$ (benzene); identical with authentic sample. (Found: C, 84·0; H, 12·3. Calc. for $C_{30}H_{52}O$: C, 84·0; H, 12·2%.)

Friedelin and epifriedelinol are very abundant in Nature and frequently occur together; thus, for example, these two triterpenoids have been shown to be present in species of lichens,[2] in some oceanic green algae[3] and in certain types of peat[4] and brown coal.[5]

In plants, friedelin and epifriedelinol are often accompanied by friedelinol and by β-sitosterol, as well as by other triterpenoids such as β-amyrin. Table 1 surveys the plants which have been examined and shown to contain friedelin, the part of the plant studied is indicated and the table also lists the more important co-occurring triterpenoids. The results of this survey show that friedelin is not restricted to any particular plant family and thus any taxonomic conclusions are precluded. In addition to the plants listed in the table, nineteen species of the Gramineae family have recently been examined;[6] these also contain friedelin and related triterpenoids.

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TABLE 1

Plant family	Genus and species*	Source	Epifriedelinol	Friedelinol	β-Sitosterol	Related compounds	Reference
FAGACEAE	*Quercus robur* L.	Bark	—	+	+	Alnusenone, alnusenol, 20-hydroxydammar-24-en-3-one	7
	Quercus incana Roxb.	Bark	—	—	+	—	8
	Quercus suber L.	Bark	—	+	—	Cerin	9
	Quercus petrarea (Mattusehka) Liebl.	Bark	+	+	—	—	10
	Quercus championae Hook.	Leaves	+	+	+	β-Amyrenyl acetate, hop-17(21)-en-3β-yl acetate, hop-17(21)-en-3β-ol	11
	Quercus bambusaefolia	Leaves	+	+	+	—	12
	Quercus myrsinae	Leaves	+	—	—	—	12
	Quercus glauca	Leaves	+	—	+	—	13
	Castanopsis cuspidata (Thunb.) var. *sieboldii* (Makino) Nakai.	Bark	+	—	—	—	14
	Castanopsis eyrei Tuch.	Leaves	+	—	+	22-Hydroxyhopan-3-one	15
ROSACEAE	*Prunus nepalensis* Hort. ex C. Koch.	Bark	+	—	—	—	16
	Prunus turfosa Kalkman.	Bark	+	—	—	—	
	Pyrus communis L.	Bark	+	—	+	—	17
	Pyrus malus L.	Bark	+	—	+	—	18
	Pyrus pashia Buch.	Bark and leaves	—	—	+	—	19
	Photina glabra Dcne.	Bark	+	—	—	—	20
ERICACEAE	*Rhododendron metternichii* Sieb & Zucc.	Leaves	+	—	—	β-Amyrin	21
	Rhododendron cinnamomeum Wall.	Leaves	+	—	—	3β-10β-Epoxy-D: B-friedo-oleanone	22
	Rhododendron decipiens Lacaita.	Leaves	—	—	—	—	23
	Rhododendron formosum Wall.	Leaves	—	—	+	Dihydrotaraxerone	24
	Rhododendron farrerae Tate & Suet.	Leaves	—	—	—	—	25
	Rhododendron campanulatum D. Don.	Leaves	+	—	—	3β-10β-Epoxy-D: B-friedo-oleanane	26
	Rhododendron westlandii Hempsl.	Leaves	+	—	—	Cerin, 3β-5β-epoxy-3β-alnusane lupeol, α-amyrin, β-amyrin	27

VACCINIACEAE	*Vaccinium bracteatum* Thunb.	Leaves	+	—	—	—	28
EUPHORBIACEAE	*Euphorbia antiquorum* Forsk.	Stem	+	—	—	Taraxerol, taraxerone, euphol	29
	Euphorbia hirta L.	Stem	—	—	—	β-Amyrin	22, 30
	Euphorbia neriifolia L.	Leaf and stem	+	+	—	β-Amyrin, taraxerol	31
	Baccaurea sapida Muell.	Bark	+	—	+	—	32
	Bridelia stipularis Blume.	Bark	—	—	+	—	33
	Bridelia micrantha Baill.	Bark	+	—	—	Taraxerone, taraxerol	34
	Putranjiva roxburghii	Whole plant	—	+	—	3α-Hydroxyfriedelan-7-one	35
	Bischofia trifoliata (Roxb.) Hk. f.	Leaves and stem	+	+	+	—	36
	Antidesma bunias Spreng.	Leaves and stem	+	—	+	Dammara-20,24-dien-3-β-ol	37
	Sapium discolor Muell.-Arg.	Leaves	+	—	—	—	37
	Pedilanthus calcaratus Schlecht.	Whole plant	—	—	—	—	38
	Pedlianthus tehuacamis TS Brandegee.	Whole plant	—	—	—	—	38
SALICACEAE	*Salix japonica* Thunb.	Bark	+	—	—	—	14
CELASTRACEAE	*Siphonodon australe* Benth.	Bark	—	—	—	Numerous friedelane derivatives	39
	Euonymus japonicus	Leaves	+	+	—	—	40
	Euonymus radicans	Leaves	—	+	—	—	41
	Euonymus alatus	Leaves	+	+	—	—	41
BALANOPHORACEAE	*Balanops australiana* F. Muell.	Bark	+	+	—	Cerin, betulinic acid	42
LEGUMINOSAE	*Dalbergia volubilis*	Wood	—	—	—	—	43
PINACEAE	*Pinus serotina* Hort.	Bark	+	—	—	—	44
COMPOSITAE	*Mikania cordata* (Burm. f) B. L. Robinson.	Root	+	—	—	—	45, 46
	Aster tataricus L.	Root	+	—	—	Shionone, shionol A	47
	Olearia paniculata	Bark	+	—	—	Ursolic acid, dammaradienyl acetate, oleanolic acid	48
	Inula helenium L.	Root	—	—	—	Dammaradienol, stigmasterol	49

TABLE 1.—*Cont.*

Plant family	Genus and species*	Source	Epifriedelinol	Friedelinol	β-Sitosterol	Related compounds	Reference
APOCYANACEAE	*Acokanthera spectabilis* (Sond.) Hook.	Leaves	—	—	—	—	50
MYRTACEAE	*Eugenia jambolana* L.	Bark	+	—	+	—	37
	Syzygium cordatum Hochst.	Wood and bark	+	—	+	—	51
ASCLEPIADACEAE	*Sarcostemma viminale* R. Br.	Whole plant	—	—	—	β-Amyrin	52
SAPINDACEAE	*Alectryon excelsum*	Bark	+	—	+	—	53
LILIACEAE	*Hemerocallis longituba* Miq.	Roots	—	—	+	—	54
LABIATAE	*Salvia glutinosa*	Gum exudate	—	—	—	11-α-Hydroxy-β-amyrin, β-amyrin, epialnusenol	55
RUBIACEAE	*Ophiorrhiza japonica*	Whole plant	—	—	+	—	56
	Antirrhoea chinensis (Champ.) Benth. & Hook.	Leaves	+	—	+	Ursolic acid, quinovic acid cincholic acid	57
MENISPERMACEAE	*Hypserpa nitida*	Leaves	—	—	—	—	58
STERCULIACEAE	*Abroma augustum* L.	Roots	—	—	—	—	59
AMARANTHACEAE	*Iresine pringlei* S. Watts.	Stems	—	—	—	Ceryl alcohol	60
MORACEAE	*Takini brosium*†	Bark	—	—	+	—	61
	Fiscus benghalensis Banyan.	Leaf	+	—	+	—	62
CUNONIACEAE	*Ceratopetalum apetalum* D. Don.	Bark	+	+	—	—	63

GUTTIFERAE	*Calophyllum brazilense*	Wood	—	—	+	β-Amyrin, betulinic acid	64
	Calophyllum inophyllum L.	Leaves	—	—	—	β-Amyrin, α-amyrin	65
BUXACEAE	*Pachysandra terminalis* Sieb. & Zucc.	Whole plant	+	—	+	Stigmasterol, pachysandiol A, pachysandiol B	66
RUTACEAE	*Citrus paradisi* Macfayden.	Fruit	—	—	+	—	67
	Citrus aurantium var. *sinensis*	Fruit	—	—	+	Citrostadienol, ceryl alcohol	68
HIPPOCASTANACEAE	*Aesculus hippocastanum* L.	Seeds	—	—	—	Butyrospermol, taraxerol, 3β,-22β-24,28-tetrahydro-16α,-12α-epoxyolean-12-ene	69
BROMELIACEAE	*Tillandsia usneoides* L.	Whole plant	—	—	—	Artostenone, cycloartenol, 3-25-dihydroxy 9:19-cyclolanosta-23-ene	70
ARALIACEAE	*Dendropanax trifidus* (Thunb.) Makino.	Leaves	+	—	—	3β,5β-Epoxy-3β-alnusane	71
VERBENACEAE	*Clerodendrum trichotomum* Thunb.	Bark	+	—	—	—	14
URTICACEAE	*Zelkova serrata* Makino.	Bark	—	—	—	—	14
SAPOTACEAE	*Madhuca butyracea*	Bark	—	—	+	α-Amyrin, β-amyrin, α-spinasterol	72

This table covers the literature 1927–1968 (inclusive) and is based upon *Chem. Ab.*
* Where the authority is not stated the original reference should be consulted.
† The botanical classification of this plant is uncertain.

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