

Review



Bis-Iridoids: Occurrence, Chemophenetic Evaluation and Biological Activities—A Review

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Abstract: In this work, the first review paper about bis-iridoids was presented. In particular, their detailed occurrence, chemophenetic evaluation and biological activities were reported. To the best of our knowledge, two hundred and eighty-eight bis-iridoids have been evidenced so far, bearing different structural features, with the link between two seco-iridoids sub-units as the major one. Different types of base structures have been found, with catalpol, loganin, paederosidic acid, olesoide methyl ester, secoxyloganin and loganetin as the major ones. Even bis-irdioids with nonconventional structures like intra-cyclized and non-alkene six rings have been reported. Some of these compounds have been individuated as chemophenetic markers at different levels, such as cantleyoside, laciniatosides, sylvestrosides, GI-3, GI-5, oleonuezhenide, (Z)-aldosecologanin and centauroside. Only one hundred and fifty-nine bis-iridoids have been tested for their biological effects, including enzymatic, antioxidant, antimicrobial, antitumoral and anti-inflammatory. Sylvestroside I was the compound with the highest number of biological tests, whereas cantleyoside was the compound with the highest number of specific biological tests. Bis-iridoids have not always shown activity, and when active, their effectiveness values have been both higher and lower than the positive controls, if present. All these aspects have been deeply discussed in this paper, which also shows some critical issues and even suggests possible arguments for future research, since there is still a lot unknown about bis-iridoids.

Keywords: bis-iridoids; occurrence; chemophenetic value; biological activities

1. Introduction

Bis-iridoids are a sub-class of iridoids characterized by the link of two iridoidic *sensu lato* sub-units to form a bigger molecule. Actually, these sub-units may be extremely different, and the bond may occur in different positions of both the sub-units, including the glucose moiety but also after conjugation with other classes of natural compounds like phenolics and terpenes to act as a bridge between them [1–5].

They are biosynthesized following the general route for the biosynthesis of simple iridoids and *seco*-iridoids but with the further passage of the intermolecular bond of the two sub-units alone or after conjugation with bridges [6].

In the literature, there is no specific review paper on *bis*-iridoids, whereas several review papers have dealt with the topic of iridoids in general on several aspects [1–5,7–10].

In this review paper, the occurrence, chemophenetic value and biological activities of *bis*-iridoids are presented and discussed in detail. The literature search was conducted

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Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/license s/by/4.0/). on renowned scientific databases such as PubMed, PubChem, Google Scholar and Reaxys using keywords like *bis*-iridoid, *bis*-iridoids, occurrence, biological activities alone or together and specific names of compounds or plant species, as recovered from previous papers. All the papers written in English in spite of their publication year and journal were considered. Not fully accessible papers were also included. Indeed, all the papers not concerning plant species, concerning a mixture of plants where the identification of this type of compounds has not been clearly attributed, deriving from cell cultures or from sure enhancement of their production in a botanical or biotechnological manner, were neglected.

2. Occurrence of bis-Iridoids in Plants

Table 1 reports on the occurrence of *bis*-iridoids in plants in alphabetical order. In this, the organs of the plants where they have been recovered and the collection area of the species, as well as the methodologies adopted for their extraction, separation and identification, are also presented.

Name of the Compound	Plant Species	Studied	Collection	Methodology of Extraction,	Reference
I		Organ	Area	Separation and Identification	
5-hydroxy-2'''-O-caffeoyl-	Caryopteris incana	Whole plant	China	SE, PP, CC, $\alpha_{\text{[D]}}$, IR, NMR,	[10]
caryocanoside B (Figure 5)	(Thunb. ex Houtt.) Miq.	······		HR-MS	[-•]
7-O-acetyl-abelioside B	Linnaea chinensis	Aerial parts	Italy	SE, PP, CC, $\alpha_{[D]}$, IR, UV, NMR,	[11]
(Figure 30)	A.Braun & Vatke	riena parts	italy	MS	[11]
7-O-acetyl-laciniatoside IV	Linnaea chinensis	Aorial parts	Italy	SE, PP, CC, $\alpha_{[D]}$, IR, UV, NMR,	[11]
(Figure 30)	A.Braun & Vatke	Aeriai parts	Italy	MS	[11]
7-O-acetyl-laciniatoside V	Linnaea chinensis	A orial parts	Italy	SE, PP, CC, $\alpha_{[D]}$, IR, UV, NMR,	[11]
(Figure 30)	A.Braun & Vatke	Aeriai parts	Italy	MS	[11]
7-O-caffeoyl-	Lowelooig stellate (L.) Pof	Whole plant	Algoria	SE, CC, CPC, rp-FC, HPLC-	[10]
sylvestroside I (Figure 9)	Lomeiosiu sieliulu (L.) Kal.	whole plant	Algena	UV, $\alpha_{\text{[D]}}$, UV, NMR, HR-MS	[12]
7-O-(p-coumaroyl)-	Louis stallata (L.) Dof	W/h alo mlamb	Alexania	SE, CC, CPC, rp-FC, HPLC-	[10]
sylvestroside I (Figure 9)	Lomeiosiu stellutu (L.) Kar.	whole plant	Algeria	UV, $\alpha_{[D]}$, UV, NMR, HR-MS	[12]
			Japan		
6-O-(/ <i>A</i> -hydroxy-	Louissus issouiss Threeh	Champa and laseroa	(purchased	SE, PP, VV, p-HPLC-UV,	[12]
swerosyloxy)-loganin (Figure	Lonicera japonica Thund.	Stems and leaves	from a	NMR	[13]
11)			company)		
2 ^{···} -O-(E)-p-coumaroyl-	Caryopteris incana	W/h alo mlamb	China	SE, PP, CC, p-HPLC-UV, $\alpha_{[D]}$,	[10]
caryocanoside B (Figure 5)	(Thunb. ex Houtt.) Miq	whole plant	China	IR, NMR, HR-MS	[10]
2 ^{'''} -O-(Z)-p-coumaroyl-	Caryopteris incana		China	SE, PP, CC, p-HPLC-UV, $\alpha_{[D]}$,	[10]
caryocanoside B (Figure 5)	(Thunb. ex Houtt.) Miq.	whole plant	China	IR, NMR, HR-MS	[10]
3"-glucosyl-depresteroside	Cautions downson D Down	A arrial marta	Noral	DP, SE, PP, CC, CCTLC, sp-	[14]
(Figure 10)	Gentiana aepressa D.Don	Aeriai parts	Nepai	HPLC-UV, UV, NMR, MS	[14]
			Japan		
		Champa and laseroa	(purchased	SE, PP, CC, p-HPLC-UV, $\alpha_{[D]}$,	[12]
		Stems and leaves	from a	UV, NMR, HR-MS	[13]
			company)		
			China	HSE, CC, p-HPLC-UV, NMR	[15]
(Z)-aldosecologanin (Figure		-	China	-	
17)	Lonicera japonica Thunb.		(purchased	SE, PP, CC, sp-HPLC-UV,	
,			from a	NMR	[16]
		Flower buds	company)		
		-	China	USE, HPLC-MS ⁿ	[17]
			(different		1403
			populations)	SE, HPLC-PDA	[18]

Table 1. List of all the identified *bis*-iridoids in plants.

			China		
			(different	USE, UHPLC-MS ⁿ	[19]
	_		populations)		
		Aerial parts	China	USE, UHPLC-MS ⁿ	[20]
	-	riena para	(cultivated)		[=0]
		Roots	China	USE, UHPLC-MS ⁿ	[20]
	_	10005	(cultivated)		[=0]
			China		
		Flowers	(different	USE, UHPLC-MS ⁿ	[19]
	_		populations)		
			China		
		Stems	(different	USE, UHPLC-MS ⁿ	[19]
	_		populations)		
			China		
		Leaves	(different	USE, UHPLC-MS ⁿ	[19]
			populations)		
		Aprial parts	China	LISE LIHPL C-MSn	[20]
	Lonicera ferdinandi	Actial Parts	(cultivated)	00L, 01 II LC-IVI3"	[20]
	Franch.	Roots	China	LISE LIHDI C MCn	[20]
		ROOLS	(cultivated)	03E, UHF LC-M3"	[20]
	Louicora masimorniosii	A orial mante	China	LISE LIHPLC MCn	[20]
	suber achalismoio	Aeriai parts	(cultivated)	USE, UNITLC-MS"	[20]
	(Er Schwidt) Nodol	D (China		[20]
	(FI.Schindt) Nedol.	Roots	(cultivated)	USE, UHPLC-MIS.	
		A originanto	China	LICE LILIDI C MSn	[20]
	Lonicera maackii (Rupr.)	Aerial parts	(cultivated)	USE, UHPLC-MS ⁿ	
	Maxim.	Roots	China	LICE LILIDI C MC	[20]
			(cultivated)	USE, UHFEC-IVIS."	[20]
		A suist us suis	China	LICE LILIDI C MCn	[20]
	Louisona momornii A Cross-	Aerial parts	(cultivated)	USE, UHFLC-MS	[20]
	Lonicera morrowii A.Gray-	Roots	China	USE, UHPLC-MS ⁿ	[20]
			(cultivated)		[20]
		A originants	China	LICE LILIDI C Men	[20]
	Lonicera praeflorens	Aeriai parts	(cultivated)	USE, UHPLC-MS.	[20]
	Batalin	Doot-	China	LICE LILIDLC MC	[20]
		KOOIS	(cultivated)	USE, UNI ^r LC-MI5"	[20]
Aboliforosido A (Eigurs 25)	Abelia grandiflora (Rovelli	Flowerbude	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$,	[21]
Abemoroside A (Figure 35)	ex André) Rehder	riower buus	Cillia	IR, UV, NMR, HR-MS	[21]
Aboliforosido B (Eiguro 25)	Abelia grandiflora (Rovelli	Flowerbude	China	SE, PP, CC, sp-HPLC-UV, α _[D] ,	[21]
rigure 55)	ex André) Rehder	Flower buus		IR, UV, NMR, HR-MS	[21]
Abeliforosido C (Figuro 20)	Abelia grandiflora (Rovelli	Flower bude	Chipa	SE, PP, CC, sp-HPLC-UV, $\overline{\alpha_{[D]}}$,	[21]
Abenioroside C (Figure 30)	ex André) Rehder	riower buus	Cillia	IR, UV, NMR, HR-MS	[21]
Aboliforosido D (Eiguro 20)	Abelia grandiflora (Rovelli	Flower bude	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{\text{[D]}}$,	[21]
Abenioroside D (Figure 30)	ex André) Rehder	riower buus	Cillia	IR, UV, NMR, HR-MS	[21]
Aboliforosido E (Eiguro 20)	Abelia grandiflora (Rovelli	Flower bude	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{\text{[D]}}$,	[21]
Abenioroside E (Figure 30)	ex André) Rehder	riower buus	Cillia	IR, UV, NMR, HR-MS	[21]
Aboliforosido E (Eiguro 20)	Abelia grandiflora (Rovelli	Flowerbude	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$,	[21]
Abenioroside r (rigure 30)	ex André) Rehder	riower buds	China	IR, UV, NMR, HR-MS	[21]
	Abelia grandiflora (Rovelli	Logues	Ioner	HSE, PP, ACT, CC, p-TLC,	[22]
Abaliasida A (Eirona 20)	ex André) Rehder	Leaves	Japan	$\alpha_{\text{[D]}}$, IR, UV, NMR	[22]
Adeliosiae A (Figure 30)	Picrorhiza kurroa Royle ex	C1	M	USE, PP, CC, sp-HPLC-UV,	[00]
	Benth.	Stems	wyanmar	NMR	[23]
	Abelia grandiflora (Rovelli	т	т	HSE, PP, ACT, CC, p-TLC,	[22]
Abelioside A methyl acetal	ex André) Rehder	Leaves	Japan	$\alpha_{[D]}$, IR, UV, NMR	[22]
(Figure 30)	Pterocephalus hookeri	1471 1 · · ·	T:1 ·	SE, PP, CC, sp-HPLC-UV,	[0.47
,	(C.B.Clarke) F. Pritz	whole plant	11bet	NMR	[24]

	<i>Picrorhiza kurroa</i> Royle ex Benth.	Stems	Myanmar	USE, PP, CC, sp-HPLC-UV, NMR	[23]
Abelioside B (Figure 30)	Abelia grandiflora (Rovelli ex André) Rehder	Leaves	Japan	HSE, PP, ACT, CC, p-TLC, $\alpha_{\text{[D]}}$, IR, UV, NMR	[22]
Adinoside D (Figure 16)	Adina racemosa (Siebold & Zucc.) Miq.	Leaves, flowers and twigs	Taiwan (obtained from a botanical garden)	HSE, PP, CC, rp-MPLC, p- HPLC-UV, p-TLC, α _[D] , IR, UV, NMR, HR-MS	[25]
Adinoside E (Figure 16)	Adina racemosa (Siebold & Zucc.) Miq.	Leaves, flowers and twigs	Taiwan (obtained from a botanical garden)	HSE, PP, CC, rp-MPLC, p- HPLC-UV, p-TLC, α[D], IR, UV, NMR, HR-MS	[25]
Alatenoside (Figure 21)	Sarracenia alata (Alph.Wood) Alph.Wood	Whole plant	USA	SE, PP, p-rp-HPLC-UV, HPLC-ELSD, α[D], UV, NMR, HR-MS	[26]
Alatinoside (Figure 21)	Sarracenia alata (Alph.Wood) Alph.Wood	Whole plant	USA	SE, PP, p-rp-HPLC-UV, HPLC-ELSD, α[D], UV, NMR, HR-MS	[26]
Aldosecolohanin B (Figure 19)	<i>Lonicera japonica</i> Thunb.	Flower buds	China (purchased from a company)	SE, PP, CC, sp-HPLC-UV, α _{IDI} , IR, UV, NMR, HR-MS	[16]
Aldosecolohanin C (Figure 19)	<i>Lonicera japonica</i> Thunb.	Flower buds	China (purchased from a company)	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[16]
Alidyjosioside (Figure 31)	<i>Scaevola taccada</i> (Gaertn.) Roxb.	Leaves	Egypt (obtained from a botanical garden)	SE, PP, VLC, CC, MP, NMR,	[27]
Argusangolosido (Figuro 34)	<i>Linaria arcusangeli</i> Atzei & Camarda	Whole plant	Italy	SE, ACT, CC, α[D], IR, UV, NMR, MS	[28]
Arcusangeloside (Figure 54)	Linaria flava subsp. sardoa (Sommier) Arrigoni	Whole plant	Italy	SE, ACT, CC, α _[D] , IR, UV, NMR, MS	[28]
Argylioside (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, ACT, CC, rp-LPLC, α _[D] , IR, UV, NMR	[29]
Asaolaside (Figure 30)	<i>Loasa acerifolia</i> Dombey ex A.Juss.	Leaves	Germany (obtained from a botanical garden)	SE, CC, NMR SXE, PP, CC, sp-HPLC-UV, α[D], IR, UV, NMR, MS	[30]
Asperuloide A (Figure 29)	Galium maximowiczii (Kom.) Pobed.	Whole plant	South Korea	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, MS	[32]
Asperuloide B (Figure 29)	Galium maximowiczii (Kom.) Pobed.	Whole plant	South Korea	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, MS	[32]
Asperuloide C (Figure 34)	Galium maximowiczii (Kom.) Pobed.	Whole plant	South Korea	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, MS	[32]
Asperulosidyl-2'b-O- paederoside (Figure 4)	Paederia foetida L.	Aerial parts	China	SER, CC, sp-HPLC-UV, α _[D] , IR, NMR, HR-MS	[33]
Atropurpurin A (Figure 9)	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]

Atropurpurin B (Figure 9)	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]
Austrosmoside (Figure 23)	Osmanthus austrocaledonicus (Vieill.) Knobl.	Aerial parts	New Caledonia	DP, CC, CC, VLC, α _[D] , UV, NMR, HR-MS	[35]
Axillaroside (Figure 9)	Strychnos axillaris Colebr.	Bark and wood	Thailand	SER, PP, rp-MPLC, p-HPLC- UV, α[D], IR, NMR, HR-MS	[36]
Blumeoside B (Figure 8)	Fagraea blumei G.Don	Stem bark	Indonesia	SE, CC, CPC, HPLC-DAD, $\alpha_{(D)}$, IR, NMR, MS	[37]
Blumeoside D (Figure 8)	Fagraea blumei G.Don	Stem bark	Indonesia	SE, CC, CPC, HPLC-DAD, $\alpha_{\text{[D]}}$, IR, NMR, MS	[37]
Caeruleoside A (Figure 11)	Lonicera caerulea L.	Leaves	Japan	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, MS	[38]
Caeruleoside B (Figure 18)	Lonicera caerulea L.	Leaves	Japan	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, MS	[38]
	Cantleya corniculata (Becc.) R.A.Howard	n.a.	n.a.	n.a.	[39]
	Scabiosa japonica Miq.	Roots	Japan	HSE, PP, CC, MP, α _[D] , IR, UV, NMR	[40]
		Seeds	Denmark	SE, p-TLC, $\alpha_{[D]}$, UV, NMR	[41]
	Dipsacus fullonum L.	Leaves	Poland	USE, UHPLC-PDA-MS ⁿ	[42]
		Roots	Poland	USE, UHPLC-PDA-MS ⁿ	[42]
	Abelia grandiflora (Rovelli ex André) Rehder	Leaves	Japan	HSE, PP, ACT, CC, p-TLC, PLC, NMR	[22]
	Linnaea spathulata Graebn.	Leaves	Japan	SE, ACT, p-TLC, NMR	[22]
	Linnaea serrata Graebn.	Leaves	Japan	SE, ACT, p-TLC, NMR	[22]
	Scaevola montana Labill.	Aerial parts	New Caledonia	SE, CC, NMR	[43]
	Scaevola racemigera Däniker	Aerial parts	New Caledonia	SE, CC, NMR	[44]
	Dipsacus laciniatus L.	Roots	Hungary	SE, PP, CCD, CC, α _[D] , IR, UV, NMR	[45]
	<i>Cephalaria ambrosioides</i> (Sm.) Roem. & Schult.	Roots	Greece	SE, PP, CC, rp-CC, NMR	[46]
Cantleyoside (Figure 9)	<i>Lomelosia variifolia</i> (Boiss.) Greuter & Burdet	Flowering aerial parts	Greece	SE, VLC, rp-MPLC, NMR, MS	[47]
			China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, NMR	[48]
				SER, PP, CC, NMR	[49]
		Roots	China (purchased from a	SER, PP, MPLC, p-TLC, NMR	[50]
	Dipsacus inermis Wall.	Dried Roots	company) China (purchased from a company)	USE, HPLC-MS ⁿ	[51]
			China (different populations)	SE, CC, UHPLC-PDA, UHPLC-MS ⁿ	[52]
	Strychnos spinosa Lam.	Branches	Japan (cultivated)	HSE, PP, rp-MPLC, p-HPLC- UV, p-TLC, NMR	[53]
	Strychnos lucida R.Br.	Bark and wood	Thailand	HSE, PP, MPLC, rp-MPLC, p- HPLC-UV, NMR	[54]

	Strychnos axillaris Colebr.	Bark and wood	Thailand	SER, PP, rp-MPLC, p-HPLC-	[36]
	Pterocephalus pinardi Boiss.	Aerial parts	Turkey	SE, PP, rp-VLC, CC, MPLC, NMR	[55]
	<i>Cephalaria kotschyi</i> Boiss. & Hohen.	Dried roots	Azerbaijan	SE, FC, LPLC, NMR	[56]
	Cephalaria media Litv.	Dried roots	Azerbaijan	SE, CC, rp-CC, TLC, NMR	[57]
		Underground parts	Tibet	SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR	[58] [59]
		na	na	na	[60]
		11.0.	11.0.	SE PP CC rp-CC NMR	[61]
				SE, PP, HPLC-UV	[62]
			China	SER, CC, UPLC-PDA	[63]
	Pterocephalus hookeri			USE, UPLC-MS ⁿ	[64]
	(C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, p-HPLC-UV, p- TLC, NMR	[65]
			Tibet	SE, PP, CC, sp-HPLC-UV, NMR	[24]
			China (different populations)	USE, UPLC-MS ⁿ	[66]
	Pterocephalus nestorianus Nábelek	Roots	Iraq	DP, SE, PP, MPLC, p-TLC, NMR	[67]
		Roots		HSE, rp-CC, CC, NMR, MS	[68]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ	[34]
		Leaves	Tunisia	SE, DP, HPLC-MS ⁿ	[69]
	Scaevola montana Labill.	Aerial parts	New Caledonia	SE, CC, NMR	[43]
Cantleyoside dimethyl acetal	Pterocephalus pterocephalus (L.) Dörfl.	Aerial parts	Greece	SE, CC, rp-CC, $\alpha_{[D]}$, NMR, MS	[70]
(Figure 9)	Pterocephalus pinardi Boiss.	Aerial parts	Turkey	SE, PP, rp-VLC, CC, MPLC, NMR	[55]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]
Caryocanoside B (Figure 5)	<i>Caryopteris incana</i> (Thunb. ex Houtt.) Miq.	Whole plant	China	SE, PP, CC, p-TLC, α _[D] , IR, NMR, HR-MS	[10]
	<i>Centaurium erythraea</i> Rafn	n.a.	n.a.	n.a.	[71]
		Stems and leaves	Japan (purchased from a company)	SE, PP, VV, p-HPLC-UV, α _[D] , UV, NMR, HR-MS	[13]
Centauroside (Figure 21)			South Korea (different populations)	USE, HPLC-UV	
	<i>Lonicera japonica</i> Thunb.	Dried flowers	South Korea (different commercial samples)	USE, HPLC-UV	[72]
		Caulis	China (different populations)	USE, UFLC-MS ⁿ	[73]
		-	China (samples	USE, UFLC-MS ⁿ	

Flower buds Flower				
Flowers China (different USE, UFLC-MS* [73] China (samples [73] Flowers purchased USE, UFLC-MS* [73] Flowers purchased USE, UFLC-MS* [74] China (different companies) [74] China (different USE, UHPLC-MS* [74] Opplations) DP, SER, HPLC-MS* [74] China SER, HPLC-MS* [76] China USE, HPLC-DAD-MS* [75] China USE, HPLC-DAD-ELSD [77] China and Korea [78] (commercial samples) SE, HPLC-DAD-MS [79] Samples) n.a. [80] Flower buds China USE, HPLC-DAD-CL, HPLC-MS* (different USE, HPLC-DAD-MS [79] samples) n.a. [80] Flower buds China USE, HPLC-DAD-MS (different USE, HPLC-DAD-MS [79] (different USE, UPLC-MS* [71]		purchased		
Companies) China USE, UFLC-MS* populations) [73] Flowers purchased USE, UFLC-MS* purchased USE, UFLC-MS* from different companies) China (different (different USE, UHPLC-MS* (different USE, UHPLC-MS* (different USE, HPLC-DAD-MS* (different USE, HPLC-DAD-ELSD (different USE, HPLC-DAD-ELSD (commercial SER, HPLC-DAD-MS* samples) China China and Korea (commercial SE, HPLC-DAD-MS samples) ra. Flower buds China Flower buds China Flower buds China (different USE, HPLC-DAD-MS (different USE, HPLC-DAD-MS (commercial samples) China SE, HPLC-DAD-MS (different USE, HPLC-DAD-MS (commercial samples) populations) SE, HPLC-DAD-MS		from different		
Flowers basis Flowers		companies)		
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$Flower buds = \begin{cases} China & SER, HPLC-MS^{\circ} & [74] \\ DP, SER, HPLC-DAD-MS^{\circ} & [75] \\ SER, HPLC-DAD-MS^{\circ} & [76] \\ China \\ (different \\ cultivated \\ populations) \\ China & USE, HPLC-DAD-ELSD & [77] \\ (commercial \\ samples) \\ China and \\ Korea \\ (commercial \\ samples) \\ China & SE, HPLC-DAD, HPLC-MS & [78] \\ SE, HPLC-DAD, HPLC-MS & [79] \\ China and Korea \\ (commercial \\ samples) \\ China & SE, HPLC-DAD-CL, HPLC-MS & [79] \\ HSE, CC, p-HPLC-UV, NMR & [15] \\ USE, HPLC-DAD-CL, HPLC & [81] \\ USE, HPLC-DAD-CL, HPLC & [81] \\ USE, HPLC-DAD-CL, HPLC & [81] \\ USE, HPLC-DAD-MS^{\circ} & [17] \\ China & HSE, UHPLC-UV & [82] \\ (different & USE, UFLC-MS^{\circ} & [17] \\ China & USE, UFLC-MS^{\circ} & [17] \\ China & USE, UFLC-MS^{\circ} & [17] \\ China & USE, UFLC-MS^{\circ} & [16] \\ China & USE, UFLC-MS^{\circ} & [17] \\ China & USE, UFLC-MS^{\circ} & [19] \\ China & USE, UFLC-MS^{\circ} & [16] \\ China & USE, UFLC-MS^{\circ} & [73] \\ (purchased & USE, UFLC-MS^{\circ} & [73] \\ from different \\ company) & NMR & [16] \\ China & (samples \\ purchased & USE, UFLC-MS^{\circ} & [73] \\ from different \\ (cultivated) & USE, UFLC-MS^{\circ} & [73] \\ from different \\ companies) \\ China & (purchased \\ from a & USE, HPLC-UV & [72] \\ populations) \\ Leaves & China \\ (purchased \\ from a & USE, HPLC-DAD-MS^{\circ} & [86] \\ company) \\ China & USE, Tp-UHPLC-PDA-MS^{\circ} & [85] \\ \end{array}$		populations)	,	[-,]
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$Flower buds = \frac{populations}{China} = USE, HPLC-DAD-ELSD [77] (commercial samples) SE, HPLC-DAD, HPLC-MS [78] China and Korea (commercial samples) [79] China = SE, HPLC-DAD-MS [79] (commercial samples) [79] China = SE, HPLC-DAD-MS [79] China = USE, HPLC-DAD-MS [81] USE, HPLC-DAD-CL, HPLC- DAD-MSn [17] China = HSE, UHPLC-UV [82] (different = USE, HPLC-MSn [17] China = HSE, UHPLC-UV [82] (different = USE, UFLC-MSn [17] China = USE, UHPLC-UV [82] (different = USE, UFLC-MSn [19] China = USE, UHPLC-PDA [18] USE, UHPLC-PDA [18] (purchased = USE, 2D-HPLC-UV, [16] China = SE, PP, CC, sp-HPLC-UV, [16] China (samples purchased = USE, UFLC-MSn [73] from different = companies) China = (different = USE, HPLC-UV [72] populations) = China = (different = USE, HPLC-UV [72] populations) = China = (different = USE, HPLC-UV [72] populations) = China = (different = USE, HPLC-UV [72] populations) = China = (DSE, HPLC-UV [72] populations) = China = (DSE, HPLC-DAD-MSn [85] China = (purchased = USE, HPLC-UV [72] populations) = China = (DSE, HPLC-DAD-MSn [86] from a = (DSE, $		cultivated		
$Flower buds = \begin{cases} China & USE, HPLC-DAD-ELSD & [77] \\ (commercial samples) & SE, HPLC-DAD, HPLC-MS & [78] \\ China and Korea & SE, HPLC-DAD-MS & [79] \\ (commercial samples) & & & & & & & & & & & & & & & & & & &$		populations)		
$Flower buds = \begin{cases} (commercial samples) & SE, HPLC-DAD, HPLC-MS [78] \\ Samples) & SE, HPLC-DAD-MS [79] \\ (commercial samples) & SE, HPLC-DAD-MS [79] \\ (commercial samples) & SE, HPLC-DAD-MS [79] \\ (commercial samples) & SE, HPLC-DAD-MS [15] \\ USE, HPLC-DAD-CL, HPLC- DAD-MS^n [17] \\ China & USE, HPLC-MS^n [17] \\ China & HSE, UHPLC-UV [82] \\ (different USE, UFLC-MS^n [17] \\ populations) & SE, HPLC-PDA [18] \\ USE, UHPLC-MS^n [19] \\ China & USE, rp-UHPLC-PDA-MS^n [83] \\ (purchased USE, 2D-HPLC-UF, MS [84] \\ from a & SE, PP, CC, sp-HPLC-UV, \\ company) & NMR [16] \\ China \\ (samples \\ purchased USE, UFLC-MS^n [73] \\ from different \\ companies \\ China \\ (cultivated) & USE, UFLC-MS^n [73] \\ from different \\ companies \\ China \\ (purchased USE, UFLC-MS^n [73] \\ from different \\ companies \\ China \\ (purchased USE, UFLC-MS^n [85] \\ (cultivated) & USE, HPLC-UV [72] \\ populations) \\ Eaves \\ China \\ (purchased IUSE, HPLC-DAD-MS^n [86] \\ from a & USE, HPLC-DAD-MS^n [86] \\ from a & USE & HPLC-HPLC-PDA-MS^n [86] \\ from a & USE & HPLC-HPLC-HPLC-HDA \\ from a & USE & HPLC-HPLC-HDA \\ from a & USE & HPLC-HPLC$		China	USE, HPLC-DAD-ELSD	[77]
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$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		samples)		[. •]
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(commercial samples) Description [77] Flower buds China ISE, CC, p-HPLC-UV, NMR [15] USE, HPLC-DAD-CL, HPLC- DAD-MS ⁿ [81] ISE, HPLC-MS ⁿ [17] China HSE, UHPLC-UV [82] ISE, HPLC-MS ⁿ [17] China HSE, UHPLC-UV [82] ISE, HPLC-MS ⁿ [17] China HSE, UHPLC-UV [82] ISE, HPLC-MS ⁿ [17] China USE, UFLC-MS ⁿ [17] ISE		Korea	SF HPI C-DAD-MS	[79]
$\begin{tabular}{ c c c c c } \hline Samples & In.a. [80] \\ \hline Rel (15) \\ \hline China & Rel (15) \\ \hline China & Rel (15) \\ \hline USE, HPLC-DAD-CL, HPLC- \\ DAD-MS^n & [15] \\ \hline USE, HPLC-MS^n & [17] \\ \hline China & Rel (17) \\ \hline China & Rel ($		(commercial	ol, III LC DID Mo	[,]
$Flower buds = \frac{-n.a.}{Flower buds} = \frac{-n.a.}{Flowe$		samples)		
$\begin{array}{c c c c c c c } Flower buds & \begin{array}{c c c c c c } HSE, CC, p-HPLC-UV, NMR & [15] \\ USE, HPLC-DAD-CL, HPLC-DAD-CL, HPLC-DAD-MS^n & [81] \\ USE, HPLC-MS^n & [17] \\ China & USE, HPLC-UV & [82] \\ (different & USE, UFLC-MS^n & [73] \\ populations) & SE, HPLC-PDA & [18] \\ USE, UHPLC-MS^n & [19] \\ \hline \\ China & USE, rp-UHPLC-PDA-MS^n & [83] \\ (purchased & USE, 2D-HPLC-UF-MS & [84] \\ from a & SE, PP, CC, sp-HPLC-UV, \\ company) & NMR & [16] \\ \hline \\ China & (samples & ISE, UFLC-MS^n & [73] \\ from different & ISE, UFLC-MS^n & [73] \\ from different & ISE, UFLC-MS^n & [73] \\ from different & ISE, UPLC-MS^n & [85] \\ (cultivated) & USE, UFLC-MS^n & [85] \\ (cultivated) & USE, UFLC-MS^n & [85] \\ \hline \\ Leaves & \begin{array}{c} China & USE, HPLC-UV & [72] \\ populations) & ISE, HPLC-UV & [72] \\ populations & ISE, HPLC-DAD-MS^n & [86] \\ from a & China & USE, HPLC-DAD-MS^n & [86] \\ from a & ISE, HPLC-DAD-MS^n & [86] \\ \end{array}$			n.a.	[80]
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Flower buds DAD-MS ⁿ [81] USE, HPLC-MS ⁿ [17] China HSE, UHPLC-UV [82] (different USE, UFLC-MS ⁿ [73] populations) SE, HPLC-PDA [18] USE, UHPLC-MS ⁿ [73] populations) SE, HPLC-PDA [18] USE, UHPLC-MS ⁿ [19] China USE, 2D-HPLC-UF-MS [84] from a SE, PP, CC, sp-HPLC-UV, [16] China USE, UFLC-MS ⁿ [73] from different company) NMR [16] China USE, UFLC-MS ⁿ [73] from different companies) [73] from different uSE, UFLC-MS ⁿ [73] from different USE, UPLC-MS ⁿ [85] (cultivated) USE, UPLC-US ⁿ [85] Leaves China USE, HPLC-UV [72] populations) USE, HPLC-DAD-MS ⁿ [86] from a USE, HPLC-DAD-MS ⁿ [86] from a USE, TP-UHPLC-		China	USE, HPLC-DAD-CL, HPLC-	[01]
$\begin{array}{c cccc} & USE, HPLC-MS^n & [17]\\ China & HSE, UHPLC-UV & [82]\\ (different & USE, UFLC-MS^n & [73]\\ populations) & SE, HPLC-PDA & [18]\\ & USE, UHPLC-MS^n & [19]\\ \hline China & USE, rp-UHPLC-PDA-MS^n & [83]\\ (purchased & USE, 2D-HPLC-UF-MS & [84]\\ from a & SE, PP, CC, sp-HPLC-UV,\\ company) & NMR & [16]\\ \hline China & (samples & purchased & USE, UFLC-MS^n & [73]\\ from different & companies)\\ \hline China & USE, UFLC-MS^n & [73]\\ from different & companies)\\ \hline China & USE, UPLC-MS^n & [85]\\ (cultivated) & South Korea & (different & USE, HPLC-UV & [72]\\ populations) & China & (purchased & USE, HPLC-UV & [72]\\ populations) & China & (DSE, HPLC-UV & [72]\\ populations) & China & (DSE, HPLC-DAD-MS^n & [86]\\ from a & company) & China & USE, HPLC-DAD-MS^n & [83]\\ \hline \end{array}$	Flower buds		DAD-MS ⁿ	[81]
China HSE, UHPLC-UV [82] (different USE, UFLC-MS ⁿ [73] populations) SE, HPLC-PDA [18] USE, UHPLC-MS ⁿ [19] China USE, rp-UHPLC-PDA-MS ⁿ [83] (purchased USE, 2D-HPLC-UF-MS [84] from a SE, PP, CC, sp-HPLC-UV, [16] China (samples [16] China (samples [73] from different companies) [73] China USE, UFLC-MS ⁿ [73] from different companies) [73] China USE, UFLC-MS ⁿ [73] from different companies) [85] China USE, UPLC-MS ⁿ [85] (cultivated) USE, UPLC-MS ⁿ [85] Leaves China USE, HPLC-UV [72] populations) China USE, HPLC-DAD-MS ⁿ [86] from a company) USE, HPLC-PDA-MS ⁿ [83]			USE, HPLC-MS ⁿ	[17]
Initial Initial <thinitial< th=""> <th< td=""><td></td><td>China</td><td>HSE, UHPLC-UV</td><td>[82]</td></th<></thinitial<>		China	HSE, UHPLC-UV	[82]
initial conditional conditenal conditional conditional conditional cond		(different	USE, UFLC-MS ⁿ	[73]
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				[00]

		China	USE, UFLC-MS ⁿ	[73]
		(different	USE, UHPLC-MS ⁿ	[19]
		China		
		(cultivated)	USE, UPLC-MS ⁿ	[85]
	Aerial parts	China	USE, UHPLC-MS ⁿ	[20]
	1	(cultivated)		
	Roots	(cultivated)	USE, UHPLC-MS ⁿ	[20]
		China	USE, rp-UHPLC-PDA-MS ⁿ	[83]
	Stoms	China		
	otenis	(different	USE, UHPLC-MS ⁿ	[19]
		populations)		
	Branches	China	USE, UPLC-MS ⁿ	[85]
		(cultivated)	,	
	Fruits	(cultivated)	USE, UPLC-MS ⁿ	[85]
Kissenia capensis Endl.	Aerial parts	Namibia	SE, PP, CC, rp-CC, sp-rp- HPLC-UV, NMR, MS	[87]
Charlen	Dura da es	Japan	HSE, PP, rp-MPLC, p-HPLC-	[[2]]
Strychnos spinosa Lam.	Branches	(cultivated)	UV, p-TLC, NMR	[53]
		China		
	Flower buds	(different	USE, HPLC-DAD-ELSD	[77]
		cultivated		[,,]
		populations)		
		China	DP, SER, HPLC-DAD-MS ⁿ	[75]
		China		[7/]
Louisera confuca DC		(different	SER, HPLC-MS	[76]
Lonicera conjusa DC.		South Koroa		
		(different	USE, HPLC-UV	[72]
		populations)		[. –]
	Dried flowers	South Korea		
		(different		[72]
		commercial	USE, HILC-UV	[72]
		samples)		
	Aerial parts	China	USE, UHPLC-MS ⁿ	[20]
Lonicera ferdinandi	1	(cultivated)	· · · -	
Franch.	Roots	China (gultivatod)	USE, UHPLC-MS ⁿ	[20]
		(current)		
		(different		
		cultivated	USE, HPLC-DAD-ELSD	[77]
Lonicera hypoglauca Miq.	Flower buds	populations)		
			DP, SER, HPLC-DAD-MS ⁿ	[75]
		China	SER, HPLC-MS	[76]
		China		-
Louicera macrantha		(different	LISE HPLC-DAD-FLSD	[77]
		cultivated		[, ,]
Spreng.	Flower buds	populations)		
·r0'		China	DP, SER, HPLC-DAD-MS ⁿ	[75]
		(different	SER, HPLC-MS	[76]
Louisons		populations)	HSE, UHPLC-UV	[82]
Lonicera maackii (Kupr.)	Aerial parts	(cultivated)	USE, UHPLC-MS ⁿ	[20]
τνταλ1111.		(cunvaled)		

		Roots	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
	Lonicera maximowiczii	Aerial parts	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
	(Fr.Schmidt) Nedol.	Roots	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
	Lonicera praeflorens	Aerial parts	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
	Batalin	Roots	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
	<i>Lonicera rupicola</i> var. <i>syringantha</i> (Maxim.) Zabel	Flower buds	China	SER, HPLC-MS	[76]
	<i>Lonicera similis</i> Hemsl. ex F.B.Forbes & Hemsl.	Flower buds	China	SER, HPLC-MS	[76]
	Triosteum pinnatifidum Maxim.	Roots	China	SER, PP, CC, NMR	[88]
	<i>Gentianella amarella</i> subsp. <i>acuta</i> (Michx.) J.M.Gillett	Whole plant	China	SER, PP, CC, p-HPLC-UV, NMR	[89]
	Lonicera morrowii A.Gray_	Roots	South Korea (obtained from a botanical garden)	USE, PP, CC, p-HPLC-UV, NMR	[20]
	_	Aerial parts	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
		Roots	China (cultivated)	USE, UHPLC-MS ⁿ	[20]
Centauroside A (Figure 21)	<i>Centaurium erythraea</i> Rafn	Whole plant	Turkey	SE, CC, rp-FC, α _[D] , IR, UV, NMR, HR-MS	[90]
Chrysathain (Figure 22)	<i>Lonicera chrysantha</i> Turcz. ex Ledeb.	Leaves	China	SE, CC, $\alpha_{[D]}$, NMR, HR-MS	[91]
Citrifolinin A-1 (Figure 6)	Morinda citrifolia L.	Leaves	India	HSE, PP, CC, rp-CC, NMR, MS	[92]
	Strychnos cocculoides Baker	Stem bark	Tanzania	SE, VLC, CC, α _[D] , IR, UV, NMR, MS	[93]
Cocculoside (Figure 9)	Dipsacus inermis Wall.	Roots	China (purchased from a local market)	SE, PP, CC, rp-CC, sp-HPLC- UV, NMR	[94]
Coelobillardin (Figure 8)	Coelospermum balansanum Baill.	Aerial parts	New Caledonia	SE, CC, MPLC, α _[D] , IR, UV, NMR, HR-MS	[95]
Coptosapside A (Figure 31)	<i>Coptosapelta diffusa</i> (Champ. ex Benth.) Steenis	Aerial parts	China	SE, PP, MPLC, CC, α _[D] , IR, UV, NMR, HR-MS	[96]
Coptosapside D (Figure 14)	Coptosapelta diffusa (Champ. ex Benth.) Steenis	Aerial parts	China	SE, PP, MPLC, CC, α _{IDI} , IR, UV, NMR, HR-MS	[96]
Coptosapside E (Figure 14)	Coptosapelta diffusa (Champ. ex Benth.) Steenis	Aerial parts	China	SE, PP, MPLC, CC, α _[D] , IR, UV, NMR, HR-MS	[96]
Coptosapside F (Figure 14)	Coptosapelta diffusa (Champ. ex Benth.) Steenis	Aerial parts	China	SE, PP, MPLC, CC, α _(D) , IR, UV, NMR, HR-MS	[96]

Cornuofficinaliside C (Figure	Cornus officinalis Siebold	Fruits	China	SE, CC, PP, sp-HPLC-UV, $\alpha_{[D]}$,	[97]
13)	& Zucc.	1 fulls	Cimit	IR, UV, NMR, HR-MS	[,,]
Cornuofficinaliside D (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside E (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside F (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside G (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside H (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside I (Figure 13)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside J (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside K (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside L (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
Cornuofficinaliside M (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]
			China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
Cornusdiridoid A (Figure 25)	Cornus officinalis Siebold & Zucc.	Fruits	China (purchased from a local market)	SER, PP, CC, sp-HPLC-UV, NMR	[99]
Cornusdiridoid B (Figure 25)	Cornus officinalis Siebold & Zucc.	Fruits	China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
Cornusdiridoid C (Figure 25)	Cornus officinalis Siebold & Zucc.	Fruits	China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
Cornusdiridoid D (Figure 25)	Cornus officinalis Siebold & Zucc.	Fruits	China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
Cornusdiridoid E (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
Cornusdiridoid F (Figure 26)	Cornus officinalis Siebold & Zucc.	Fruits	China	HSE, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[98]
			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Comusido A (Figure 24)	Cornus officinalis Siebold	Emito	China (purchased from a local market)	SER, PP, CC, sp-HPLC-UV, NMR	[100]
Cornuside A (Figure 24)	& Zucc.	rtuits	China (different populations purchased from a company)	HSE, UHPLC-MS ⁿ	[101]
Cornuside B (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside C (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside D (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]

			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV NMR HR-MS	[99]
Correction E (Eiseure 24)	Cornus officinalis Siebold	Emilia	China (purchased from a local market)	SER, PP, CC, sp-HPLC-UV, NMR	[100]
Cornuside E (Figure 24)	& Zucc.	Fruits	China (different populations purchased from a company)	HSE, UHPLC-MS ⁿ	[101]
Cornuside F (Figure 24)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside G (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside H (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside I (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside J (Figure 24)	Cornus officinalis Siebold & Zucc.	Fruits	China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside K (Figure 24)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China (purchased from a local market)	SER, PP, CC, sp-HPLC-UV, NMR	[100]
			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside L (Figure 12)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China (different populations purchased from a company)	HSE, UHPLC-MS ⁿ	[101]
			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside M (Figure 12)	Cornus officinalis Siebold & Zucc.	Fruits	China (different populations purchased from a company)	HSE, UHPLC-MS ⁿ	[101]
			China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[99]
Cornuside N (Figure 12)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China (different populations purchased from a company)	HSE, UHPLC-MS ⁿ	[101]
	Cornus officinalis Siebold		China	SER, CC, p-HPLC-UV, α _[D] , IR, UV, NMR. HR-MS	[99]
Cornuside O (Figure 12)	& Zucc.	Fruits	China	SE, CC, PP, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[97]

Craigoside B (Figure 22)	Jasminum abyssinicum	Root bark	Congo	SE, PP, CCD, $\alpha_{\text{[D]}}$, UV, CD,	[102]
Craigoside C (Figure 22)	Jasminum abyssinicum	Root bark	Congo	NMR, HR-MS SE, PP, CCD, α _[D] , UV, CD, NMR HR-MS	[102]
Demethyl-hydroxy- oleonuezhenide	Syringa vulgaris L.	Flowers	Poland	HSE, CC, p-HPLC-UV, $\alpha_{[D]}$, UV, NMR, HR-MS	[103]
Demethyl-oleonuezhenide	Syringa vulgaris L.	Flowers	Poland	HSE, CC, p-HPLC-UV, α[D], UV, NMR, HR-MS	[103]
Depresteroside (Figure 10)	<i>Gentiana depressa</i> D.Don	Aerial parts	Nepal	DP, SE, PP, CC, CCTLC, UV, NMR, MS ⁿ	[104]
Dioscoridin C (Figure 5)	Valeriana italica Lam.	Roots	Turkey	HSE, PP, CC, MPLC, α _[D] , IR, UV, NMR, HR-MS	[105]
Dipsanoside C (Figure 10)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[48]
Dipsanoside D (Figure 10)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[48]
Dipsanoside E (Figure 10)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[48]
Dipsanoside F (Figure 11)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[48]
Dipsanoside G (Figure 31)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[48]
Dipsanoside J (Figure 10)	Dipsacus inermis Wall.	Dried roots	China	HSE, PP, CC, p-TLC, p-rp- HPLC-UV, α _[D] , IR, NMR, HR- MS	[106]
Dipsanoside M (Figure 11)	Dipsacus inermis Wall.	Dried roots	China	SER, CC, rp-CC, rp-FC, p- HPLC-UV, α[D], IR, UV, NMR, HR-MS	[107]
Dipsanoside N (Figure 11)	Dipsacus inermis Wall.	Dried roots	China	SER, CC, rp-CC, rp-FC, p- HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[107]
Dipsaperine (Figure 11)	Dipsacus inermis Wall.	Roots	China (purchased	SE, PP, CC, rp-CC, sp-HPLC- UV, α[D], IR, UV, ECD, NMR, HR-MS	[94]
			market)	SER, PP, MPLC, p-HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[108]
Disperoside A (Figure 7)	Gardenia jasminoides J.Ellis	Fruits	China	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[109]
Disperoside B (Figure 7)	Gardenia jasminoides J.Ellis	Fruits	China	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[109]
Floribundal (Figure 28)	Scaevola floribunda A.Gray	Heartwood	Japan	SXE, PP, VLC, MP, α _[D] , IR, UV, NMR, MS	[110]
Fraximalacoside (Figure 18)	Fraxinus malacophylla Hemsl.	Leaves	China (obtained from a botanical garden)	HSE, PP, CC, HPLC-UV, α _{IDI} , IR, UV, NMR, MS	[111]
	Fraxinus mandshurica Rupr.	Whole plant	China (different populations)	USE, HPLC-DAD, UPLC-MS	[112]
GI-3 (Figure 17)	Fraxinus americana L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{[D]}$, TLC	[113]

		Leaves		SE, CC, TLC, IR, UV, NMR	[114]
			USA	SE, PP, CC, MP, $\alpha_{[D]}$, TLC	[113]
	Fraxinus excelsior L.	Seeds	Morocco	HSE, PP, CC, HPLC-UV, NMR	[115]
	Fraxinus ornus L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{\text{[D]}}$, TLC	[113]
	Fraxinus pennsylvanica Marshall	Seeds	USA	SE, PP, CC, MP, $\alpha_{[D]}$, TLC	[113]
	Olea europaea L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{[D]}$, TLC	[113]
	Syringa vulgaris L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{\text{[D]}}$, TLC	[113]
		Duis d fourits		SE, PP, CC, p-HPLC-UV, NMR	[116]
	Lioustana lusidum	Dried mults		SER, PP, CC, NMR	[117]
	W T Aiton		China	USE, UHPLC-MS ⁿ	[118]
	W.I.Alton	Fruits		SER, PP, CC, p-HPLC-UV, MP, α _[D] , IR, UV, NMR, HR- MS	[119]
	Osmanthus fragrans Lour.	Seeds	China	SE, PP, CC, NMR	[120]
	Ligustrum japonicum	Fruits	South Korea	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[121]
	Thunb.	Dried fruits	South Korea	SE, PP, CC, rp-HPLC-UV, NMR, MS	[122]
	Fraxinus mandshurica Rupr.	Seeds	China (purchased from a	SE, PP, CC, HPLC-DAD, NMR	[123]
		Carla	company)		[110]
	Fraxinus americana L.	Leaves	- USA	SE, CC, TLC, IR, UV, NMR	[113] [114]
			USA	SE, PP, CC, MP, $\alpha_{\text{[D]}}$, TLC	[113]
	Fraxinus excelsior L.	Seeds	Morocco	HSE, PP, CC, HPLC-UV, NMR	[115]
	Fraxinus ornus L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{\text{[D]}}$, TLC	[113]
	Fraxinus pennsylvanica Marshall	Seeds	USA	SE, PP, CC, MP, $\alpha_{\text{[D]}}$, TLC	[113]
GI-5 (Figure 17)	Olea europaea L.	Seeds	USA	SE, PP, CC, MP, $\alpha_{[D]}$, TLC	[113]
	Syringa vulgaris L.	Seeds	USA	SE, PP, CC, MP, α ^[D] , TLC	[113]
	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-HPLC, α _[D] , IR, UV, NMR, HR-MS	[124]
	Fraxinus mandshurica Rupr.	Seeds	China (purchased from a company)	SE, PP, CC, HPLC-DAD, NMR	[123]
	Globularia trichosantha Fisch. & C.A.Mey.	Underground parts	Turkey	HSE, PP, rp-VLC, CC, MPLC, $\alpha_{(D)}$, IR, NMR, MS	[125]
	Globularia meridionalis (Podp.) O.Schwarz	Aerial parts	Italy	SE, PP, CC, NMR	[126]
Globuloside A (Figure 7)		Aerial parts	Croatia	SER, HPLC-PDA, HPLC- PDA-MS ⁿ	[127]
	Giovularia alypum L.	Leaves	Croatia	USE, HPLC-PDA-MS ⁿ SXE, HPLC-PDA-MS ⁿ	[128]
Clabulacida P (Figure ()	Globularia trichosantha Fisch. & C.A.Mey.	Underground parts	Turkey	HSE, PP, rp-VLC, CC, MPLC, $\alpha_{(D)}$, IR, UV, NMR, MS	[125]
Gioduloside B (Figure 6)	Globularia meridionalis (Podp.) O.Schwarz	Aerial parts	Italy	SE, PP, CC, NMR	[126]

Globuloside C (Figure 11)	Globularia cordifolia L.	Roots and	Turkey	HSE, PP, VLC, MPLC, CC,	[129]
Hookerinoid A (Figure 28)	Pterocephalus hookeri	rhizomes Underground	China	α[D], IR, UV, NMR, HR-MS SER, PP, CC, sp-HPLC-UV,	[130]
	(C.B.Clarke) E.Pritz. Pterocevhalus hookeri	parts Underground		α _[D] , IR, UV, NMR, HR-MS SER, PP, CC, sp-HPLC-UV,	
Hookerinoid B (Figure 28)	(C.B.Clarke) E.Pritz.	parts	China	$\alpha_{\rm [D]}$, IR, UV, NMR, HR-MS	[130]
Hydroxy-oleonuezhenide	Syringa vulgaris L.	Flowers	Poland	HSE, CC, p-HPLC-UV, α _[D] , UV, NMR, HR-MS	[103]
Ilicifolioside A (Figure 19)	Osmanthus heterophyllus (G.Don) P.S.Green	Leaves	Japan	SE, PP, CC, p-HPLC-UV, α _[D] , UV, NMR, HR-MS	[131]
Ilicifolioside B (Figure 22)	Osmanthus heterophyllus (G.Don) P.S.Green	Leaves	Japan	SE, PP, CC, p-HPLC-UV, α_{D} , UV, NMR, HR-MS	[131]
Incaside (Figure 29)	Mussaenda incana Wall.	Stem bark	n.a.	n.a.	[132]
Iridolinarin A (Figure 29)	Linaria japonica Miq.	Whole plant	Japan	SE, PP, CC, $\alpha_{[D]}$, IR, UV, NMR, HR-MS	[133]
Iridolinarin B (Figure 33)	Linaria japonica Miq.	Whole plant	Japan	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[133]
Iridolinarin C (Figure 29)	Linaria japonica Miq.	Whole plant	Japan	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[133]
	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[134]
Iso-jaspolyoside A (Figure 17)) Olea europaea L.	Wood	Spain	SER, CC, rp-HPLC-DAD, NMR	[135]
			Spain (different populations)	SE, HPLC-DAD, HPLC-DAD- MS	[136]
<i>Iso-</i> jaspolyoside B (Figure 18)	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[134]
Iso-jaspolyoside C (Figure 18)	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[134]
	Ligustrum lucidum W.T.Aiton	Dried fruits	China	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[116]
la oloopuzhonido (Fizuro 15)	Ligustrum japonicum Thunb.	Fruits	South Korea	SER, PP, CC, rp-CC, α _[D] , IR, UV, NMR, HR-MS	[121]
iso-oleonuzienide (rigure 15)	Fraxinus mandshurica Rupr.	Seeds	China (purchased from a company)	SE, PP, CC, HPLC-DAD, NMR	[123]
Japonicoside E (Figure 33)	Lonicera japonica Thunb.	Flower buds	China (purchased from a company)	SER, CC, p-HPLC-UV, sp- HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[137]
Jasmigeniposide B (Figure 1)	Gardenia jasminoides J.Ellis	Fruits	China (purchased from a company)	SER, PP, CC, rp-HPLC-UV, a[d], IR, UV, NMR, HR-MS	[138]
Jasnervoside F (Figure 20)	Jasminum nervosum Lour.	Stems	China (purchased from a local market)	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[139]

Jasnudifloside D (Figure 14)	Jasminum nudiflorum Lindl.	Stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[140]
Jasnudifloside E (Figure 14)	Jasminum nudiflorum Lindl.	Stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[140]
Jasnudifloside H (Figure 14)	Jasminum nudiflorum Lindl.	Leaves	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[141]
Jasnudifloside L (Figure 14)	Jasminum nudiflorum Lindl.	Leaves	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[141]
	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[134]
	Olea europaea L.	Wood	Spain	SER, CC, rp-HPLC-DAD, NMR	[135]
Jaspolyanoside (Figure 23)			Spain (different populations)	SE, HPLC-DAD, HPLC-DAD- MS	[136]
	Syringa oblata subsp. dilatata (Nakai) P.S.Green & M.C.Chang	Twigs	South Korea	SE, PP, CC, rp-CC, rp-HPLC- UV, NMR	[142]
	Fraxinus mandshurica Rupr.	Seeds	China (purchased from a company)	SE, PP, CC, HPLC-DAD, NMR	[123]
	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-HPLC-UV, α_{D} , IR, UV, NMR, HR-MS	[124]
Jaspolyanthoside (Figure 22)	Jasminum nervosum Lour.	Stems	China (purchased from a local market)	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[139]
	Jasminum grandiflorum subsp. floribundum (R.Br. ex Fresen.) P.S.Green	Aerial parts	Saudi Arabia	USE, PP, HPLC-DAD, UPLC- HR-MS	[143]
Jaspolyosida (Eigura 22)	Jasminum polyanthum Franch.	Flowers	China (purchased from a company)	HSE, PP, CC, p-HPLC, α _{ID} , IR, UV, NMR, HR-MS	[124]
Jaspolyoside (Figure 23)	<i>Syringa reticulata</i> (Blume) H.Hara	Bark	China	SE, PP, CC, rp-CC, NMR	[144]
	Olea europaea L.	Wood	Spain	SER, CC, rp-HPLC-DAD, NMR	[135]

			Spain (different	SE, HPLC-DAD, HPLC-DAD- MS	[136]
	Syringa oblata subsp. dilatata (Nakai) P.S.Green & M.C.Chang	Twigs	South Korea	SE, PP, CC, rp-CC, rp-HPLC- UV, NMR	[142]
	Jasminum urophyllum Hemsl.	Whole plant	Taiwan	SE, PP, CC, CPC, p-TLC, α _[D] , IR, UV, NMR, MS	[145]
Jasuroside A (Figure 20)	Jasminum nudiflorum Lindl.	Leaves and stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, α _{IDI} , IR, UV, NMR, HR-MS	[146]
	Jasminum urophyllum Hemsl.	Whole plant	Taiwan	SE, PP, CC, CPC, p-TLC, α _[D] , IR, UV, NMR, MS	[145]
Jasuroside C (Figure 20)	Jasminum nudiflorum Lindl.	Leaves and stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, α _{IDI} , IR, UV, NMR, HR-MS	[146]
Jasuroside G (Figure 20)	Jasminum urophyllum Hemsl.	Leaves and stems	Taiwan	SE, PP, CC, rp-CC, α _[D] , IR, UV, NMR, MS	[147]
	<i>Kickxia commutata</i> (Bernh. ex Rchb.) Fritsch	Flowering aerial parts	Bulgaria	SE, ACT, CC, $\alpha_{[D]}$, NMR	[148]
Kickxin (Figure 1)	<i>Kickxia elatine</i> (L.) Dumort.	Flowering aerial parts	Bulgaria	SE, ACT, CC, $\alpha_{[D]}$, NMR	[148]
	<i>Kickxia spuria</i> (L.) Dumort.	Flowering aerial parts	Bulgaria	SE, ACT, CC, $\alpha_{[D]}$, NMR	[148]
Korolkoside (Figure 17)	Lonicera korolkowii Stapf	Aerial parts	Japan (purchased from a company)	SE, PP, CC, rp-HPLC-UV, α[D], NMR, HR-MS	[149]
	Lonicera japonica Thunb.	n.a.	n.a.	n.a.	[150]
Kurdnestorianoside (Figure 11)	Pterocephalus nestorianus Nábelek	Flowers	Iraq	DP, SE, MPLC, α _[D] , IR, UV, NMR, HR-MS	[67]
	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α _[D] , IR, UV, NMR	[45]
	<i>Cephalaria scoparia</i> Contandr. & Quézel	Whole plant	Turkey	SE, PP, rp-MPLC, MPLC, NMR	[151]
	Cephalaria gazipashensis Sümbül	Aerial parts	Turkey	SE, PP, DF, rp-VLC, CC, MPLC, NMR	[152]
Laciniatoside I (Figure 31)		Underground parts	Tibet	SER, PP, CC rp-CC, NMR	[58]
	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, TLC, sp-HPLC-MS, NMR	[59]
		n.a.	n.a.	n.a.	[60]
		Whole plant	China	USE, UPLC-MS ⁿ	[64]
	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α[D], IR, UV, NMR	[45]
Laciniatoside II (Figure 30)	<i>Linnaea chinensis</i> A.Braun & Vatke	Aerial parts	Italy	SE, PP, CC, NMR	[11]
Eachilatoside II (Figure 50)	Dipsacus ferox Loisel.	Leaves and branches	Italy	SE, CC, NMR	[153]
	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, CC rp-CC, NMR	[58]

		Underground parts	Tibet	SER, PP, TLC, sp-HPLC-MS, NMR	[59]
		n.a.	n.a.	n.a.	[60]
			China	SE, PP, HPLC-UV	[62]
		Whole plant	Clinia	USE, UPLC-MS ⁿ	[64]
		·······	Tibet	SE, PP, CC, sp-HPLC-UV, NMR	[24]
	Handroanthus impetiginosus (Mart. ex DC.) Mattos	Leaves	Egypt (obtained from a botanical garden)	PE, PP, HPLC-MS ⁿ	[154]
Laciniatoside III (Figure 29)	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α _[D] , IR, UV, NMR	[45]
Laciniatoside IV (Figure 30)	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α _[D] , IR, UV, NMR	[45]
		Flowering aerial parts	TT	SE, CC, CCC, α _[D] , IR, UV, NMR	[155]
	Dipsacus iaciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, $\alpha_{[D]}$, IR, UV, NMR	[45]
	Cephalaria balansae Raus	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	Cephalaria elmaliensis HubMor. & V.A.Matthews	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
Laciniatoside V (Figure 30)	Cephalaria isaurica V.A.Matthews	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	<i>Cephalaria scoparia</i> Contandr. & Quézel	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	Cephalaria speciosa Boiss. & Kotschy	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	Cephalaria stellipilis Boiss.	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	Cephalaria sumbuliana Göktürk	Whole plant	Turkey	USE, PP, HPLC-MS ⁿ	[156]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]
Lasianoside G (Figure 4)	Lasianthus verticillatus (Lour.) Merr.	Levaes	Japan	SE, PP, rp-CC, HPLC-UV, α[D], IR, UV, NMR, MS	[157]
Lasianoside H (Figure 5)	Lasianthus verticillatus (Lour.) Merr.	Levaes	Japan	SE, PP, rp-CC, HPLC-UV, α _[D] , IR, UV, NMR, MS	[157]
Lasianoside I (Figure 5)	Lasianthus verticillatus (Lour.) Merr.	Levaes	Japan	SE, PP, rp-CC, HPLC-UV, α _[D] , IR, UV, NMR, MS	[157]
Liguside A (Figure 20)	Ligustrum lucidum W.T.Aiton	Fruits	China	SER, PP, CC, p-HPLC-UV, MP, α _[D] , IR, UV, NMR, HR- MS	[119]
	Ligustrum lucidum W.T.Aiton	Fruits	China	SER, PP, CC, p-HPLC-UV, MP, α[D], IR, UV, NMR, HR- MS	[119]
Liguside B (Figure 20)	<i>llex pubescens</i> Hook. & Arn.	Roots	China (purchased from a company)	SE, PP, CC, rp-HPLC-UV, NMR, HR-MS	[158]
Ligustrinoside (Figure 1)	Strychnos lucida R.Br.	Wood	Indonesia	SE, PP, CC, MPLC, α _[D] , IR, UV, NMR, MS	[159]
Lisianthoside (Figure 23)	<i>Lisianthius jefensis</i> A.Robyns & T.S.Elias	n.r.	n.r.	SE, CC, sp-HPLC-UV, NMR	[160]

	Dipsacus inermis Wall.	Roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, NMR	[48]
Loasafolioside (Figure 30)	Loasa acerifolia Dombey ex A.Juss.	Leaves	Germany (obtained from a botanical garden)	SXE, PP, CC, sp-HPLC-UV, α[D], IR, UV, NMR, MS	[161]
Longifloroside (Figure 3)	<i>Pedicularis longiflora</i> Rudolph	Whole plant	China	SE, SER, DP, PP, CC, NMR, MS	[162]
Minutifloroside (Figure 6)	Palicourea minutiflora (Müll.Arg.) C.M.Taylor	Leaves and branches	Brazil	SE, PP, CC, $\alpha_{\text{[D]}}$, NMR, HR-MS	[163]
Molihuaside A (Figure 16)	Jasminum sambac (L.) Aiton	Flowers	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, MS	[164]
	<i>Jasminum flexile</i> Vahl	Aerial parts	India	SE, PP, CC, p-TLC, NMR, MS	[165]
Molihuaside C (Figure 16)	Jasminum sambac (L.) Aiton	Flowers	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, MS	[164]
Molihuaside D (Figure 16)	Jasminum sambac (L.)	Flowers	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, MS	[164]
	$\frac{Jasminum flexile Vahl}{Jasminum sambac (L.)} Aerial parts India SE, PP, CC, p-TLC, NMR, MS [165] [Jasminum sambac (L.) Aiton Flowers China SER, PP, CC, rp-CC, MP, \alpha_{[D]}, IR, UV, NMR, MS [164]P (Figure 16) Jasminum sambac (L.) Aiton Flowers China Aiton Eaves and stems Taiwan SE, PP, CC, rp-CC, MP, \alpha_{[D]}, IR, UV, NMR, MS [164]P (Figure 16) Jasminum sambac (L.) Aiton Flowers China Aiton SER, PP, CC, p-TLC, \alpha_{[D]}, NMR [166] SER, PP, CC, rp-CC, MP, \alpha_{[D]}, IR, UV, NMR, MS [164]P (Figure 16) Jasminum sambac (L.) Aiton Flowers China SER, PP, CC, p-TLC, \alpha_{[D]}, NMR [166] IR, UV, NMR, MS [164] IR, UV, NMR, MS [165] IR, UV, NMR, HR-MS [167] IR, UV, NMR, HR-MS [167] Cornus officinalis Siebold & Fruits China SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] Cornus officinalis Siebold & Fruits China China China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]}, IR, UV, NMR, HR-MS [167] China (purchased SER, PP, CC, sp-HPLC-UV, \alpha_{[D]} [100] $				
Molihuaside E (Figure 16)	Jasminum sambac (L.) Aiton	Flowers	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, MS	[164]
Neo-cornuside C (Figure 12)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China	SER, PP, CC, sp-HPLC-UV, α[d], IR, UV, NMR, HR-MS	[167]
Neo-cornuside D (Figure 23)	<i>Cornus officinalis</i> Siebold & Zucc.	Fruits	China	SER, PP, CC, sp-HPLC-UV, α[d], IR, UV, NMR, HR-MS	[167]
<i>Neo</i> -cornuside F (Figure 23)	Cornus officinalis Siebold & Zucc.	Fruits	China (purchased from a local market)	SER, PP, CC, sp-HPLC-UV, a[d], IR, UV, NMR, HR-MS	[100]
<i>Neo</i> -polyanoside (Figure 15)	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α[D], IR, UV, NMR, HR- MS	[168]
Nudifloside A (Figure 14)	Jasminum nudiflorum Lindl.	Stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[140]
Nudifloside B (Figure 14)	Jasminum nudiflorum Lindl.	Stems	Japan (obtained from a botanical garden)	HSE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[140]
Officinaloside A (Figure 21)	Cornus officinalis Siebold & Zucc.	Twigs	China	SE, PP, CC, rp-CC, HPLC-UV, $\alpha_{[D]}$, IR, UV, NMR, HR-MS	[169]
Oleoneonuezhenide	Syringa vulgaris L.	Bark	Poland	HSE, HPLC-DAD-MS ⁿ	[170]
Oleonuozhonido (Figure 15)	Ligustrum japonicum Thunb.	Fruits	Japan (purchased from a company)	SE, PP, CC, rp-CC, α _[D] , IR, UV, NMR, MS	[171]
Oleonuezneniae (Figure 15)		Leaves	South Korea	USE, PP, CC, rp-CC, sp- HPLC-UV, NMR	[172]
	Ligustrum obtusifolium Siebold & Zucc.	Leaves	n.a.	n.a.	[173]

				SER, PP, CC, p-HPLC-UV,	
		Fruits	China	MP, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-	[119]
			. Crimia	MS	
				SE, PP, CC, NMR	[116]
	Ligustrum lucidum		n.a.	n.a.	[174]
	W.T.Aiton	Dried fruits	China	USE, UHPLC-MS ⁿ	[113]
			China		
			(purchased	SE, CC, HPLC-DAD, HPLC-	[4 - -]
			from a	MS	[175]
			company)		
			China		
	ller nubescens Hook &		(purchased	SE PP CC rp-HPI C-UV	
	Arn	Roots	from a	NMR HR MS	[158]
	AIII,		(company)		
	Caurings shlats subor		company)		
	Syringu obiutu subsp.	Territore	Courth Konne	SE, PP, CC, rp-CC, rp-HPLC-	[140]
		Twigs	South Korea	UV, NMR	[142]
	P.S.Green & M.C.Chang				
	Ligustrum japonicum Thunb.	Dried fruits	South Korea	SE, PP, CC, rp-HPLC-UV, NMR, MS	[122]
		Flowers		HSE, CC, p-HPLC-UV, α _[D] , UV, NMR, HR-MS	[103]
	Syringa vulgaris L.	Whole plant	Poland	HSE, HPLC-DAD-MS ⁿ	[176]
	-	Bark	•	HSE, HPLC-DAD-MS ⁿ	[170]
		na	na	na.	[177]
	-	1101	China		[1, ,]
			(purchased	SF PP CC p-HPI C-UV	
Paederoscandoside (Figure 3)	Paederia foetida L.	Stems	from a	NMR	[178]
	-		company)	I VIVIIX	
		Aorial parts	China	SER CC on HPLC UV NMR	[33]
		Aeriai parts	Clilla	SER, CC, Sp-TH EC-0V, NNK	[55]
	-	Stems		SE, PP, CC, PP-CC, HPLC-UV,	[179]
		1471 1 1 .	China	$\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[100]
		whole plant	~	SER, PP, HPLC-MS ⁿ , HR-MS ⁿ	[180]
Paederoside B (Figure 7)	Paeaeria foetiaa L.	Stems	China		
			(purchased	SE, PP, CC, HPLC-MS	[178]
			from a	-,,,,	
			company)		
Patriscabiobisin A (Figure 34)	Patrinia scabiosifolia Link	Whole plant	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$,	[181]
	5	1		IR, UV, NMR, HR-MS	
Patriscabiobisin B (Figure 34)	Patrinia scabiosifolia Link	Whole plant	China	SE, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$,	[181]
		······ P·····		IR, UV, NMR, HR-MS	[]
				SE, PP, CC, sp-HPLC-UV, α_{D} ,	[181]
Patriscabiobisin C (Figure 27)	Patrinia scapiosifolia Link	Whole plant	China	IR, UV, NMR, HR-MS	[101]
i attiseabiobisiit e (i iguie 27)	1 utrititu seuotosijottu Ellik	whole plant	Clillia	SE, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$,	[182]
				IR, UV, NMR, HR-MS	[102]
Phylottopido A (Eiguno 22)	Gynochthodes umbellata	Logues	Thailand	SE, CC, p-HPLC-UV, $\alpha_{[D]}$, IR,	[102]
Flukettoside A (Figure 55)	(L.) Razafim. & B.Bremer	Leaves	Indiana	UV, NMR, HR-MS	[105]
Physical and P (Eissure 22)	Gynochthodes umbellata	I	The:1	SE, CC, p-HPLC-UV, α _[D] , IR,	[100]
Phukettoside B (Figure 33)	(L.) Razafim. & B.Bremer	Leaves	Thalland	UV, NMR, HR-MS	[165]
	Gynochthodes umbellata	-		SE, CC, p-HPLC-UV, $\alpha_{[D]}$, IR,	
Phukettoside C (Figure 33)	(L.) Razafim. & B.Bremer	Leaves	Thailand	UV, NMR, HR-MS	[183]
	Gynochthodes umbellata	_		SE, CC, p-HPLC-UV, $\alpha_{\text{[D]}}$, IR,	
Phukettoside D (Figure 2)	(L.) Razafim. & B.Bremer	Leaves	Thailand	UV, NMR. HR-MS	[183]
	Picconia excelsa (Aiton)			- , , , , , ,	
	DC.	Foliage	Spain	SE, PP, CC, $\alpha_{[D]}$, NMR	[184]
Picconioside I (Figure 7)				HSE, PP, MPLC, rp-MPLC, p-	
	Strychnos lucida R.Br.	Bark and wood	Thailand	HPLC-UV, NMR	[54]

	Leonotis nepetifolia (L.) R.Br.	Aerial parts	Vietnam	SE, PP, CC, rp-CC, NMR, MS	[185]
Picconioside II (Figure 34)	Galium maximowiczii (Kom.) Pobed.	Whole plant	South Korea	SE, PP, CC, p-HPLC-UV, NMR	[32]
Picrorhizaoside E (Figure 32)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Rhizomes	China (cultivated)	SER, PP, CC, rp-CC, HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[186]
Picrorhizaoside F (Figure 32)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Rhizomes	China (cultivated)	SER, PP, CC, rp-CC, HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[186]
Picrorhizaoside G (Figure 32)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Rhizomes	China (cultivated)	SER, PP, CC, rp-CC, HPLC- UV, α[D], IR, UV, NMR, HR- MS	[186]
	Jasminum polyanthum Franch.	Flowers	China (purcahsed from a company)	HSE, PP, CC, p-TLC, p-HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[134]
Polyanoside (Figure 15)	Jasminum sambac (L.) Ait	Leaves	Egypt (different populations)	PE, HPLC-PDA-MS ⁿ	[187]
	Jasminum multiflorum (Burm.f.) Andrews	Leaves	Egypt	PE, PP, VLC, HPLC-PDA-MS ⁿ	[188]
Premnaodoroside D (Figure 4)) Premna odorata Blanco	Leaves	Japan	SE, PP, CC, rp-CC, DCCC, HPLC-UV, α[D], IR, UV, NMR, HR-MS	[189]
		Leaves	Egypt	SE, PP, HPLC-MS	[190]
Premnaodoroside E (Figure 4)	Premna odorata Blanco	Leaves	Japan	SE, PP, CC, rp-CC, DCCC, HPLC-UV, α _(D) , IR, UV, NMR, HR-MS	[189]
Premnaodoroside F	Premna odorata Blanco	Leaves	Japan	SE, PP, CC, rp-CC, DCCC, HPLC-UV, α[D], IR, UV, NMR, HR-MS	[189]
Premnaodoroside G	Premna odorata Blanco	Leaves	Japan	SE, PP, CC, rp-CC, DCCC, HPLC-UV, α[D], IR, UV, NMR, HR-MS	[189]
Ptehoside C (Figure 31)	<i>Pterocephalus hookeri</i> (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[24]
Ptehoside D (Figure 31)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[24]
Ptehoside E (Figure 31)	<i>Pterocephalus hookeri</i> (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[24]
Ptehoside F (Figure 31)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[24]
Ptehoside G (Figure 31)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[24]
Ptehoside H (Figure 31)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[24]
Ptehoside I (Figure 31)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	Tibet	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[24]
Pterhookeroside (Figure 28)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, CC, sp-HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[191]
	Pterocephalus hookeri	Underground parts	Tibet	SER, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[192]
Pterocenoid B (Figure 28)	(C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, HPLC-UV,	[193]

NMR

Pterocenoid C (Figure 28)	Pterocephalus hookeri (C B Clarko) E Pritz	Underground	Tibet	SER, PP, CC, sp-HPLC-UV,	[192]
Pterocenoid D (Figure 28)	Pterocephalus hookeri	Underground narts	Tibet	SER, PP, CC, sp-HPLC-UV,	[192]
Pterocenoid E (Figure 28)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, HPLC-UV, <i>a</i> (D), UV, NMR, HR-MS	[193]
Pterocenoid F (Figure 28)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, HPLC-UV, α _(D) , UV, NMR, HR-MS	[193]
Pterocenoid G (Figure 33)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, HPLC-UV, α _[D] , UV, NMR, HR-MS	[193]
Pterocenoid H (Figure 28)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, HPLC-UV, α _{(D]} , UV, NMR, HR-MS	[193]
	Pterocephalus pinardi Boiss.	Aerial parts	Turkey	SE, PP, rp-VLC, CC, α _[D] , IR, NMR, HR-MS	[55]
	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	USE, UPLC-MS ⁿ	[64]
Pterocephaline (Figure 11)			China	HSE, PP, CC, p-TLC, p-rp- HPLC-UV, NMR	[106]
	Dipsacus inermis Wall.	Roots	China (purchased from a local market)	SER, PP, MPLC, p-HPLC-UV, α_{D} , IR, UV, NMR, HR-MS	[108]
Pteroceside A (Figure 9)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, CC, rp-CC, sp- HPLC-UV, α[D], IR, UV, NMR, HR-MS	[58]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]
Pteroceside B (Figure 9)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, CC, rp-CC, sp- HPLC-UV, α[D], IR, UV, NMR, HR-MS	[58]
Pteroceside C (Figure 9)	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, CC, rp-CC, sp- HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[58]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ , NMR	[34]
Pubescensoside (Figure 6)	Anarrhinum forskaohlii subsp. pubescens D.A.Sutton	Aerial parts	Egypt	SE, DP, PP, CC, NMR, HR-MS	[194]
Pubzenoside (Figure 23)	<i>llex pubescens</i> Hook. & Arn.	Roots	China (purchased from a company)	SER, PP, CC, rp-HPLC-UV, α[D], IR, UV, NMR, HR-MS	[195]
Radiatoside (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, ACT, PC, TLC, CC, α _[D] , IR, UV, NMR	[196]
Radiatoside B (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, ACT, PC, TLC, CC, α _[D] , IR, UV, NMR	[197]
Radiatoside C (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, ACT, PC, TLC, CC, $\alpha_{[D]}$, IR, UV, NMR	[197]
Radiatoside D (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, ACT, PC, TLC, α _[D] , IR, UV, NMR	[198]
Radiatoside E (Figure 1)	<i>Argylia radiata (</i> L.) D.Don	Whole plant	Chile	SE, CC, $\alpha_{\text{[D]}}$, IR, UV, NMR, MS	[30]
Radiatoside F (Figure 1)	Argylia radiata (L.) D.Don	Whole plant	Chile	SE, CC, $\alpha_{\text{[D]}}$, IR, UV, NMR, MS	[30]
Randinoside (Figure 1)	Catunaregam spinosa (Thunb.) Tirveng.	Stems	Brazil	SE, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[199]
Rapulaside A (Figure 34)	Heracleum rapula Franch.	Roots	China	SE, PP, CC, p-HPLC-UV, α _[D] , NMR, MS	[200]

Rapulaside B (Figure 34)	Heracleum rapula Franch	. Roots	China	SE, PP, CC, p-HPLC-UV, α_{D} , NMR, MS	[200]
Reticunin A (Figure 27)	Neonauclea reticulata (Havil.) Merr.	Stems	Taiwan	SE, PP, CC, HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[201]
Reticunin B (Figure 27)	Neonauclea reticulata (Havil.) Merr.	Stems	Taiwan	SE, PP, CC, HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[201]
Rotunduside (Figure 1)	Cyperus rotundus L.	Rhizomes	China	SER, PP, CC, α _{ID]} , IR, NMR, HR-MS	[202]
Rotunduside A (Figure 2)	Cyperus rotundus L.	Rhizomes	China	SER, PP, CC, α _[D] , IR, NMR, HR-MS	[203]
Safghanoside G (Figure 19)	Syringa persica L.	Leaves	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, p-HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[204]
	Fraxinus mandshurica Rupr.	Seeds	China (purchased from a company)	SE, PP, CC, HPLC-DAD, NMR	[123]
Safghanoside H (Figure 19)	Syringa persica L.	Leaves	Japan (obtained from a botanical garden)	HSE, PP, CC, p-TLC, p-HPLC- UV, α _[D] , IR, UV, NMR, HR- MS	[204]
Salvialoside E (Figure 28)	Salvia digitaloides Diels	Roots	China	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[205]
Saprosmoside A (Figure 6)	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
Saprosmoside B (Figure 5)	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
Saprosmoside C (Figure 3)	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
Saprosmoside D (Figure 3)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, CC, p-HPLC-UV, NMR	[178]
	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
	V	Stems Whole plant	China	SE, PP, CC, rp-CC, NMR	[179]
Saprosmoside E (Figure 4)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, CC, p-HPLC-UV, NMR	[178]
		Aerial parts	China	SER, CC, sp-HPLC-UV, NMR	[33]
	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[206]
Saprosmoside F (Figure 3)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, CC, HPLC-MS	[178]
		Aerial parts	China	SER, CC, sp-HPLC-UV, NMR	[33]
Saprosmoside G (Figure 7)	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[207]

Saprosmoside H (Figure 2)	Saprosma scortechinii King & Gamble	Leaves and stems	Malaysia	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[207]
Saungmaygaoside A (Figure 10)	Picrorhiza kurroa Royle ex Benth.	Stems	Myanmar	USE, PP, CC, p-TLC, α _[D] , IR, UV, NMR, HR-MS	[23]
Saungmaygaoside B (Figure 10)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Stems	Myanmar	USE, PP, CC, sp-HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[23]
Saungmaygaoside C (Figure 10)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Stems	Myanmar	USE, PP, CC, sp-HPLC-UV, α[d], IR, UV, NMR, HR-MS	[23]
Saungmaygaoside D (Figure 10)	<i>Picrorhiza kurroa</i> Royle ex Benth.	Stems	Myanmar	USE, PP, CC, p-TLC, α _[D] , IR, UV, NMR, HR-MS	[23]
Scaevoloside (Figure 31)	Scaevola racemigera Däniker	Aerial parts	New Caledonia	SE, CC, $\alpha_{\text{[D]}}$, IR, UV, NMR	[44]
Sclerochitonoside C (Figure 12)	Sclerochiton harveyanus Nees	Leaves	England (obtained from a botanical garden)	SE, PP, CC, HPLC-UV, NMR, MS	[208]
Seemannoside A (Figure 18)	<i>Lisianthius seemanii</i> Perkins	Aerial parts	Panama	SE, CC, rp-MPLC, sp-HPLC- UV-NMR, MP, απη, IR, MS	[209]
Seemannoside B (Figure 18)	Lisianthius seemanii Perkins	Aerial parts	Panama	SE, CC, rp-MPLC, sp-HPLC- UV-NMR, MP, α _{IDI} , IR, MS	[209]
Semipapposiridoid A (Figure 9)	<i>Scabiosa semipapposa</i> Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, α _[D] , IR, UV, NMR, HR-MS	[210]
Semipapposiridoid B (Figure 9)	Scabiosa semipapposa Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[210]
Semipapposiridoid C (Figure 9)	<i>Scabiosa semipapposa</i> Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[210]
Semipapposiridoid D (Figure 9)	Scabiosa semipapposa Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[210]
Semipapposiridoid E (Figure 31)	<i>Scabiosa semipapposa</i> Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, α _[D] , IR, UV, NMR, HR-MS	[210]
Semipapposiridoid F (Figure 31)	<i>Scabiosa semipapposa</i> Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, $\alpha_{\text{[D]}}$, IR, UV, NMR, HR-MS	[210]
	Cautiqua contamfida Poll	Aerial parts	Turkey	SE, PP, CC, MPLC, α _[D] , IR, UV, NMR, HR-MS	[211]
	Gentunu septemjuu 1 all.	Whole plant	Azerbaijan	SE, HPLC-DAD, HPLC-DAD- MS ⁿ	[212]
Septemfidoside (Figure 10)	Gentiana olivieri Griseb.	Whole plant	Uzbekistan	SE, SER, PP, CC, p-HPLC-UV, NMR	[213]
	Gentiana lutea L.	Leaves	Montenegro (different populations)	USE, HPLC-DAD, HPLC-MS ⁿ	[214]
	Lomelosia stellata (L.) Raf.	Whole plant	Algeria	SE, CC, CPC, FC, HPLC-UV, NMR	[12]
Strychoside A (Figure 17)	Strychnos spinosa Lam.	Branches	Japan (cultivated)	HSE, PP, rp-MPLC, p-HPLC- UV, p-TLC, α _[D] , IR, UV, NMR, HR-MS	[53]
Swerilactone A (Figure 33)	Swertia mileensis T.N.Ho & W.L.Shih	Whole plant	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, HR-MS	[215]
Swerilactone B (Figure 33)	Swertia mileensis T.N.Ho & W.L.Shih	Whole plant	China	SER, PP, CC, rp-CC, MP, α _[D] , IR, UV, NMR, HR-MS	[215]
Swerilactoside A (Figure 21)	Swertia mileensis T.N.Ho & W.L.Shih	Whole plant	China	SER, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$, IR, UV, NMR, HR-MS	[216]
Swerilactoside B (Figure 21)	<i>Swertia mileensis</i> T.N.Ho & W.L.Shih	Whole plant	China	SER, PP, CC, sp-HPLC-UV, $\alpha_{[D]}$, IR, UV, NMR, HR-MS	[216]

Swerilactoside C (Figure 21)	Swertia mileensis T.N.Ho & W.L.Shih	Whole plant	China	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[216]
Swertianoside A (Figure 22)	Swertia angustifolia Buch Ham. ex D.Don	Whole plant	China	SER, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[217]
	Dinsacus fullonum L	Seeds	Denmark	SE p-TLC AND UV NMR	[41]
	Acicarpha tribuloides Juss.	Aerial parts	Peru	SE, PP, CC, HPLC-UV, α[D], NMR, MS	[218]
	<i>Linnaea chinensis</i> A.Braun & Vatke	Aerial parts	Italy	SE, PP, CC, NMR	[11]
	Strychnos lucida R.Br.	Bark and wood	Thailand	HSE, PP, MPLC, rp-MPLC, p- HPLC-UV, NMR	[54]
		Underground parts	Tibet	SER, PP, CC rp-CC, NMR	[58]
		Aerial parts	n.a.	n.a.	[17]
	-	Aerial partsII.a.II.a.[17]Whole plantChinaSE, PP, HPLC-UV[62]UndergroundSER, CC, UPLC-PDA[63]UndergroundTibetSER, PP, TLC, sp-HPLC-MS, NMR[59]E.Pritz.n.a.n.a.n.a.[60]			
	Whole plant China SE, FP, HPLC-UV Whole plant China SER, CC, UPLC-PDA Underground Tibet SER, PP, TLC, sp-HPLC-M Pterocephalus hookeri parts NMR	SER, PP, TLC, sp-HPLC-MS, NMR	[59]		
	(C.B.Clarke) E.Pritz.	n.a.	$\begin{tabular}{ c c c c c c c } \hline SER, PP, CC, $a(D), IR, UV, $NMR, HR-MS$ [217] \\ \hline Denmark SE, p-TLC, $a(D), UV, NMR [41] \\ \hline Peru SE, PP, CC, HPLC-UV, $a(D), NMR, MS [218] \\ \hline Italy SE, PP, CC, NMR [11] \\ \hline Italy SE, PP, CC, NMR [11] \\ \hline Thailand HSE, PP, MPLC, rp-MPLC, P-$HPLC-UV, NMR [54] \\ \hline Tibet SER, PP, CC rp-CC, NMR [58] \\ \hline n.a. n.a. 1.2 [17] \\ \hline China SER, CC, UPLC-DA [63] \\ \hline SER, CC, UPLC-PDA [63] \\ \hline NMR 1.2 \\ \hline NM$	[60]	
	· · · · ·	Whole plant	China	USE, UPLC-MS ⁿ	[64]
Sylvestroside I (Figure 9)		i i i i	$\begin{array}{c cccc} \text{tt} & \text{China} & \underbrace{\text{SE, PP, HPLC-UV}}_{\text{SER, CC, UPLC-PDA} & [62]} \\ \text{nd} & \\ \text{Tibet} & \underbrace{\text{SER, CC, UPLC-PDA}}_{\text{NMR}} & [59] \\ \hline \text{n.a.} & \text{n.a.} & [60] \\ \hline \text{n.a.} & \text{n.a.} & [60] \\ \hline \text{nt} & \text{China} & \\ \hline \\ & \\ \text{Tibet} & \underbrace{\text{SE, PP, CC, p-HPLC-UV, p-}}_{\text{TLC, NMR}} & [65] \\ \hline \\ \text{nt} & \\ \hline \\ \text{China} & \\ \hline \\ \\ & \\ \hline \\ \hline$		
		Whole plant	China (different populations)	USE, UPLC-MS ⁿ	[66]
	Lomelosia stellata (L.) Raf.	Whole plant	Algeria	SE, CC, CPC, FC, HPLC-UV, NMR	[12]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ	[34]
		Roots	China (purchased from a company)	SER, PP, MPLC, p-TLC, NMR	[50]
	Dipsacus inermis Wall.	Whole plantChinaNMR, HR-MS1L.SeedsDenmarkSE, p-TLC, $\alpha_{(D)}$, UV, NMRJuss.Aerial partsPeruSE, PP, CC, HPLC-UV, $\alpha_{(D)}$, NMR, MSJuss.Aerial partsItalySE, PP, CC, HPLC, UV, $\alpha_{(D)}$, NMR, MSa.SeedsDenmarkSE, PP, CC, NMRBr.Bark and woodThailandHSE, PP, MPLC, rp-MPLC, p-HPLC-UV, NMRAerial partsn.a.n.a.Aerial partsn.a.n.a.Aerial partsn.a.n.a.Mhole plantChinaSER, PP, CC, rp-CC, NMRUnderground partsTibetSER, PP, TLC, sp-HPLC-UVUnderground partsTibetSER, PP, TLC, sp-HPLC-US, NMRMhole plantChinaUSE, UPLC-MS, NMRWhole plantChinaUSE, UPLC-MS, NMRWhole plantAlgeriaSE, CC, CPC, FC, HPLC-UV, p- TLC, NMRNaf.Whole plantAlgeriaVall.China (different populations)SE, CC, CPC, FC, HPLC-UV, HPLC- MS^Vall.China (different populations)SE, CC, UHPLC-PDA, UHPLC-MS^Vall.China (different populations)SE, CC, UHPLC-PDA, UHPLC-MS^I.SeedsDenmarkSE, p-P, UC, FC, rp-MPLC, NMRI.SeedsDenmarkSE, p-P, UC, PC, NMRI.SeedsDenmarkSE, p-TLC, α_{0} , UV, NMRI.SeedsDenmarkSE, p-TLC, α_{0} , UV, NMRI.SeedsDenmarkSE, p-TLC, α_{0} , UV, NMR <td>[52]</td>	[52]		
		n.a.	n.a.	n.a.	[219]
	Scabiosa semipapposa Salzm. ex DC.	Aerial parts	ttChinaSER, PP, CC, $\alpha_{[D]}$, IR, UV, NMR, HR-MSttChinaSER, PP, CC, $\alpha_{[D]}$, IR, UV, NMR, HR-MSDenmarkSE, PTLC, $\alpha_{[D]}$, UV, NMRsDenmarkSE, PTLC, $\alpha_{[D]}$, UV, NMRsItalySE, PP, CC, HPLC-UV, $\alpha_{[D]}$, NMR, MSsItalySE, PP, CC, NMRodThailandHSE, PP, MPLC, rp-MPLC, p- 	[210]	
	Dipsacus fullonum L.	Seeds	Denmark	SE, p-TLC, $\alpha_{[D]}$, UV, NMR	[41]
	<i>Abelia grandiflora</i> (Rovelli ex André) Rehder	Leaves	Japan	HSE, PP, ACT, CC, p-TLC, PLC, NMR	[22]
Sylvestroside II (Figure 9)	<i>Linnaea chinensis</i> A.Braun & Vatke	Aerial parts	Italy	SE, PP, CC, NMR	[11]
	actoside C (Figure 21) Swertla mileensis T.N.Ho & W.L.Shih & W.L.Shih & W.L.Shih & W.L.Shih & W.L.Shih & W.Hole plant China SER, PP, CC, au, JR, UV, NMR, HR-MS Step, CC, au, JR, UV, NMR, HR-MS Step, CC, au, JR, UV, NMR, HR-MS Dipacaus fullorum L. Seeds Denmark SE, P-TLC, au, UV, NMR Aciarpha tribuloides Juss. Aerial parts Italy SE, PP, CC, MR NMR, MS Intrance chinensis A.Braun & Vatke Strychnes lucida R.Br. Bark and wood Thailand HSE, PP, CC, PLIC, UV, NMR SER, PP, CC, TMPLC, P, MPLC, MS Stroside II (Figure 9) Stroside II (Figure 3)	[210]			
	-	Seeds	Denmark	SE, p-TLC, α _[D] , UV, NMR	[41]
	-	Leaves	Poland	USE, UHPLC-PDA-MS ⁿ	[42]
		Roots	Poland	USE, UHPLC-PDA-MS ⁿ	[42]
	Dipsacus fullonum L	Leaves	Estonia	DESE, HPLC-DAD-MS	[220]
Sylvestroside III (Figure 30)	-	Leaves	Estonia	hinaSER, PP, CC, $\alpha_{[D]}$, IR, UV, NMR, HR-MS[21hinaSER, PP, CC, $\alpha_{[D]}$, IR, UV, NMR, HR-MS[21imarkSE, PP, CC, $\alpha_{[D]}$, UV, NMR[4]eruSE, PP, CC, $nPLC$ -UV, $\alpha_{[D]}$, NMR, MS[21ialySE, PP, CC, HPLC-UV, $\alpha_{[D]}$, NMR, MS[21ialySE, PP, CC, NMR[1]ialandHSE, PP, MPLC, rp-MPLC, P- HPLC-UV, NMR[5]ia.n.a.[1]ialandSER, PP, CC rp-CC, NMR[5]ia.n.a.[1]ia.n.a.[1]ibetSER, PP, HPLC-UV[6]ibetSER, PP, TLC, sp-HPLC-MS, NMR[5]ia.n.a.[6]ibetSE, PP, CC, p-HPLC-UV, p- TLC, NMR[6]hinaUSE, UPLC-MS^n[6]lations)[6]geriaSE, CC, CPC, FC, HPLC-UV, p- MS^n[7]hinaSER, PP, MPLC, p-TLC, NMR[5]nhinaSE, CC, Sp-HPLC-UV, HPLC- MS^n[3]hinaSER, PP, MPLC, p-TLC, NMR[5]iations)UHPLC-MS^n[5]a.n.a.[2]markSE, pP, CC, rp-MPLC, 	[221]
	Scaevola montana Labill.	Aerial parts	New Caledonia	SE, CC, NMR	[43]

	Scaevola racemigera Däniker	Aerial parts	New Caledonia	SE, CC, NMR	[44]
	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α _[D] , IR, UV, NMR	[45]
	Acicarpha tribuloides Juss.	Aerial parts	Peru	SE, PP, CC, HPLC-UV, α _[D] , NMR, MS	[218]
	<i>Linnaea chinensis</i> A.Braun & Vatke	Aerial parts	Italy	SE, PP, CC, NMR	[11]
		Underground parts	Tibet	SER, PP, CC rp-CC, NMR	[58]
	_	n.a.	n.a.	n.a.	[222]
	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Underground parts	Tibet	SER, PP, TLC, sp-HPLC-MS, NMR	[59]
	· · · · ·	n.a.	n.a.	n.a.	[60]
	-			SE, PP, HPLC-UV	[62]
		Whole plant	China	USE, UPLC-MS ⁿ	[64]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ	[34]
	Scaevola montana Labill.	Aerial parts	New Caledonia	SE, CC, NMR	[43]
Culvestreeide III dimethul	Dtavocanholus koskavi	Underground parts	Tibet	SER, PP, CC rp-CC, NMR	[58]
acotal (Figure 30)	(C B Clarko) E Pritz -	n.a.	n.a.	n.a.	[60]
acetai (Figure 50)	(C.D.Clarke) E.I IIIZ.	Underground parts	Tibet	SER, PP, TLC, sp-HPLC-MS, NMR	[59]
	Scabiosa atropurpurea L.	Whole plant	Turkey	SE, CC, sp-HPLC-UV, HPLC- MS ⁿ	[34]
		Seeds	Denmark	SE, p-TLC, $\alpha_{[D]}$, UV, NMR	[41]
		Leaves	Estonia	DESE, HPLC-DAD-MS	[220]
	Dipsacus fullonum L	Leaves	Estonia	SE, CC, rp-FC, HPLC-DAD- MS, NMR	[221]
	Dipsacus laciniatus L.	Aerial parts	Hungary	SE, PP, CCD, CC, α_{D} , IR, UV, NMR	[45]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel.	Leaves and branches	Italy	SE, CC, NMR	[153]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel.	Jeeus Denmark SE, p-TLC, α[D], UV, NMR fullonum L. Leaves Estonia DESE, HPLC-DAD-MS [Leaves Estonia SE, CC, rp-FC, HPLC-DAD-MS [laciniatus L. Aerial parts Hungary SE, PP, CCD, CC, α[D], IR, UV, NMR ferox Loisel. Leaves and branches Italy SE, CC, NMR [Underground parts Tibet SER, PP, CC rp-CC, NMR [Underground Tibet SER, PP, TLC, sp-HPLC-MS. [[153] [58]		
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. - Pterocephalus hookeri	Leaves and branches Underground parts Underground parts	Italy Tibet Tibet	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR	[153] [58] [59]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Leaves and branches Underground parts Underground parts n.a.	Italy Tibet Tibet n.a.	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a.	[153] [58] [59] [60]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Leaves and branches Underground parts Underground parts n.a.	Italy Tibet Tibet n.a. China	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV	[153] [58] [59] [60] [62]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Leaves and branches Underground parts Underground parts n.a. Whole plant	Italy Tibet Tibet n.a. China Tibet	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR	[153] [58] [59] [60] [62] [24]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz. Scabiosa atropurpurea L.	Leaves and branches Underground parts Underground parts n.a. Whole plant Whole plant	Italy Tibet Tibet n.a. China Tibet Turkey	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR SE, CC, sp-HPLC-UV, HPLC- MS ⁿ	[153] [58] [59] [60] [62] [24] [34]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz. Scabiosa atropurpurea L.	Leaves and branches Underground parts Underground parts n.a. Whole plant Whole plant Underground parts	Italy Tibet Tibet n.a. China Tibet Turkey Tibet	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR SE, CC, sp-HPLC-UV, HPLC- MS ⁿ SER, PP, CC rp-CC, NMR	[153] [58] [59] [60] [62] [24] [34] [58]
Sylvestroside IV (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz. Scabiosa atropurpurea L. Pterocephalus hookeri	Leaves and branches Underground parts Underground parts n.a. Whole plant Whole plant Underground parts Underground parts	Italy Tibet Tibet n.a. China Tibet Turkey Tibet	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR SE, CC, sp-HPLC-UV, HPLC- MS ⁿ SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR	[153] [58] [59] [60] [62] [62] [24] [34] [58] [59]
Sylvestroside IV (Figure 30) Sylvestroside IV dimethyl	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz. Scabiosa atropurpurea L. Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Leaves and branches Underground parts Underground n.a. Whole plant Whole plant Underground parts Underground parts n.a.	Italy Tibet Tibet n.a. China Tibet Turkey Tibet Tibet n.a.	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR SE, CC, sp-HPLC-UV, HPLC- MS ⁿ SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a.	[153] [58] [59] [60] [62] [24] [34] [58] [59] [60]
Sylvestroside IV (Figure 30) Sylvestroside IV dimethyl acetal (Figure 30)	Dipsacus ferox Loisel. Pterocephalus hookeri (C.B.Clarke) E.Pritz. Scabiosa atropurpurea L. Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Leaves and branches Underground parts Underground n.a. Whole plant Whole plant Underground parts Underground parts n.a. Whole plant	Italy Tibet Tibet n.a. China Tibet Turkey Tibet Tibet n.a. Tibet	SE, CC, NMR SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, HPLC-UV SE, PP, CC, sp-HPLC-UV, NMR SE, CC, sp-HPLC-UV, HPLC- MS ⁿ SER, PP, CC rp-CC, NMR SER, PP, TLC, sp-HPLC-MS, NMR n.a. SE, PP, CC, sp-HPLC-UV, NMR	[153] [58] [60] [62] [24] [34] [58] [59] [60] [24]

	Clinopodium serpyllifolium subsp. fruticosum (L.) Bräuchler	Leaves	Palestine	DP, USE, UHPLC-DAD-MS ⁿ	[223]
Tricoloroside (Figure 9)	Loasa tricolor Ker Gawl.	Whole plant	Chile	SE, ACT, CC, MP, $\alpha_{\text{[D]}}$, IR, UV, NMR	[224]
Tricoloroside methyl ester (Figure 9)	<i>Loasa acerifolia</i> Dombey ex A.Juss.	Leaves	Germany (obtained from a botanical garden)	SXE, PP, CC, sp-HPLC-UV, α[D], IR, UV, NMR, MS	[225]
	Triplostegia glandulifera Wall. ex DC.	Roots	n.a.	n.a.	[226]
	Strychnos spinosa Lam.	Branches	Japan (cultivated)	HSE, PP, rp-MPLC, p-HPLC- UV, p-TLC, NMR	[53]
	Strychnos lucida R.Br.	Bark and wood	Thailand	HSE, PP, MPLC, rp-MPLC, p- HPLC-UV, NMR	[54]
	Dipsacus inermis Wall.	Roots	China	HSE, PP, CC, rp-CC, p-TLC, rp-HPLC-UV, NMR	[48]
				HSE, PP, CC, p-TLC, p-rp- HPLC-UV, NMR	[106]
			China (purchased from a company)	SER, PP, MPLC, p-TLC, NMR	[50]
		n.a.	n.a.	n.a.	[219]
Triplostoside A (Figure 9)		Dried Roots	China (purchased from a	USE, HPLC-MS ⁿ	[51]
			<u>company</u>)		[227]
			n.a.	n.a.	[227]
			(different populations)	SE, CC, UHPLC-PDA, UHPLC-MS ⁿ	[52]
			n.a.	n.a.	[228]
	Strychnos axillaris Colebr.	Bark and wood	Thailand	SER, PP, rp-MPLC, p-HPLC- UV, NMR	[36]
	Pterocephalus hookeri (C.B.Clarke) E.Pritz.	Whole plant	China	SE, PP, CC, rp-CC, NMR	[61]
				USE, UPLC-MS ⁿ	[64]
		n.a.	n.a.	n.a.	[222]
		n.a.	n.a.	n.a.	[229]
		n.a.	n.a.	n.a.	[60]
		Whole plant	Tibet	SE, PP, CC, p-HPLC-UV, p- TLC, NMR	[65]
	Scabiosa semipapposa Salzm. ex DC.	Aerial parts	Algeria	SE, rp-VLC, FC, rp-MPLC, NMR	[210]
Tripterospermumcin B methy	d Tripterospermum chinense (Migo) Harry Sm.	Aerial parts	China	SE, PP, CC, α _[D] , IR, UV, NMR, HR-MS	[230]
acetal (Figure 19)				SER, PP, CC, p-HPLC-UV, NMR	[231]
Tripterospermumcin D (Figure 10)	Tripterospermum chinense (Migo) Harry Sm.	Aerial parts	China	SER, PP, CC, p-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[231]
Urceolatoside A (Figure 27)	Viburnum urceolatum Siebold & Zucc.	Leaves	Japan	SE, PP, CC, $\alpha_{[D]}$, MP, IR, UV, NMR	[232]
Urceolatoside B (Figure 27)	<i>Viburnum urceolatum</i> Siebold & Zucc.	Leaves	Japan	SE, PP, CC, α _[D] , MP, IR, UV, NMR	[232]

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Urceolatoside C (Figure 27)	<i>Viburnum urceolatum</i> Siebold & Zucc.	Leaves	Japan	SE, PP, CC, α _[D] , MP, IR, UV, NMR	[232]
Valeridoid B (Figure 27)	Valeriana jatamansi Jones	Roots and rhizomes	China (purchased from a local market)	SE, PP, CC, p-TLC, α _[D] , IR, UV, NMR, HR-MS	[233]
Valeridoid C (Figure 27)	Valeriana jatamansi Jones	Roots and rhizomes	China (purchased from a local market)	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[233]
Valeridoid D (Figure 27)	Valeriana jatamansi Jones	Roots and rhizomes	China (purchased from a local market)	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[233]
Valeridoid E (Figure 34)	Valeriana jatamansi Jones	Roots and rhizomes	China (purchased from a local market)	SE, PP, CC, sp-HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[233]
Valeridoid F (Figure 34)	Valeriana jatamansi Jones	Roots and rhizomes	China (purchased from a local market)	SE, PP, CC, sp-HPLC-UV, α _{IDI} , IR, UV, NMR, HR-MS	[233]
Wulfenoside (Figure 7)	Wulfenia carinthiaca Jacq.	Underground parts	Austria	SE, CC, HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[234]
Dimer of alpinoside and	Globularia alypum L.	Aerial parts	Croatia	SER, HPLC-PDA, HPLC- PDA-MS ⁿ	[127]
alphioside		Leaves	Croatia	USE, HPLC-PDA-MS ⁿ	[128]
Dimer of aperuloside and asperulosidic acid (Figure 3)	Lasianthus attenuatus var. attenuatus	Leaves	Japan	SE, PP, CC, HPLC-UV, α _[D] , IR, UV, NMR, HR-MS	[235]
	Lasianthus verticillatus (Lour.) Merr.	Leaves	Japan	SE, PP, rp-CC, HPLC-UV, α _[D] , IR, UV, NMR, MS	[152]
Dimer of nuezhenide and 11- methyl-oleoside	Olea europaea L.	Fruits	Tunisia (cultivated)	SE, HPLC-UV, UHPLC-MS ⁿ	[236]
Dimer of oleoside and 11- methyl-oleoside	Olea europaea L.	Fruits	Tunisia (cultivated)	SE, HPLC-UV, UHPLC-MS ⁿ	[236]
Dimer of paederosidic acid I (Figure 2)	Paederia foetida L.	Roots	Vietnam	SXE, PP, CC, rp-HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, MS	[237]
		Stems	China (purchased from a company)	SE, PP, HPLC-MS ⁿ	[178]
Dimer of paederosidic acid II (Figure 2)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, HPLC-MS ⁿ	[178]
Dimer of paederosidic acid and asperuloside I (Figure 3)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, CC, HPLC-MS ⁿ	[178]
Dimer of paederosidic acid and asperuloside II (Figure 3)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, HPLC-MS ⁿ	[178]
			China	SE, PP, HPLC-MS ⁿ	[178]
Dimer of paederosidic acid and asperuloside III (Figure 3)	Paederia foetida L.	Stems	China (purchased	SE, PP, HPLC-MS ⁿ	[178]

			from a		
			company)		
Dimer of paederosidic acid and asperuloside IV (Figure 4)	Paederia foetida L.	Stems	China (purchased from a company)	SE, PP, HPLC-MS ⁿ	[178]
Dimer of paederosidic acid and paederoside (Figure 2)	Paederia foetida L.	Roots	Vietnam	SXE, PP, CC, rp-HPLC-UV, $\alpha_{\text{[D]}}$, IR, UV, NMR, MS	[237]
Dimer of paederosidic acid and paederosidic acid methyl ester (Figure 2)	Paederia foetida L.	Roots	Vietnam	SXE, PP, CC, rp-HPLC-UV, α_{D} , IR, UV, NMR, MS	[237]
Iridoid glycoside dimer I (Figure 16)	Jasminum azoricum L.	Leaves	Egypt (obtained from a botanical garden)	HSE, PP, CC, α _[D] , MP, IR, UV, NMR, MS	[238]

Legend: 2D-HPLC-UF-MS: bidimensional high-performance liquid chromatography coupled to ultrafiltration and mass spectrometry; $\alpha_{\text{[D]}}$: optical rotation; ACT: active charcoal treatment; CC; column chromatography; CCC: counter current chromatography; CCD: countercurrent distribution chromatography; CC-TLC: countercurrent thin-layer chromatography; CPC: centrifugal partition chromatography; DCCC: droplet countercurrent chromatography DESE: extraction by means of deep eutectic solvents; DP: Defatting procedure; ECD: electronic circular dichroism; FC: flash chromatography; HPLC-DAD: high-performance liquid chromatography coupled to diode array detector; HPLC-DAD-CL: high-performance liquid chromatography coupled to diode array detector and chemiluminescence detector; HPLC-DAD-ELSD: high-performance liquid chromatography coupled to diode array detector and evaporative light scattering detector; HPLC-DAD-MS: high-performance liquid chromatography coupled to diode array detector and mass spectrometry; HPLC-DAD-MSⁿ: high-performance liquid chromatography coupled to diode array detector and tandem mass spectrometry; HPLC-ELSD: high-performance liquid chromatography coupled to evaporative light scattering detector; HPLC-MS: high-performance liquid chromatography coupled to mass spectrometry; HPLC-MSn: high-performance liquid chromatography coupled to tandem mass spectrometry; HPLC-PDA: high-performance liquid chromatography coupled to photo diode array spectroscopy; HPLC-PDA-MSⁿ: high-performance liquid chromatography coupled to photo diode array spectroscopy and tandem mass spectrometry; HPLC-UV: high-performance liquid chromatography coupled to ultraviolet spectroscopy; HR-MS: high resolution mass spectrometry; HSE = hot solvent extraction by maceration; IR = infrared spectroscopy; LPLC: low pressure liquid chromatography; MP = melting point; MPLC: medium pressure liquid chromatography; MS: mass spectrometry; MSⁿ: tandem mass spectrometry; n.a.: not accessible; NMR: nuclear magnetic resonance spectroscopy; PC: paper chromatography; p-HPLC-UV: preparative high-performance liquid chromatography coupled to ultraviolet spectroscopy; PP: partition procedure; p-rp-HPLC-UV: preparative reversed-phase high-performance liquid chromatography coupled to ultraviolet spectroscopy; p-TLC: preparative thin-layer chromatography; rp-CC: reversed-phase column chromatography; rp-FC: reversed-phase flash chromatography; rp-HPLC-DAD: reversed-phase high-performance liquid chromatography coupled to diode array detector; rp-HPLC-UV: reversed-phase high-performance liquid chromatography coupled to ultraviolet spectroscopy; rp-LPLC: reversed-phase low pressure liquid chromatography; rp-MPLC: reversed-phase medium pressure liquid chromatography; rp-UHPLC-PDA-MSⁿ: reversed-phase ultra-high-performance liquid chromatography coupled to photo diode array spectroscopy and tandem mass spectrometry; rp-VLC: reversed-phase vacuum liquid chromatography; -: solvent extraction by maceration; -R: solvent extraction under reflux; SXE: extraction by Soxhlet; sp-HPLC-UV: semi-preparative high-performance liquid chromatography coupled to ultraviolet spectroscopy; sp-rp-HPLC-UV: semi-preparative reversed-phase high-performance liquid chromatography coupled to ultraviolet spectroscopy; TLC: thin-layer chromatography; UFLC-MSⁿ: ultra-fast liquid chromatography coupled to tandem mass spectrometry; UHPLC-MSn: ultra-high-performance liquid chromatography coupled to tandem mass spectrometry; UHPLC-PDA: ultra-high-performance liquid chromatography coupled to photo diode array spectroscopy; UHPLC-PDA-MSⁿ: ultra-high-performance liquid chromatography coupled to photo diode array spectroscopy and tandem mass spectrometry; UHPLC-PDA: ultra-performing liquid chromatography coupled to photo diode array spectroscopy; UHPLC-UV: ultra-performing liquid chromatography coupled to ultraviolet spectroscopy; UHPLC-PDA: ultra-performing liquid

chromatography coupled to photo diode array spectroscopy; UHPLC-PDA-MSⁿ: ultra-performing liquid chromatography coupled to photo diode array spectroscopy and tandem mass spectrometry; UPLC-HR-MS: ultra-performing liquid chromatography coupled to high resolution mass spectrometry; UPLC-MSⁿ: ultra-performing liquid chromatography coupled to mass spectrometry; UPLC-MSⁿ: ultra-performing liquid chromatography coupled to tandem mass spectrometry; UPLC-MSⁿ: ultra-performing liquid chromatography coupled to tandem mass spectrometry; USE: extraction with ultrasound; UV: ultraviolet spectroscopy; VLC: vacuum liquid chromatography.

To the best of our knowledge, two hundred and eighty-eight *bis*-iridoids have been identified in plants, so far. Sixty are structurally characterized by the link between two iridoid sub-units, fifty-four by the link between one iridoid sub-unit and one *seco*-iridoid sub-unit, ninety-two by the link between two *seco*-iridoid sub-units, nine by the link between two non-glucosidic iridoid sub-units, eleven by the link between one non-glucosidic iridoid sub-unit and one non-glucosidic *seco*-iridoid sub-unit, six by the link between one iridoid sub-unit and one non-glucosidic iridoid sub-unit, thirty-four by the link between one iridoid sub-unit and one non-glucosidic iridoid sub-unit, thirty-four by the link between one non-glucosidic iridoid sub-unit and one *seco*-iridoid sub-unit, twenty-two by a non-conventional *bis*-iridoid structure. By consequence, *bis*-iridoids with two *seco*-iridoid sub-unit and one non-glucosidic iridoid sub-unit and one non-glucosidic iridoid sub-unit and one non-glucosidic sub-unit and one non-glucosidic structure. By consequence, *bis*-iridoid sub-unit and one non-glucosidic structure. *bis*-iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid sub-unit and one non-glucosidic iridoid sub-unit and one iridoid s

Different types of iridoid, seco-iridoid and non-glucosidic iridoid base structures are used to form *bis*-iridoids. Catalpol, loganic acid, loganin and paederosidic acid, together with their derivatives, are the most common for iridoids, whereas oleoside methyl ester and secoxyloganin, together with their derivatives, are the most common for *seco*-iridoids and loganetin, together with its derivatives, is the most common for non-glucosidic iridoids. Other present base structures for iridoids include 8-O-acetyl-harpagide, adoxoside, arborescoside, ajugoside, anthirride, anthirrinoside, aucubin, euphroside, gardenoside, gardoside, geniposide, scandoside and their derivatives. Other present base structures for seco-iridoids include morronoside, seco-loganol, seco-loganoside, swertiamarin, 9-oxoswerimuslactone A and their derivatives. Other present base structures for non-glucosidic iridoids include iso-boonein, alyxialactone and their derivatives. Indeed, among the nonconventional bonds, there are intra-cyclic bis-iridoids, bonds with differently functionalized five carbon rings fused with other rings or not, and bonds with iridoids deprived of their classical double bond between carbons 3 and 4. From a specific observation of these base structures, it can be easily established that not all the existing base structures for iridoids, seco-iridoids and non-glucosidic iridoids are present in bis-iridoids, as well as not all the possible non-conventional bonds, and this may, indeed, represent an interesting research line for the future.

For what concerns the general structures of *bis*-iridoids, the literature survey has displayed some important issues. The first one regards the real existence of compounds having methyl, ethyl and dimethyl acetal groups, like in abelioside A methyl acetal, abeliforoside C, abeliforoside E, cantleyoside dimethyl acetal, cocculoside, dipsanoside J, saugmaygasoside D, sylvestroside III dimethyl acetal, sylvestroside IV dimethyl acetal, triplostoside A and tripterospermumcin B methyl acetal or having methyl ester, ethyl and butyl groups, like in aldosecolohanin B, atropurpurins A–B, pterocesides A–C, cornuside K, hookerinoid A, hookerinoid B, pterhookeroside and tricoloroside methyl ester. Given the methodologies adopted for their extraction and isolation, these compounds are likely to be artifacts [239], even if they are often found, thus evidencing their extreme ease of formation. Yet, these have not been considered as artifacts but as natural. It is not very simple to establish which is correct, but this whole situation can be easily solved by a simple analytical procedure constituted of steps of maceration, separation and identification using non-corresponding solvents, meaning not methanol for methyl acetal, dimethyl acetal and methyl ester compounds and not ethanol and butanol for ethylated and butylated compounds. The presence of these functional groups in the same compounds obtained following this way will be clear evidence of the fact they are not artifacts. In this sense, this topic may also be an involved line for future research. Another detected issue regards (E)-aldosecologanin and centauroside. Indeed, they are often considered as different compounds, but they present the same structure, and thus, they are the same compound. In the future, more attention must be paid to this aspect. Another issue is surely the need for major harmonization on the names of these compounds. This has been widely shown for the compounds named GI-3 and GI-5 in this paper. Actually, in others, they are named GI-3 and GI-5 or GL-3 and GL-5, but they are all the same. One single name for each compound is compulsory in order to avoid confusion and possible identification mistakes. Lastly, it is important to underline that most of the existing *bis*-iridoids have trivial names but not in a few cases: dimer of alpinoside and alpinoside, dimer of aperuloside and asperulosidic acid, dimer of paederosidic acids, dimer of paederosidic acid, and paederoside, dimer of paederosidic acid and paederoside, dimer of paederosidic acid and paederoside, but this should always be encouraged, since it can really diminish the possibility of giving different names to the same structure, considering them to be new when they are not. The most fitting example of this is the compound named in this review as iridoid glycoside dimer I.

The most present compound in plants is cantleyoside, which has been reported in twenty-one different species belonging to ten different genera and four different families. Its highest occurrence is in four different genera (Cephalaria, Dipsacus, Pterocephalus and Strychnos), whereas, in two genera (Abelia and Lomelosia), its presence is singular. Conversely, several compounds have been found in single species. The presence of specific compounds in different species of the same genus, in different genera of the same family and in different families of the same order is extremely important, since it allows the individuation of chemophenetic markers at these levels. On the contrary, the presence of specific compounds in single species has no chemophenetic relevance due to their extremely limited distribution. The compound with the highest number of reports in the same species is centauroside in Lonicera japonica with twenty-three citations. Centauroside is also the compound with the highest number of studies for different populations of the same species (Lonicera japonica) collected in different countries. The multiple presence of the same compound at every classification level confirms that this compound is usually biosynthesized here, which is extremely important under the chemophenetic standpoint, potentially considering it as a chemophenetic marker.

For what concerns the organs of the species studied, flowers, flower buds, seeds, twigs, leaves, stems, stem bark, bark, wood, heartwood, roots and rhizomes have all been mentioned. A combination of two different organs has also been studied (stems and leaves, leaves and branches, flowers and twigs, bark and wood and roots and rhizomes), as well as more organs (whole plant, aerial parts, flowering aerial parts, foliage and underground parts). In some papers, the organs studied have been dried (generally, in the open air) prior to the phytochemical analysis, as dictated by the local Pharmacopeias (roots of *Dipsacus inermis*, flower buds and roots of *Lonicera* spp. and dried fruits of *Ligustrum* spp.). In all the other cases, the organs were fresh. For non-volatile secondary metabolites like *bis*-iridoids, the renowned issue regarding the utilization of dried or fresh organs for the phytochemical analysis is not so relevant given that they are generally stable at high temperatures but not too high [240,241].

For what concerns the collection areas of the species, all the continents are included. The highest number of reports where *bis*-iridoids have been found is in Asian countries, with China as the most numerous. The countries with the highest numbers of reports are Italy for Europe, Algeria for Africa, the USA for America and New Caledonia for Oceania. On the other hand, some countries (Montenegro, Namibia and Tanzania) have been mentioned only once. The number of reports for the occurrence of *bis*-iridoids in the plants of different territories is strictly correlated with the number of species in the territory that biosynthesize them, but it is not an absolute mirror of their worldwide distribution, since this also depends on their search. Either way, a little parallelism between the distribution of iridoids and *bis*-iridoids is present [242].

For what concerns the methodologies for the extraction, isolation and identification of *bis*-iridoids, classical procedures have been utilized. Maceration has been the most common extraction method. Column chromatography and HPLC techniques have been mostly employed as separation methodologies, whilst different spectroscopic and spectrometric techniques together have been used for the identification. All these methods are widely accepted for the analysis of non-volatile metabolites, not causing big issues, except for those previously discussed.

The structures of all the fully characterized *bis*-iridoids isolated from plants are reported in Figures 1–35.



Figure 1. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 1.



Figure 2. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 2.



Figure 3. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 3.



Figure 4. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 4.



 $R_1 = OH, R_2 = caffeoyl: 5-hydroxy-2"'-O-caffeoyl-caryocanoside B$ $<math>R_1 = H, R_2 = (E)$ -p-coumaroyl: 2"'-O-(E)-p-coumaroyl- caryocanoside B $R_1 = Me, R_2 = (Z)$ -p-coumaroyl: 2"'-O-(Z)-p-coumaroyl- caryocanoside B

Figure 5. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 5.



Figure 6. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 6.


Figure 7. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 7.



Figure 8. Structures of *bis*-iridoids in plants—iridoid plus iridoid part 8.



Figure 9. Structures of *bis*-iridoids in plants—iridoid plus *seco*-iridoid part 1.



Figure 10. Structures of *bis*-iridoids in plants—iridoid plus *seco*-iridoid part 2.



Figure 11. Structures of *bis*-iridoids in plants—iridoid plus *seco*-iridoid part 3.



Figure 12. Structures of *bis*-iridoids in plants—iridoid plus *seco*-iridoid part 4.



Figure 13. Structures of *bis*-iridoids in plants—iridoid plus *seco*-iridoid part 5.



Figure 14. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 1.



Figure 15. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 2.



Figure 16. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 3.



Figure 17. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 4.



Figure 18. Structures *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 5.



Figure 19. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 6.



Figure 20. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 7.



Figure 21. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 8.



Figure 22. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 9.



Figure 23. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 10.



Figure 24. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 11.



Figure 25. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 12.



Figure 26. Structures of *bis*-iridoids in plants—*seco*-iridoid plus *seco*-iridoid part 13.



Figure 27. Structures of *bis*-iridoids in plants—non-glucosidic iridoid plus non-glucosidic iridoid.



Figure 28. Structures of *bis*-iridoids in plants—non-glucosidic iridoid plus non-glucosidic *seco*-iridoid.



Figure 29. Structures of *bis*-iridoids in plants—iridoid plus non-glucosidic iridoid.



Figure 30. Structures of *bis*-iridoids in plants-non-glucosidic iridoid plus *seco*-iridoid part 1.



Figure 31. Structures of bis-iridoids in plants-non-glucosidic iridoid plus seco-iridoid part 2.



Figure 32. Structures of non-conventional *bis*-iridoids in plants—part 1.



Figure 33. Structures of non-conventional *bis*-iridoids in plants—part 2.



Figure 34. Structures of non-conventional *bis*-iridoids in plants-part 3.



Figure 35. Structures of non-conventional bis-iridoids in plants - part 4.

The dimer of alpinoside and alpinoside, the dimer of nuezhenide and 11-methyl-oleoside, the dimer of oleoside and 11-methyl-oleoside, demethyl-hydroxy-oleonuezhenide, demethyl-oleonuezhenide, hydroxy-oleonuezhenide and oleoneonuezhenide have not been fully characterized, and their structures have not been drawn. This may surely be an argument for future research. Additionally, the structures of premnaodoroside F and premnaodoroside G have not been drawn, since they are constituted by two isomers.

3. Chemophenetic Evaluation of bis-Iridoids

As Table 1 clearly displays, bis-iridoids have been found in many families: Apiaceae Lindl., Aquifoliaceae Bercht. & J.Presl, Bignoniaceae Juss., Calyceraceae R.Br. ex Rich., Caprifoliaceae Juss., Cornaceae Bercht. ex J.Presl, Gentianaceae Juss., Goodeniaceae R.Br., Lamiaceae Martinov, Loasaceae Juss., Loganiaceae R.Br. ex Mart., Oleaceae Hoffmanns. & Link, Orobanchaceae Vent., Plantaginaceae Juss., Rubiaceae Juss., Sarraceniaceae Dumort., Stemonuraceae Kårehed and Viburnaceae Raf. Their highest occurrence is in Rubiaceae, reported from fourteen different genera (Adina Salisb., Catunaregam Wolf, Coelospermum Blume, Coptosapelta Korth., Galium L., Gardenia J.Ellis, Gynochthodes Blume, Lasianthus Jack, Morinda L., Mussaenda Burm. ex L., Neonauclea Merr., Paederia L., Palicourea Aubl. and Saprosma Blume), whereas the lowest was in ten families, having been reported in one only genus each (Apiaceae: Heracleum L.; Aquifoliaceae: Ilex L.; Calyceraceae: Acicarpha Juss.; Cornaceae: Cornus L.; Cyperaceae: Cyperus L.; Goodeniaceae: Scaevola L.; Loganiaceae: Strychnos L.; Orobanchaceae: Pedicularis L.; Sarraceniaceae: Sarracenia Tourn. ex L.; Stemonuraceae: Cantleya Ridl.; Viburnaceae: Viburnum L.). Bis-iridoids have been reported in two Bignoniaceae genera (Argylia D.Don and Handroanthus Mattos), in twelve Caprifoliaceae genera (Abelia Gronov., Cephalaria Schrad., Dipsacus L., Linnaea Gronov., Lomelosia Raf., Lonicera L., Patrinia Juss., Pterocephalus Vaill. ex Adans., Scabiosa L., Triosteum L., Triplostegia Wall. ex DC. and Valeriana L.), in six Gentianaceae genera (Centaurium Hill, Fagraea Thunb., Gentiana Tourn. ex L., Gentianella Moench, Swertia L. and Tripterospermum Blume), in five Lamiaceae genera (Caryopteris Bunge, Clinopodium L., Leonotis (Pers.) R.Br. and Premna L., Salvia L.), in two Loasaceae genera (Kissenia R.Br. ex Endl. and Loasa Adans.); in seven Oleaceae genera (Fraxinus Tourn. ex L., Jasminum L., Ligustrum L., Olea L., Osmanthus Lour., Picconia DC. and Syringa L.) and in six Plantaginaceae genera (Anarrhinum Desf., Globularia Tourn. ex L., Kickxia Dumort., Linaria Mill., Picrorhiza Royle ex Benth. and Wulfenia Jacq.). This occurrence is not in perfect agreement with the one for simple iridoids [242]. In fact, several families (Acanthaceae Juss., Actinidiaceae Gilg & Werderm., Apocynaceae Juss., Asteraceae Giseke, Cardiopteridaceae Blume, Celastraceae R.Br., Centroplacaceae Doweld & Reveal, Columelliaceae D.Don, Cucurbitaceae Juss., Cyperaceae Juss., Daphniphyllaceae Müll.Arg., Ericaceae Juss., Escalloniaceae R.Br. ex Dumort., Eucommiaceae Engl., Fabaceae Juss., Euphorbiaceae Juss., Fouquieriaceae DC., Garryaceae Lindl., Gel-miaceae Struwe & V.A.Albert, Gri-liniaceae J.R.Forst. & G.Forst. ex A.Cunn., Hamamelidaceae R.Br, Hydrangeaceae Dumort., Icacinaceae Miers, Lentibulariaceae Rich., Malpighiaceae Juss., Malvaceae Juss., Martyniaceae Horan., Meliaceae Juss., Menyanthaceae Dumort., Metteniusaceae H.Karst. ex Schnizl., Montiniaceae Nakai, Nyssaceae Juss. ex Dumort., Passifloraceae Juss. ex Rous-l, Paulowniaceae Nakai, Pedaliaceae R.Br., Roridulaceae Martinov, Salicaceae Mirb., Sarraceniaceae Dumort., Scrophulariaceae Juss., Stilbaceae Kunth, Stylidiaceae R.Br. Symplocaceae Desf. and Verbenaceae J.St.-Hil.) are absent from Table 1, as well as a myriad of genera [242–245], and this clearly demonstrates that *bis*-iridoids must be separately considered from simple iridoids for biochemical, chemophenetic and pharmacological purposes and that their biosynthesis is only due to genetic factors and not to a combination of genetic and environmental factors.

Simple iridoids are generally considered as chemophenetic markers at different systematic levels from subspecies to orders [242]. The order with the highest occurrence of *bis*-iridoids is Lamiales, presenting a certain parallelism with simple iridoids [242]. From a careful and exhaustive evaluation of Table 1, some chemophenetic markers among *bis*iridoids could be individuated at different levels. In particular, given their distribution, cantleyoside, laciniatosides and sylvestrosides can be used as chemophenetic markers for the Caprifoliaceae family, GI3 and GI5 for the Oleaceae family, oleonuezhenide for the *Ligustrum* genus and (*Z*)-aldosecologanin and centauroside for the *Lonicera* genus. For what concerns the other compounds, some have been reported in single species, while others in too many. For this, at the moment, they do not have the necessary characteristics to act as chemophenetic markers. Yet, future phytochemical studies might be useful in this sense, providing further information.

4. Biological Activities of bis-Iridoids

Table 2 displays the biological activities associated with *bis*-iridoids. These are divided according to the type of activity, considering the methods employed and the effectiveness values of *bis*-iridoids in comparison with the positive controls.

Compound	Type of Biological Ac- tivity	Employed Methodol- ogy or Cells or Strains	Effectiveness Value	Positive Control with Effectiveness Value	Reference
(3 <i>R,5S</i>)-5-carboxy-vin- cosidic acid 22-loganin ester	Anti-inflammatory	Inhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cells	$IC_{50} = 21.3 \ \mu M$	L-NMMA (IC50 = 22.6 µM)	[108]
5-hydroxy-2'''-O- caffeoyl-caryocanoside B	Enzymatic	α-glucosidase	No effect	Acarbose (IC50=3.49 μM)	[10]
7-O-caffeoyl- sylvestroside I	Antioxidant	DPPH ⁻	No effect	Ascorbic acid (IC50 = 6.3 μg/mL)	
		Enterococcus faecalis ATCC1054	MIC = 31.2 μg/mL	Gentamycin (MIC = 16 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	[12]
	Απισαcteriai	Staphylococcus aureus CIP53.154	MIC = 62.5 μg/mL	Gentamycin (MIC = 4 <u>µg/mL</u>) Vancomycin (MIC > 64 µg/mL)	

Table 2. Associated biological activities of all the identified bis-iridoids in plants.

7-O(p-counarcyl)-sylvestroside I $7-O(p-counarcyl)-sylvestroside I $ $Antitumoral $ $Antit$					Gentamycin (MIC = 4	
7-0-(p-cournarcy)!- sylvestroside l sylvestroside l $C(PS4,127) = C(PS4,127) = C(PS4,127$			Escherichia coli CIP54.127	$MIC = 250 \mu g/mL$	μg/mL)	
$7 \cdot O \cdot (p \cdot coumarcy!) \cdot sylvestroside I = 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$				1,110 200 ptg/1112	Vancomycin (MIC > 16	
$7-O-(p-cournaroyi)-sylvestroside 1 = 1 \frac{F-O-(p-cournaroyi)-}{sylvestroside 1} = 1 \frac{F-F-O-(p-cournaroyi)-}{sylvestroside 1} = 1 \frac{F-O-(p-cournaroyi)-}{sylvestroside 1} = 1 \frac{F-O-(p-cournaroyi)-}{sy$					μg/mL)	
$7 \cdot O \cdot (p \cdot coumaroyl) \cdot sylvestroside 1 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaroyl) \cdot sylvestroside 2 \\ 7 \cdot O - (p \cdot coumaro$					Gentamycin (MIC =	
$\frac{p_{ulcrimis}}{r_{ulcrimis}} = \frac{p_{ulcrimis}}{r_{ulcrimis}} = \frac{p_{ulcrimis}}{r_{ulcrimis}$			Staphylococcus	MIC = 31.2 µg/mL	$0.25 \mu\text{g/mL}$	
7-O-(p-coumarcy)-sylvestroside 1 + Initiantorial HT1080 (MTT assay) HIC = 125 µg/mL Antitumoral HT1080 (MTT assay) HCs = 35.9 µg/mL Mushrom anti-tyro- sinase HT1080 (MTT assay) HCs = 35.9 µg/mL Mushrom anti-tyro- No effect $MiC = 6.8µg/mL) + No treported Koji cat (Clos = 6.8 µg/mL) + No treported Koji cat (Clos = 6.8 µg/mL) + No treported Koji cat (Clos = 6.8 µg/mL) + No treported MIC = 31.2 µg/mL + Qg/mL + Qg/mL) + Qg/mL + Qg/mL$			epiaermis		vancomycin (MIC = 4	
$\frac{Pseudomonas}{aeruginosa ATCC9027} MIC = 125 \mug/mL \frac{Pseudomonas}{Pseudomonas} MIC = 125 \mug/mL \frac{Pseudomonas}{Pseudomonas} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC = 16 - \mug/mL)} MIC = 31.2 \mug/mL \frac{Pg/mL}{Vanconycin (MIC = 16 - \mug/mL)} MIC = 31.2 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 31.2 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 31.2 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 31.2 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 16 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mug/mL \frac{Pg/mL}{Vanconycin (MIC > 64 - \mug/mL)} MIC = 125 \mu$					Light Contomucin (MIC = 8	
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			aeruoinosa ATCC9027	MIC = 125 µg/mL	Vancomycin (MIC > 64	
$ \begin{array}{ c c c c c } \hline \hline Antitumoral HT1080 (MTT assay) ICso = 35.9 µg/mL Not reported Kojic acid (ICso = 6.8 µg/mL) \\ \hline \hline Enzymatic sinase No effect No effect Si gy/mL Not reported (Cso = 6.3 µg/mL) \\ \hline \hline Antioxidant DPPH No effect Si gy/mL No effect Si gy/mL Not reported (ICso = 6.3 µg/mL) \\ \hline \hline Antioxidant DPPH No effect Si gy/mL Not reported (MIC = 6.3 µg/mL) \\ \hline \hline \hline Centamycin (MIC = 16 µg/mL) \\ \hline \hline Gentamycin (MIC = 62.5 µg/mL) \\ \hline \hline Gentamycin (MIC = 64 µg/mL) \\ \hline \hline Gentamycin (MIC = 64 µg/mL) \\ \hline \hline Gentamycin (MIC = 64 µg/mL) \\ \hline \hline \hline Gentamycin (MIC = 64 µg/mL) \\ \hline \hline \hline \hline \\ Si aphylococcus aureus \\ CIP53.154 \\ \hline \hline \\ Si aphylococcus eureus \\ CIP54.127 \\ \hline \\ Si aphylococcus eridermis \\ eridermis \\ \hline \hline \\ \hline $					ug/mL)	
$\frac{1}{2^{\prime\prime\prime} - O_{-}(p-coumarcyl)-sylvestroside I} \\ \frac{1}{2^{\prime\prime\prime} - O_{-}(p-coumarcyl)-caryocanoside B} \\ \frac{1}{2^{\prime\prime} - O_{-}(p-coumarcyl)-caryocanoside B} \\ \frac{1}{2^{\prime\prime} - O_{-}(p-coumarcyl)-caryocanoside B} \\ \frac{1}{2^{\prime\prime} - O_{-}(p-coumarcyl)$	-	Antitumoral	HT1080 (MTT assav)	IC ₅₀ = 35.9 µg/mL	Not reported	
$\frac{1}{2} \frac{1}{2} \frac{1}$	-		Mushroom anti-tyro-		Kojic acid (IC ₅₀ = 6.8	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $		Enzymatic	sinase	No effect	μg/mL)	
$\frac{Antioxidant}{(2)-p-coumaroyl-caryocanoside B} \frac{Antioxidant}{(2)-p-coumaroyl-caryocanoside B} \frac{Antioxidant}{(2)-p-coumaroyl-caryocanoside B} \frac{Antioxidant}{(2)-p-coumaroyl-caryocanoside B} \frac{Antioxidant}{(2)-aldosecologanin} \frac{Anti-inflammatory}{(2)-aldosecologanin} Anti$		A		NI (C)	Ascorbic acid (IC50 =	
7-O-(p-coumaroy!)-sylvestroside 1 $7-O-(p-coumaroy!)-sylvestroside 1$ $7-O-(p-coumaroy!)-sylvestroside 1$ $7-O-(p-coumaroy!)-sylvestroside 1$ $7-O-(p-coumaroy!)-sylvestroside 1$ $Antibacterial$ $Accelosecus Anti-Acarbose (ICs=4.32) Anti-Acarbose (ICs=4.32) Acarbose (ICs=4$	_	Antioxidant	DPPH	No effect	6.3 μg/mL)	
7-O-(p-coumaroy!)-sylvestroside I = 1 - 2 matrix (IIC) = 1 - 2 matrix (IIC) = 3 - 1 - 2 matrix (IIC) = 3 - 2 mat	-				Gentamycin (MIC = 16	
$7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I = 125 \mu g/mL$ $7-O-(p-coumaroyl)-sylvestroside I = 11080 (MTT assay) = 1108 ($			Enterococcus faecalis	$MIC = 31.2 \mu g/mI$	μg/mL)	
7-O-(p-coumaroyl)-sylvestroside I $7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I = 0$ $7-O-$			ATCC1054	wite = 51.2 μg/ittL	Vancomycin (MIC > 64	
7-O-(p-coumaroyl)-sylvestroside I $7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $Antibacterial$ $F-cherichia coli (CIP53.154)$ $F-cherichia coli (CIP54.127)$ $F-cherichia coli (C$					μg/mL)	
$7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $Antibacterial$ $Actrose (ICso = 3.49 \\ \mu M$ $Ito = 125 \ \mu g/mL$ $Acarbose (ICso = 3.49 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 3.49 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 3.49 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 4.32 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 4.32 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 4.32 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 4.32 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbose (ICso = 4.32 \\ \mu M$ $Ito = 125 \ \mu G mtibacterial$ $Acarbo$					Gentamycin (MIC = 4	
$\frac{7 - O - (p - \text{coumaroyl})}{\text{sylvestroside I}}$ $\frac{\text{Antibacterial}}{\text{sylvestroside I}}$ $\frac{\text{Bischerichia coli}}{\text{CIP54.127}}$ $\frac{\text{MIC} = 125 \mu\text{g/mL}}{\text{MIC} = 31.2 \mu\text{g/mL}}$ $\frac{\text{Gentamycin (MIC = 4} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Centamycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\frac{\text{Gentamycin (MIC = 8} \\ \mu\text{g/mL})}{\text{Vancomycin (MIC = 8} \\ \mu\text{g/mL})}}$ $\text{G$			Staphylococcus aureus	MIC = 62.5 µg/mL	μg/mL)	[12]
$7-O-(p-coumaroyl)-sylvestroside I$ $7-O-(p-coumaroyl)-sylvestroside I$ $3-Antibacterial$ $Antibacterial$ $Actibacterial$ $Acarbose (ICso = 3.49 \\ \mu M)$ $(2)-aldosecologanin$ $Anti-inflammatory$ $Action In LPS-stimu-lated RAW 264.7$ $Acarbose (ICso = 4.32 \\ \mu M)$ $Acarbose (ICso$			CIP53.154	111C 02.0 µg/112	Vancomycin (MIC > 64	
$\begin{array}{c} \mbox{Figure 1} \\ \mbox{Figure 2} \\ \mbox$		Antibacterial			μg/mL)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $				MIC = $125 \mu g/mL$	Gentamycin (MIC = 4	
$\frac{1}{3} \frac{1}{3} \frac{1}$	7-O-(<i>n</i> -coumaroyl)-		Escherichia coli		μg/mL)	
$\frac{\mu g/mL}{Gentamycin (MIC = 0.25 \ \mu g/mL)}{Gentamycin (MIC = 4 \ \mu g/mL)}$ $\frac{Staphylococcus}{epidermis}$ $MIC = 31.2 \ \mu g/mL \frac{0.25 \ \mu g/mL}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 4 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin (MIC = 8 \ \mu g/mL)}$ $\frac{O(25 \ \mu g/mL)}{Vancomycin ($	sylvestroside I		CIP54.127		Vancomycin (MIC > 16	
$\frac{Staphylococcus}{epidermis} MIC = 31.2 \ \mu g/mL \frac{0.25 \ \mu g/mL)}{Vancomycin (MIC = 4 \\ \mu g/mL)}$ Gentamycin (MIC = 4 $\frac{g/mL}{Vancomycin (MIC = 8 \\ \mu g/mL)}$ Gentamycin (MIC = 8 $\frac{g/mL}{Vancomycin (MIC = 8 \\ \mu g/mL)}$ MIC = 125 \ \mu g/mL \frac{1}{Vancomycin (MIC > 64 \\ \mu g/mL)} Cancomycin (MIC > 64 $\frac{g/mL}{Vancomycin (MIC > 64 \\ \mu g/mL)}$ $\frac{g/mL}{Vancomycin (MIC > 64 \\ \mu g/mL)}$ $\frac{g/mL}{Vancomyc$			Staphylococcus epidermis	MIC = 31.2 μg/mL	μg/mL)	
$MIC = 31.2 \ \mu g/mL) = \frac{0.25 \ \mu g/mL}{Vancomycin (MIC = 4)}$ $\frac{\mu g/mL}{Vancomycin (MIC = 4)}$ $\frac{\mu g/mL}{Vancomycin (MIC = 8)}$ $\mu g/mL$					Gentamycin (MIC = 0.25 ug/mI)	
$\frac{Pseudomonas}{aeruginosa} ATCC9027 \qquad MIC = 125 \ \mu g/mL) \qquad Gentamycin (MIC = 4 \ \mu g/mL) \qquad Gentamycin (MIC = 8 \ \mu g/mL) \qquad Vancomycin (MIC > 64 \ \mu g/mL) \qquad Vancomycin (MIC = 8 \ Vancomycin (IC_{50} = 3.49 \\ \mu M) \qquad (I0) \qquad Vancomycin (IC_{50} = 20.07 \ \mu M) \qquad (I0) \qquad Vancomycin (IC_{50} = 4.32 \\ \mu M) \qquad Vancomyc$					Vancomycin (MIC = 4	
$\frac{Pseudomonas}{aeruginosa ATCC9027} \qquad MIC = 125 \ \mu g/mL \qquad Gentamycin (MIC = 8 \\ \mu g/mL) \\ \hline Vancomycin (MIC > 64 \\ \mu g$					vancontycht (Mic – 4	
$\frac{Pseudomonas}{aeruginosa ATCC9027} MIC = 125 \ \mu g/mL \frac{\mu g/mL}{Vancomycin (MIC > 64 \ \mu g/mL)}$ $\frac{Antitumoral \ HT1080 (MTT assay) \ No effect \ Not reported \ \mu g/mL}{Enzymatic} \frac{Mushroom anti-tyro-sinase}{No effect} \frac{No effect \ \mu g/mL}{No effect} \frac{Kojic acid (ICso = 6.8 \ \mu g/mL)}{\mu M} [10]$ $\frac{2'''-O-(E)-p-coumaroyl-caryocanoside B}{Caryocanoside B} Enzymatic \ \alpha-glucosidase \ Cargue Coisdase \ Cargue Coisdase \ Acarbose (ICso = 3.49 \ \mu M) [10]$ $\frac{Anti-inflammatory}{ICso = 0.38 \ \mu M} \frac{Acarbose (ICso = 3.49 \ \mu M)}{\mu M} [10] $ $Inhibition of NO \ pro-duction in LPS-stimu-ICso = 0.38 \ \mu M \ Mino (ICso = 20.07 \ \mu M) \ ICso = 4.32 \ \mu M \ Mino (ICso = 4.32 \ \mu M) \ Mino ($					$\frac{\mu g/\Pi L}{Contamycin}$	
$\frac{\text{Antitumoral}}{\text{aeruginosa}} \text{ATCC9027} \qquad \text{MIC} = 125 \ \mu\text{g/mL} \qquad \frac{\text{Pg/MEY}}{\text{Vancomycin (MIC > 64}} \\ \mu\text{g/mL}) \qquad \frac{\mu\text{g/mL}}{\mu\text{g/mL}} \\ \frac{\text{Antitumoral}}{\text{Enzymatic}} \qquad \frac{\text{HT1080 (MTT assay)}}{\text{Sinase}} \qquad \text{No effect} \qquad \frac{\text{No reported}}{\mu\text{g/mL}} \\ \frac{\text{Kojic acid (ICs_0 = 6.8)}}{\mu\text{g/mL}} \\ \frac{\mu\text{g/mL}}{\mu\text{M}} \qquad \frac{101}{\mu\text{g/mL}} \\ \frac{2^{\prime\prime\prime}-O_{-}(E)-p\text{-coumaroyl-}}{\text{caryocanoside B}} \qquad \text{Enzymatic} \qquad \frac{\alpha\text{-glucosidase}}{\alpha\text{-glucosidase}} \qquad \frac{\text{No effect}}{\text{IC}_{50} = 0.38 \ \mu\text{M}} \qquad \frac{\text{Acarbose (IC}_{50} = 3.49 \ \mu\text{M})}{\mu\text{M}} \qquad [10] \\ \frac{101}{\mu\text{g/mL}} \\$			Pseudomonas aeruginosa ATCC9027	MIC = 125 μg/mL	ug/mL	
$\frac{\mu g/mL}{\mu g/mL}$ $\frac{2'''-O-(E)-p-coumaroyl-caryocanoside B}{Enzymatic}$ $\frac{\alpha - glucosidase}{\alpha - glucosidase}$ $\frac{\alpha - glucosidase}{1C_{50} = 0.38 \ \mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{I(10)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{I(10)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{I(10)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{I(10)}{\mu M}$ $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ $\frac{I(10)}{\mu M}$ $I(10$					Vancomycin (MIC > 64	
$\frac{\text{Antitumoral}}{\text{Enzymatic}} + \frac{\text{HT1080 (MTT assay)}}{\text{Enzymatic}} + \frac{\text{No effect}}{\text{Sinase}} + \frac{\text{No effect}}{\text{No effect}} + \frac{\text{Not reported}}{\text{Mushroom anti-tyro-sinase}} + \frac{\text{No effect}}{\text{Sinase}} + \frac{\text{Kojic acid (ICs0 = 6.8 } \mu g/mL)}{\mu g/mL} + \frac{(10)^{-1}}{\mu g/mL} + (10)^{-$			8		$\mu g/mL$	
$\frac{1}{10}$ Enzymatic $\frac{Mushroom anti-tyro-sinase}{sinase}$ No effect $\frac{Kojic acid (IC_{50} = 6.8 \ \mu g/mL)}{\mu M}$ [10] 2'''-O-(E)-p-coumaroyl- caryocanoside B Enzymatic α -glucosidase No effect $\frac{Acarbose (IC_{50} = 3.49 \ \mu M)}{\mu M}$ [10] 2'''-O-(Z)-p-coumaroyl- caryocanoside B Enzymatic α -glucosidase IC_{50} = 0.38 \ \mu M $Acarbose (IC_{50} = 3.49 \ \mu M)$ [10] Inhibition of NO pro- (Z)-aldosecologanin $\frac{Anti-inflammatory}{IC_{50} = 0.28 \ \mu M}$ $\frac{Acarbose (IC_{50} = 20.07 \ \mu M)}{IC_{50} = 20.07 \ \mu M}$ [15] Enzymatic α -glucosidase IC_{50} = 0.62 \ \mu M $\frac{Acarbose (IC_{50} = 4.32 \ \mu M)}{\mu M}$	-	Antitumoral	HT1080 (MTT assay)	No effect	Not reported	
$\frac{\text{Enzymatic}}{(Z)-aldosecologanin} = \frac{\text{Enzymatic}}{(Z)-aldosecologanin} = (Z)-(Z)-(Z)-(Z)-(Z)-(Z)-(Z)-(Z)-(Z)-(Z)-$	-	E	Mushroom anti-tyro-	NI (C)	Kojic acid (IC50 = 6.8	
$\frac{2'''-O-(E)-p-\text{coumaroyl-}}{\text{caryocanoside B}} \xrightarrow{\text{Enzymatic}} \alpha-\text{glucosidase} \xrightarrow{\text{No effect}} \frac{\text{Acarbose (IC}_{50}=3.49}{\mu\text{M}} \text{[10]}$ $\frac{2'''-O-(Z)-p-\text{coumaroyl-}}{\text{caryocanoside B}} \xrightarrow{\text{Enzymatic}} \alpha-\text{glucosidase} \overrightarrow{\text{IC}}_{50}=0.38 \mu\text{M} \xrightarrow{\text{Acarbose (IC}_{50}=3.49}{\mu\text{M}} \text{[10]}$ $\frac{\text{Acarbose (IC}_{50}=3.49}{\mu\text{M}} \text{[10]}$ $\frac{10}{\mu\text{M}} [10]$		Enzymatic	sinase	No effect	μg/mL)	
$\frac{\text{caryocanoside B}}{\text{caryocanoside B}} = \frac{\text{Enzymatic}}{\text{Enzymatic}} = \frac{\text{cargucosidase}}{\text{cargucosidase}} = \frac{\text{Ro effect}}{\mu M} = \frac{\mu M}{\mu M} = \frac$	2 ^{····} -O-(<i>E</i>)- <i>p</i> -coumaroyl-	Enzymatic	a alucosidaso	No offect	Acarbose (IC50 = 3.49	[10]
$\frac{2'''-O-(Z)-p-\text{coumaroyl-}}{\text{caryocanoside B}} \xrightarrow{\text{Enzymatic}} \alpha-\text{glucosidase} \xrightarrow{\text{IC}_{50} = 0.38 \mu\text{M}} \xrightarrow{\text{Acarbose (IC}_{50} = 3.49 \\ \mu\text{M})} [10]$ $\frac{\text{Acarbose (IC}_{50} = 3.49 \\ \mu\text{M})}{\text{Inhibition of NO pro-}} \xrightarrow{\text{Acarbose (IC}_{50} = 20.07 \mu\text{M})} \frac{\text{Acarbose (IC}_{50} = 20.07 \mu\text{M})}{\text{Iated RAW 264.7}} = 10$ $\frac{\text{C}_{50} = 0.62 \mu\text{M}}{\text{Enzymatic}} \xrightarrow{\text{Acarbose (IC}_{50} = 4.32 \\ \mu\text{M})} = 10$	caryocanoside B	Enzymatic	a-glucosluase	No effect	μΜ)	[10]
$\frac{(Z)-aldosecologanin}{(Z)-aldosecologanin} = \frac{(Z)-aldosecologanin}{(Z)-aldosecologanin} = (Z)-aldosecologani$	$2^{\prime\prime\prime}$ -O-(Z)-p-coumaroyl-	Enzymatic	a-glucosidase	$IC_{50} = 0.38 \text{ mM}$	Acarbose (IC50 = 3.49	[10]
$(Z)-aldosecologanin \qquad $	caryocanoside B	Litzymatic	u-grucosidase	1C ₅₀ - 0.50 μινι	μΜ)	[10]
$(Z)-aldosecologanin \qquad Anti-inflammatory duction in LPS-stimu- IC_{50} = 7.96 \ \mu M \qquad Mino (IC_{50} = 20.07 \ \mu M) \\ \underline{lated RAW 264.7} \qquad [15] \\ \underline{Carbon Constraint} \\ Carbon Const$			Inhibition of NO pro-			
(Z)-aldosecologanin Iated RAW 264.7 [15] Enzymatic α -glucosidase IC ₅₀ = 0.62 μ M Acarbose (IC ₅₀ = 4.32 μ M)	(Z)-aldosecologanin	Anti-inflammatory	duction in LPS-stimu-	$IC_{50} = 7.96 \ \mu M$	Mino (IC ₅₀ = 20.07 μM)	
Enzymatic α -glucosidase IC ₅₀ = 0.62 μ M Acarbose (IC ₅₀ = 4.32 μ M)			lated RAW 264.7			[15]
		Enzymatic	α -glucosidase	$IC_{50} = 0.62 \ \mu M$	Acarbose (IC $_{50}$ = 4.32	
		, ,	0	•	μΜ)	
ATP-citrate lyase No effect $BMS303141$ (IC ₅₀ = 0.2	Abeliforoside C	Enzymatic	ATP-citrate lyase Acetyl-CoA carbox-	No effect No effect	BMS303141 (IC $_{50} = 0.2$	[21]
Abeliforoside C Enzymatic $\frac{\mu M}{4 \operatorname{cottri} CoA \operatorname{corberry}}$ [21]					μΜ)	
Acetyr-CoA carbox- vlaco No effect ND-630 (IC_{50} = 1.6 nM)					ND-630 (IC50 = 1.6 nM)	
y1050 RMS203141 (IC			ylase		BMS303141 (IC = 0.2	
Abeliforoside D Enzymatic ATP-citrate lyase No effect UM [21]	Abeliforoside D	Enzymatic	ATP-citrate lyase	No effect	uM)	[21]

		Acetyl-CoA carbox-	No effect	ND-630 (IC ₅₀ = 1.6 nM)	
		ATP-citrate lyase	No effect	BMS303141 (IC ₅₀ = 0.2	
Abeliforoside E	Enzymatic	Acetyl-CoA carbox- vlase	No effect	ND-630 (IC $_{50}$ = 1.6 nM)	[21]
		ATP-citrate lyase	No effect	BMS303141 (IC ₅₀ = 0.2 µM)	[01]
Abeliforoside F	Enzymatic	Acetyl-CoA carbox- ylase	No effect	ND-630 (IC ₅₀ = 1.6 nM)	[21]
Abelioside A	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 107% (at the concen- tration of 10 μM)	Damnacanthal (Cell proliferation % = 158% at the concentration of 10μ M)	[23]
Abelioside B	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 129% (at the concen- tration of 10 µM)	Damnacanthal (Cell proliferation % = 158% at the concentration of 10μ M)	[23]
		Caco2 (MTT assay)	$IC_{50} = 5.49 \ \mu M$	Paclitaxel (IC50=2.63 µM)	
Abelioside A methyl ace- tal	Antitumoral	Huh-7 (MTT assay)	$IC_{50} = 8.49 \ \mu M$	Paclitaxel (IC50=1.71 µM)	[24]
		SW982 (MTT assay)	$IC_{50} = 7.91 \ \mu M$	Paclitaxel (IC50=1.99 µM)	
Asperulosidyl-2′b-O- paederoside	Anti-inflammatory	Inhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cells	IC ₅₀ = 49.76 μM	Indomethacin (IC50 = 23.93 µM)	[108]
Atropurpurin A	Enzymatic	α-glucosidase from Saccharomyces cere- visiae	IC ₅₀ = 86.96 µM	Acarbose (IC ₅₀ = 175.00 μM)	[34]
Atropurpurin B	Enzymatic	α-glucosidase from Saccharomyces cere- visiae	IC ₅₀ = 92.59 μM	Acarbose (IC ₅₀ = 175.00 μM)	[34]
Diaman de D	Antincident	Bleaching of the H2O- soluble carotenoid crocin	Low effect (value not reported)	Rutin (value not re- ported) Gallic acid (value not reported)	[27]
Blumeoside B	Antioxidant	DPPH [.]	No effect	Quercetin (value not reported) BHT (value not re- ported)	[37]
Blumeoside D	Antioxidant	Bleaching of the H2O- soluble carotenoid crocin	Low effect (value not reported) Similar effect (value not reported)	Rutin (value not re- ported) Gallic acid (value not reported)	[07]
		DPPH [.]	No effect	Quercetin (value not reported) BHT (value not re- ported)	[37]
		Caco2 (MTT assay)	No effect	Paclitaxel (IC50=2.63 µM)	[24]
Cantleyoside	Antitumoral	Huh-7 (MTT assay)		Paclitaxel (IC50 = 1.71 µM)	
		SW982 (MTT assay)		Paclitaxel (IC ₅₀ = 1.99 μM)	

		A549 (MTT assay)		Florouracil (IC ₅₀ = 0.177 µg/mL)	
		Bel7402 (MTT assay)		Florouracil (IC ₅₀ = 0.542 µg/mL)	
		BGC-823 (MTT assay)		Florouracil (IC ₅₀ = 0.695 µg/mL)	[48]
		HCT-8 (MTT assay)		Florouracil (IC ₅₀ = 0.67 µg/mL)	
		A2780 (MTT assay)		Florouracil (IC ₅₀ = 0.569 µg/mL)	
		MCF-7 (MTT assay)			
		HepG2 (MTT assay)	$IC_{50} > 50 \ \mu M$	Not reported	[61]
		H460 (MTT assay)		1	
-		α -glucosidase from			
	Enzymatic	Saccharomyces cere- visiae	$IC_{50} = 30.2 \ \mu M$	Acarbose (IC ₅₀ = 175.00 μ M)	[34]
-	Neuroprotective	Aβ25–35 induced cell death in PC12 cells	Inhibition % = 23.17% (at the con- centration of 10 μM)	Salvianolic acid B (In- hibition % = 18.28% at the concentration of 10 μ M)	[49]
	Anti inflammatory	Inhibition of NO pro- duction in LPS-acti-	$IC_{50} > 50 \ \mu M$	L-NMMA (IC ₅₀ = 22.6 μM)	[50]
	Anti-initaliinatory	vated RAW264.7 mac- rophage cells	IC ₅₀ = 89.48 μM	L-NMMA (IC50 = 19.36 µM)	[65]
	Anti-arthritic	Inhibition of NO pro- duction in LPS-stimu- lated human rheuma- toid arthritis fibro- blast synovial cells Inhibition of TNF-α production in LPS- stimulated human rheumatoid arthritis fibroblast synovial cells Inhibition of IL-1β/6 production in LPS- stimulated human rheumatoid arthritis fibroblast synovial cells a-glucosidase from	Good effect (values not reported)	Not reported	[115]
_	Enzymatic	Saccharomyces cere- visiae	IC50 = 35.64 µM	Acarbose (IC ₅₀ = 175.00 μM)	[34]
Cantleyoside dimethyl acetal	Antibacterial	Staphylococcus aureus	DIZ = 11 mm	Amoxicillin (DIZ = 21 mm)	
		ATCC25923	11 11111	Clavulanic acid (DIZ = 22 mm)	
		Staphylococcus epider- midis ATCC12228	DIZ = 12 mm	Amoxicillin (DIZ = 21 mm) Clavulanic acid (DIZ = 24 mm)	[70]
		Pseudomonas aeru- ginosa ATCC27853	DIZ = 10 mm	Amoxicillin (DIZ = 25 mm) Clavulanic acid (DIZ = 20 mm)	

				Amoxicillin (DIZ = 22	
		Escherichia coli ATCC25922	DIZ = 10 mm	mm)	
				Clavulanic acid (DIZ =	
				23 mm)	
				Amoxicillin (DIZ = 23	
		Enterobacter cloacae	DIZ = 8 mm	mm)	
		ATCC13047		Clavulanic acid (DIZ =	
				25 mm)	
		7/1 1 - 11		Amoxicillin (DIZ = 24	
		Kiebsiella pneumoniae	DIZ = 10 mm	<u> </u>	
		AICCI3003		Clavulanic acid (DIZ = 22 mm)	
		Candida albicano		Amphotoricin (DIZ -	
			DIZ = 9 mm	23 mm)	
		Candida tronicalis		Amphotericin (DIZ =	
	Antifungal	ATCC13801	DIZ = 10 mm	24 mm)	
		Candida olahrata		Amphotericin (DIZ =	
		ATCC28838	DIZ = 10 mm	25 mm)	
		1 . 1		Acarbose (IC50 = 3.49	[10]
Caryocanoside B	Enzymatic	α -glucosidase	No effect	μ M)	[10]
	Antioxidant	Peroxy-nitrite spiking test	No effect	Not reported	[81]
		Inhibition of NO pro-			
	Anti-inflammatory	duction in LPS-stimu- lated RAW 264.7 α-elucosidase	$IC_{50} = 12.6 \ \mu M$	Mino (IC50 = 20.07 µM)	
					[15]
Centauroside	Enzymatic			Acarbose (IC50 = 4.32	
	Muscle contraction	di gluccostudoc		μΜ)	
		Intestine tissue motil- ity in mice	Relative frequency	Loperamide hydro-	[89]
				chloride (Relative fre-	
			motility $\% = 98.4\%$	quency motility % =	
				$\frac{02.7}{0}$	
		MCF-7	No effect	uM	
				Carbonlatin (IC 50 = 12.5	
Centauroside A	Antitumoral	MDA-MB-453	No effect	uM)	[90]
		3T3-L1		Carboplatin (IC ₅₀ = 16.1	
			$IC_{50} = 152.7 \ \mu M$	μM)	
	A 1			Etoposide (IC50 not re-	[01]
Chrysathain	Antitumoral	HL-60 (MTT assay)	IC50 ~ 70 μg/mL	ported)	[91]
		Inhibition of UVB-in-			
Citrifolinin A 1	Engumetic	duced Transcriptional	No offect	Not reported	[02]
Citilioninin A-1	Enzymatic	Activator Protein-1	no ellect	Not reported	[92]
		activity			
Cocculoside		A549			
	Antitumoral	H157	No effect	Adriamycin (value not	[94]
	7 intituitional	HepG2	No cheet	reported)	
		MCF-7			
	Enzymatic	Acetylcholinesterase	No effect	Tacrine (value not re-	
	J	C-1		ported)	
		Salmonella enterica	No effect	Kanamycin (MIC = 0.39 mg/mL)	[96]
Coptosapside A	side A Antibacterial	dilution method)			
		Tunhimunium LIV 1			
		v8956 (broth microdi			
		lution method)			
		incon menou			

		Pseudomonas aeru-			
		ginosa PA01 (broth			
		microdilution			
		method)			
		Proteusbacillus vulgaris			
		CPCC160013 (broth			
		microdilution			
		method)			
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mycobacterium smeg-			
		matis mc2155 (broth			
		microdilution			
		method)			
		Staphylococcus aureus			
		ATCC25923 (broth			
		microdilution			
		method)			
		Salmonella enterica			
		serovar (broth micro-			
		dilution method)			
		Typhimurium UK-1			
		χ8956 (broth microdi-			
		lution method)			
		Pseudomonas aeru-			
		ginosa PA01 (broth			
		microdilution			
		method)			
		Proteusbacillus vulgaris			
		CPCC160013 (broth		Kanamycin (MIC =	
Coptosapside B	Antibacterial	microdilution	No effect	0.39 mg/mL)	[96]
		method)			
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mycobacterium smeg-			
		<i>matis</i> mc2155 (broth			
		microdilution			
		method)			
		Staphylococcus aureus			
		ATCC25923 (broth			
		microdilution			
		method)			
		Salmonella enterica			
		serovar (broth micro-			
		dilution method)			
		Typhimurium UK-1			
		χ8956 (broth microdi-			
Coptosapside C	Antibacterial	lution method)	No effect	Kanamycin (MIC = 0.39 mg/mL)	[96]
		Pseudomonas aeru-			
		ginosa PA01 (broth			
		microdilution			
		method)			
		Proteusbacillus vulgaris			
		CPCC160013 (broth			

		microdilution			
		method)			
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mycobacterium smeg-			
		<i>matis</i> mc2155 (broth			
		microdilution			
		method)			
		Staphylococcus aureus			
		ATCC25923 (broth			
		microdilution			
		method)			
		Salmonella enterica			
		serovar (broth micro-			
		dilution method)			
		Typhimurium UK-1			
		$\chi 8956$ (broth microdi-			
		lution method)			
		Pseudomonas aeru-			
		ginosa PA01 (broth			
		microdilution			
		method)			
		Proteushacillus vuloaris			
		CPCC160013 (broth			
Coptosapside D	Antibacterial	microdilution	No effect	Kanamycin (MIC =	[96]
Coprosupside D	7 intibucteriui	method)	i to chect	0.39 mg/mL)	[20]
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mucohacterium smeq-			
		matic mc2155 (broth			
		microdilution			
		method)			
		Stanlaylococcus aurous			
		ATCC25022 (broth			
		microdilution			
		microdilution			
		C-lucculturing			
		Saimonella enterica			
		serovar (broth micro-			
		Typnimurium UK-1			
		χ8956 (broth microdi-			
		lution method)			
		Pseudomonas aeru-			
	A	ginosa PAUI (broth		Kanamycin (MIC =	10(1
Coptosapside E	Antibacterial	microdilution	No effect	0.39 mg/mL)	[96]
		method)		U .	
		Proteusbacillus vulgaris			
		CPCC160013 (broth			
		microdilution			
		method)			
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mycobacterium smeg-			
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		<i>matis</i> mc2155 (broth			
		microdilution			
		method)			
		Staphylococcus aureus			
		ATCC25923 (broth			
		microdilution			
		method)			
		Salmonella enterica			
		serovar (broth micro-			
		dilution method)			
		Typhimurium UK-1			
		χ8956 (broth microdi-			
		lution method)			
		Pseudomonas aeru-			
		ginosa PA01 (broth			
		microdilution			
		method)			
		Proteusbacillus vulgaris			
		CPCC160013 (broth	IC -		
Coptosapside F	Antibacterial	microdilution No effect	ic – [96]		
		method))		
		Escherichia coli			
		CICC10003 (broth mi-			
		crodilution method)			
		Mycobacterium smeg-			
		<i>matis</i> mc2155 (broth			
		microdilution			
		method)			
		Staphylococcus aureus			
		ATCC25923 (broth			
		microdilution			
		method)			
		Relative glucose con- Consumption = 0.624 Rosiglitazone (1.33		
Cornuofficinaliside C	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of 10 µM centration of 10	μΜ)		
		Relative glucose con- Consumption = 0.887 Rosiglitazone (1.33		
Cornuofficinaliside D	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of $10 \mu\text{M}$ centration of 10	μM)		
		Relative glucose con- Consumption = 0.595 Rosiglitazone (1.33		
Cornuofficinaliside E	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of $10 \mu\text{M}$ centration of 10	μM)		
		Relative glucose con- Consumption = 1.493 Rosiglitazone (1.33		
Cornuofficinaliside F	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of $10 \mu\text{M}$ centration of 10	μM)		
		Relative glucose con- Consumption = 0.841 Rosiglitazone (1.33		
Cornuofficinaliside G	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of $10 \mu\text{M}$ centration of 10	μM)		
	A	Kelative glucose con- Consumption = 3.249 Kosiglitazone (1.33		
Cornuomicinaliside H	Antialabetic	sumption in insulin- mixi/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of 10 µM centration of 10	<u>μ</u> νι)		
	A	Kelative glucose con- Consumption = 0.704 Kosiglitazone (1.33		
Cornuofficinaliside I	Antidiabetic	sumption in insulin- mM/OD at the con- (mM/OD at the	con- [97]		
		induced HepG2 cells centration of 10 µM centration of 10	μivi)		

Cornuofficinaliside J	Antidiabetic	Relative glucose con- C sumption in insulin-	Consumption = 1.063 mM/OD at the con-	Rosiglitazone (1.33 (mM/OD at the con-	[97]
		induced HepG2 cells	centration of $10 \mu M$	centration of 10 µM)	
Cornuofficinaliside K	Antidiabetic	Relative glucose con- C sumption in insulin- induced HepG2 cells	M/OD at the con- centration of 10 μ M	(mM/OD at the con-	[97]
Cornuofficinaliside L	Antidiabetic	Relative glucose con- C sumption in insulin-	Consumption = 1.886 mM/OD at the con-	Rosiglitazone (1.33 (mM/OD at the con-	[97]
Cornuofficinaliside M	Antidiabetic	Relative glucose con- C sumption in insulin- induced HenG2 cells	Consumption = 0.652 mM/OD at the con- centration of 10 μ M	Rosiglitazone (1.33 (mM/OD at the con-	[97]
	Antidiabetic	Relative glucose con- sumption in insulin- induced HepG2 cells	EC ₅₀ = 15.31 μM	Rosiglitazone (EC ₅₀ = 3.35μ M)	[100]
-	Antioxidant	DPPH	No effect	Trolox (IC ₅₀ = 33.12 μM)	
Cornusdiridoid A		ABTS ^{.+}	IC ₅₀ = 79.24 μM	$\frac{\text{Trolox} (\text{IC}_{50} = 23.2 \mu\text{M})}{\text{A carbose} (\text{IC}_{50} = 276.3 \mu\text{M})}$	
-	Enzymatic	α -glucosidase	$IC_{50} = 243.5 \ \mu M$	μM)	[98]
	Anti-inflammatory	Inhibition of LPS-in- duced NO production in RAW 264.7 cells	IC ₅₀ = 28.87 μM	Indomethacin (IC50 = 48.32 µM)	
	Antioxidant	DPPH	IC ₅₀ = 78.25 μM	Trolox (IC ₅₀ = 33.12	
		ABTS ^{.+}	IC ₅₀ = 44.16 μM	Trolox (IC ₅₀ = 23.2 μ M)	
Cornusdiridoid B	Enzymatic	α -glucosidase	IC ₅₀ = 251.9 μM	Acarbose (IC ₅₀ = 276.3 µM)	[98]
-	Anti-inflammatory	Inhibition of LPS-in- duced NO production in RAW 264.7 cells	IC ₅₀ = 29.52 μM	Indomethacin (IC50 = 48.32 μM)	
	Antioxidant	DPPH	IC50 = 44.89 µM	Trolox (IC ₅₀ = 33.12 µM)	
_		ABTS+	No effect	Trolox (IC ₅₀ = 23.2 μ M)	
Cornusdiridoid C	Enzymatic	α -glucosidase	$IC_{50} = 267.1 \ \mu M$	Acarbose (IC ₅₀ = 276.3 μM)	[98]
-	Anti-inflammatory	Inhibition of LPS-in- duced NO production in RAW 264.7 cells	No effect	Indomethacin (IC50 = 48.32 μM)	
	Antioxidant	DPPH	No effect	Trolox (IC ₅₀ = 33.12 µM)	
_	1 Introduction	ABTS ⁺⁺	IC ₅₀ = 48.99 μM	Trolox (IC ₅₀ = 23.2 μ M)	
Cornusdiridoid D	Enzymatic	α -glucosidase	IC ₅₀ = 516.3 µM	Acarbose (IC ₅₀ = 276.3 μM)	[98]
	Anti-inflammatory	Inhibition of LPS-in- duced NO production in RAW 264.7 cells	IC ₅₀ = 34.12 μM	Indomethacin (IC50 = 48.32 μM)	
	Antioxidant	DPPH ⁻	IC ₅₀ = 36.60 μM	Trolox (IC ₅₀ = 33.12 μM)	
Cornusdiridoid E		ABTS ^{.+}	$IC_{50} = 48.99 \ \mu M$	Trolox (IC ₅₀ = 23.2 μM)	
	Enzymatic	α -glucosidase	No effect	Acarbose (IC ₅₀ = 276.3 μM)	[98]
	Anti-inflammatory	Inhibition of LPS-in- duced NO production in RAW 264.7 cells	No effect	Indomethacin (IC50 = 48.32 μM)	

				$Trolox (IC_{50} = 33.12)$	
	Antioxidant	DPPH	$IC_{50} = 60.17 \ \mu M$	uM)	
		ABTS.+	IC ₅₀ = 17.10 µM	Trolox (IC ₅₀ = 23.2 μ M)	
Cornusdiridoid F	Enzymatic	α -glucosidase	No effect	Acarbose (IC ₅₀ = 276.3 μ M)	[98]
		Inhibition of LPS-in-			
	Anti-inflammatory	duced NO production	IC50 = 26.84 µM	Indomethacin $(IC_{50} = 48.22 \text{ mM})$	
	-	in RAW 264.7 cells	·	48.32 μM)	
		Relative glucose con-		Rosiglitazone (EC=0 =	
	Antidiabetic	sumption in insulin-	No effect	3.35 µM)	[100]
		induced HepG2 cells		0.00 μ	
Cornuside A		Inhibition of the acti-			
	Anti-inflammatory	vation of IL-6-in-	No effect	Genistein (IC ₅₀ = 24.8	[99]
	5	duced STAT3 in		μΜ)	
		HepG2 cells			
		Inhibition of the acti-		Consistein (IC 24.9	
Cornuside B	Anti-inflammatory	vation of IL-6-in-	No effect	Genistein $(IC_{50} = 24.8$	[99]
		HopC2 colls		μινι)	
		Inhibition of the acti			
		vation of II _6_in_		Conistoin (IC 50 = 24.8	
Cornuside C	Anti-inflammatory	duced STAT3 in	$IC_{50} = 11.9 \ \mu M$	uM)	[99]
		HepG2 cells		μινι)	
		Inhibition of the acti-			
		vation of IL-6-in-	IC50 = 79.1 µM	Genistein (IC50 = 24.8 µM)	
Cornuside D	Anti-inflammatory	duced STAT3 in			[99]
		HepG2 cells			
	Antidiabetic	Relative glucose con-		Pagialitazona (EC-a-	
		sumption in insulin-	No effect	$3.35 \mu\text{M}$	[100]
		induced HepG2 cells		5.55 µWI)	
Cornuside E		Inhibition of the acti-	IC ₅₀ = 47.0 µM		[99]
	Anti-inflammatory	vation of IL-6-in-		Genistein (IC ₅₀ = 24.8	
	5	duced STAT3 in		μΜ)	
		HepG2 cells			
		Inhibition of the acti-		Consistein (IC 24.9	
Cornuside F	Anti-inflammatory	duced STAT2 in	$IC_{50} = 29.7 \ \mu M$	Genistein ($IC_{50} = 24.8$	[99]
		HenC2 cells		μινι)	
		Inhibition of the acti-			
		vation of IL-6-in-		Genistein (IC50 = 24.8	
Cornuside G	Anti-inflammatory	duced STAT3 in	$IC_{50} = 27.6 \ \mu M$	uM)	[99]
		HepG2 cells			
		Inhibition of the acti-			
Comucida II	Anti inflorence storm	vation of IL-6-in-	$IC_{-1} = 10.4 \text{ mM}$	Genistein (IC50 = 24.8	1001
Cornuside H	Anti-initaminatory	duced STAT3 in	$1C_{50} = 19.4 \ \mu M$	μΜ)	[99]
		HepG2 cells			
Cornuside I		Inhibition of the acti-			
	Anti-inflammatory	vation of IL-6-in-	$IC_{50} = 21.9 \ \mu M$	Genistein (IC50 = 24.8	[99]
		duced STAT3 in		μΜ)	[22]
		HepG2 cells			
		Inhibition of the acti-			
Cornuside J	Anti-inflammatory	vation of IL-6-in-	IC_{50} = 43.0 μM	Genistein (IC50 = 24.8	[99]
		aucea 51A13 in		μ _M)	
		riepG2 cells			

	Antidiabetic	Relative glucose con- sumption in insulin- induced HepG2 cells	EC ₅₀ = 70.43 μM	Rosiglitazone (EC50 = 3.35 μM)	[100]
Cornuside K	Anti-inflammatory	Inhibition of the acti- vation of IL-6-in- duced STAT3 in HepG2 cells	No effect	Genistein (IC50 = 24.8 µM)	[99]
Cornuside L	Anti-inflammatory	Inhibition of the acti- vation of IL-6-in- duced STAT3 in HepG2 cells	IC_{50} = 12.2 µM	Genistein (IC50 = 24.8 µM)	[99]
Cornuside M	Anti-inflammatory	Inhibition of the acti- vation of IL-6-in- duced STAT3 in HepG2 cells	$IC_{50} = 40.5 \ \mu M$	Genistein (IC50 = 24.8 µM)	[99]
Cornuside N	Anti-inflammatory	Inhibition of the acti- vation of IL-6-in- duced STAT3 in HepG2 cells	IC ₅₀ = 52.6 μM	Genistein (IC50 = 24.8 µM)	[99]
Cornuside O	Anti-inflammatory	Inhibition of the acti- vation of IL-6-in- duced STAT3 in HepG2 cells	$IC_{50} = 71.9 \ \mu M$	Genistein (IC50 = 24.8 µM)	[99]
	Anti-inflammatory	Inhibition of CD11b expression in cyto- chalasin A and f-MLP stimulated neutro- phils	Inhibition % = 1.5% (at the concentration of 50 μM)	Quercetin (No effect) Oleuropein (Inhibition % = 19.5% at the con- centration of 50 μ M)	
		Inhibition of ROS pro- duction in f-MLP stimulated neutro- phils	Inhibition % = 59% (at the concentration of 50 μM)	Quercetin (Inhibition % = 93.2% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 73.7% at the con- centration of 50 μ M)	
Demethyl-hydroxy- oleonuezhenide		Inhibition of IL-8 ex- pression in LPS stim- ulated macrophages	Inhibition % = 47.6% (at the concentration of 50 μM)	Quercetin (Inhibition % = 78.3% at the con- centration of 50 µM) Oleuropein (Inhibition % = 13.5% at the con- centration of 50 µM)	[103]
		Inhibition of IL-10 ex- pression in LPS stim- ulated macrophages	No effect	Oleuropein (Induction % = + 172% at the con- centration of 50 μ M)	
		Inhibition of TNF-α expression in LPS stimulated macro- phages	Inhibition % = 38.1% (at the concentration of 50 μM)	Quercetin (Inhibition % = 91.1% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 71.7% at the con- centration of 50 μ M)	
Demethyl- oleonuezhenide	Anti-inflammatory	Inhibition of CD11b expression in cyto- chalasin A and f-MLP stimulated neutro-	No effect	Quercetin (No effect)Oleuropein (Inhibition $\% = 19.5\%$ at the concentration of 50 μ M)	[103]

phils

				Quercetin (Inhibition	
		Inhibition of ROS pro-	In hibition $0/-44.40/$	% = 93.2% at the con-	
		duction in f-MLP	1000000000000000000000000000000000000	centration of 50 µM)	
		stimulated neutro-	(at the concentration	Oleuropein (Inhibition	
		phils	of 50 µM)	% = 73.7% at the con-	
		r		centration of 50 µM)	
				Quercetin (Inhibition	
				% = 78.2% at the con	
		Inhibition of IL-8 ex-	Inhibition % = 62.3%	70 - 70.5% at the con-	
		pression in LPS stim-	(at the concentration	Centration of 50 µWi)	
		ulated macrophages	of 50 µM)	Oleuropein (Inhibition	
		1 0		% = 13.5% at the con-	
				centration of 50 μ M)	
		Inhibition of IL-10 ex-	Induction $\% = +$	Oleuropein (Induction	
		pression in LPS stim-	65.4% (at the concen-	-% = +172% at the con-	
		ulated macrophages	tration of 50 µM)	centration of 50 µM)	
				Quercetin (Inhibition	
		Inhibition of TNF- α	T 1 11 11 0/ 1/ 00/	% = 91.1% at the con-	
		expression in LPS	Inhibition $\% = 16.2\%$	centration of 50 μ M)	
		stimulated macro-	(at the concentration	Oleuropein (Inhibition	
		phages	ot 50 µM)	% = 71.7% at the con-	
		1 0		centration of 50 µM)	
			Inhibition % =	Cisplatin (Inhibition %	
		HeLa (MTT assav)	12 23% (at the con-	= 99.93% at the concen-	[105]
		field (Miff dobdy)	centration of 30 uM)	tration of 30 µM)	[100]
			Inhibition % =	Cisplatin (Inhibition %	
Diagonidin C	Antitumoral	12790 (MTT access)	12.20% (at the con	= 05.02% at the concern	[105]
Dioscontain C	Antitumorai	A2700 (WITT assay)	12.29 % (at the con-	- 50.02 % at the concent-	[105]
			L 1 1 0/		
			Inhibition $\% =$	Cisplatin (Inhibition %	54 O = 1
		T47D (MTT assay)	33.42% (at the con-	= 57.95% at the concen-	[105]
			centration of 30 µM)	tration of 30 µM)	
		A549 (MTT assav)		Florouracil (IC ₅₀ = 0.177	
			-	μg/mL)	
		Bol7402 (MTT assaw)		Florouracil (IC ₅₀ = 0.542	
		Den 402 (WITT ussuy)	_	μg/mL)	
Dinanacida C	Antitumoral	PCC 972 (MTT access)	No effect	Florouracil (IC50 = 0.695	[48]
Dipsatioside C	Annumora	DGC-025 (MITT assay)		μg/mL)	
			-	Florouracil (IC50 = 0.67	
		HC1-8 (M11 assay)		μg/mL)	
			-	Florouracil (IC ₅₀ = 0.569	
		A2780 (MTT assay)		ug/mL)	
				Florouracil (IC ₅₀ = 0.177	
		A549 (MTT assay)		ug/mL)	
			-	$\frac{\mu g}{\Pi L}$ Florouracil (IC ₅₀ = 0.542	
		Bel7402 (MTT assay)		ug/mI)	
			-	$\frac{\mu g/\Pi L}{Element a cil (IC = -0.605)}$	
Dipsanoside D	Antitumoral	BGC-823 (MTT assay)	No effect	1101001100110011001000000000000000000	[48]
-			-	μg/mL)	
		HCT-8 (MTT assay)		Florouracil ($IC_{50} = 0.67$	
			-	μg/mL)	
		$\sqrt{2780}$ (MTT access)		Florouracil (IC ₅₀ = 0.569	
		AZ/00 UVIT I assavi		(*)	
		A2700 (WITT assay)		μg/mL)	
		A 549 (MTT accar)		μg/mL) Florouracil (IC50 = 0.177	
		A549 (MTT assay)		μg/mL) Florouracil (IC50 = 0.177 μg/mL)	
Dinconceido E	A ptitum and	A549 (MTT assay)	No offert	$\mu g/mL)$ Florouracil (IC ₅₀ = 0.177 $\mu g/mL)$ Florouracil (IC ₅₀ = 0.542	[40]
Dipsanoside E	Antitumoral	A549 (MTT assay) Bel7402 (MTT assay)	No effect	$\mu g/mL)$ Florouracil (IC ₅₀ = 0.177 $\mu g/mL)$ Florouracil (IC ₅₀ = 0.542 $\mu g/mL)$	[48]
Dipsanoside E	Antitumoral	A549 (MTT assay) Bel7402 (MTT assay)	No effect	$\mu g/mL)$ Florouracil (IC ₅₀ = 0.177 $\mu g/mL)$ Florouracil (IC ₅₀ = 0.542 $\mu g/mL)$ Florouracil (IC ₅₀ = 0.695	[48]

$\frac{ \mathbf{r}(1-\mathbf{s}_{1}(\mathbf{M}) \mathbf{sssy})}{ \mathbf{A} ^{2} 220 (\mathbf{MTT} \mathbf{sssy})} = \frac{ \mathbf{g}_{1}^{(\mathbf{m}_{1})} }{ \mathbf{B}^{(\mathbf{m}_{1})} } = \frac{ \mathbf{g}_{2}^{(\mathbf{m}_{1})} }{ \mathbf{B}^{(\mathbf{m}_{1})} } = \frac{ \mathbf{g}_{2}^{(\mathbf{m}_{1})$					Florouracil (IC50 = 0.67	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			HCT-8 (MTT assay)		μg/mL)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			A2780 (MTT assav)		Florouracil (IC50 = 0.569	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					μg/mL)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			A549 (MTT assay)		Florouracil (IC ₅₀ = 0.177	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					$\frac{\mu g/mL}{Elements and constraints}$	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Bel7402 (MTT assay)		1000000000000000000000000000000000000	
Dipsanoside F Antitumoral BCC-823 (MTT assay) No effect $\mu g(mL)$ Florouraci (ICs = 0.67 $\mu g(mL)$) Florouraci (ICs = 0.59 $\mu g(mL)$) Florouraci (ICs = 0.542 $\mu g(mL)$) Florouraci (ICs = 0.542 $\mu g(mL)$) Florouraci (ICs = 0.67 $\mu g(mL)$) Florouraci (ICs = 0.59 $\mu g(mL)$) Florouraci (ICs = 1.37 μM					Florouracil (IC ₅₀ = 0.695	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dipsanoside F	Antitumoral	BGC-823 (MTT assay)	No effect	μg/mL)	[48]
$\frac{110^{10} (MT1 assay)}{110^{10} (MT1 assay)} = \frac{110^{10} (MT1 assay)}{100^{10} (MT1 assay)} = \frac{100^{10} (MT1 assay)}{100^$			HCT-8 (MTT assau)		Florouracil (IC ₅₀ = 0.67	
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $			A2780 (MTT assay)		Florouracil (IC $_{50}$ = 0.569	
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $			A549 (MTT assay)		1000000000000000000000000000000000000	
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Bel7402 (MTT assay)		μg/mL)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dinsanoside G	Antitumoral	BGC-823 (MTT assay)	No effect	Florouracil (IC50 = 0.695	[48]
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dipsuitostae G	7 intitumorui	buc 020 (WH I ussuy)	No ellect	μg/mL)	[10]
			HCT-8 (MTT assay)		Florouracil (IC ₅₀ = 0.67	
$\frac{A2780 (MTT assay)}{\mu g/mL}$ $\frac{A2780 (MTT assay)}{\mu g/mL}$ $\frac{\mu g/mL}{\mu g/mL}$ $$					$\frac{\mu g/mL}{Elements}$	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			A2780 (MTT assay)		$\mu g/mL$	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			Inhibition of LPS-in-		(19/112)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Dinconocido I	Anti inflammatawa	duced NO production	No offect	Not reported	[106]
$\frac{phages}{phages} = \frac{phages}{phages} = ph$	Dipsanoside j	Anti-initiation y	in RAW264.7 macro-	No effect	Not reported	[100]
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			phages			
Dipsanoside MAntiviralDifference croplate screening as- say)ICso = 84.03 μ MDiatcatein (ICso = 1.37 μ M)[107]Dipsanoside NAntiviralHIV-1 integrase inhibition activities (mi- croplate screening as- say)ICso = 92.67 μ MBaicalein (ICso = 1.37 μ M)[107]Dipsanoside NAntiviral $\frac{A549}{H157}$ HE77No effectBaicalein (ICso = 1.37 μ M)[107]DipasaperineEnzymaticAcetylcholinesterase MCF-7No effectBaicalein (ICso = 1.37 μ M)[107]DipasaperineEnzymaticAcetylcholinesterase rophage cellsNo effectTacrine (value not reported) μ M)[94]Disperoside AEnzymaticAcetylcholinesterase rophage cellsNo effectTacrine (value not reported) μ M)[108]Disperoside BEnzymaticA-glucosidaseICso > 50 μ MNot reported[109]Disperoside BEnzymaticA-glucosidaseICso > 50 μ MNot reported[109]EnzymaticMMP-2ICso < 100 μ MDoxycycline (ICso > 100 μ M[122]GI-3Inhibition of IL-2 pro- Inhibition of IL-2 pro- Inhibition of IL-2 pro- Inhibition of IL-2 pro- Inhibition of IL-2 pro-Inhibition of IL-2 pro- Inhibition of IL-2 pro- Inhibition of IL-2 pro-Inhibition of IL-2 pro-			HIV-1 integrase inhi-		Paiaelain (IC 1.27	
Error area From the stretching as say) μm) Dipsanoside N Antiviral HIV-1 integrase inhibition activities (microplate screening assay) IC ₃₀ = 92.67 μM Baicalein (IC ₃₀ = 1.37 μM) [107] Dipasaperine Antitumoral HI57 No effect Adriamycin (value not reported) [94] Dipasaperine Enzymatic Acetylcholinesterase No effect Tacrine (value not reported) [94] Dipasaperine Enzymatic Acetylcholinesterase No effect Tacrine (value not reported) [94] Dipasaperine Enzymatic Acetylcholinesterase No effect Tacrine (value not reported) [94] Dipasaperine Enzymatic Acetylcholinesterase No effect Tacrine (value not reported) [108] Dipasaperine Enzymatic Acetylcholinesterase No effect Tacrine (value not reported) [108] Dipasaperine Enzymatic A-glucosidase IC ₅₀ > 50 μM Not reported [109] Disperoside A Enzymatic A-glucosidase IC ₅₀ > 50 μM Not reported [109] Disperoside B Enzymatic A-glucosidase IC ₅₀ < 100 μM	Dipsanoside M	Antiviral	croplate screening as-	$IC_{50} = 84.03 \ \mu M$	Balcalein $(IC_{50} = 1.37)$	[107]
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$\frac{say)}{Antitumoral} + \frac{A549}{H157} + \frac{A549}{H157} + \frac{Adriamycin (value not reported)}{P(94)} + \frac{P(94)}{P(94)} + \frac$	Dipsatioside iv	2 unuvitar	croplate screening as-	ic ₅₀ - <i>γ</i> 2.07 μινι	μΜ)	[107]
$\frac{A549}{H157}$ $\frac{A549}{H157}$ $\frac{H262}{MCF-7}$ $\frac{Action of H2}{MCF-7}$ $\frac{Action of NO effect}{MCF-7}$ $\frac{Action of NO effect}{Ported}$ $\frac{Facrine (value not reported)}{Ported}$ $Facrine (valu$			say)			
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DipasaperineEnzymaticAcetylcholinesteraseNo effectTacrine (value not reported)Mti-inflammatoryInhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cellsL-NMMA (IC50 = 22.6 µM)[108]Disperoside AEnzymaticA-glucosidaseIC50 > 50 µMNot reported[109]Disperoside BEnzymaticA-glucosidaseIC50 > 50 µMNot reported[109]Disperoside BEnzymaticA-glucosidaseIC50 > 50 µMNot reported[109]GI-3Inhibition of IL-2 pro- duction in T-actionalInhibition of IL-2 pro- duction in T-actionalDosycycline (IC50 > 100 µM[122]		Antitumoral	HenG2	No effect	reported)	
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Anti-inflammatoryInhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cellsIC50 = 20.5 μML-NMMA (IC50 = 22.6 μM)[108]Disperoside AEnzymaticA-glucosidaseIC50 > 50 μMNot reported[109]Disperoside BEnzymaticA-glucosidaseIC50 > 50 μMNot reported[109]EnzymaticMMP-2IC50 < 100 μM	Dipasaperine	Enzymatic	Acetylcholinesterase	No enect	ported)	
Anti-inflammatory duction in LPS-activated RAW264.7 mac-rophage cells IC50 = 20.5 µM L-NMMA (IC50 = 22.6 µM) [108] Disperoside A Enzymatic A-glucosidase IC50 > 50 µM Not reported [109] Disperoside B Enzymatic A-glucosidase IC50 > 50 µM Not reported [109] Enzymatic MMP-2 IC50 < 100 µM			Inhibition of NO pro-			
MMP-9 IC50 < 100 μM Doxycycline (IC50 > 100 μM GI-3 Inhibition of IL-2 pro-		Anti-inflammatory	duction in LPS-acti-	$IC_{50} = 20.5 \ \mu M$	L-NMMA ($IC_{50} = 22.6$	[108]
Disperoside A Enzymatic A-glucosidase IC ₅₀ > 50 µM Not reported [109] Disperoside B Enzymatic A-glucosidase IC ₅₀ > 50 µM Not reported [109] Enzymatic MMP-2 IC ₅₀ < 100 µM Doxycycline (IC ₅₀ >100 µM) [122] GI-3 Inhibition of IL-2 pro- buting in T-acting to d			rophage cells		μινι)	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Disperoside A	Enzymatic	A-glucosidase	$IC_{50} > 50 \ \mu M$	Not reported	[109]
$\frac{\text{MMP-2}}{\text{MMP-9}} \frac{\text{IC}_{50} < 100 \mu\text{M}}{\text{IC}_{50} > 100 \mu\text{M}} \frac{\text{Doxycycline (IC}_{50} > 100 \mu\text{M})}{\mu\text{M}} $ [122] GI-3 Inhibition of IL-2 pro-	Disperoside B	Enzymatic	A-glucosidase	$IC_{50} > 50 \ \mu M$	Not reported	[109]
GI-3 $\frac{MMP-9}{IC_{50} < 100 \ \mu M} \qquad \mu M$		Fnzymatic	MMP-2	IC50 < 100 µM	Doxycycline (IC50 >100	[122]
GI-3 Inhibition of IL-2 pro-		Enzymane	MMP-9	$IC_{50} < 100 \ \mu M$	μΜ)	[122]
and a set of a set of the set of a set	GI-3		Inhibition of IL-2 pro-			
Immunosupressive colls after treatment No effect Not reported [121]		Immunosupressive	auction in 1 activated	No effect	Not reported	[121]
with PMA			with PMA			

		Adipogenesis inhibi- tion	Inhibition % = 2.1% (at the concentration of 1 mg/mL)	Not reported	
	Weight losing	Activation of PPARα- mediated pathways	Activation $\% = 21.0\%$ (at the concentration of 10^{-4} M)	WY14,643 (Activation $\% = 100\%$ at the con- centration of 10^{-5} M)	[115]
		GTS inhibition in 3T3- L1 preadipocytes	No effect	Not reported	
	Pain killing	Induction of ERK and CREB phosphoryla- tion in primary corti- cal neuron	No effect	Not reported	[116]
		Adipogenesis inhibi- tion	Inhibition % = 100% (at the concentration of 1 mg/mL)	Not reported	
GI-5	Weight losing	Activation of PPARα- mediated pathways	Activation % = 14.2% (at the concentration of 10^{-4} M)	WY14,643 (Activation % = 100% at the con- centration of 10^{-5} M)	[115]
		GTS inhibition in 3T3- L1 preadipocytes	No effect	Not reported	
		Inhibition of CD11b expression in cyto- chalasin A and f-MLP stimulated neutro- phils	Inhibition % = 12.8% (at the concentration of 50 μM)	Quercetin (No effect) Oleuropein (Inhibition % = 19.5% at the con- centration of 50 µM)	
	Anti-inflammatory	Inhibition of ROS pro- duction in f-MLP stimulated neutro- phils	Inhibition % = 59% (at the concentration of 50 μM)	Quercetin (Inhibition % = 93.2% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 73.7% at the con- centration of 50 μ M)	
Hydroxy-oleonue- zhenide		Inhibition of IL-8 ex- pression in LPS stim- ulated macrophages	Inhibition % = 48.6% (at the concentration of 50 μM)	Quercetin (Inhibition % = 78.3% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 13.5% at the con- centration of 50 μ M)	[103]
		Inhibition of IL-10 ex- pression in LPS stim- ulated macrophages	Induction % = + 58.9% (at the concen- tration of 50 μM)	Oleuropein (Induction % = + 172% at the con- centration of 50 μ M)	
		Inhibition of TNF-α expression in LPS stimulated macro- phages	Inhibition % = 11.8% (at the concentration of 50 μM)	Quercetin (Inhibition % = 91.1% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 71.7% at the con- centration of 50 μ M)	
Hookerinoid A	Anti-inflammatory	Inhibition of NF-kB pathway in a lucifer- ase reporter gene	$LC_{50} = 18 \text{ mM}$	Not reported	[130]
Hookerinoid B	Anti-inflammatory	Inhibition of NF-kB pathway in a lucifer- ase reporter gene	LC ₅₀ = 16 mM	Not reported	[130]
Iso-jaspolyoside A	Antioxidant	DPPH	$EC_{50} = 100 \ \mu g/mL$	BHT (EC ₅₀ = 111 μg/mL)	[135]
Iso-oleonuzhenide	Pain killing	Induction of ERK and CREB	Not reported	Not reported	[116]

$\begin{tabular}{ c c c c c } \hline Prince primary cortical neu-ron $$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$ 00$ $$$$ 00$ $$$ 00$ $$$ 00$ $$$$ 00$ $$$ 00$ $$$$ 00$ $$$ 00$ $$$$ 00$ $$$$ 00$ $$$$ 00$ $$$$$$$						
$\frac{1}{1} \text{ limitunosupressive} \frac{1}{2} limitunosupressive$			phosphorylation in			
Inhibition of IL-2 pro-duction in Tactivatedevels after treatmentwith PMAJasmigeniposide B Antiviral HINIJaponicoside E Anti-inflammatory IPVJaponicoside F Anti-inflammatory IPVAnti-inflammatory IPVJaponicoside F Anti-inflammatory IPVAnti-Inflammatory IPVAnti-Inflammator			primary cortical neu-			
Inhibition of IL-2 pro-duction in Tativatedeells after treatmentwith PMA			ron			
			Inhibition of IL-2 pro-			
		Immunosupressive	duction in T activated	No effect	Not reported	[121]
			cells after treatment		rr	[]
Jasmigeniposide B Antiviral H1N1 H3N2 No effect Not reported [138] Japonicoside E Anti-inflammatory LPS-stimulated Raw 246.7 cells Inhibition % = 28.31% (at the con- Ascorbic acid (ICs = centration of 5 0.88 µg/mL) (ILPS-stimulated Raw 246.7 cells Inhibition % = 28.31% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- centration of 1 µM) (ILPS- 41.75% (at the con- treated BV2 cells (ILPS- 40.37% (at the con- treated BV2 cells (ILP			with PMA			
$ \begin{tabular}{ c c c c c c } \hline Jasonigoniposide B & Antiviral HSN2 & No effect & Not reported [138] \\ \hline FV-1 & Inhibition of PGE2 in \\ Inhibition of PGE2 in \\ IPS-stimulated Raw & No effect & Not reported [137] \\ \hline Mathematical Constraints of the transformation of the transformat$			H1N1	-		
	Jasmigeniposide B	Antiviral	H3N2	No effect	Not reported	[138]
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$			EV-71			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			Inhibition of PGE2 in			
$ \begin{tabular}{ c c c c c } \hline 246.7 cells $$ Inhibition \% = $$ Inhibition \% = $$ 28.31\% (at the con-centration of 5$$ 0.88 µg/mL)$$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	Japonicoside E	Anti-inflammatory	LPS-stimulated Raw	No effect	Not reported	[137]
$ \begin{tabular}{ c c c c c } \hline \begin{tabular}{ c c c c c } \hline \begin{tabular}{ c c c c c c } \hline \begin{tabular}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			246.7 cells			
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$				Inhibition % =		
$ \begin{array}{ c c c c c c } \hline \mbox{Multin} & DPTH & centration of $ 0.88 \mug/mL \\ \mug/mL & \mug/mL & \mug/mL \\ \hline \mbox{multin} & \mug/mL & \mug$		Antiovidant		28.31% (at the con-	Ascorbic acid (IC50 =	
$\begin{tabular}{ c c c c c c } & & & & & & & & & & & & & & & & & & &$		Antioxidant	DFFH	centration of 5	0.88 µg/mL)	
$\begin{tabular}{ c c c c c c c } \label{eq:approx_bis} \end{tabular} \$				μg/mL)		
$ \begin{tabular}{ c c c c c c } eq:control_co$			Inhibition of NO pro-	Inhibition % =	Curcumin (Inhibition	
$ \begin{tabular}{ c c c c c c } \hline Introduction I & Intr$			duction in LPS-	43.15% (at the con-	% = 41.78% at the con-	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			treated BV2 cells	centration of 10 µM)	centration of 1 µM)	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	т · 1 г		Inhibition of TNF- α	Inhibition % = 13.8%	Curcumin (Inhibition	[120]
	Jasnervoside F	Anti-inflammatory	production in LPS-	(at the concentration	% = 60.37% at the con-	[139]
			treated BV2 cells	of 10 µM)	centration of 1 µM)	
			Inhibition of IL-1b	Inhibition % =	Curcumin (Inhibition	
$\frac{1}{142}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{A-549}{HC-78}$ $\frac{HC-78}{BEL-7402}$ $\frac{HC-78}{BEL-7402}$ $\frac{HC-78}{BEL-7402}$ $\frac{HC-78}{BEL-7402}$ $\frac{HC-78}{BHT}$ $\frac{HC-78}{B$			production in LPS-	23.35% (at the con-	% = 46.67% at the con-	
$\frac{A-549}{HC-T8} = No effect = Florouracil (value not reported) = 111 \\ HC-T8} = No effect = Florouracil (value not reported) = 114.0 \\ Florouraci (value not reported) = 104.0 \\ Florouraci (value not repor$			treated BV2 cells	centration of 10 µM)	centration of 1 µM)	
			A-549			
		Antitumoral	HC-T8	No effect	Florouracil (value not	
			BEL-7402	<u> </u>	reported)	
			DDDU		BHT (EC50 = 111	[405]
		Antioxidant	DPPH	$EC_{50} = 711 \mu g/mL$	μg/mL)	[135]
NeuroprotectionNeuroprotectionNGF secretion in C6 cells(at the concentration of 50 µg/mL)6-shogaol (Secretion % = 168.58%)[142]JaspolyosideAntioxidant $DPPH$ $EC_{50} = 51 µg/mL$ $BHT (EC_{50} = 111 µg/mL)$ [135]JaspolyosideSuperoxide anion $EC_{50} = 4.97 µM$ $BHA (EC_{50} = 26.46 µg/mL)$ [144]NeuroprotectionNGF secretion in C6 cellsSecretion % = 171.64 % (at the concentration of 50 µg/mL)[142]KorolkosideToxicityNGF secretion in C6 cellsSecretion % = 171.64 % (at the concentration of 50 µg/mL)6-shogaol (Secretion % = 168.58%)[142]KorolkosideToxicityMiceening (LDs-not cal- culated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureus MurumMIC = 64 µg/mL MIC = 32 µg/mLGentamycin (MIC = 1 µg/mL)[151]Laciniatoside IAntibacterialEscherichia coliMIC = 16 µg/mL MIC = 32 µg/mLGentamycin (MIC = 4 µg/mL)[151]	Jaspolyanoside			Secretion % = 114.4%		
$\frac{1}{1}$ $\frac{1}$		Neuroprotection	NGF secretion in C6	(at the concentration	6-shogaol (Secretion %	[142]
$Iaspolyoside = Iabel Matrix MIC = 64 \mug/mL = Iabel Matrix MIC = 64 \mug/mL = Iabel Matrix MIC = 16 \mug/mL = Iabel MIC = 16 \mug/mL =$		1	cells	of 50 µg/mL)	= 168.58%)	[++++]
$\begin{tabular}{ c c c c c c c } \hline Lec & Si & \mug/mL & [135] \\ \hline \mug/mL & [144] \\ \hline No & effect & \mug/mL & [144] \\ \hline No & effect & \mug/mL & [144] \\ \hline No & effect & \mug/mL & [144] \\ \hline No & effect & \mug/mL & [144] \\ \hline No & effect & \mug/mL & [144] \\ \hline Neuroprotection & NGF secretion in CG \\ cells & cells & cells & cells & (at the concentration of 50 & \mug/mL) & [142] \\ \hline Not lethal but weak- & ening (LDso not cal- culated) & Not reported & [142] \\ \hline Not reported & Staphylococcus aureus & MIC = 64 & \mug/mL & [149] \\ \hline Staphylococcus epider- & midis & MIC = 32 & \mug/mL & [149] \\ \hline Salmonella typhi- & murium & MIC = 64 & \mug/mL & [149] \\ \hline Bacillus cereus & MIC = 16 & \mug/mL & [151] \\ \hline Bacillus cereus & MIC = 16 & \mug/mL & [151] \\ \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$					BHT (EC50 = 111	[105]
Interpretation is the interpretation is th				$EC_{50} = 51 \mu g/mL$	µg/mL)	[135]
AntioxidantNo effect $\mu g/mL$ [144]JaspolyosideSuperoxide anion $EC_{50} = 4.97 \ \mu M$ $BHA (EC_{50} = 16.5 \ \mu g/mL)$ [144]NeuroprotectionNGF secretion in C6 cellsSecretion % = 171.64 % (at the concentra- tion of 50 \ \mu g/mL)6-shogaol (Secretion % = 168.58%)[142]KorolkosideToxicityMiCeening (LD ₅₀ not cal- culated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureus Staphylococcus epider- midisMIC = 64 \ µg/mL MIC = 32 \ µg/mLGentamycin (MIC = 1 µg/mL)[151]Laciniatoside IAntibacterialMIC = 16 \ µg/mL Bacillus cereusMIC = 16 \ µg/mL MIC = 32 \ µg/mL[151]			DPPH		BHA (EC ₅₀ = 26.46	
JaspolyosideSuperoxide anion $EC_{50} = 4.97 \mu M$ $BHA (EC_{50} = 16.5 \mu g/mL)$ [144]NeuroprotectionNGF secretion in CellsSecretion % = 171.64 $\%$ (at the concentration of 50 $\mu g/mL$)6-shogaol (Secretion % = 168.58%)[142]KorolkosideToxicityMiceening (LD50 not calculated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureusMIC = 64 $\mu g/mL$ MIC = 32 $\mu g/mL$ Gentamycin (MIC = 1 $\mu g/mL$)Laciniatoside IAntibacterialEscherichia coliMIC = 16 $\mu g/mL$ [151]Bacillus cereusMIC = 16 $\mu g/mL$ Gentamycin (MIC = 4 $\mu g/mL$)[151]		Antioxidant		No effect	ug/mL)	[144]
$\frac{1}{1} \frac{1}{1} \frac{1}$	Iaspolvoside				BHA (EC ₅₀ = 16.5	
NeuroprotectionNGF secretion in C cellsSecretion % = 171.64 % (at the concentra- tion of 50 µg/mL)6-shogaol (Secretion % = 168.58%)[142]KorolkosideToxicityMiceening (LDso not cal- culated)Not reported[149]KorolkosideToxicityMiceening (LDso not cal- culated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureus MIC = 32 µg/mLMIC = 64 µg/mL µg/mL)Gentamycin (MIC = 1 µg/mL)[151]Laciniatoside IAntibacterialEscherichia coliMIC = 16 µg/mL MIC = 32 µg/mL[151]	,		Superoxide anion	EC50 = 4.97 μM	ug/mL)	[144]
NeuroprotectionNGF secretion in C6 cells% (at the concentra- tion of 50 µg/mL)6-shogaol (Secretion % = 168.58%)[142]KorolkosideToxicityNot lethal but weak- ening (LD50 not cal- culated)Not reported[149]KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureus MIC = 32 µg/mLMIC = 32 µg/mL µg/mL)Gentamycin (MIC = 1 µg/mL)[151]Laciniatoside IAntibacterialMIC = 16 µg/mL Bacillus cereusGentamycin (MIC = 4 µg/mL)[151]				Secretion % = 171.64	10, 1	
cellstion of 50 µg/mL)= 168.58%)t = 1KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]Laciniatoside IAntibacterialStaphylococcus aureus MIC = 32 µg/mLMIC = 64 µg/mL µg/mL)Gentamycin (MIC = 1 µg/mL)Laciniatoside IAntibacterialSalmonella typhi- muriumMIC = 64 µg/mL MIC = 16 µg/mLGentamycin (MIC = 1 µg/mL)Laciniatoside IAntibacterialMIC = 16 µg/mL MIC = 16 µg/mLGentamycin (MIC = 4 µg/mL)[151]		Neuroprotection	NGF secretion in C6	% (at the concentra-	6-shogaol (Secretion %	[142]
KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]Staphylococcus aureusMIC = 64 µg/mLMIC = 32 µg/mLGentamycin (MIC = 1 µg/mL)[151]Laciniatoside IAntibacterialSalmonella typhi- muriumMIC = 16 µg/mL[151]Escherichia coliMIC = 16 µg/mLGentamycin (MIC = 4 µg/mL)[151]		· · · · · · · · · · · · · · · · · · ·	cells	tion of 50 µg/mL)	= 168.58%)	[]
KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]KorolkosideToxicityMiceening (LD50 not cal- culated)Not reported[149]KorolkosideStaphylococcus aureusMIC = 64 µg/mLMIC = 32 µg/mLGentamycin (MIC = 1 µg/mL)Laciniatoside IAntibacterialSalmonella typhi- muriumMIC = 64 µg/mLGentamycin (MIC = 1 µg/mL)Escherichia coliMIC = 16 µg/mLGentamycin (MIC = 4 µg/mL)[151]				Not lethal but weak-		
$ \begin{array}{c} Interview of the construction of the construct$	Korolkoside	Toxicity	Mice	ening (LD50 not cal-	Not reported	[149]
Laciniatoside I Antibacterial Laciniatoside I I I I I I I I I I I I I I I I I I I	Ttorontoorde	roadity	111100	culated)	riorreponeu	[117]
Laciniatoside I Antibacterial Antibacterial Escherichia coli MIC = 32			Stanhylococcus aureus	$MIC = 64 \mu\sigma/mI$		
Laciniatoside IAntibacterial $\frac{midis}{midis}$ MIC = 32 µg/mLGentamycin (MIC = 1 µg/mL)Laciniatoside IAntibacterial $\frac{Salmonella typhi-murium}MIC = 64 µg/mLµg/mL)Escherichia coliMIC = 16 µg/mL[151]Bacillus cereusMIC = 16 µg/mLGentamycin (MIC = 4µg/mL)$			Stanhylococcus enider-			
Laciniatoside IAntibacterialSalmonella typhi- muriumMIC = 64 µg/mLµg/mL) $IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII$			midis	MIC = $32 \mu g/mL$	Gentamycin (MIC = 1	
Laciniatoside IAntibacterial $MIC = 64 \ \mu g/mL$ $\mu g/mL$ [151] $Bacillus cereus$ $MIC = 16 \ \mu g/mL$ $MIC = 4 \ \mu g/mL$ $MIC = 4 \ \mu g/mL$ [151]			Salmonalla tumbi-		ug/mI)	
Laciniatoside IAntibacterial $IIII = 16 \ \mu g/mL$ [151]Escherichia coliMIC = 16 \ \mu g/mLGentamycin (MIC = 4Bacillus cereusMIC = 32 \ \mu g/mL\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \			วนเกเอกอเนน เypni- miirinm	MIC = 64 μ g/mL	M8/1111)	
Escherichu conMIC = 16 μ g/mLGentamycin (MIC = 4Bacillus cereusMIC = 32 μ g/mL μ g/mL)	Laciniatoside I	Antibacterial	Fecherichia coli	$MIC = 16 \mu g/mI$	-	[151]
Diacutas cereasMIC = 10 μ g/mLGentanych (MIC = 4Klebsiella pneumoniaeMIC = 32 μ g/mL μ g/mL)			Bacillus carous	$MIC = 16 \mu g/mL$	Gentamycin (MIC = 4 $\mu\alpha/mI$)	
$Mic = 52 \ \mu g/iiiL \qquad \mu g/iIL \qquad $			Klahojalla manmonia	$MIC = 32 \mu g/mL$		
Contamusin ($MIC = 1$			Reosiena prieumontale	wiie – 52 μg/iiiL	μg/mL)	
Enterococcus faecalis MIC = 16 μ g/mL (MC = 16 μ g/mL)			Enterococcus faecalis	MIC = 16 µg/mL	$\mu g/mL$	

		Dogudomouro		Contomucin (MIC - 2	
		Pseudomonus deru- ginosa	MIC = 16 µg/mL	Gentamycin (MIC = 2 $\mu g/mL$)	
		Caco2 (MTT assay)		Paclitaxel (IC ₅₀ = 2.63 µM)	
Laciniatoside II	Antitumoral	Huh-7 (MTT assay)	No effect	Paclitaxel (IC50=1.71 µM)	[24]
		SW982 (MTT assay)		Paclitaxel (IC50=1.99 µM)	
Laciniatoside V	Enzymatic	α -glucosidase from <i>Saccharomyces cere</i> -	IC ₅₀ = 25.01 µM	Acarbose (IC ₅₀ = 175.00	[34]
	5	visiae	ı	μΜ)	
	Toxicity	Brine shrimp	LC ₅₀ = 150 ppm	Not reported	[160]
	Antifungal	Cladosporium	No effect	Propiconazole (MIC =	[209]
		cucumcvinum	No clieet	1 μg/mL)	[207]
		A549 (MTT assay)		Florouracil (IC ₅₀ = 0.177 $\mu g/mL$)	
Lisianthoside		Bel7402 (MTT assay)		Florouracil (IC ₅₀ = 0.542 µg/mL)	
	Antitumoral	BGC-823 (MTT assay)	No effect	Florouracil (IC ₅₀ = 0.695 µg/mL)	[48]
		HCT-8 (MTT assay)		Florouracil (IC ₅₀ = 0.67 µg/mL)	
		A2780 (MTT assay)		Florouracil (IC ₅₀ = 0.569 µg/mL)	
	Antioxidant	DPPH ⁻	Not reported	Not reported	
Minutifloroside		Candida albicans ATCC90028	MIC = 9.765 μg/mL	Fluconazole (MIC not	[163]
	Antifungai	<i>Candida glabrata</i> ATCC90030	MIC = 1250 μg/mL	reported)	
		Relative glucose con-		Posialitazona (EC-a-	
<i>Neo</i> -cornuside C	Antidiabetic	sumption in insulin- induced HepG2 cells	EC ₅₀ = 1.275 μM	1.127 μM)	[167]
		Relative glucose con-		Rosiglitazone (EC50 =	
<i>Neo</i> -cornuside D	Antidiabetic	sumption in insulin-	No effect	1.127 μM)	[167]
		Relative glucose con-			
<i>Neo</i> -cornuside F	Antidiabetic	sumption in insulin-	$EC_{50} = 40.12 \ \mu M$	Rosiglitazone (EC50 = 3.35 μM)	[167]
		Bacillus cereus	$MIC = 25 \mu g/mL$	Ampicillin (MIC = 6.25	
		Bacillus subtilis	MIC = $12.5 \mu g/mL$	$\mu g/mL$	
Officinaloside A	Antibacterial	Staphylococcus aureus	MIC = 50 μ g/mL	Ampicillin (MIC = 12.5 µg/mL)	[169]
		Escherichia coli	No effect	Ampicillin (No effect)	
		Inhibition of CD11b		Quercetin (No effect)	
Oleonuezhenide		expression in cyto- chalasin A and f-MLP stimulated neutro- phile	Inhibition % = 2% (at the concentration of 50 μM)	^t Oleuropein (Inhibition % = 19.5% at the con- centration of 50 μM)	
	Anti-inflammatory	Pilli5		Ouercetin (Inhibition	[103]
2-2-2-10-10-10-10-10-10-10-10-10-10-10-10-10-		Inhibition of ROS pro-	T 1 11 1.1 0/ 40 -0/	% = 93.2% at the con-	[]
		duction in f-MLP	Inhibition % = 42.4%	centration of 50 µM)	
		stimulated neutro-	(at the concentration	Oleuropein (Inhibition	
		phils	οι 50 μΙΝΙ)	% = 73.7% at the con-	
				centration of 50 μ M)	

		Inhibition of IL-8 ex- pression in LPS stim- ulated macrophages	Inhibition % = 40% (at the concentration of 50 μM)	Quercetin (Inhibition % = 78.3% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 13.5% at the con- centration of 50 μ M)	
		Induction of IL-10 ex- pression in LPS stim- ulated macrophages	Induction % = + 89.6% (at the concen- tration of 50 μM)	Oleuropein (Induction % = + 172% at the con- centration of 50 μ M)	
		Inhibition of TNF-α expression in LPS stimulated macro- phages	Inhibition % = 10.9% (at the concentration of 50 μM)	Quercetin (Inhibition % = 91.1% at the con- centration of 50 μ M) Oleuropein (Inhibition % = 71.7% at the con- centration of 50 μ M)	
	Enzymatic	MMP-2 MMP-9	IC ₅₀ < 100 μM IC ₅₀ < 100 μM	Doxycycline (IC50 >100 µM)	[122]
	Pain killing	Induction of ERK and CREB phosphoryla- tion in primary corti- cal neuron	No effect	Not reported	[116]
	Neuroptrection	6-OHDA-induced in SH-SY5Y cells	Relative protection % = 42.8 (at the con- centration of 10 µg/mL)	EGGG (Relative pro- tection % = 72.0 at the concentration of 10 μg/mL)	[172]
		NGF secretion in C6 cells	Secretion % = 72.39% (at the concentration of 50 µg/mL)	6-shogaol (Secretion % = 168.58%)	[142]
	Ostaogopic	MC3T3-E1 prolifera- tion	Proliferation % = 10% (at the concen- tration of 5 μM)	Alendronate sodium (cell proliferation % = 5% at the concentration of 5 µM)	[175]
	Osteogenie	ALP in MC3T3-E1 cells	Activity % = + 25% (at the concentration of 5 μM)	Alendronate sodium (activity % = + 10% (at the concentration of 5 μ M)	[175]
Paederoscandoside	Anti-inflammatory	Inhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cells	IC ₅₀ = 37.41 μM	Indomethacin (IC50 = 23.93 µM)	[108]
		HL-60 (MTT assay)	IC ₅₀ = 17.9 μM	Cisplatin (IC ₅₀ = 2.8 μ M) Paclitaxel (IC ₅₀ < 0.008 μ M)	
		SMMC-7721 (MTT as- say)	IC ₅₀ = 19.7 μM	Cisplatin (IC ₅₀ = 5.9 μ M) Paclitaxel (IC ₅₀ < 0.008 μ M)	
Patriscabiobisin A	Antitumoral	MCF-7 (MTT assay)	IC ₅₀ = 23.9 μM	Cisplatin (IC ₅₀ = 20.4 μ M) Paclitaxel (IC ₅₀ < 0.008 μ M)	[181]
		SW-480 (MTT assay)	IC ₅₀ = 17.6 μM	Cisplatin (IC ₅₀ = 7.6 μ M) Paclitaxel (IC ₅₀ < 0.008 μ M)	

			Inhibitory % =	Tacrine (Inhibitory % =	
	Enzymatic	Acetylcholinesterase	36.03% (at the con-	51.01% at the concen-	
			centration of 50 µM)	tration of 0.4 μM)	
				Cisplatin (IC50 = 2.8	
		HI 60 (MTT accay)		μΜ)	
		11L-00 (W111 assay)		Paclitaxel (IC50 < 0.008	
				μΜ)	
			-	Cisplatin (IC50 = 5.9	
		SMMC-7721 (MTT as-		μΜ)	
		say)		Paclitaxel (IC50 < 0.008	
				μM)	
	Antitumoral		No effect	Cisplatin (IC ₅₀ = 20.4	
Patriscabiobisin B				uM)	[181]
		MCF-7 (MTT assay)		Paclitaxel (IC ₅₀ < 0.008	[-]
				uM)	
			-	Cisplatin (IC $50 = 7.6$	
				uM)	
		SW-480 (MTT assay)		Paclitaxel ($IC_{50} < 0.008$	
				uM)	
			Inhibitory % =	Tacrine (Inhibitory % =	
	Fnzymatic	Acetylcholinesterase	21.91% (at the con-	51.01% at the concen-	
	Litzymatic	<i>Rectylenomicsterase</i>	centration of 50 µM)	tration of 0.4 µM)	
			centration of 50 µWI)	$\frac{1}{1} \frac{1}{1} \frac{1}$	
				$Cispiani (IC_{50} - 2.0)$	
		HL-60 (MTT assay)	No offect	$\frac{\mu(v)}{Doction of (IC = 0.008)}$	[181]
			no effect	racintaxer (IC50 < 0.000	
			_	µıvı)	[100]
		FIL-00		Circletin (IC _ 5.0	[102]
				Cisplatin ($IC_{50} = 5.9$	[181]
		say)		μM)	
			No effect	Paclitaxel (IC50 < 0.008	
			<u>-</u>	μΜ)	
		SMMC-7721		Not reported	[182]
	Antitumoral		No effect	Cisplatin (IC50 = 20.4	
Patriscabiobisin C		MCF-7 (MTT assay)		μΜ)	[181]
i uniccuciorismi e		wici-7 (with assay)		Paclitaxel (IC50 < 0.008	
				μΜ)	
		MCF-7		Not reported	[182]
				Cisplatin (IC50 = 7.6	
				μΜ)	
		SW-480 (MTT assay)	No effect		[181]
				Paclitaxel (IC50 < 0.008	
-				μΜ)	
		SW-480	No effect	Not reported	[182]
			Inhibitory % =	Tacrine (Inhibitory % =	
	Enzymatic	Acetylcholinesterase	37.87% (at the con-	51.01% at the concen-	[181]
	5		centration of 50 µM)	tration of 0.4 µM)	
Phukettoside A		DDDLI		Ascorbic acid (IC50 =	
		DPPH		32.2 µM)	
		Y 11 · · · 1	-	Allopurinol (IC50 = 4.6	
		Xanthine oxidase		μM)	[183]
	Antioxidant		No effect	Superoxide dismutase	
		HL-60 antioxidant		(Inhibition $\% = 100\%$ at	
			-	the dose of 60 U/mL)	
				Nor-dihydro-guaiaretic	
		LOX		acid $(IC_{12} = 4.5 \text{ m})$	

		Aromatase		Letrozole (IC ₅₀ = 1.4 nM)	
		Superoxide anion		Callic acid (ICro = 2.9	
		radical formation		μ M)	
		(XXO assay)		Deveryhiein (IC	
		say)		$0.79 \ \mu M)$	
		A549 (MTT assay)		Doxorubicin (IC ₅₀ = 0.19μ M)	
		HeLa (MTT assay)		Doxorubicin (IC ₅₀ = 0.16μ M)	
	Antitumoral	HepG2 (MTT assay)	No effect	Doxorubicin (IC ₅₀ = 0.33μ M)	
		MRC-5 (MTT assay)		$\frac{1}{1} \frac{1}{1} \frac{1}$	
		MDA-MB-231		$\frac{1.01 \mu M}{\text{Doxorubicin (IC}_{50} = 1.18 \mu M)}$	
		MOLT-3		Etoposide (IC $_{50}$ = 0.018	
		DPPH·		Ascorbic acid (IC ₅₀ = 32.2 µM)	
		Xanthine oxidase		$\frac{52.2 \ \mu M}{\text{Allopurinol} (\text{IC}_{50} = 4.6)}$	
		HL-60 antioxidant	No effect	Superoxide dismutase (Inhibition % = 100% at the dose of 60 U/mL)	
	Antioxidant	LOX		Nor-dihydro-guaiaretic acid (IC ₅₀ = 4.5 μM)	
		Aromatase		Letrozole (IC ₅₀ = 1.4 nM)	
		Superoxide anion radical formation (XXO assay)		Gallic acid (IC50 = 2.9 µM)	(100)
Phukettoside B		HuCCA-1 (MTT as- say)		Doxorubicin (IC ₅₀ = 0.79 µM)	[183]
		A549 (MTT assay)		Doxorubicin (IC ₅₀ = $0.19 \mu M$)	
		HeLa (MTT assay)		Doxorubicin (IC ₅₀ = 0.16 μM)	
	Antitumoral	HepG2 (MTT assay)	No effect	Doxorubicin (IC ₅₀ = 0.33 µM)	
		MRC-5 (MTT assay)		Doxorubicin (IC ₅₀ = 1.31 µM)	
		MDA-MB-231		Doxorubicin (IC ₅₀ = 1.18 µM)	
		MOLT-3		Etoposide (IC50 = 0.018 µM)	
		DPPH·		Ascorbic acid (IC50 = 32.2 µM)	
Phukettoside C	Antioxidant	Xanthine oxidase		Allopurinol (IC ₅₀ = 4.6 μ M)	
		HL-60 antioxidant	No effect	Superoxide dismutase (Inhibition % = 100% at the dose of 60 U/mL)	[183]
		LOX		Nor-dihydro-guaiaretic acid (IC50 = 4.5 μM)	

		Aromatase		Letrozole (IC ₅₀ = 1.4	
		Superovide anion	-	nM)	
		radical formation		Gallic acid (IC50 = 2.9 µM)	
		HuCCA-1 (MTT as-	- - No effect	Doxorubicin (IC ₅₀ =	
		say)		0.79 μM)	
		A 549 (MTT accost)		Doxorubicin (IC ₅₀ =	
		A349 (W111 assay)		0.19 µM)	
		HeLa (MTT assay)		Doxorubicin (IC ₅₀ =	
		· · · · · · · · · · · · · · · · · · ·		0.16 µM)	
	Antitumoral	HepG2 (MTT assay)		$\frac{0.33 \ \mu\text{M}}{1000}$	
		MRC-5 (MTT assay)		Doxorubicin (IC50 = 1.31 μM)	
		MDA-MB-231	_	Doxorubicin (IC ₅₀ = 1.18 μM)	
		MOLT-3	-	Etoposide (IC ₅₀ = 0.018 μ M)	
		DPPH·		Ascorbic acid (IC ₅₀ =	
			-	<u>32.2 µM)</u>	
		Xanthine oxidase		Allopurinol (IC50 = 4.6	
	Antioxidant	HL-60 antioxidant		Superoxide dismutase	
				(Inhibition $\% = 100\%$ at	
			No offect	the dose of 60 U/mL)	
		LOX	No effect	Nor-dihydro-guaiaretic	
			-	acid (IC ₅₀ = 4.5μ M)	[183]
		Aromatase		Letrozole (IC50 = 1.4 nM)	
		Superoxide anion radical formation		Gallic acid (IC50 = 2.9 µM)	
Phukettoside D		(XXO assay)			
	Antitumoral	HuCCA-I (MII as-		$0.79 \text{ \mu}\text{M}$	
			-	Doxorubicin (IC ₅₀ =	
		A549 (MTT assay)	- No effect	0.19 μM)	
		HeLa (MTT assay)		Doxorubicin (IC ₅₀ = 0.16 μM)	
		HepG2 (MTT assay)		Doxorubicin (IC ₅₀ = 0.33 μM)	
		MRC-5 (MTT assay)		Doxorubicin (IC ₅₀ = 1.31 µM)	
		MDA-MB-231		Doxorubicin (IC ₅₀ = 1.18 µM)	
		MOI T-3		Etoposide (IC ₅₀ = 0.018	
		WICEI-5		μΜ)	
Picconioside I	Enzymatic	A-glucosidase	Inhibition % = 63.8%	Acarbose (Inhibition % = 95.1%)	[185]
		Hyaluronidase	IC50 = 35.8 μg/mL	Disodium cromogly-	[186]
				$\frac{\text{cate (IC50 = 64.8 \mu g/mL)}}{\text{Kototifon fumorate}}$	
Picrorhizaoside E	Enzymatic			$(IC_{50} = 76.5 \text{ µg/mL})$	
				$\frac{10.0 \ \mu g/mL}{10.0 \ \mu g/mL}$	
				μg/mL)	

				Disodium cromogly-	
Picrorhizaoside F				$cate (IC_{50} = 64.8 \ \mu g/mL)$	
	Enzymatic	Hvaluronidase	No effect	Ketotifen fumarate	[186]
)		$(IC_{50} = 76.5 \ \mu g/mL)$	[]
				Tranilast (IC50 = 227	
				μg/mL)	
				Disodium cromogly-	
				cate (IC ₅₀ = 64.8 μ g/mL)	
		Hyaluronidase		Ketotifen fumarate	[186]
Picrorhizaoside G	Enzymatic		No effect	$(IC_{50} = 76.5 \text{ µg/mL})$	
				Trapilast (ICar 227	
				$\frac{11}{11} \frac{11}{11} 11$	
		Caco2 (MTT assav)		Paclitaxel ($IC_{50} = 2.63$	
				μΜ)	
Ptobosido C	Antitumoral	Hub 7 (MTT accast)	No offect	Paclitaxel (IC50 = 1.71	[24]
I tenoside C	Antituliolai		NO effect	μΜ)	[24]
				Paclitaxel (IC50 = 1.99	
		SW982 (MTT assay)		μM)	
				Paclitaxel (IC ₅₀ = 2.63	
		Caco2 (MTT assay)		uM)	
				Paclitaxel (IC $_{50}$ = 1.71	
Ptehoside D	Antitumoral	Huh-7 (MTT assay)	No effect	I defitaxer (Fest 1.71	[24]
		SW982 (MTT assay)		$\frac{\mu(v)}{\mu(v)}$	
				Pacificatel ($IC_{50} = 1.99$	
		· · ·		μΜ)	
		Caco2 (MTT assay)		Paclitaxel ($IC_{50} = 2.63$	[24]
				μΜ)	
Ptehoside F	Antitumoral	Hub-7 (MTT assay)	No effect	Paclitaxel ($IC_{50} = 1.71$	
i tenoside E	7 intituitiofui	man (min usbay)	i to cheet	μΜ)	
		SW082 (MTT access)		Paclitaxel (IC50 = 1.99	
		5 v v 902 (WIII assay)		μΜ)	
	Antitumoral			Paclitaxel (IC50 = 2.63	[24]
		Cacoz (MTT assay)		μΜ)	
			No effect	Paclitaxel ($IC_{50} = 1.71$	
Ptehoside F		Huh-7 (MTT assay)		uM)	
				$\frac{\mu(t)}{Paclitaxel (IC_{50}=1.99)}$	
		SW982 (MTT assay)		I defituxer (Test 1.75	
				Paclitaval (ICro-2.63	
		Caco2 (MTT assay)	No effect	1 actitatel (10.50 - 2.05)	
Ptehoside G	Antitumoral	Huh-7 (MTT assav)		Paclitaxel ($IC_{50} = 1.71$	
		SW982 (MTT assay)		μΜ)	
				Paclitaxel ($IC_{50} = 1.99$	
				μΜ)	
		Caco? (MTT accar)		Paclitaxel (IC50 = 2.63	10.41
		Cacoz (IVIIII assay)		μΜ)	
				Paclitaxel (IC50 = 1.71	
rtenoside H	Antitumoral	Huh-7 (MTT assay)	ino effect	μM)	[24]
		SW982 (MTT assay)		Paclitaxel ($IC_{50} = 1.99$	
				uM)	
		Inhibition of LPS_in		p	
		duced NO production			
Pterocephaline	Anti-inflammatory	in RAW264.7 macro	No effect	Not reported	[101]
•	5	in KAW264.7 macro-			
		phages			
Diama 1D	A set is a	limition of NO re-		Quercetin (IC50 = 22.8	[102]
Pterocenoia B	Anti-inflammatory	iease in KAW264.7	$1C_{50} = 36.0 \mu\text{M}$	μM)	[193]
		macrophages			

		Inhibition of the pro- duction of TNF-α in in LPS-induced RAW264.7 macro- phages	Inhibition % ~ 60% (at the concentration of 50 μM)	Not reported	
		Inhibition of TNF-in- duced NF-κB activa- tion in a luciferase re- porter gene	Not reported	Not reported	[192]
Pterocenoid C	Anti-inflammatory	Inhibition of TNF-in- duced NF-κB activa- tion in a luciferase re- porter gene	Not reported	Not reported	[192]
Pterocenoid E	Anti-inflammatory	Inhibition of NO re- lease in RAW264.7 macrophages	No effect	Quercetin (IC50=22.8 µM)	[193]
Pterocenoid F	Anti-inflammatory	Inhibition of NO re- lease in RAW264.7 macrophages	No effect	Quercetin (IC50=22.8 µM)	[193]
Pterocenoid G	Anti-inflammatory	Inhibition of NO re- lease in RAW264.7 macrophages	No effect	Quercetin (IC50=22.8 µM)	[193]
Pterocenoid H	Anti-inflammatory	Inhibition of NO re- lease in RAW264.7 macrophages	No effect	Quercetin (IC50=22.8 µM)	[193]
Pteroceside A	Enzymatic	α-glucosidase from Saccharomyces cere- visiae	IC50 = 38.46 µM	Acarbose (IC ₅₀ = 175.00 μM)	[34]
Pteroceside C	Enzymatic	α-glucosidase from Saccharomyces cere- visiae	IC ₅₀ = 82.01 μM	Acarbose (IC ₅₀ = 175.00 μM)	[34]
Pubescensoside	Antitumoral	A459 (MTT assay)	$IC_{50} = 13.9 \ \mu g/mL$	Not reported	[194]
		Effect after induction by PAF in rabbits	Aggregation % = 42.9%	BN52021 (Aggregation % = 0.6%)	
Rapulaside A	Platelet aggregation	Effect after induction by AA in rabbits Effect after induction	Aggregation % = 69.2% Aggregation % =	Aspirin (Aggregation % = 4.7%) Aspirin (Aggregation	[200]
		by ADP in rabbits Effect after induction by PAF in rabbits	68.9% Aggregation % = 53.9%	% = 65.9%) BN52021 (Aggregation % = 0.6%)	
Rapulaside B	Platelet aggregation	Effect after induction by AA in rabbits	Aggregation % = 73.6%	Aspirin (Aggregation % = 4.7%)	[200]
		Effect after induction by ADP in rabbits	Aggregation % = 66.8%	Aspirin (Aggregation % = 65.9%)	
Reticunin A	Anti-inflammatory	Inhibition of NO pro- duction in LPS-stimu- lated RAW264.7 mac-	No effect	Indomethacin (IC50 = 46.71 μg/mL)	[201]
Reticunin B	Anti-inflammatory	Inhibition of NO pro- duction in LPS-stimu- lated RAW264.7 mac- rophages	No effect	Indomethacin (IC50 = 46.71 μg/mL)	[201]
Rotunduside	Antibacterial	Inhibitory activity on MRB (chemilumines- cence)	IC50 = 198.09 µmol/L	Rutin (IC50 = 15.07 μmol/L) Dexamethasone (IC50 = 355.14 μmol/L)	[202]

Rotundoside A	Antibacterial	Inhibitory activity on MRB (chemilumines- cence)	IC50 = 217.13 μmol/L	Rutin (IC ₅₀ = 15.07 μ mol/L) Dexamethasone (IC ₅₀ = 355.14 μ mol/L)	[203]
Saprosmoside E	Anti-inflammatory	Inhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cells	No effect	Indomethacin (IC50 = 23.93 μM)	[108]
Saprosmoside F	Anti-inflammatory	Inhibition of NO pro- duction in LPS-acti- vated RAW264.7 mac- rophage cells	IC50 = 39.57 μM	Indomethacin (IC50 = 23.93 µM)	[108]
Saungmaygaoside A	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 79% (at the concen- tration of 10 µM)	-	
Saungmaygaoside B	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 105% (at the concen- tration of 10 µM)	- Damnacanthal (Cell proliferation % = 158%	[23]
Saungmaygaoside C	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 120% (at the concen- tration of 10 μM)	at the concentration of 10 μM)	[-0]
Saungmaygaoside D	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 144% (at the concen- tration of 10 μM)		
Sclerochitonoside C	Insecticidal	Mortality of immature <i>Frankliniella</i> occidentalis	Mortality % = 15% (at the concentration of 0.10 mM)	Not reported	[208]
Seemannoside A	Antifungal	Cladosporium cucumcvinum	No effect	Propiconazole (MIC = 1 µg/mL)	[209]
Seemannoside B	Antifungal	Cladosporium cucumcuinum	No effect	Propiconazole (MIC = $1 \mu g/mL$)	[209]
	Antioxidant	DPPH	No effect	Ascorbic acid (IC ₅₀ = 6.3 µg/mI)	
		Enterococcus faecalis ATCC1054	MIC = 125 μg/mL	Gentamycin (MIC = 16 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	
		Staphylococcus aureus CIP53.154	MIC = 250 μg/mL	Gentamycin (MIC = 4 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	
Septemfidoside	Antibacterial	Escherichia coli CIP54.127	MIC = 500 μg/mL	Gentamycin (MIC = 4 $\mu g/mL$) Vancomycin (MIC > 16 $\mu g/mL$)	[12]
		Staphylococcus epidermis	MIC = 250 μg/mL	Gentamycin (MIC = 0.25 µg/mL) Vancomycin (MIC = 4 ug/mL)	
		Pseudomonas aeruginosa ATCC9027	MIC = 250 μg/mL	Gentamycin (MIC = 8 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	
	Antitumoral	HT1080 (MTT assay)	No effect	Not reported	
	Enzymatic	Mushroom anti-tyro- sinase	No effect	Kojic acid (IC50 = 6.8 μg/mL)	

	Antioxidant	DPPH	No effect	Ascorbic acid (IC ₅₀ = 6.3 µg/mL)	
		Enterococcus faecalis ATCC1054	MIC = 500 µg/mL	Gentamycin (MIC = 16 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	
	Antibacterial	Staphylococcus aureus CIP53.154	MIC = 62.5 μg/mL	Gentamycin (MIC = 4 $\mu g/mL$) Vancomycin (MIC > 64 $\mu g/mL$)	
		Escherichia coli CIP54.127	MIC = 62.5 μg/mL	Gentamycin (MIC = 4 μ g/mL) Vancomycin (MIC > 16 μ g/mL)	[12]
Sylvestroside I		Staphylococcus epidermis	MIC = 125 µg/mL	Gentamycin (MIC = $0.25 \ \mu g/mL$) Vancomycin (MIC = 4 $\mu g/mL$)	
		Pseudomonas aeruginosa ATCC9027	MIC = 125 μg/mL	Gentamycin (MIC = 8 μ g/mL) Vancomycin (MIC > 64 μ g/mL)	
	Antitumoral	HT1080 (MTT assay)	No effect	Not reported	
	Enzymatic	Mushroom anti-tyro- sinase	No effect	Kojic acid (IC50 = 6.8 µg/mL)	
	Spasmolytic	Inhibitory effects on the electrically-in- duced contractions in guinea-pig ileum	Inhibition % > 45% (at the concentration of 0.001 M)	Vancomycin (MIC > 64 µg/mL)	[218]
	Anti inflormatore	Inhibition of NO pro- duction in LPS-acti-	$IC_{50} > 50 \ \mu M$	L-NMMA (IC50 = 22.6 µM)	[50]
	Anti-initaminatory	vated RAW264.7 mac- rophage cells	IC ₅₀ =101.42 μM	L-NMMA (IC ₅₀ = 19.36 µM)	[65]
Sylvestroside III	Spasmolytic	Inhibitory effects on the electrically-in- duced contractions in guinea-pig ileum	Inhibition % > 40% (at the concentration of 0.001 M)	Vancomycin (MIC > 64 µg/mL)	[218]
		Caco2 (MTT assay)	$IC_{50} = 7.27 \ \mu M$	Paclitaxel (IC50=2.63 μM)	
Sylvestroside IV	Antitumoral	Huh-7 (MTT assay)	IC50=11.41 µM	Paclitaxel (IC50 = 1.71 μM)	[24]
		SW982 (MTT assay)	IC ₅₀ = 7.23 μM	Paclitaxel (IC50 = 1.99 µM)	
Sylvestroside IV dime- thyl acetal	Antiviral	Inhibition of the ex- pression of Vpr in TREx-HeLa-Vpr cells	Cell proliferation % = 171% (at the concen- tration of 10 μM)	Damnacanthal (Cell proliferation % = 158% at the concentration of 10 µM)	[23]
		Caco2 (MTT assay)	No effect	Paclitaxel (IC50=2.63 μM)	
	Antitumoral	Huh-7 (MTT assay)	No effect	Paclitaxel (IC50=1.71 μM)	[24]
		SW982 (MTT assay)	No effect	Paclitaxel (IC ₅₀ =1.99 μM)	
Swerilactone A	Antiviral	HBV virus (inhibition of the secretion of	IC ₅₀ = 3.66 mM	Not reported	[215]

		HBsAg in HepG 2.2.15 cells) HBV virus (inhibition of the secretion of HBeAg in HepG 2.2.15 cells)	IC50 = 3.58 mM	_	
Swerilactone B	Antiviral	HBV virus (inhibition of the secretion of HBsAg in HepG 2.2.15 cells) HBV virus (inhibition of the secretion of HBeAg in HepG 2.2.15 cells)	No effect	Not reported	[215]
Swortianocida A	Antiviral	Hepatitis B virus ef- fects (inhibition on the secretion of HBsAg)	IC50 = 0.18 mM	Tenofovir (IC50=1.31 mM)	[217]
Swernanoside A		Hepatitis B virus ef- fects (inhibition on the secretion of HBeAg)	IC50 = 0.12 mM	Tenofovir (IC50= 1.15 mM)	[217]
		Inhibition of NO mus	No effect	Not reported	[106]
	Anti-inflammatory Antitumoral	duction in LPS-acti-	No effect	L-NMMA (IC ₅₀ = 19.36 μM)	[65]
		rophage cells	$IC_{50} > 50 \ \mu M$	L-NMMA (IC50 = 22.6 µM)	[50]
Triplostoside A		A549 (MTT assay) Bel7402 (MTT assay)		Florouracil (IC ₅₀ = 0.177 $\mu g/mL$) Florouracil (IC ₅₀ = 0.542 $\mu g/mL$) Florouracil (IC ₅₀ = 0.695	1401
		HCT-8 (MTT assay) A2780 (MTT assay)	по епест	$\frac{\mu g/mL)}{Florouracil (IC_{50} = 0.67)}$ $\frac{\mu g/mL)}{Florouracil (IC_{50} = 0.569)}$ $\mu g/mL)$	[40]
Valeridoid B	Antitumoral	GSC-3 (MTT assay) GSC-12 (MTT assay) GSC-18 (MTT assay)	No effect	Not reported	[233]
Valeridoid C	Antitumoral	GSC-3 (MTT assay) GSC-12 (MTT assay) GSC-18 (MTT assay)	No effect	Not reported	[233]
Valeridoid D	Antitumoral	GSC-3 (MTT assay) GSC-12 (MTT assay) GSC-18 (MTT assay)	No effect	Not reported	[233]
Valeridoid E	Antitumoral	GSC-3 (MTT assay) GSC-12 (MTT assay) GSC-18 (MTT assay)	No effect	Not reported	[233]
Valeridoid F	Antitumoral	GSC-3 (MTT assay) GSC-12 (MTT assay) GSC-18 (MTT assay)	$IC_{50} = 42.42 \ \mu M$ $IC_{50} = 41.4 \ \mu M$ $IC_{50} = 47.55 \ \mu M$	Not reported	[233]

Legend: DIZ = diameter of inhibition zone; EC₅₀ = half-maximal effective response; IC₅₀ = half-maximal inhibitory concentration; LC₅₀ = half-maximal lethal concentration; MIC = minimum inhibitory concentration.

Only one hundred and fifty-nine bis-iridoids have been studied for their biological activities. The highest number of biological studies has been observed for sylvestroside I, whereas cantleyoside is the compound presenting the highest number of biological studies for the same type. Conversely, only one type of biological assay has been performed for several *bis*-iridoids. Among the types, not all of them have been performed with the enzymatic assay as the major one. Not all the bis-iridoids have shown biological activity, and some have shown activities only for some assays, with effectiveness values both higher and lower than the positive controls when present. No clear preference of *bis*-iridoids for a specific biological activity among the studied ones has been observed, given that they exert, at least, one, except immunosuppressive. However, bis-iridoids have mostly shown anti-inflammatory, antibacterial, antiviral and enzymatic inhibitory effects, which are in perfect agreement with those reported for simple iridoids [9,242]. In-depth structure-activity relation speeches are not so easy to perform at the moment, because biological studies on *bis*-iridoids have been few, too sectorial and generally not specific from this point of view. Nevertheless, a generic conclusion from the careful observation of Table 2 indicates that the presence and the type of substituent, as well as the type of sub-unity, greatly affect the activity and the effectiveness of *bis*-iridoids, as already observed for simple iridoids [9,242]. At the moment, the comparison of the effectiveness values between bis-iridoids and simple iridoids cannot be performed as well, for the same previous reasons but also because some *bis*-iridoids are unconventionally structured (there is no base structure to compare to), almost all *bis*-iridoids are constituted by different sub-units (it is impossible to establish the starting compound) and the bond between the sub-units of *bis*-iridoids transforms the base structure and modifies its geometry (the comparison may not be reliable due to possible different mechanisms of action). Under all these last aspects, it is obvious that *bis*-iridoids need to be further studied.

5. Conclusions

In this review paper, two hundred and eighty-eight *bis*-iridoids have been listed and detailed with their occurrence in plants and the methodologies of extraction, isolation and identification and also one hundred and fifty-nine out of these with their biological activities. The *bis*-iridoids reported so far in the literature are mainly characterized by the link between two *seco*-iridoids sub-units under the structural profile and mostly exert anti-inflammatory, antibacterial, antiviral and enzymatic inhibitory activities, both with good and low effectiveness values. The chemophenetic evaluation has allowed to individuate cantleyoside, laciniatosides, sylvestrosides and GI3 and GI5 as chemophenetic markers for the Caprifoliaceae and Oleaceae families, respectively, and oleonuezhenide and (*Z*)-aldosecologanin and centauroside as chemophenetic markers for the *Ligustrum* and *Lonicera* genus, respectively. Yet, many aspects of *bis*-iridoids are still to be discovered, elucidated and completed, and this review paper, meaning to work as a multi-comprehensive database for the future, has clearly proven this.

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