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Chinese Journal of Natural Medicines
·*Review*·

Natural products chemistry research 2010's progress in China

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[ABSTRACT] This article reviews the progresses made by Chinese scientists in the field of natural products chemistry in 2010. Selected compounds with unique structural features and/or promising bioactivities were described herein on the basis of structural types.
[KEY WORDS] Natural products chemistry; Natural compounds; Research progress

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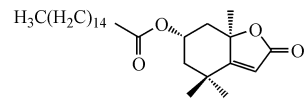
In 2010, Chinese scientists were continually active in the field of natural products chemistry research. For instance, the RSC journal *Nat Prod Report* published the review about the chemical structures and biosynthesis of new diterpenoid alkaloids (1998-2008) by Prof. WANG Feng-Peng of West China School of Pharmacy, Sichuan University. Prof. GUO Yue-Wei of Shanghai Institute of Materia Medica, Chinese Academy of Sciences was awarded the Paul Scheuer prize, set up and issued by Akademie Gemeinnützliger Wissenschaften zu Erfurt, for his distinguished achievements in marine natural products chemistry. On the other hand, the year of 2011 is an adjustive year for most Chinese scientists from the perspective of research papers. Compared with 2009, papers published in international journals such as *Org Lett*, *J Nat Prod*, *Tetrahedron*, and *Planta Med* had an obvious decline in 2010. For example, the total number of papers published in *J Nat Prod* dropped from 83 in 2009 to 57 in 2010. Additionally, Chinese scientists reported a series of novel structures/skeletons from the Meliaceae family in the past two years, prompting a research hot point around the highly oxygenated limonoids. In 2010, these papers went down both on quantity and quality.

Following the convention of the past years, we summarize here the achievements and progresses Chinese scientists have made in 2009 based on the classified novel structures/skeletons with interesting bioactivities from published articles.

1 Terpenes

1.1 *Monoterpenes*

One monoterpene, 3-*O*-palmitoylloliolide (**1**), was isolated from the aerial parts of *Parasenecio deltophylla*, with inhibitory activity on Hela cell proliferation[1].



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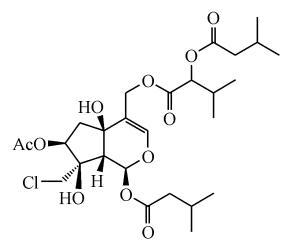
Irioids, a special kind of monoterpenes, are prevalent in plants, but they are not common to have Cl or S atoms substituting on the skeleton. A chlorinated iridoid, volvaltrate B (**2**), was isolated from *Valeriana jatamansi*[2]. Two thio-substituted irioids, epipaederoside and epipaederosidic acid (**3**), were isolated from *Saprosma ternatum* [3].



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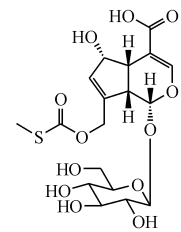

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1.2 *Sesquiterpenes*

A sesquiterpenoid with chain structure, (5*Z*)-6-[5-(2-hydroxypropan-2-yl)-2-methyl-tetrahydrofuran-2-yl]-3-methyl-hexa-1, 5-dien-3-*O*-beta-glucopyranoside (**4**), was isolated from *Breynia fruticosa* and *Breynia rostrata* (Euphor-

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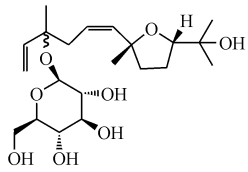
biaceae)[4]. Anhuienol (**5**), a 6-eremophilene derivative with an unusual pendant, was produced as phytoalexin in the fresh leaves of *Chloranthus anhuiensis* K.F. Wu in response to abiotic stress elicitation by $CuCl_2$[5]. Scorzoaustriacin (**6**) was identified as a guaianolide derivative possessing an unusual aminomethyl-γ-butyrolactone structural unit from the roots of *Scorzonera austriaca*[6]. By bioassay guided isolation, five sesquiterpene lactones, including henrylactone A (**7**) with a dilactone moiety, were obtained from *Illicium henryi*, with moderate activities against HBsAg and HBeAg secretion in the HBV transfected Hep G 2.2.15 cell lines[7].

An illudane-illudane bis-sesquiterpene, agrocybone (**8**), was isolated from the basidiomycete *Agrocybe salicacola*.



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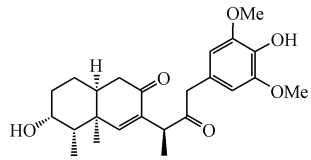

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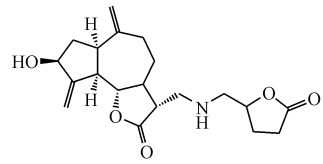

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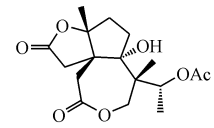

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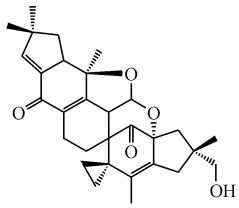

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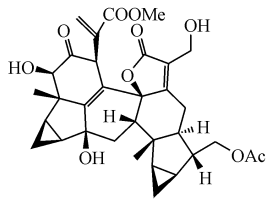

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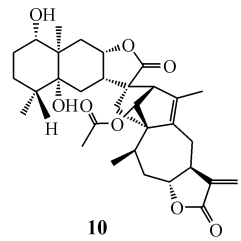

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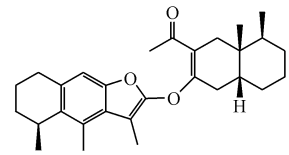

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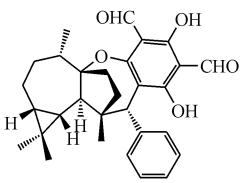
From the leaves of *Psidium guajava*, psiguadials A (**12**) and B (**13**)[12], and psidials B and C (**14**)[13], were isolated as unusual sesquiterpenoid-diphenylmethane meroterpenoids. Two 3-nor-methyl-chamigrane sesquiterpene peroxides, steperoxides A (**15**) and B, were isolated from basidiomycete *Steccherinum ochraceum*. This is the first report on the isolation of chamigrane sesquiterpene from higher fungi[14]. Volvalerenone A (**16**) was identified as a mononorsesquiterpenoid with an unprecedented 5/6/6 tricyclic ring system from the roots of *Valeriana officinalis*[15].



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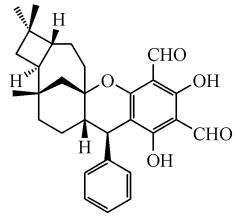

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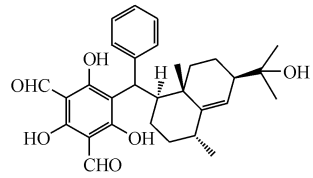

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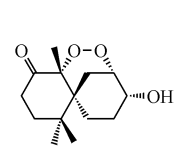

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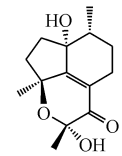

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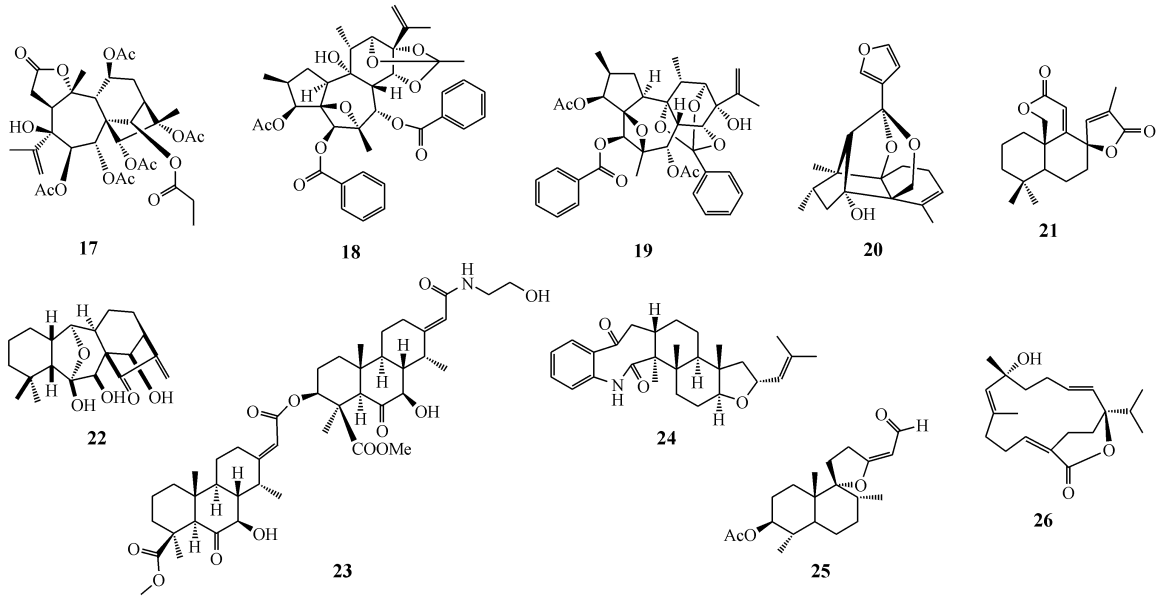
1.3 *Diterpenes*

Four highly acylated diterpenoids with a 3, 4-secograyanane skeleton were isolated from the flower buds of *Rhododendron molle*, of which secorhodomollolide D (**17**) exhibited significant analgesic and sedative effects at a dose of 5 $mg·kg^{-1}$[16]. Three highly functionalized daphnane diterpenoids, which featured an oxygen-bridged four-member-ring system and a linkage mode of 12, 13, 14-orthoester, were isolated from the stems of *Trigonostemon thyrsoideum*. Among them, trigonothyrin C (**18**) was observed to inhibit HIV-1 induced cytopathic effects with the EC_{50} of 2.19 $μg·mL^{-1}$ and the therapeutic index (TI) more than 90[17]. From *Trigonostemon chinensis*, trigochinins A-C were isolated as three highly oxygenated diterpenes, and trigochinin C (**19**) showed significant inhibition against MET tyrosine kinase activity with IC_{50} of 1.95 $μmol·L^{-1}$[18].

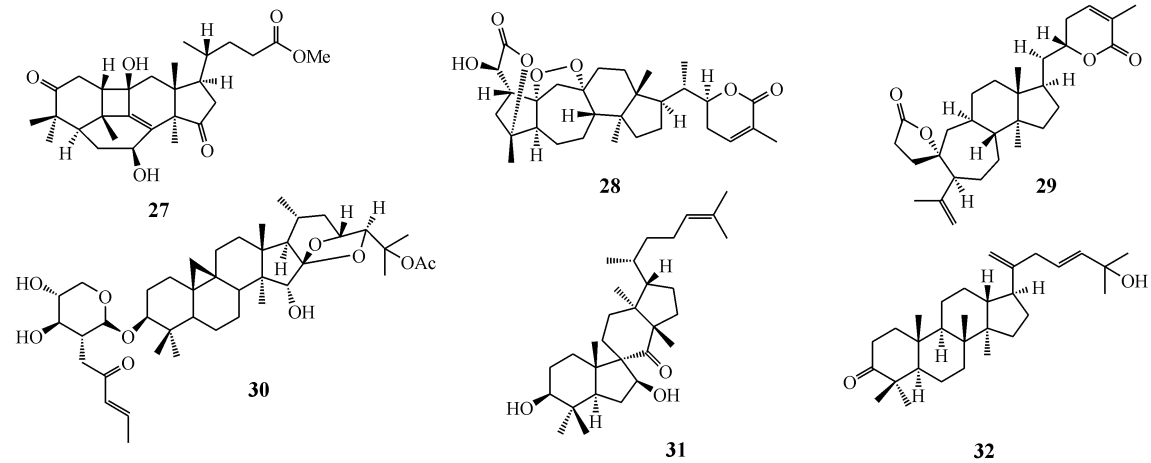
Scaparvin A (**20**), a caged *cis*-clerodane diterpenoid possessing an unprecedented C-6/C-11 bond and a ketal ring, was characterized from the Chinese liverwort *Scapania parva* [19]. Castanolide and *epi*-castanolide (**21**), two diterpenoids possessing a unique *seco*-norabietane skeleton, were isolated from *Salvia castanea* Diels f. *pubescens* Stib. Their structures featured a six-membered *α*, *β*-unsaturated lactone ring and a five-membered *α*-methyl-*α*, *β*-unsaturated γ-spirolactone moiety[20]. Luanchunins A (**22**) and B were obtained from the stems and leaves of *Isodon rubescens* var. *lushanensis*, and both showed potent cytotoxic activity against HL-60 with IC_{50} of 4.81 and 3.52 $μmol·L^{-1}$, respectively[21]. A cassaine

diterpenoid-diterpenoid amide dimer, erythrophlesin E (**23**), was isolated from *Erythrophleum fordii*, with significantly selective cytotoxic activities (IC_{50} < 10 μmol·L^{-1}) against BGC-823 and A2780[22]. Two indoloditerpene derivatives, asporyzins A (**24**) and B, together with one indoloditerpene asporyzin C, were isolated from an endophytic fungus *Aspergillus oryzae*[23]. Two labdane diterpenes, negundoins C (**25**) and E, were isolated from *Vitex negundo*. Both exhibited potency on nitric oxide production by LPS-stimulated RAW 264.7 macrophages, and significantly reduced the levels of the iNOS protein and COX-2 protein as well[24]. Laevigatlactone B (**26**) and other cembranoid diterpenes were isolated from the leaves of *Croton laevigatus*. Compound **26** exhibited modest cytotoxicity against Hela cells[25].



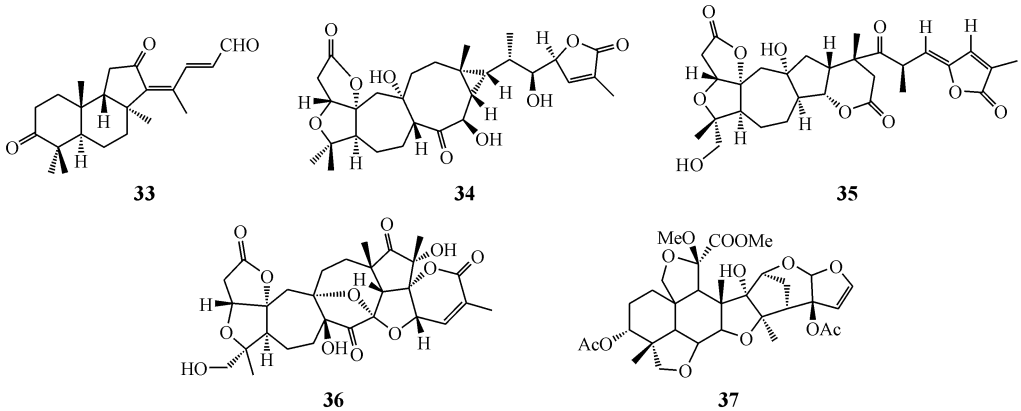
1.4 *Triterpens*

Methyl ganosinensate A (**27**) and other triterpenoids with an unusual four-membered ring skeleton produced by a bond across C-1 to C-11 were isolated from the fruiting body of *Ganoderma sinense*[26]. Schinalactone A (**28**), a cytotoxic triterpenoid possessing a rearranged cycloartane type triterpenoid skeleton with a five membered carbon ring featuring C-30 connected to C-1 (ring B), was separated from the roots and stems of *Schisandra sphenanthera*. Compound **28** showed significant cytotoxicity against SK-BR-3 and PANC-1 cell lines with IC_{50} of 5.2 and 5.9 μmol·L^{-1}, respectively[27]. An extensive study of the triterpenoid compounds from the stems of *Kadsura ananosma* led to the isolation of kadnanolactone A (**29**)[28]. Seven 9, 19-cycloartane triterpene glycosides were isolated from the roots of *Cimicifuga fetida*, and compound **30** showed significant cytotoxicity against the human HepG2 cell line[29]. Kansuinone (**31**), a rearranged euphane triterpenoid containing a spiro [5, 6] ring system, was isolated from the roots of *Euphorbia kansui*. Compound **31** exhibited inhibitory activity against human and mouse 11β-HSD1 (11β-hydroxysteroid dehydrogenase type 1) with IC_{50} of 1.12 and 1.08 μmol·L^{-1}, respectively[30]. Aglaiabbreviatin E (**32**) and other triterpenoids were isolated from the stems of *Aglaia abbreviate*. Compound **32** showed cytotoxic activities against K562, SMMC-7721, MCF-7, KB, and multi-drug-resistant MCF-7/ADM and KB/VCR human tumor cell lines as well[31].



1.5 *Nortriterpenes*

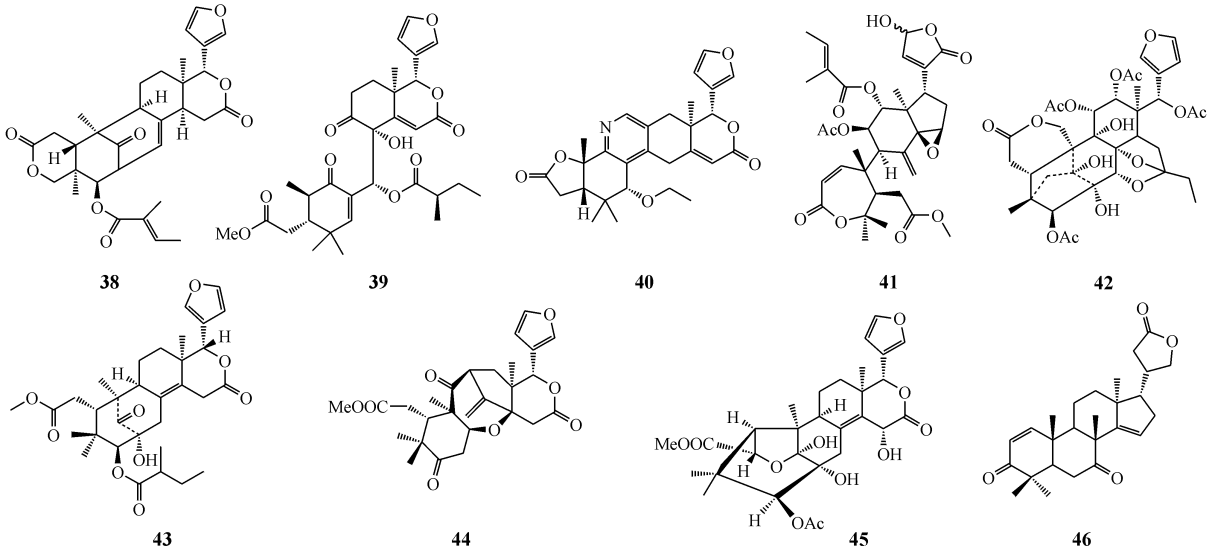
Globostelletin I (**33**), exhibiting potent inhibition against A2780, and other isomalabaricane-derived nortriterpenes were isolated from the marine sponge *Rhabdastrella globostellata*[32]. Pre-schisanartanins C (**34**) and D with pre-schisanartane backbone, together with propintrilactones A (**35**) and B possessing wuweiziartane framework, were isolated from the stems of *Schisandra propinqua* var. *propinqua* [33]. From the same plant, ten highly oxygenated nortriterpenoids with a schisanartane skeleton, schisandilactones A (**36**)-J, were also isolated. Their structures featured a polycyclic framework composed of 7/8/5 consecutive carbocycles, which were organized by similar 5/5/7/5/7/5 rings A-F and varied oxygen-containing rings G and H[34]. A tetranortriterpene, 3, 20-diacetylmethoxymeliacarpinin (**37**), was isolated from *Melia azedarach*[35].



33 **34** **35**

36 **37**

Godavarins A (**38**)-J were isolated from the seeds of an Indian mangrove *Xylocarpus moluccensis* collected in the mangrove wetlands of Godavari estuary, Andhra Pradesh. All compounds exhibited marked antifeedant activity against the third-instar larvae of *Brontispa longissima* (Gestro) at a concentration of 0.5 mg·mL^{-1}[36]. From seeds of a Chinese mangrove *Xylocarpus granatum* collected in Hainan Island, ten 9, 10-*seco*-mexicanolides, hainangranatumins A (**39**)-J, were isolated. Among them, hainangranatumin G (**40**) contained a central pyridine ring in its structure[37]. Four B-*seco* prieurianin-class limonoids, mulavanins A (**41**)-D, were isolated from *Munronia delavayi*[38]. Chuktabularin E (**42**) and other 16-norphragmalin limonoids were isolated from the stem bark of *Chukrasia tabularis* var. *velutina*. Their structures possessed a biosynthetically extended propionyl or acetyl group at C-15 and a characteristic ketal moiety between the limonoid skeleton and the acyl substituent at C-15[39]. Cipadesins N (**43**) and O were isolated from *Cipadessa baccifera* as two mexicanolid-type limnoids[40]. From the stem bark of *Cipadessa baccifera*, two trijugin-type limonoids, cipatrijugins E (**44**) and F, were yielded. Compound **44** showed significant cytotoxicity against MCF-7, SW480, HL-60, and SMMC-7721 cells with IC_{50} of 5.0, 6.6, 4.5, and 21.6 μmol·L^{-1}, respectively[41]. Khayalenoid C (**45**) was obtained from stems of *Khaya senegalensis*[42]. Meliatoosenin A (**46**) was separated from the stem bark of *Melia toosendan* [43].



38 **39** **40** **41** **42**

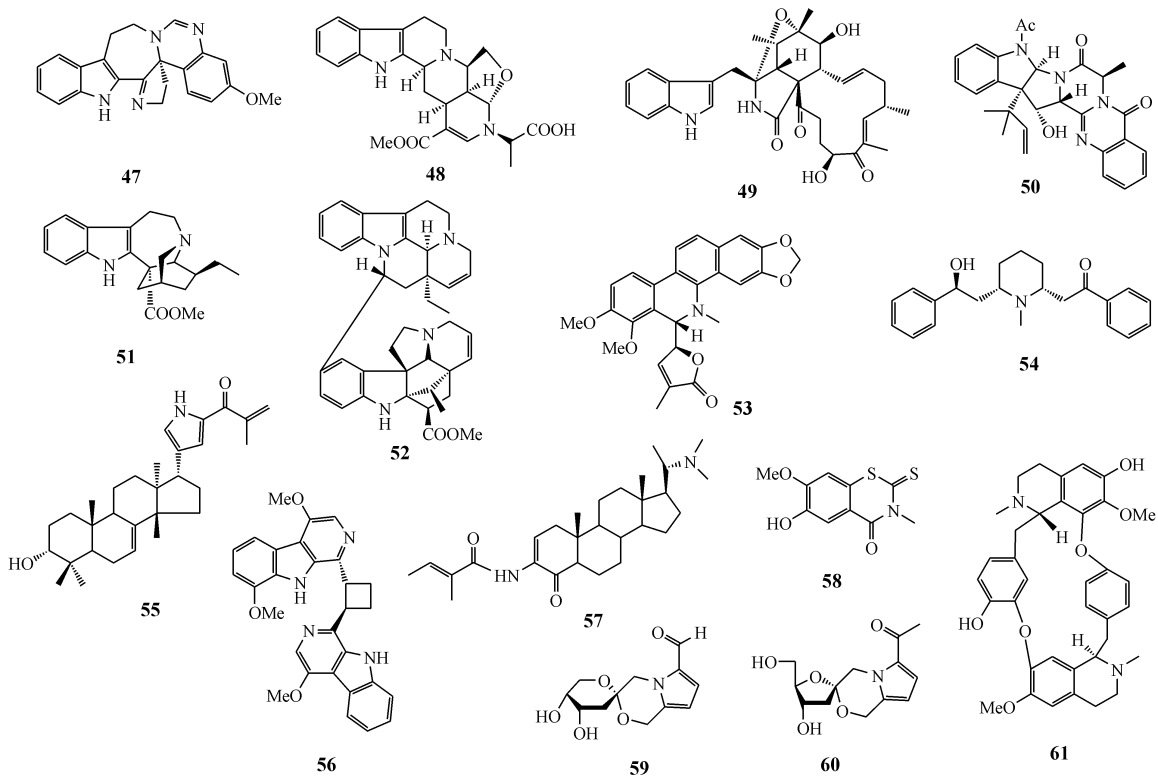
43 **44** **45** **46**

2 Alkaloids

Three indole alkaloids with a unique polycyclic system were isolated from the leaves of *Trigonostemon lii*. Amongst them, trigonoliimine A (**47**) showed modest anti-HIV-1 activity[44]. Two monoterpenoid indole alkaloids, aminocadam-

bines A (**48**) and B, characterized by tetrahydrofuran and 1, 2, 3, 4-tetrahydropyridine rings, were isolated from the leaves of *Neolamarckia cadamba*[45]. Chaetoglobosin W (**49**), which was unique in its possession of an oxolane ring formed *via* an oxygen bridge between C-3 and C-6, was isolated from the solid culture of *Chaetomium globosum* IFB-E041[46]. 16α-Hydroxy-5N-acetylardeemin (**50**) was isolated from the fermentation broth of an endophytic fungus *Aspergillus terreus*, with an inhibitory effect against acetylcholinesterase[47]. Two indole alkaloids, coronaridine (**51**) and voacangine, were isolated from the stems of *Ervatamia hainanensis* through bioassay-guided fractionation and chromatography technique. Both compounds exhibited the same level of acetylcholinesterase (AChE) inhibition activities as galantamine [48]. Melodinine H (**52**) and other bisindole alkaloids were isolated from *Melodinus tenuicaudatus*, and all of them showed potent cytotoxicity against a panel of human cancer cell lines[49].

Maclekarpine A (**53**) and other dihydrobenzophenanthridine alkaloids were isolated from the roots of *Macleaya microcarpa*, and **53** showed potent inhibitory activity against BGC-823cell lines[50]. A diphenacyl-piperidine alkaloid sonneratine A (**54**), identified as a piperidine ring bearing two phenacyl substitutes at C-2 and C-6, was isolated from the leaves and stems of the Hainan mangrove *Sonneratia hainanensis*[51]. A tirucallane-type alkaloid, laxiracemosin E (**55**), was isolated from the bark of *Dysoxylum laxiracemosum*, with significant cytotoxicity against HL-60, SMMC-7721, A-549, MCF-7 and SW480 cell lines[52]. Qussidine A (**56**) was identified as a bis-*β*-carboline alkaloid possessing a novel cyclobutane moiety from the stems of *Picrasma quassioides*[53]. Pachysamine M (**57**) and other pregnane alkaloids were isolated from *Pachysandra axillaris*[54]. Two heterocyclic compounds, bretschneiderazines A (**58**) and B, were isolated from *Bretschneidera sinensis*[55]. Pyrrole ketohexoside derivatives, pollenopyrrosides A (**59**) and B (**60**), were isolated from the extract of bee-collected *Brassica campestris* pollen. They represent a novel carbon skeleton with a six-six and a five-six member dioxaspirocycle bearing nitrogen atom, respectively[56]. Two curine-type bisbenzylisoquinoline alkaloids were isolated from the roots of *Cyclea wattii*. Among them, wattisine A (**61**) showed significant cytotoxic activities against HCT-8 and Bel-7402 cell lines[57].

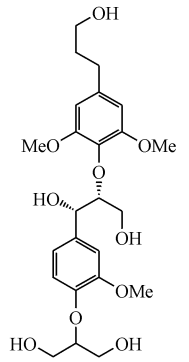


3 Lignans

A neolignan **62** was isolated from the stem bark of *Illicium difengpi*, exhibiting moderate *β*-glucuronidase release inhibitory activities in rat polymorphonuclear leukocytes (PMNs) induced by platelet-activating factor (PAF) with IC_{50} of 1.62 μmol·L^{-1} (Ginkgolide B as the positive control, IC_{50} 2.35 μmol·L^{-1})[58]. Marlignan C (**63**) and other dibenzocyclooctadiene lignans were isolated from the leaves and stems of *Schisandra wilsoniana*. All compounds showed moderate anti-HIV activities[59]. A lignan glycoside with anti-HIV-1 activity, lancilignanside A (**64**), was isolated from leaves and stems of *Schisandra lancifolia*[60]. Investigation of the leaves of *Morus alba* L. yielded a 2-arylbenzofuran derivative, moracin W (**65**), which showed cytotoxicity against BGC823 and HCT8 human cancer cell lines[61].

4 Coumarins

Mucodianin A (**66**) was isolated from the vine stems of *Mucuna birdwoodiana*. This is the first report of 7-quinonylcoumarin as stable form in natural products[62]. A biscoumarin, eryciboside B (**67**), was characterized from the roots and stems of *Erycibe hainanesis*. Compound **67** showed potent activity against D-galactosamine-induced cytotoxicity in WB-F344 rat hepatic epithelial stemlike cells at concentration of 10 μmol·L^{-1} with the inhibition ratio of 19.8%, without any obvious cytotoxic effects[63].



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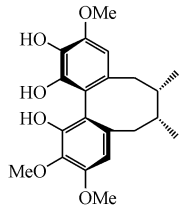

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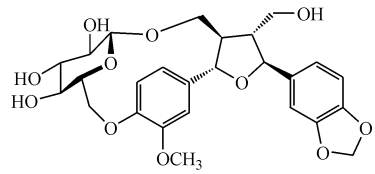

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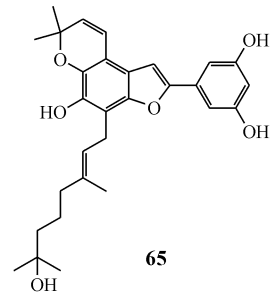

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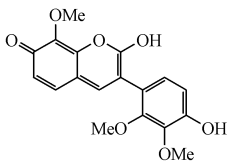

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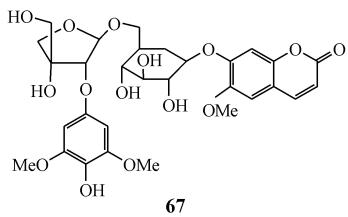

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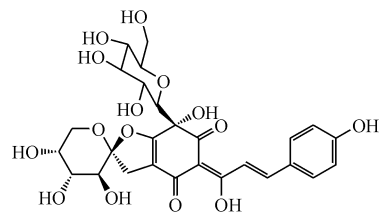
5 Flavones

Saffloquinosides A and B were isolated as two quinochalcone compounds from the florets of *Carthamus tinctorius*. Saffloquinoside A (**68**) had an uncommon six-five member dioxaspirocycle while saffloquinoside B (**69**) possessed a cyclohexatrione skeleton with a benzyl group and two C-glycosyl units[64]. A dihydroflavnol named (2*R*, 3*R*) pinobanksin-3-caffeoylate (**70**) was isolated from the Chinese mangrove plant *Laguncularia racemosa* (L) Gaertn. f. Compound **70** showed significant anti-oxidative activity in the DPPH and TEAC free-radical-scavenging assays, and also potent inhibition toward FLT3 and SAK, individual human tumor related protein kinases[65]. A series of dimeric and trimeric xanthone *O*-glycosides were isolated from the entire plant of *Swertia punicea*. Among them, puniceaside B (**71**) exhibited potent neuroprotective activity against H_2O_2-induced PC12 cell damage, the cell viability is (75.1 ± 9.0)% at the concentration of 12.5 μg·mL^{-1} (edaravone as the positive control, the cell viability is (74.3 ± 3.9)% at the same concentration)[66]. A flavonoid, 6-(2-hydroxy-5-carboxyphenyl)-apigenin (**72**), was isolated from *Selaginella tamariscina*[67]. Brainicin (**73**) was identified as a flavanol coupled with phenylpropyl and shikimic acid units from *Brainea insignis*[68].



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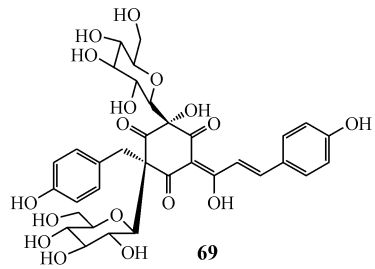

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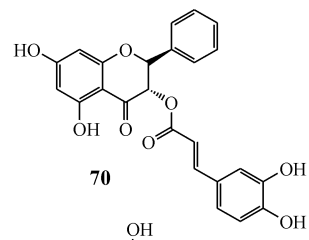

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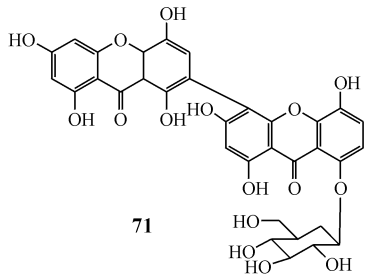

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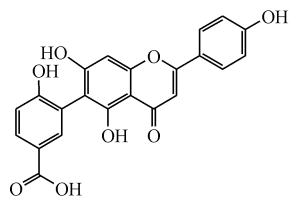

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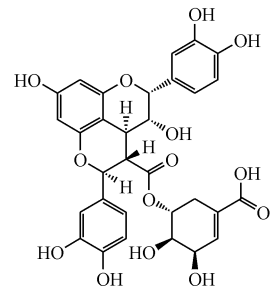

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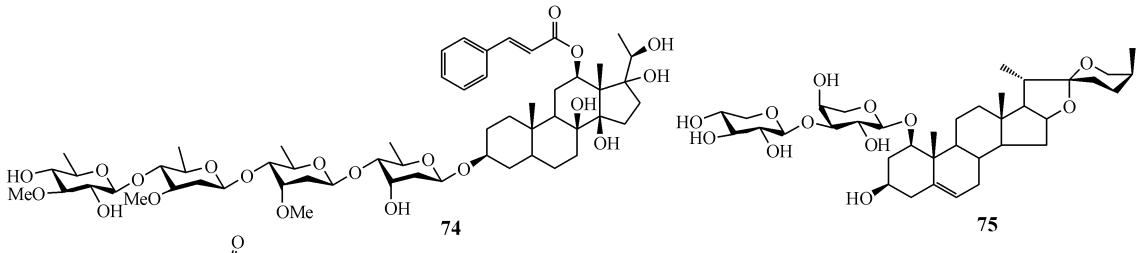
6 Steroids

Five C_{21} steroidal glycosides including **74** were isolated from the stems of *Marsdenia tenacissima*. All of them showed cytotoxic toward BEL-7402, KB and A549 cell lines [69]. Angudracanoside F (**75**) was identified as a spiro steroidal saponin possessing a sulfate group in the sugar moieties from *Dracaena angustifolia.* Compound **75** showed inhibition activity against *Cryptococcus neoformans* with IC_{50} of 9.5 μg·mL^{-1}[70]. Two novel 19-norbufadienolides, bufogargarizins A (**76**) and B, were isolated from the venom of *Bufo bufo gargarizans*[71]. The steroids ergone **77** was isolated from *Polyporus umbellatus* by bioassay-guided approach. This compound showed potent anticancer activity against HepG2, Hep-2 and Hela cell lines[72]. An unprecedented ring A-*seco* C_{21} sterol **78** was isolated from the bark of *Melia azedarach*[73].



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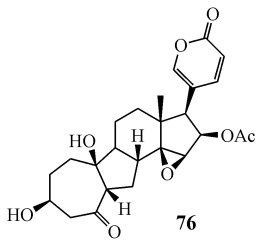

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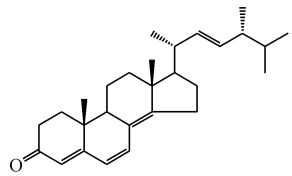

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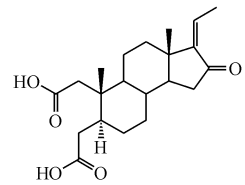

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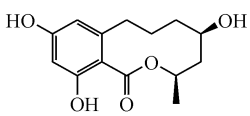
7 Lactones

3*R*, 5*R*-sonnerlactone (**79**) and 3*R*, 5*S*-sonnerlactone were isolated from the mangrove endophytic fungus Zh6-B1 obtained from the South China Sea, both showing antiproliferative activity against KV/MDR human oral floor carcinoma cells[74]. Swerilactones E (**80**) and F, two lactones with a phenyl group, were isolated from *Swertia mileensis*. Both compounds exhibited significant inhibitory activities against the secretion of HBsAg and HBeAg on the HBV-transfected Hep G 2.2.15 cell[75]. A cytotoxic roridin-type trichothecene macrolide named roritoxin E (**81**) was characterized from the solid culture of *Myrothecium roridum* IFB- E091. Compound **81** exhibited inhibitory activity against SGC-7901 and SMMC-7721 cell lines[76]. Vibralactone D (**82**) was isolated from cultures of the basidiomycete *Boreostereum vibrans* with inhibitory activities against isozymes of 11*β*-hydroxysteroid dehydrogenases (HSD) from different resources[77]. A *β*-resorcylic acid lactone named paecilomycin E (**83**) was isolated from the mycelial solid culture of *Paecilomyces* sp. SC0924, with antiplasmodial activity against *Plasmodium falciparum* line 3D7 with IC_{50} of 20.0 n mol·L^{-1} and moderate activity against the *P. falciparum* line Dd2[78].



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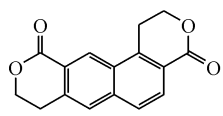

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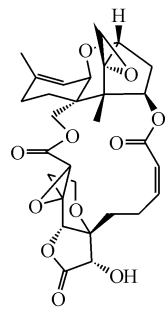

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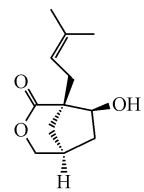

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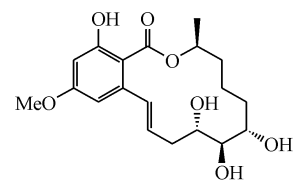

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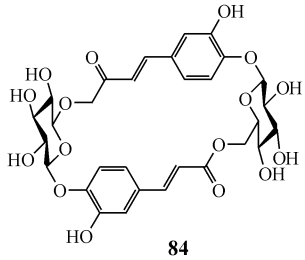
8 Phenols

Cyclic 4-*O*-*β*-D-glucopyranosylcaffeic acid dimer (**84**), the first cyclic phenolic acid glycoside dimer, was isolated from *Gentiana loureirii*[79]. Three phloroglucinols, possessing a unprecedented benzyl benzo[b]furo[3, 2-d]furan skeleton, were isolated from the roots of *Lysidice rhodostegia.* Lysidicin F (**85**) was further characterized as the first example of natural product with *trans*-fused furan rings[80]. A highly brominated metabolite **86** was isolated from the red alga *Laurencia similis* with strong inhibitory activities against protein tyrosine phosphatase 1B (PTP1B)[81].



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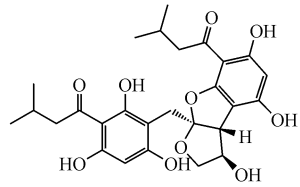

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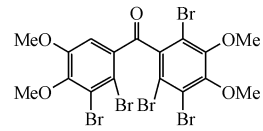

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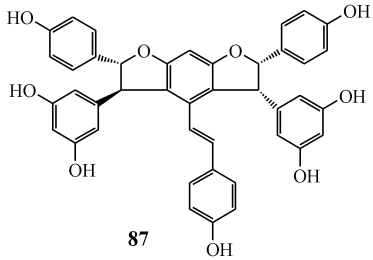
9 Stilbenes

Three trimeric stilbenes, *trans*-suffruticosol D (**87**), *cis*-suffruticosol D, and *cis*-gnetin H, were isolated from the seeds of *Paeonia suffruticosa*[82].



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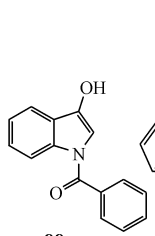
10 Amides

Oxytrofalcatins A (**88**)-F were firstly isolated as natural *N*-benzoylindoles from the roots of *Oxytropis falcata*[83]. An amide named 10-phenyl-[12]-cytochalasin Z17 (**89**) was characterized from the liquid culture of the endophytic fungus *Aspergillus terreus* IFB-E030[84]. A coumaroylspermidine, N^1, N^5-(*Z*)-N^{10}-(*E*)-tri-*p*-coumaroylspermidine (**90**), was isolated from safflower (*Carthamus tinctorius* L.) through an bioactivity-guided isolation. Compound **90** showed significant inhibitory action on serotonin (5HT) uptake in Chinese hamster ovary (CHO) cells expressing 5HT transporter (SERT) (S6 cells) with IC_{50} of (0.54 ± 0.15) μmol·L^{-1}[85]. Aspochalsin R (**91**) with unprecedented oxidation at C-19 was isolated from the marine-derived fungus *Spicaria elegans*[86]. Trivially (-)-alternarlactam (**92**), a cytotoxin with double antitumor pharmacophores in a new framework, was isolated from *Alternaria* sp. HG1 culture. Compound **92** showed inhibitory activity against Hela and QGY-7701 with the IC_{50} of 1.10 and 1.52 μg·mL^{-1}, respectively[87].



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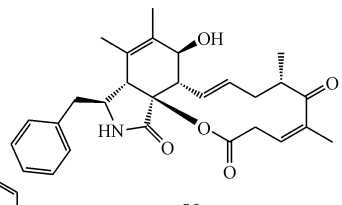

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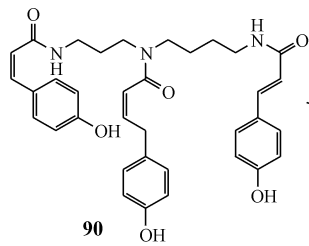

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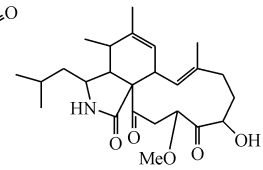

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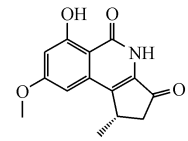

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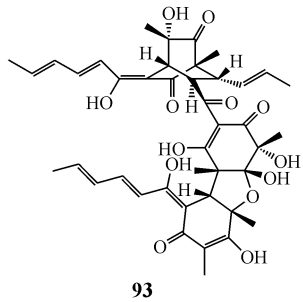
11 Cyclic ketones

Three sorbicillin trimers, trisorbicillinones B (**93**), C and D, were isolated from a deep ocean sediment derived fungus, *Phialocephala* sp. FL30r[88]. Bioactivity-directed fractionation of the extract of the mangrove endophytic fungus *Talaromyces* sp. ZH-154, which was isolated from the stem bark of *Kandelia candel* (L.) Druce (Rhizophoraceae) afforded a metabolite 7-epiaustdiol (**94**). Compound **94** exhibited significant inhibition activity against *Pseudomonas aeruginosa* [89]. Naphthospironone A (**95**), a novel polycyclic metabolite with an unprecedented spiro[bicyclo[3.2.1]octene-pyran]dione ring system, was isolated from alkalophilic *Nocardiopsis* sp. (YIM DT266), which were separated from an alkaline soil sample (pH 10) collected from the Datun tin mine tailings area[90].



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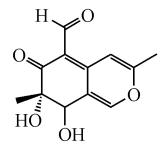

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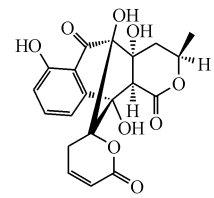

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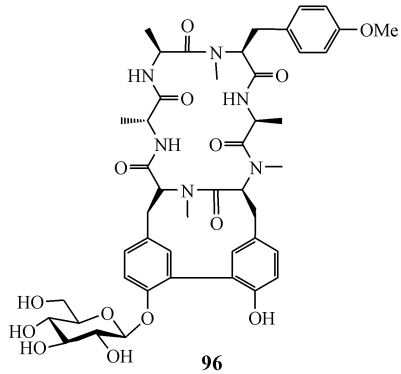
12 Cyclopeptides

A cyclic hexapeptide named rubiyunnanin B (**96**) was isolated from the roots of *Rubia yunnanensis* (Franch.) Diels. Compound **96** showed moderate cytotoxicity against MDA-MB-231, A549, BGC-823, U251 and B16 cancer cell

lines[91]. Tunicyclin D (**97**) was isolated from the root of *Psammosilene tunicoides*, exhibiting antifungal activity against *Candida albicans* (SC5314), *Candida albicans* (Y0109), *Candida tropicalis*, *Candida parapsilosis*, and *Cryptococcus neoformans* (BLS108)[92].

13 Others

Menellin A (**98**), a highly oxygenated cyclopentene derivative with C8 skeleton, was obtained from a South China Sea gorgonian *Menella* sp. Compound **98** showed moderate anti-inflammatory inhibition against lipopolysaccharide (LPS)-induced nitric oxide (NO) production in RAW264.7 macrophages[93]. Two polyoxygenated *seco*-cyclohexenes named uvarisubols A (**99**) and B were isolated from the twig of *Uvaria tonkinensis* var. s*ubglabra*[94]. Four C10-acetylenic glycosides including 4, 6-decadiyne-1-*O*-*β*-D-apiofuranosyl-(1→6)-*β*-D-glucopyranoside (**100**) were isolated from the whole plants of *Saussurea cordifolia* [95]. From the root barks of *Periploca sepium*, perisesaccharide B (**101**) and other oligosaccharides were afforded. The boat conformation of oleandronic acid *δ*-lactone in their structures was firstly reported[96]. A dimeric naphtho-*γ*-pyrone, rubasperone C (**102**), was characterized from the mangrove endophytic fungus *Aspergillus tubingensis* (GX1-5E). Compound **102** exhibited mild *α*-glucosidase inhibitory activity with an IC_{50} of 97.3 μmol·L^{-1}[97].



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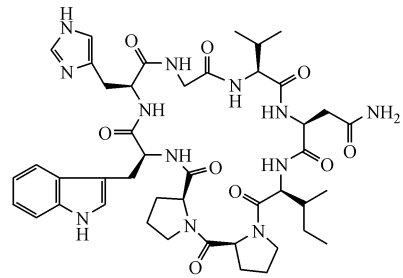

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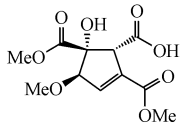

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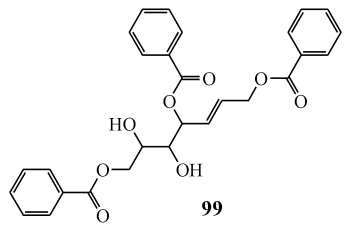

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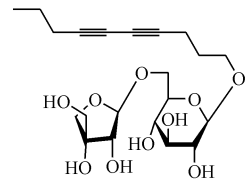

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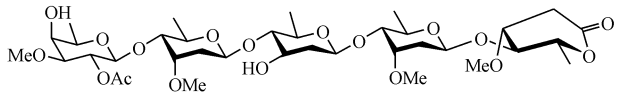

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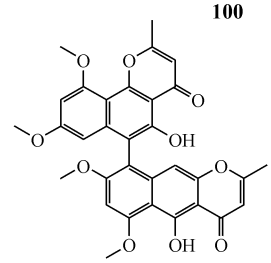

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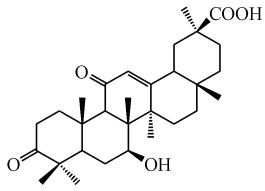
14 Biotransformation

Cunninghamella blakesleeana AS 3.970 was used as biocatalysis to transform glycyrrhetinic acid (GA). Two major derivatives, 3-oxo-7*β*-hydroxy-glycyrrhetinic acid (**103**) and 7*β*-hydroxy-glycyrrhetinic acid, were identified from the culture. The results showed that *Cunninghamella blakesleeana* AS 3.970 has the capability of hydroxylation of C_7 and oxidation of C_3-OH[98].



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Perspective

In recent years, Chinese scientists have made outstanding achievements in the field of natural products chemistry after years of hard work. Therefore, it is becoming a more and more important and urgent topic for every researcher in this field how to incorporate other disciplines such as pharmacology, biology, etc and do researches with distinctive features based on our unique resources of traditional Chinese medicines. It is believed that after a short period of adjustment, Chinese scientists will gain more

achievements under the guidance of new ideas and new methods.

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2010 年我国天然药物化学研究进展

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【摘　要】 本文综述了 2010 年我国科学家在天然药物化学领域内的研究成果。选择其中具有新颖性或者显著生物活性的化合物, 按其结构分类分别介绍。

【关键词】 天然药物化学; 天然化合物; 研究进展

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