REVIEW ON PHYTOCHEMICAL STUDY OF ASTERACEAE IN TAIWAN (1996~2005)

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Asteraceae is the third largest family (next to Orchidaceae and Poaceae) of flowering plants in Taiwan. Two hundred twenty-one species and 20 additional infraspecific taxa in 84 genera were recorded in the 2nd edition of Flora of Taiwan (1998). About 74 species in 51 genera have been used in folk medicine, and 30 species in 22 genera have been studied chemically. The diversity and complexity of the chemical constituents in these plants are enormous. Various natural products such as terpenes, flavonoids, coumarins, alkaloids, polyalkynes, etc. have been found. Among them, sesquiterpenes and polyalkynes are often species-specific.

Folk medicine of Asteraceae used in Taiwan is claimed to have the properties of antipyretic, detoxication, antibacterial, antiphlogistic, hypotention, blood stasis removal, hemostasis, expectoration, cough-relieving, and most importantly, antihepatitis and antitumor.

Prior to 1990, the majority of studies on Asteraceae in Taiwan focused on chemical analysis. *In vitro* studies using selected cells or cell line to screen the activities of crude extracts were the theme in the 1990s. More recently, pure compounds were isolated and studied in relation to their action mechanisms. Due to lots of plants of this family are commomly used as folk medicine. Review articles have already appeared on the natural product research in Taiwan before 1996. This present review deals with the plants of Asteraceae which have been investigated in Taiwan during 1996 to 2005.

Key words: Asteraceae, medicinal plants, phytochemical study, Taiwan, 1996~2005

Introduction

Taiwan is a continental island that straddles the Tropic of Cancer. Its subtropical location combines with a tall range of steep, rugged mountains creates a wide array of environments. Ecological features range from tropical to alpine, which support a rich and diverse flora of over 4,000 species. Asteraceae is the third largest family (next to Orchidaceae and Poaceae) of flowering plants in Taiwan. Two hundred twenty-one species and 20 additional infraspecific taxa in 84 genera are recorded in the 2nd edition of Flora of Taiwan.[1] Owing to their ubiquitous distribution, plants of Asteraceae are easy to find and to collect. About 60% of Asteraceaeous genera in Taiwan have been used as herbal medicine. About 74 species of Asteraceae have been recorded in folk medicine.[2,3] However, some are used only occasionally or

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locally. Plants such as *Artemisia capillaries* Thunb., *Bidens pilosa* L. var. *minor* (Blume) Sherff, *Carpesium abrotanoides* L., *Echinops grijsii* Hance, *Elephantopus scaber* L., *Ixeris chinensis* (Thunb.) Nakai, *Petasites formosana* Kitam., *Pluchea indica* (L.) Less., *Sigesbeckia orientalis* L., *Taraxacum formosanum* Kitam., *Tithonia diversifolia* (Hemsl.) A. Gray, *Vernonia patula* (Dryand.) Merr., *Wedelia chinensis* (Osbeck) Merr. are commonly used folk medicine, which are claimed to have various curing effects against, in particular, hepatitis and cancer. Economic development accompanied by modernization in recent decades has led to much habitat destruction in Taiwan. Over-exploitation of medicinal herbs poses further threats to plants of Asteraceae on this island. Many are now exceedingly or possibly extinct in the wild. For example, plants of *Echinops grijsii* are now known only from local cultivation as medicinal herbs. Wild populations are believed to have been wiped out.

As a group of plants widely used in Taiwanese folk medicine, studies of the chemical properties of Asteraceae started early in the 1960s. Non-polar chemical studies were the focus during 1960s to 1980s. As a result, various natural products such as sesquiterpenes, diterpenes, triterpenoids, flavonoids, etc. have been elucidated. After the 1980s, advancement of precise instruments and increase of research manpower and budget led to the findings of various novel compounds. Investigators paid special attention to practical uses, pharmacologically oriented studies became trend. In the 1990s, active compounds were isolated and their action mechanisms were studied. In this report, we provide an overview of the medicinal researches on Asteraceae in Taiwan from 1996 to 2005.

Phytochemical Study of Asteraceae in Taiwan (1996-2005)

No	Common name	Scientific name	Parts, [a] Reference and Compound
1	茵陳蒿	*Artemisia capillaries* Thunb.	Aerial part [4] — isorhamnetin, quercetin, isorhamnetin 3-*O*-β-D-galactoside, quercetin3-*O*-β-D-galactoside, isorhamnetin 3-*O*-D-robinoside, quercetin 3-*O*-D-robinoside Aerial part [5] — capillaridins A-H (**1-8**), capillin, capillene, *O*-methoxycapillene Aerial part [6] — artemisidin A (**9**), artemicapins A-D (**10-13**), capillarisin, 7-methylcapillarisin, 6-demethoxycapillarisin, 6-demethoxy-4'-methyl-capillarisin, arcapillin, cirsilineol, cirsimaritin, chrysoeriol, velutin, vicenin-II, vitexin, kumatakenin, luteolin-3',4',7-trimethyl ether hesperidin, liquiritin, lucenin, scoparone, isosabaudin, 6-methoxy-7,8-methylenedioxy-coumarin, isoscopoletin, scopoletin, 5,7,8-trimethoxycoumarin, 5-hydroxy-6,7-dimethoxy-coumarin, arscotin, leptodactylone, scopolin, aesculetin, isoscopolin, fraxinol methyl ether, alkyl-*p*-hydroxycinnamate, caffeic acid, ferulic acid,

Phytochemical Study of Asteraceae in Taiwan (1996-2005) (Continued)

No	Common name	Scientific name	Parts, [a] Reference and Compound
			methyl ferulate, 3-hydroxy-4-methoxycinnamic acid, methyl-*p*-hydroxycinnamate, *trans*-*p*-hydroxy-cinnamic acid, methyl paraben, vanillin, 3,4-di-methoxybenzoic acid, resacetophenone, vanillic acid, 2,6-dimethoxybenzoquinone, quinic acid 4-*O*-coumarate, chlorogenic acid, sesamin, 9-β--xylopyranosyl-(+)-isolariciresinol, pluviatide, honokiol, phytal, 13^2-hydroxy(13^2-*R*)pheophytin b, 13^2-hydroxy(13^2-*S*)pheophytin a
1	茵陳蒿	*Artemisia capillaries* Thunb.	
2	蒼朮	*Atractylodes chinensis*(DC) Koidz	Root [7] — atractylodin (**14**), acetylatractylodinol (**15**). Root [8] — taraxeryl acetate, β-amyrin acetate, β-amyrin, ψ -taraxasterol, lupeol, β-sitosterol, stigmasterol, atractylenolide I, β-eudesmol, hinesol, hinesolone.
3	白朮	*Atractylodes ovata* Thunb.	Root [9] — atractylon, atractylenolide I, -II, -III.
4	小白花鬼針	*Bidens pilosa* L. var. *minor* (Blume) Sherff	Whole plant [10] — pilosol A (**16**), 1-phenylhepta-5t--ene-1,3-diyne 1-phenylhepta-1,3,5-triyne, α-toco-pherylchinon, 2-phenylethanol, linolenic acid, methyl linolenate, ethyl linolenate, 2-butoxyethyl linolenate, linoleic acid, ethyl linoleate, 2-butoxy-ethyl linoleate, 2-butoxyethyl oleate, 2-butoxy-ethanol, phytol, phytenoic acid, squalene, β-sito-sterol, stigmasterol, 5α-stigmasta-7-en-3β-ol, 5α--stigmasta-7,22-dien-3β-ol.
5	走馬胎	*Blumea lancenolaria* (Roxb.)Druce	Stem [11] — stigmast-4-en-3-one, stigmast-4,22-dien-3--one, friedelanol, scopoletin, sinapic aldehyde, syringaldehyde, 4-hydroxy-3-methoxy-*trains*--cinnamaldehyde, aurantiamide acetate.
6	黃金珠	*Carpesium nepalense* Less.	Aerial plant [12] — nepalolides A-D (**17-20**), ineupatorolide.
7	菊花	*Chrysanthemum morifolium* (Ramat.) Tzvel.	Flower [13] — Naringinin, apigenin 7-*O*-β-D-glucopyrano-side, luteolin, luteolin 7-*O*-β-D-glucopyranoside, diosmetin 7-*O*- β-D -glucopyranoside, 3,5-dicaffeoyl quinic acid, β-sitosteryl-3- *O*-β-D-glucoside.
8	茯苓菜	*Dichrocephala bicolor* (Roth.) Schltdl.	Whole plant [14] — 4,5-dicaffeoyl quinic acid, 3,4-dicaffeoyl quinic acid, 3,5-dicaffeoyl quinic acid, ethyl 4,5-dicaffeoyl quinate, methyl 3,5-dicaffeoyl quinate, 5-caffeoyl quinic acid, caffeic acid, quercetin-3-*O*-rutinoside.

Phytochemical Study of Asteraceae in Taiwan (1996-2005) (Continued)

No	Common name	Scientific name	Parts, [a] Reference and Compound
9	漏盧	*Echinops grijsii* Hance	Root [15] — 5-(but-3-en-1-ynyl)-2,2'-bithiophene, α-terthienyl, cardopatine, isocardopatine, 5-acetyl-2,2'--bithiophene, 5-(4-isovaleroyloxybut-1-ynyl)- 2,2'--bithiophene, 5-(3,4-diacetoxybut-1-ynyl)-2,2'-bithiophene, 5-(3-acetoxy-4-isovaleroyloxybut-1--ynyl)-2,2'-bithiophene, 5-hydroxy(4-isovaleroyloxy--but-1-ynyl)-2,2'-bithiophene, 5-(3-hydroxy-4--acetoxybut-1-ynyl)-2,2'-bithiophene, 5-(4-hydroxy--but-1-ynyl)-2,2'-bithiophene, 5-(3,4-dihydroxybut--1-ynyl)-2,2'-bithiophene, 2-(3,4-diacetoxybut-1--ynyl)-5-(prop-1-ynyl)thiophene, 2-(3,4-dihydroxy--but-1-ynyl)-5-(prop-1-ynyl)thiophene.
10	基隆澤蘭	*Eupatorium kiirunense*(Kitam.) C.H.Ou & S.W.Chung	Leaf [16] — eupakirunsins A-E (**21-25**), eupaheliangolide A (**26**), 15-acetoxyheliangin (**27**), 3-*epi*-heliangin (**28**), heliangin, 8,10-epoxy-9-acetoxythymol angelate.
11	台灣山菊	*Farfugium japonicum* (L.) Kitam. var. *formosanum* (Hay.)Kitam.	Root [17] — farformolide B, 8β,10β-dihydroxy-6β--methoxyeremophilenolide, 6β,8β,10β-trihydroxy-eremophilenolide (**29**), 3β-acetoxyl-8α-hydroxy-6β--methoxyeremophil-7(11)**,**9-dien-8,12-olide (**30**), 8α-hydroxy-6β-methoxyeremophil-7(11)**,**9-dien--8,12-olide ,10β-hydroxy-6β-methoxyfuranoeremophilane, furanoeremophilan-6β,10βdiol, 6β-ethoxy--10β-hydroxyfuranoeremophilane (**31**), farfugin A, caffeic acid, methyl caffeate, *p*-hydroxybenzaldehyde, 4-hydroxymethylketone, petasiphenol, β-sitosterol, stigmasterol. Aerial part [17] — farformolide B, 8β,10β-dihydroxy-6β-methoxyeremophilenolide, liguhodgsonal, phytol, phytan-3-methoxy-1,2-diol, phytan-1,2,3-triol, 4-acetonyl-3,5-dimethoxy-*p*-quinol, methyl caffeate, methyl 4-hydroxy-3-methoxycinnamate, *p*-hydroxybenzoic acid, friedelin, friedelan-3β-ol, ursolic acid, α-amyrin, β-sitosterol, stigmasterol, β-sitosteryl-3--*O*-β-D-glucoside, stigmasteryl-3-*O*-β-D-glucoside, α-amyrin, α-amyrin acetate, palmitic acid.
12	蘭嶼木耳菜	*Gynura elliptica* Yabe & Hay.	Root [18] — (+)-gynunone (**32**), gynunol (**33**), (+)-senecionine, (+)-senkirkine, 6-acetyl-2,2-dimethylchroman-4-one, 6-hydroxy-2,2-dimethylchroman -4-one, vanillin, syringaldehyde.
13	白鳳菜	*Gynura formosana* Kitam.	Aerial part [19] — 6-acetyl-2-hydroxymethyl-2'-methylchroman-4-one (**34**).

Phytochemical Study of Asteraceae in Taiwan (1996-2005) (Continued)

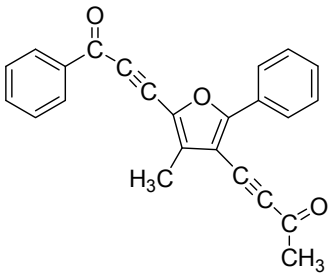
No	Common name	Scientific name	Parts, [a] Reference and Compound
14	黃花三七草	*Gynura japonica* (Thumb.) Juel.	Root [20] — (–)-α-tocospirone (**35**), (–)-gynuraone (**36**), (22*E*,24*S*)-7α-hydroperoxystigmasta-5,22-dien--3β-ol (**37**), (22*E*,24*S*)-stigmasta-1,4,22-trien-3--one (**38**), (22*E*, 24*R*)-stigmasta-1,4-dien-3-one (**39**), caryophylene oxide, (24*R*)-7α-hydroperoxy-stigmasta-5,22-dien-3β-ol, (22*E*)-stigmasterone, β-sitosterone, stigmasterol, β-sitosterol, 6-acetyl--2-hydroxymethyl-2-methylchroman-4-one, β-sitost eryl 3-*O*-β-D-glucopyranoside, stigmasteryl 3-*O*-β--D-glucopyranoside, vanillin, benzoic acid, hexaco-sanoic acid, palmitic acid, Root [21] — gynuramides I-IV (**40-43**), friedelan-3β-ol, friedelan-3β-one, tetracosan-1-ol, hexacosan-1-ol, octacosan-1-ol, triacontan-1-ol, dotriacontan-1-ol, 1,3-dipalmityl-2-oley glyceride, 5-methyl-5-(4,8,12-trimethyltridecyl)dihydrofuran-2-one, α-tocospiro A, α-tocospiro B, α-amyrin, β-amyrin, cycloarta-24-(31)-en-3β-ol, lupeol, stigmast-3-one, stigmast-22--en-3-one, ergost-3-one, cholest-3-one, 7α-hydroxy-stigmasterol, 7α-hydroxy-β-sitosterol, linoleic acid, 4-hydroxybenzaldehyde, methyl 4-hydroxybenzoate, 6β-hydroxystigmasterone, 6β-hydroxy-β-sitosterone, 7-oxostigmasterol, 7-oxo-β-sitosterol, 4-hydroxy-benzoic acid, (22*E*)-5α,8α-epidioxyergost-6,22-dien--3β-ol, 1-pentadecanoylglycerol, 1-hexadecanoyl glycerol, 1-heptadecanoylglycerol, 1-octadecanoyl-glycerol, 7-oxositosteryl-3-*O*-β-D-glucoside, 7-oxo-stigmasteryl-3-*O*-β-D-glucoside.
15	兔兒菜	*Ixeris chinensis* (Thunb.) Nakai,	Whole plant [22] — 17-epilupenyl actate (**44**), ixerenol (**45**), lupenyl acetate, germanicyl acetate, β-amyrin acetate, taraxeryl acetate, multiflorenyl acetate, taraxasteryl acetate, ψ-taraxasteryl acetate, α--amyrin acetate, bauerenyl acetate, dammaradienyl acetate, butyrospermyl acetate, tirucalla-7,21-dien-3-β-yl acetate, lupenone, germanicone, β-amyrenone, taraxasterone, ψ-taraxasterone, α-amyrenone, bauerenone, lupeol, germanicol, β-amyrin, olean-13(18)-en-3β-ol, taraxerol, multiflorenol, taraxasterol, ψ-taraxasterol, α-amyrin, bauerenol, isobauerenol, dammaradienol, butyrospermol, tirucalla-7,21-dien-3β-ol, cycloartenol, 24--methylenecycloartenol, 3β-acetoxytaraxaster-20--en-30-al, 3β-hydroxytaraxaster-20-en-30-al.

Phytochemical Study of Asteraceae in Taiwan (1996-2005) (Continued)

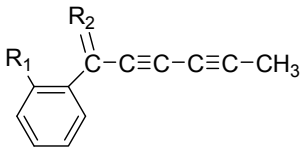
No	Common name	Scientific name	Parts, [a] Reference and Compound
16	山萵苣	*Lactuca indica* L.	Whole plant [23] — lactucains A-C (**46- 48**), lactucaside (**49**), 11β,13-dihydrolactucin, cichoriosides B, quercetin, quercetin 3-*O*-glucoside, rutin, apigenin, luteolin, luteolin 7-*O*-glucuronide, chlorogenic acid.
17	台灣款冬	*Petasites formosana* Kitam.	Aerial part [24] — petasones A-B (**50- 51**), *S*-petasitin (**52**), petasinol (**53**), *S* -petasin, *S*-isopetasin, petasitin. Aerial part [25] — petasinones A-D (**54-57**), petasin, isopetasin, petasol, isopetasol. Root [26] — bakkenolides-Db~-Dh (**58-64**), -Fa (**65**), -Fb (**66**), -I~-M (**67-71**), -Na (**72**), -Nb (**73**), -O~-T (**74-79**), -Ua (**80**), -Ub (**81**), -V~-X (**82-84**), -Ya (**85**), -Yb (**86**), -Za (**87**), Zb (**88**), -III (**89**), bekkenolides-B, -D, -G, -H, -Uc, and –II, β-sitosterol, β-sitosterol-β-D--glucopyranoside, phosphoric acid I, glycerol ester II, *p*-hydroxybenzaldehyde,3,4-dihydroxybenzaldehyde , *p*-hydroxybenzoic acid, vanillin, vanillic acid, methyl protocatechuate, methyl paraben, protocatechuic acid, *p*-methoxyphenylpropanoic acid, *cis*-caffeic acid, methyl caffeate, ferulic acid, caffeic acid, chlorogenic acid, *N*-*p*-coumaroyltyramine, 3-methylthio-2-propenoic acid methyl ester, morin, *scyllo*-inositol, 3-methyl-β-lactone, lupeol. Root [27] — bakkenolides-G-H (**90-91**), deisobutyryl bakkenolide-H (**92**), bakkenolide-D, lupeol, ferulic acid. Leaf [28] — petasiformin-A (**93**), petasiphyll-A (**94**).
18	鳳毛菊	*Saussurea japonica* (Thunb.) DC.	Aerial part [29] — 11α,12α-oxidotaraxerone (**95**), saussurenoside (**96**), taraxasteryl acetate, lupenone, oleic acid, lupeol, β-sitosterol, stigmasterol, *epi*-ψ-taraxastanonol, 5-hydroxy-4',7-dimethoxy-flavone, apigenin.
19	臺灣蒲公英	*Taraxacum formosanum* Kitam	Aerial part [30] — taraxacine-A (**97**), taraxacine-B (**98**), taraxafolin (**99**), ψ-taraxasteryl acetate, β-amyrin acetate, β-sitosterol, stigmasterol, 13^2-hydroxy -(13^2-*R*)-pheophytin-b, indole-3-carbox-aldehyde, methyl pheophorbide-b, (3*R*,6*R*,7*E*)-3--hydroxy-4,7-megastigma-dien-9-one, 2,6,6-trimethyl -4-hydroxy-1-cyclohexene-1-carboxaldehyde, β-sitosteryl-3-*O*-glucoside, stigmateryl-3-*O*--glucoside, 3-carboxy-1,2,3,4-tetrahydro-β-carboline, luteolin-7-*O*-gluccoside, dihydrosyringin, caffeic acid, ferulic acid, 1,2,3,4-tetrahydro-1,3,4-

Phytochemical Study of Asteraceae in Taiwan (1996-2005) (Continued)

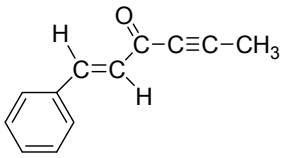
No	Common name	Scientific name	Parts, [a] Reference and Compound
			-trioxo-β-carboline, indole-3-carboxylic acid, isoetin-7-*O*-glucosyl-2'-*O*-xyloside, aesculetin, *p*-hydroxycinnamic acid, benzoic acid, *p*-hydroxy-phenyl acetic acid methyl ester, phenylalanine, methyl paraben.
19	臺灣蒲公英	*Taraxacum formosanum* Kitam	Root [31] — taraxafolide (**100**), (+)-taraxafolin-B (**101**), taraxinic acid β-D-glucoside, methyl ferulate, 4--hydroxy-3-methoxy-*trans*-cinnamaldehyde, syring-aldehyde, syringic acid, methyl syringate, 4-hydroxy -benzaldehyde, 4-hydroxybenzoic acid, methylpara-ben, 4-methoxybenzoic acid, vanillin, vanillic acid, methyl vanillate, 3-formyl indole, methyl indole-3-carboxylate, nicotinamide, stigmasterol, β-sitosterol.
20	五爪金英	*Tithonia diversifolia* (Hemsl.) A. Gray	Leaf [32] — methyl 4α-hydroxy-11(13)-eudesmen-12-oate (**102**), diversifolol (**103**). Leaf [33] — 1-acetyltagitinin A (**104**), 8β-isobutyryloxy cumambranolide (**105**), methyl-4α-hydroxy-11(13)--eudesmen-12-oate, diversifolol, methyl 3α-acetoxy -4α-hydroxy-11(13)-eudesmen-12-oate, tagitinin A. Root [34] — diversifolide (**106**), 6-acetyl-7-hydroxy-2,3--dimethylchromone (**107**), 2-deacetyl-11β,13--dihydoxyxanthinin, 2-acetyl-2,2-dimethylchromene , 6-acetyl-7-hydroxy-2,2-dimethylchromene, 6-acetyl-7-methoxy-2,2-dimethylchromene.
21	嶺南野菊	*Vernonia patula* (Dryand.) Merr.	Whole plant[35,36] — lupeol acetate, 3-*epi*-fridelinol, 1--dotriacontanol, β-sitosterol, stigmasterol, friedelin, β-amyrin acetate, β-sitosterol-3-*O*-β-glucoside, stigmasterol-3-*O*-β-glucoside, luteolin, tricin, luteolin 4'-*O*-β-D-glucoside, luteolin 7-*O*-β-D-gluco-side, 3,4-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid, ethyl 3,4-di-caffeoylquinate, chlorogenic acid, esculetin, caffeic acid, protocatechuic acid.
22	雙花蟛蜞菊	*Wedelia biflora* (L.) DC.	Whole plant[37] — (–)-kaur-16en-19-oic acid, friedelin, 3-*epi*-friedelinol, 15α-isobutyroyloxykaur-16-en-19--oic acid, β-sitosterol, stigmasterol.



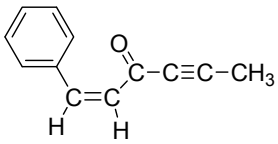
capillaridin A (**1**)



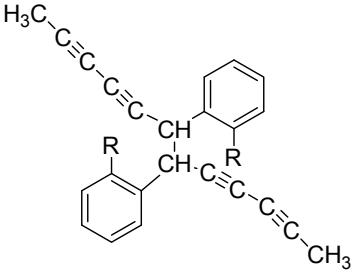
capillaridin B (**2**): R_1=H, R_2=H(OH)
capillaridin E (**5**): R_1=OCH_3, R_2= O



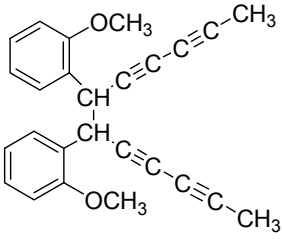
capillaridin C (**3**)



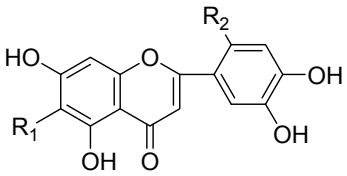
capillaridin D (**4**)



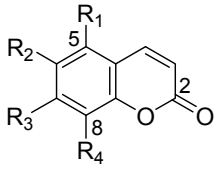
capillaridin F (**6**): R=H
capillaridin G (**7**): R=OCH_3



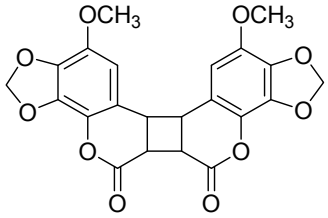
capillaridin H (**8**)



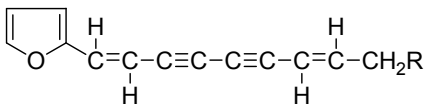
artemisidin A (**9**): R_1=R_2= -*O*-β-D-glucopyranosyl



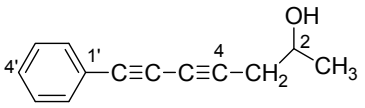
artemicapin A (**10**): R_1= R_4=OCH_3, R_2,R_3= -OCH_2O-
artemicapin B (**11**): R_1=OCH_3, R_2,R_3= -OCH_2O-, R_4=OH
artemicapin C (**12**): R_1=H, R_2=OH, R_3, R_4= -OCH_2O-



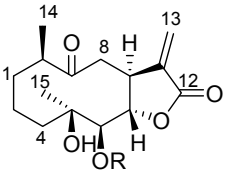
artemicapin D (**13**)



atractylodin (**14**): R=H
acetylatractylodinol (**15**): R=$OCOCH_3$



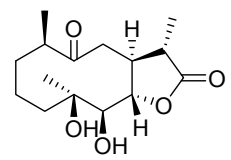
7-phenylhepta-4,6-diyne-2-ol (**16**)



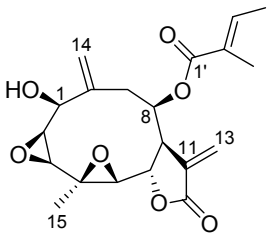
nepalolide A (**17**): R= senecioyl,

nepalolide B (**18**): R= tigloyl,

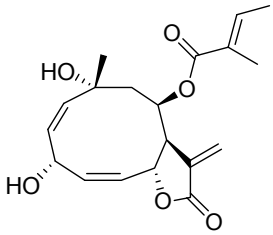
nepalolide C (**19**): R=angeloyl,



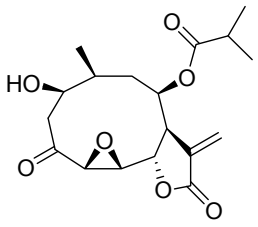
nepalolide D (**20**)



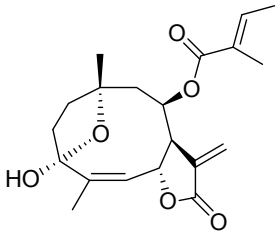
eupakirunsin A (**21**)



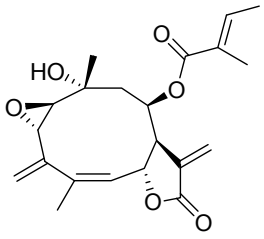
eupakirunsin B (**22**)



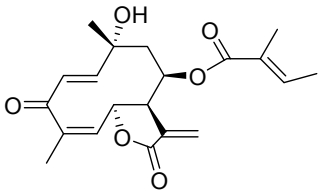
eupakirunsin C (**23**)



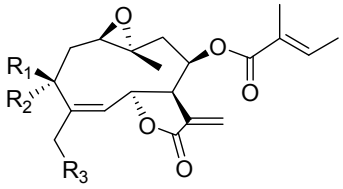
eupakirunsin D (**24**)



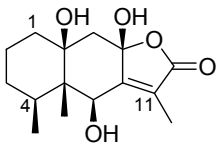
eupakirunsin E (**25**)



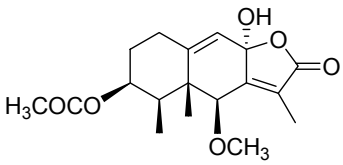
eupaheliangolide A (**26**)



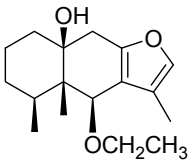
15-acetoxyheliangin (**27**): R_1=OH, R_2=H, R_3=OAc
3-epi-heliangin (**28**): R_1=R_3=H, R_2=OH
heliangin: R_1=OH, R_2= R_3=H



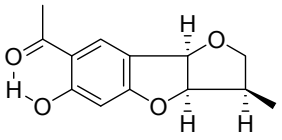
6β,8β,10β-trihydroxyeremophilenolide (**29**)



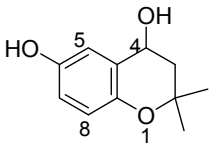
3β-acetoxy-8α–hydroxy-6β-methoxy-eremophil-7(11),9-dien-8,12-olide (**30**)



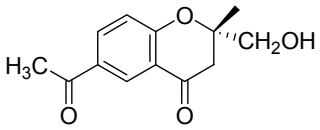
6β–ethoxy–10β-hydroxyfuranoeremophilane (**31**)



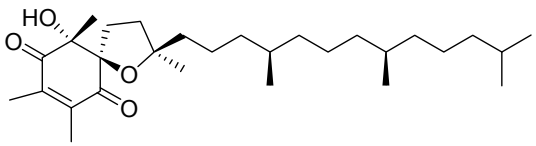
(+)-gynunone (**32**)



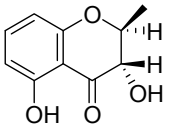
gynunol (**33**)



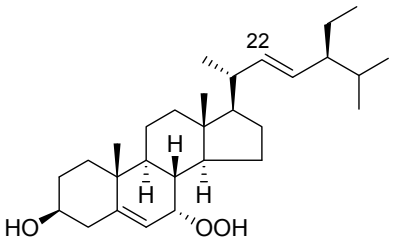
6-acetyl-2-hydroxymethyl-2'-methylchroman-4-one (**34**)



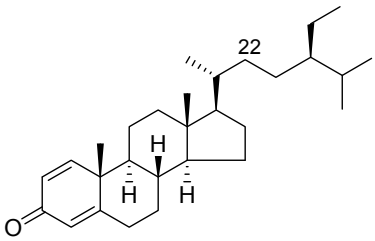
(-)-α-tocospirone (**35**)



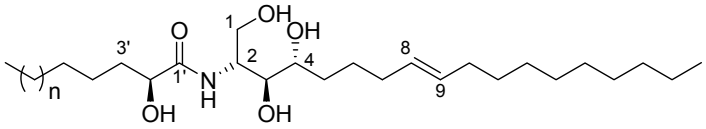
gynuraone (**36**)



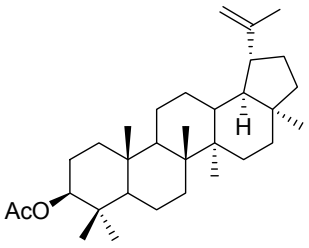
(22*E*, 24*S*)-7α-hydroperoxystigmasta-5,22-dien-3-ol (**37**)



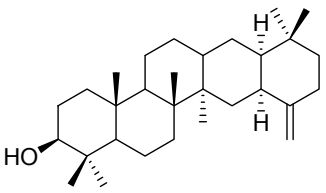
(22*E*, 24*S*)stigmasta-1,4,22-trien-3-one (**38**)
(22*E*, 24*R*)stigmasta-1,4-dien-3-one (**39**)



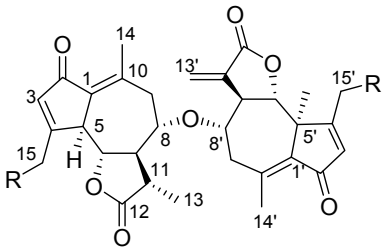
gynuramidesl-I (**40**): n=19
gynuramidesl-II (**41**): n=18
gynuramidesl-III (**42**): n=17
gynuramidesl-IV (**43**): n=16



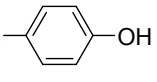
17-epilupenyl acetate (**44**)

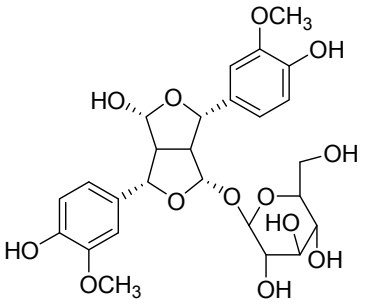


ixerenol (**45**)

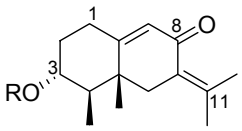


lactucain A (**46**): R=H
lactucain B (**47**): R=OH
lactucain C (**48**): R=-





lactucaside (**49**)



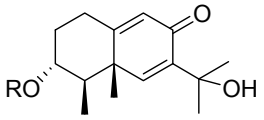
petasone A (**50**): R= COCH = CHS(O)Me

petasone B(**51**): R= COCH = CHS(O)Me

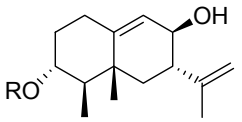
pe*tasin*one B (**55**): R= COCH = CHOM**e**

pe*tasin*one C (**56**): R= COCH = CHOM**e**

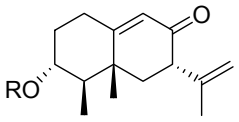
pe*tasin*one D (**57**): R= COCH = CH(O)S(O)M**e**



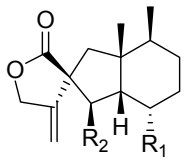
S-petasitin (**52**): R= **CO**CH = CHSMe



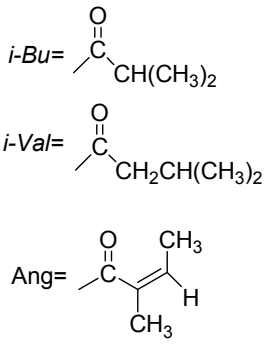
pe*tas*inol (**53**): R= COCH = CHSM**e**

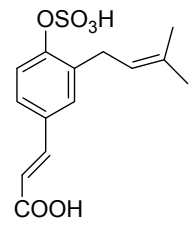


pe*tasin*one A (**54**): R= COCH = CHOM**e**

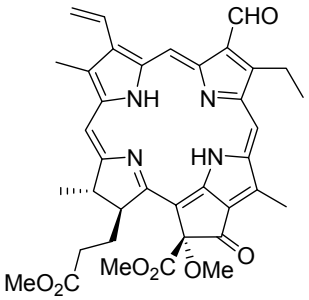


	R_1	R_2
bakkenolides		
58: (*R*)-*cis*-OCOCH=CHSOCH$_3$		OAc
59: (*S*)-*cis*-OCOCH=CHSOCH$_3$		OAc
60: OAc		*cis*-OCOCH=CHSCH$_3$
61: OAc		*(S)-trans*-OCOCH=CHSOCH$_3$
62: *(S)-trans*-OCOCH=CHSOCH$_3$		OAc
63: OAc		(*R*)-*cis*-OCOCH=CHSOCH$_3$
64: OAc		(*S*)-*cis*-OCOCH=CHSOCH$_3$
65: OAng		*O-i-Val*
66: *O-i-Val*		OAng
67: H		O-*i-Bu*
68: H		O-*i-Val*
69:*O-i-Bu*		OAng
70: OAc		OAc
71: OCOCH(CH$_3$)CH$_2$CH$_3$		O-*i-Bu*
72: *O-i-Val*		O-*i-Bu*
73:*O-i-Bu*		O-*i-Val*
74: OCOCH(CH$_3$)CH$_2$CH$_3$		O-*i-Val*
75: OCOCH(CH$_3$)CH$_2$CH$_3$		OAng
76: *O-i-Val*		O-*i-Val*
77: OH		OAng
78: H		OH
79: (*R*)-*cis*-OCOCH=CHSOCH$_3$		O-*i-Val*
80: OH		O-*i-Bu*
81: *O-i-Bu*		OH
82: *O-i-Val*		OH
83: OCOC(=CH$_2$)CH(OH)(CH$_3$)		OAc
84: OAc		OH
85: OH		*cis*-OCOCH=CHSOCH$_3$
86: *cis*-OCOCH=CHSOCH$_3$		OH
87: *O-i-Bu*		OCOCH=C(CH$_3$)$_2$
88: OCOCH=C(CH$_3$)$_2$		O-*i-Bu*
89: OH		OH
90: OAc		OCOCH$_2$CH(CH$_3$)$_2$
91: OCOCH(CH$_3$)$_2$		OCOCH(CH$_3$)$_2$
92: OH		OCOCH(CH$_3$)$_2$

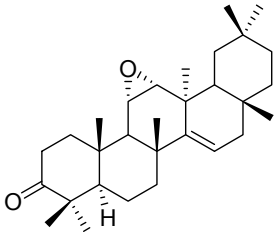




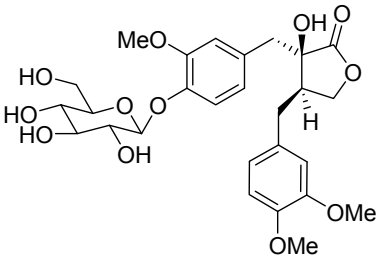
petasiformin-A (**93**)



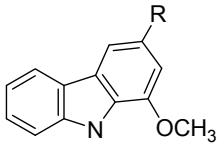
petasiphyll-A (**94**)



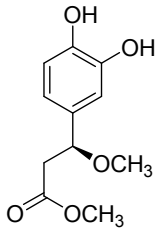
11α,12α-oxidotaraxerone (**95**)



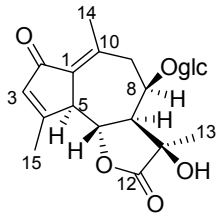
saussurenoside (**96**)



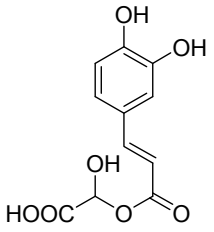
taraxacine-A (**97**): R=H
taraxacine-B (**98**): R=COOH



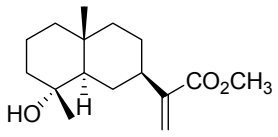
(*S*)-taraxafolin (**99**)



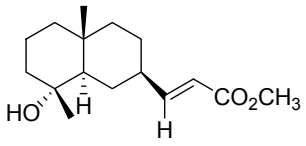
taraxafolide (**100**)



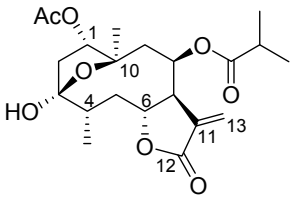
(+)-taraxafolin-B (**101**)



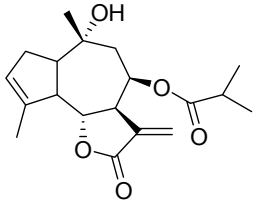
methyl 4α-hydroxy-11(13)-eudesmen-12-ate (**102**)



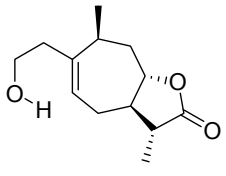
diversifolol (**103**)



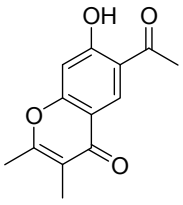
1-acetyltagitinin A (**104**)



8β-isobutyryloxycumambranolide (**105**)



diversifolide (**106**)



6-acetyl-7-hydroxy-2,3-dimethylchromone (**107**)

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臺灣菊科藥用植物之化學研究回顧(1996~2005)

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在臺灣菊科植物是開花植物中第三大科植物，僅次於蘭科和禾本科。根據臺灣植物誌第二版(Flora of Taiwan, 1998)記載在84屬植物中包含有221種及20個種下分類群。其中大約有51屬74種的植物被用於民間藥，並且有24屬29種的植物經化學成分研究。這些植物的化學成分非常多樣性與複雜性。已經被發現的化學成分有terpenes，flavonoids，coumarins，alkaloids，polyalkynes等。這些化合物中sesquiterpenes 及polyalkynes 通常是有物種特異性。

在臺灣被使用作民間藥的菊科植物常被用於作清熱解毒劑、抗菌劑、消炎劑、降壓、活血化瘀、去痰、止咳、抗肝炎及抗腫瘤等。

1990年之前大部分的研究單純集中於化學成分分析，之後配合活體外細胞株進行粗萃取物活性篩選，最近則進一步將活性成分分離並進行作用機制的研究。由於本科植物在民間藥常被使用。1996年之前在臺灣相關成分研究的回顧已發表，本篇係收載1996年~2005年之間臺灣地區對菊科植物的化學成分研究。

關鍵詞：菊科、藥用植物、植物化學成分研究、臺灣、1996年~2005年

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