Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2015; 4(2): 21-39
Received: 14-04-2015
Accepted: 17-05-2015

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Triterpenes and sterols of family Apocynaceae (2013-1955), A review

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Abstract
To present a collection of data regarding the phytochemical content (triterpenes and sterols) of family Apocyanaceae. Literature was collected from various published textbooks and scientific papers, then the required data was summarized and presented in tabulated form. Triterpenes and sterols are two of the major phytochemicals reported in this family. This review presents an overview on the reported phytochemicals (triterpenes and sterols) of family Apocyanaceae.

Keywords: Apocynaceae, triterpenes, sterols.

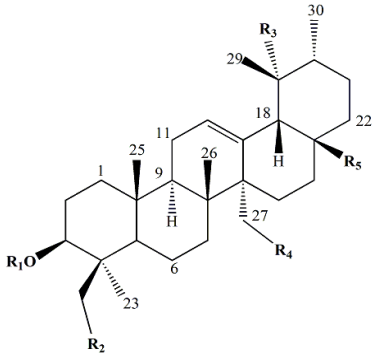
Abbreviations
1-Organ used
Aerial parts (AP.); Barks (B.); Flower (Fl.), Fruits (Fr.); Latex (La.); Leaves (Le.); Leaves and stems (Le.&St.); Leaves and stem barks (Le.&St.B.); Pods (Po.); Rhizomes (Rhi.); Roots (R.); Root barks (RB.); Seeds (Se.); Seed pods (SP.); Stems (St.); Stem barks (St.B.); Whole plants (WP.).

2-Genera of the plants
Adenium (*Ad.*); *Alstonia* (*Als.*); *Alyxia* (*Aly.*); *Amalocalyx* (*Ama.*); *Amsonia* (*Ams.*); *Apocynum* (*Apo.*); *Aspidosperma* (*Asp.*); *Beaumontia* (*Be.*); *Caralluma* (*Cara.*); *Carissa* (*Cari.*); *Catharanthus* (*Cat.*); *Cerbera* (*Cer.*); *Cynanchum* (*Cyn.*); *Dipladenia* (*Di.*); *Ecdysanthera* (*Ecd.*); *Echites* (*Ech.*); *Funtumia* (*Fu.*); *Himatanthus* (*Hi.*); *Holarrhena* (*Ho.*); *Ichnocarpus* (*Ich.*); *Laseguea* (*Las.*); *Mandevilla* (*Ma.*); *Melodinus* (*Mel.*); *Mucoa* (*Mu.*); *Nerium* (*Ne.*); *Parahancornia* (*Par.*); *Peltastes* (*Pel.*); *Pentalinon* (*Pen.*); *Pluberia* (*Plub.*); *Plumeria* (*Plum.*); *Rhazya* (*Rha.*); *Tabernaemontana* (*Ta.*); *Thevetia* (*Th.*); *Trachelospermum* (*Tr.*); *Vinca* (*Vi.*); *Wrightia* (*Wr.*).

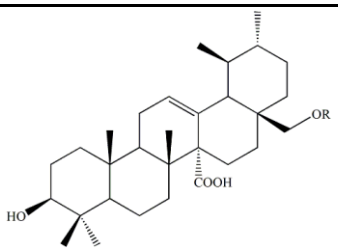
1. Introduction
The family Apocynaceae, which is known as Dogbane family, is a family of about 300 genera and 1300 species [1]. It is primarily distributed in the tropics and subtropics but poorly represented in the temperate regions [2]. It is one of the important latex-forming families [3]. Apocynaceae is divided into five subfamilies: Rauvolfioideae, Apocynoideae, Periplocoideae, Secamonoideae and Asclepiadoideae [4, 5]. It is worthy mentioned that family Apocynaceae is closely related to the Asclepiadaceae [6]. Reviewing the available literature, it was evident that alkaloids of family Apocynaceae have been extensively reported [7]. Triterpenes and sterols are found to be widely distributed in family Apocynaceae, while nothing could be traced about the chemical review of the triterpenes and sterols. This phytochemical review includes the reported triterpenes and sterols, which are isolated from the plants of this family. The data was summarized and recorded in tabulated form.

2. Method
Relevant literatures related to 'triterpenes and sterols from family Apocyanaceae' admissions were obtained from different sources viz., PubMed, Sciencedirect and SciFinder databases. The articles that were published from 2013 to 1955 were collected.

Table 1: A list of isolated triterpenes from family Apocynaceae.

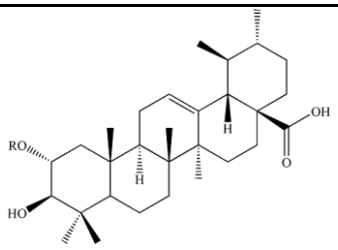
No.	Name	Structure	Source	Organ	Reference
Ia-Ursane type					
					
		R_1 R_2 R_3 R_4 R_5			
1	*α*-Amyrin	**R_1, R_2, R_3, R_4**=H, **R_5**=CH_3	*Als. scholaris*	Fl.	[8]
			Als. scholaris	R.&RB.	[9]
			Mu. duckei	Le.	[10]
			Ich. frutescens	St.	[11]
			Cyn. acutum	WP.	[12]
			Ma. guanabarica	Le.	[13]
			Ma. moricandiana	Le.	[13]
			Be. grandiflora	AP.	[14]
			Ne. oleander	Le.	[15]
			Par. amapa	R.	[16]
			Hi. sucuuba	La.	[17]
			Plum. obtusa	L.	[18]
			Par. amapa	B.&La.	[19]
2	*α*-Amyrin acetate	**R_1**=Acetate, **R_2, R_3, R_4**=H, **R_5**=CH_3	*Als. scholaris*	AP.	[20]
			Als. scholaris	F.	[8]
			Als. scholaris	Le.	[9]
			Als. scholaris	R.&RB.	[9]
			Als. scholaris	St.B.	[9]
			Ich. frutescens	St.	[11]
			Ta. catharinensis	RB.	[21]
			Hi. sucuuba	La.	[22]
			Hi. sucuuba	Le.	[22]
			Par. amapa	R.	[16]
			Ta. markgrafiana	B.	[23]
			Th. neriifolia	Le.	[24]
			Hi. phagedaenica	St.	[25]
			Als. scholaris	La.	[3]
			Als. verticillosa	B.	[3]
3	*α*-Amyrin cinnamate	**R_1**=Cinnamoyl, **R_2, R_3, R_4**=H, **R_5**=CH_3	*Hi. sucuuba*	La.	[22]
			Hi. sucuuba	Le.	[22]
			Hi. sucuuba	B.	[26]
			Hi. articulata	La.	[27]
4	Urs-12-ene-3*β*,28-diol	**R_1, R_2, R_3, R_4**=H, **R_5**=CH_2OH	*Ne. oleander*	Le.	[15]
5	3*β*-Hydroxyurs-12-en-28-aldehyde	**R_1, R_2, R_3, R_4**=H, **R_5**=CHO	*Ne. oleander*	Le.	[15,28]
6	Ursolic acid (3*β*-Hydroxyursan-12-en-28-oic acid)	**R_1, R_2, R_3, R_4**=H, **R_5**=COOH	*Asp. ulei*	Le.	[29]
			Als. scholaris	AP.	[9]
			Als. boonei	B.	[9]
			Als. scholaris	F.	[9]
			Plum. obtusa	Le.	[10]
			Plum. acuminata	Le.	[30]
			Cari. spinarum	R.	[31]
			Ich. frutescens	R.	[11]
			Rha. stricta	R.	[32]
			Ne. oleander	WP.	[33]
			Asp. illustre	Le.&St.B.	[34]
			Ne. oleander	Le.	[35,15]
			Ta. catharinensis	RB.	[21]
			Mu. duckei	Le.	[36]
			Als. scholaris	Le.	[37]
			Als. scholaris	F.	[37]
			Plum. obtusa	Le.&St.B.	[38]
			Cari. carandas	Le.	[39]

			Aly. sinensis	St.	[40]
			Di. martiana	AP.	[41]
			Hi. articulata	Le.	[27]
			Ho. pubescens	Le.	[42]
			Th. neriifolia	Le.	[24]
			Plum. obtusa	Le.	[43]
			Ech. hirsuta	WP.	[44]
7	Pomolic acid	**R_1**, **R_2**, **R_4**=H, **R_3**=OH, **R_5**=COOH	*Di. martiana*	AP.	[41]
8	3β,27-Dihydroxyurs-12-en-28-oic acid	**R_1**, **R_2**, **R_3**=H, **R_4**=OH, **R_5**=COOH	*Ne. oleander*	Le.	[35,15]
9	Methyl ursolate	**R_1**, **R_2**, **R_3**, **R_4**=H, **R_5**=$COOCH_3$	*Fu. africana*	Le.	[45]
10	28-Nor-urs-12-ene-3*β*,17*β*-diol	**R_1**, **R_2**, **R_3**, **R_4**=H, **R_5**=OH	*Ne. oleander*	Le.	[28]
11	28-Norurs-12-en-3*β*-ol	**R_1**, **R_2**, **R_3**, **R_4**, **R_5**=H	*Ne. oleander*	Le.	[15]
12	Peltastine A (3*β*-[5-phenyl-(2*E*,4*E*)-penta-2,4-dienoyloxy]-urs-12-ene)	**R_1**=(2*E*,4*E*)-5-phenylpenta-2,4-dienoyloxy, **R_2**, **R_3**, **R_4**=H, **R_5**= CH_3	*Pel. peltatus*	St.	[46]
13	3*β*-Hydroxy-27-P-(*E*)-coumaroyloxyurs-12-en-28-oic acid	**R_1**, **R_2**, **R_3**=H, **R_4**=O-*E*-Coumaroyl, **R_5**=COOH	*Ne. oleander* *Cari. carandas* *Plum. obtusa*	Le. Le. Le.	[35] [39] [47]
14	3*β*-Hydroxy-27-P-(*Z*)-coumaroyloxyurs-12-en-28-oic acid	**R_1**, **R_2**, **R_3**=H, **R_4**=O-*Z*-Coumaroyl, **R_5**=COOH	*Ne. oleander* *Plum. obtusa*	Le. Le.	[35] [42]
15	Carissin (3*β*-Hydroxy-27-*E*-feruloyloxyurs-12-en-28-oic acid)	**R_1**, **R_2**, **R_3**=H, **R_4**=*E*-feruloyl, **R_5**=COOH	*Cari. carandas*	Le.	[39]
16	Urs-12-en-3*β*-hydroxy-27-*Z*-feruloyloxy-28-oic acid	**R_1**, **R_2**, **R_3**=H, **R_4**=*Z*-feruloyl, **R_5**=COOH	*Plum. obtusa*	Le.&St.B.	[38]
17	Obtusin (3*β*-Hydroxy-24-P-*E*-coumaroyloxyurs-12-en-28-oic acid)	**R_1**, **R_3**, **R_4**=H, **R_5**=COOH, **R_2**=O-*E*-Coumaroyl	*Plum. obtusa*	Le.	[18]



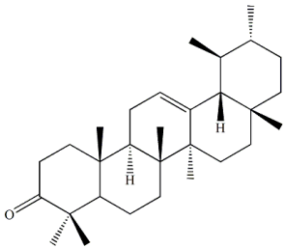
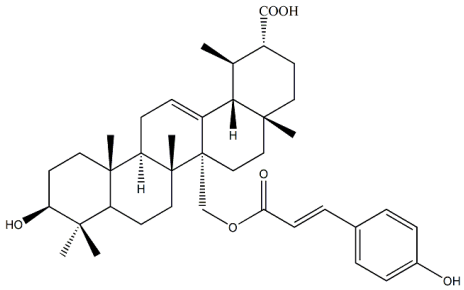
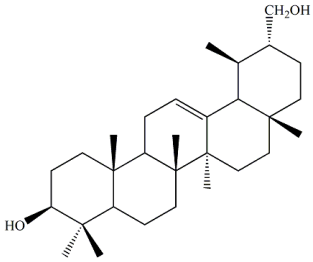
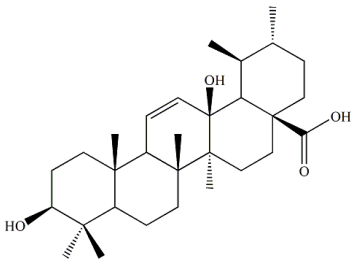
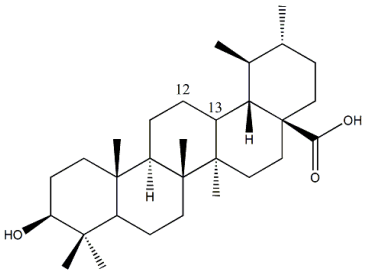
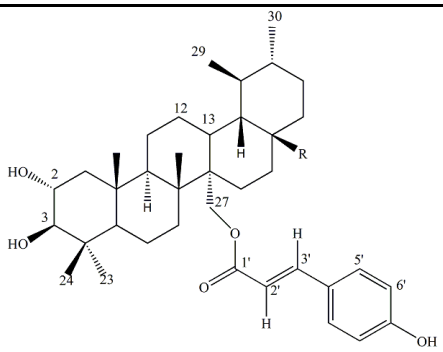
R

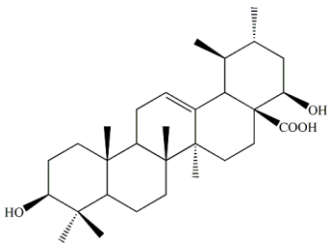
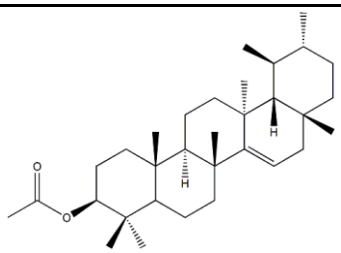
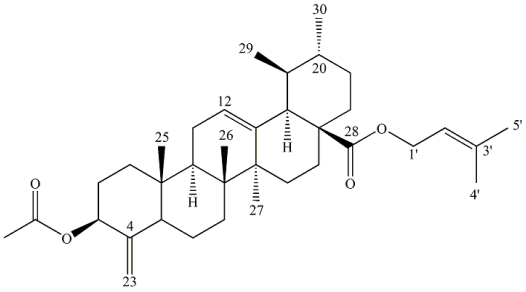
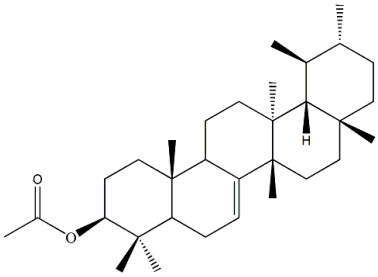
18	*Cis*-karenin (28-[(*Z*)-p-Coumaroyloxy]-3*β*-hydroxyurs-12-en-27-oic acid)	(*Z*)-p-Coumaroyloxy	*Ne. oleander*	Le.	[48]
19	Trans-karenin (28-[(*E*)-p-Coumaroyloxy]-3*β* -hydroxyurs-12-en-27-oic acid)	(*E*)-p-Coumaroyloxy	*Ne. oleander*	Le.	[48]

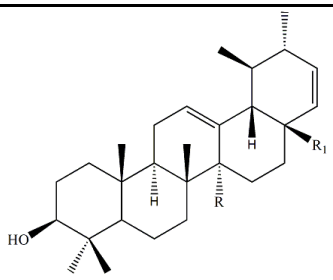


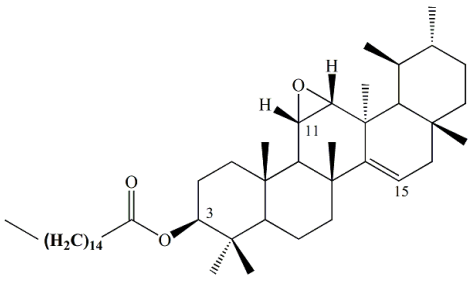
R

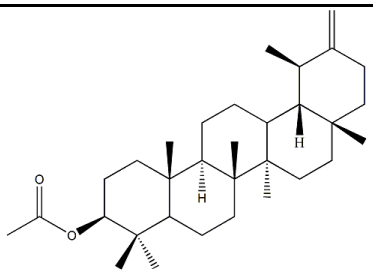
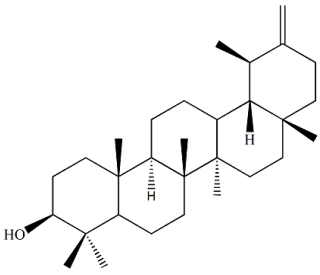
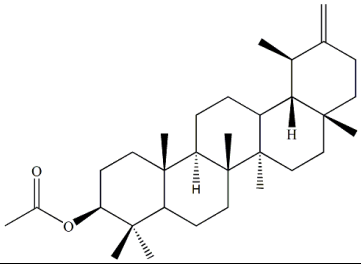
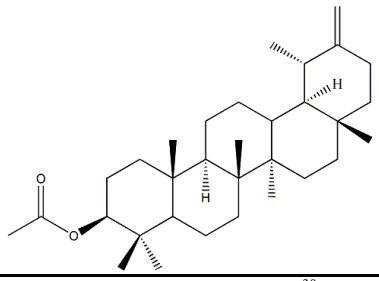
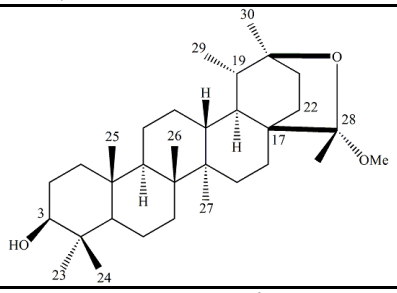
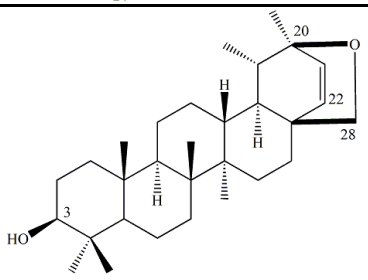
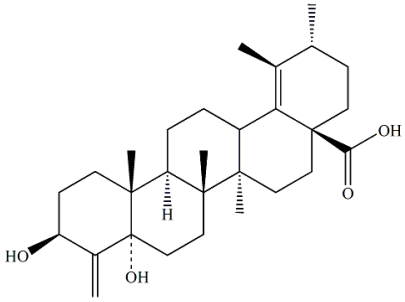
20	Neriucoumaric acid (3*β*-Hydroxy-2*α*-cis-*P*-coumaryloxy-urs-12-en-28-oic acid)	(*Z*) P-Coumaroyl	*Plum. obtusa* *Ne. oleander*	Le. Le.	[18] [49,50]
21	Isoneriucoumaric acid (3*β*-Hydroxy-2*α*-trans-*P*-coumaryloxy-urs-12-en-28-oic acid)	(*E*) P-Coumaroyl	*Plum. obtusa* *Ne. oleander*	Le. Le.	[18] [49,50]

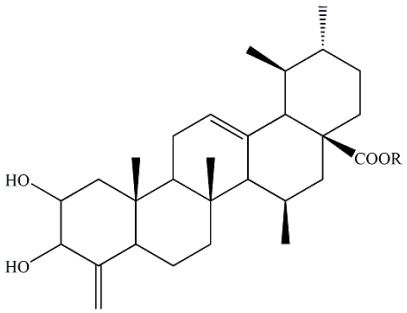
22	Urs-12-en-3-one		*Plum. obtusa*	Le.&St.B.	[38]
23	Obtusilic acid (3*β*-Hydroxy-27-*P*-*Z*-coumaroyloxyurs-12-en-30-oic acid)		*Plum. obtusa*	Le.	[18]
24	Rubrinol (3*β*,30-Dihydroxyurs-12-ene)		*Plum. rubra* *Plum. rubra*	R. WP.	[30] [42]
25	3*β*,13*β* -Dihydroxyurs-11-en-28-oic acid		*Ne. oleander*	Le.	[15]
26	12,13-Dihydroursolic acid		*Ne. oleander*	Le.	[51]
					
		R			
27	Coumarobtusanoic acid	COOH	*Plum. obtusa*	Le.	[47]
28	Coumarobtusane	CH_3	*Plum. obtusa*	Le.	[47]

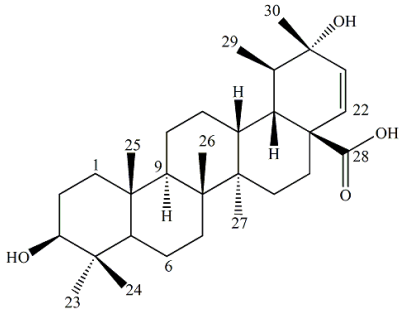
29	Urs-12-ene-3*β*, 22*β*-diol-17-carboxylic acid		*Cari. spinarum*	R.	[31]
30	Isoursenyl acetate		*Ta. markgrafiana* *Ta. catharinensis*	B. RB.	[23] [21]
31	Alstoprenylene		*Als. scholaris*	Fl.	[8]
Ib-Friedoursanes					
32	Baurenyl acetate		*Ta. markgrafiana* *Ta. catharinensis*	B. RB.	[23] [21]



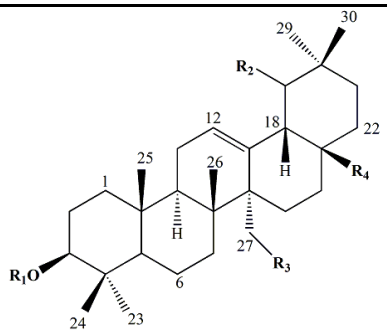
	R	R_1			
33	CH_3	COOH	*Plum. obtusa*	Le.	[42]
34	COOH	$CH_2OC_2H_5$	*Plum. obtusa*	Le.	[42]
35	D-Friedours-14-en-11α, 12*α*-epoxy-3*β*-yl palmitate		*Ecd. rosea*	AP.	[52]

36	20(30)-Ursen-3-yl acetate		*Ta. markgrafiana*	B.	[23]
37	20(30)-Ursa-ene-3-ol		*Als. scholaris*	AP.	[20]
38	20(30)-Ursen-3*β*-yl acetate		*Ta. catharinensis*	RB.	[21]
39	Taraxasteryl acetate [(20(30)-Taraxasten-3*β*-yl acetate)]		*Plum. rubra* *Ta. catharinensis* *Plum. rubra* *Ta. markgrafiana*	R. RB. WP. B.	[30] [21] [42] [23]
40	20*β*,28-Epoxy-28*α*-methoxytaraxa-steran-3*β*-ol		*Ne. oleander*	Le.	[28]
41	20*β*,28-Epoxytaraxaster-21-en-3*β*-ol		*Ne. oleander*	Le.	[28]
42	Kanerin		*Ne. oleander*	Le.	[51]

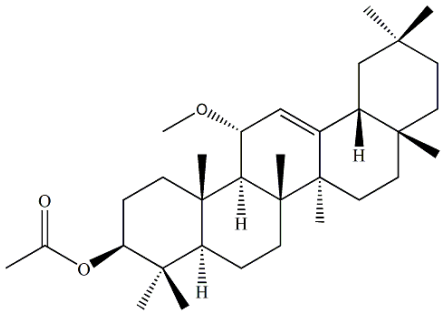
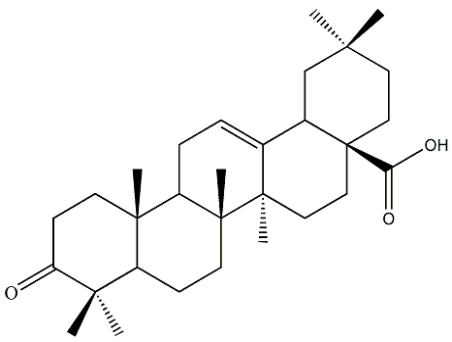


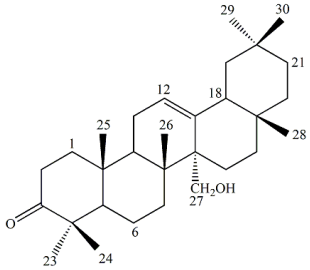
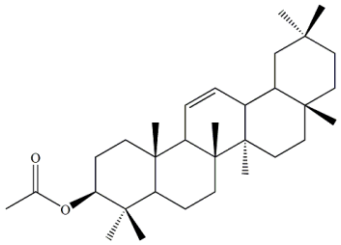
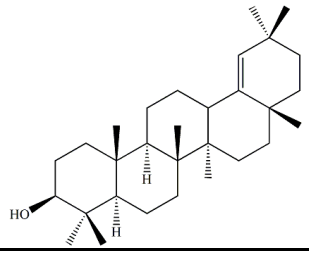
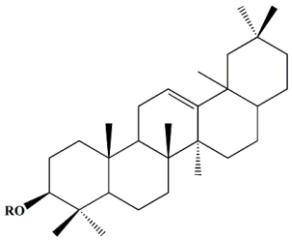
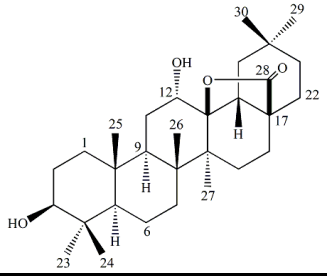
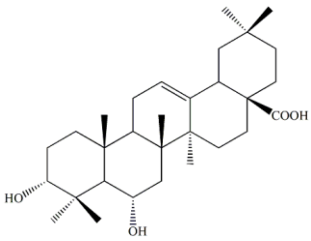
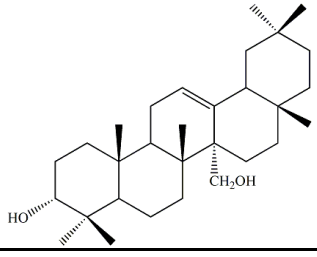
		R			
43	Plumeric acid	H	*Plum. acutifolia*	Le.	[42]
44	Methyl plumerate	CH_3	*Plum. acutifolia*	Le.	[42]
45	Oleanderic acid (3*β*,20*α*-Dihydroxyurs-21-en-28-oic acid)		*Ne. oleander*	Le.	[15]

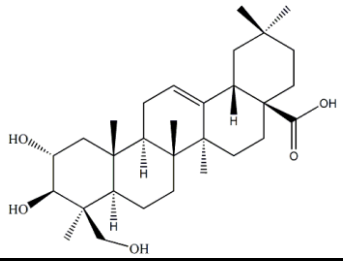
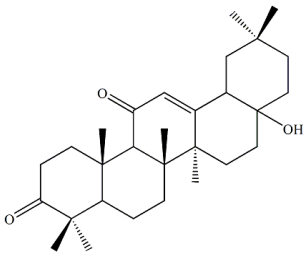
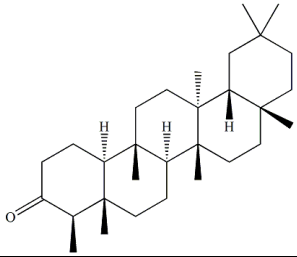
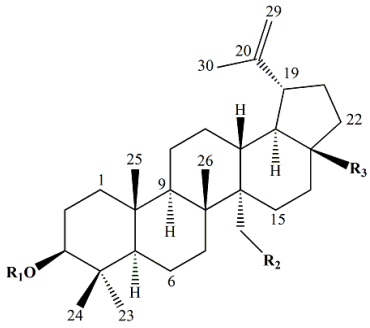
II-Oleanane type

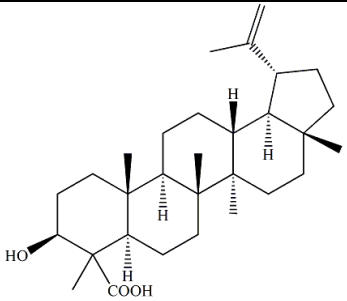


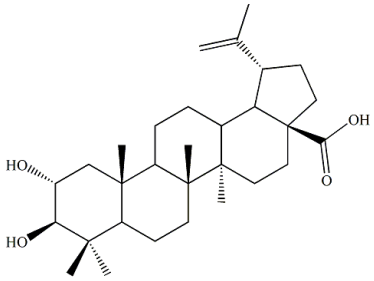
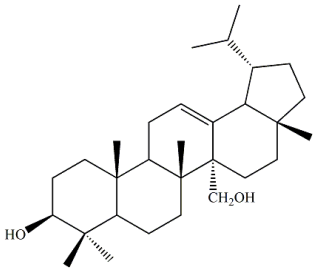
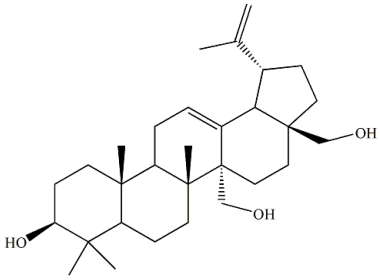
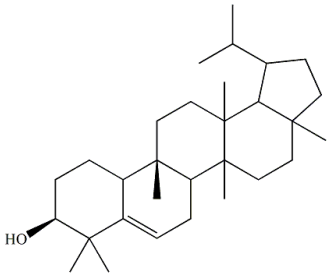
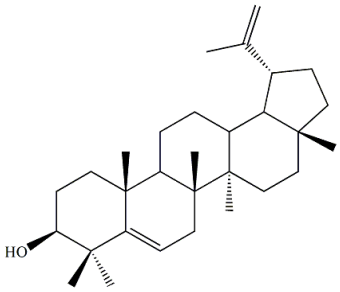
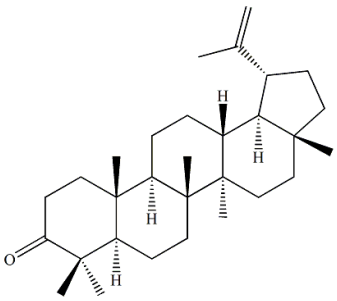
		R_1	R_2	R_3	R_4			
46	*β*-Amyrin	**R₁**, **R₂**, **R₃**=H, **R₄**=CH_3				*Als. boonei*	B.	[9]
						Als. scholaris	Fl.	[9]
						Mu. duckei	Le.	[10]
						Ma. guanabarica	Le.	[13]
						Ma. moricandiana	Le.	[13]
						Asp. illustre	Le.&St.B.	[34]
						Als. scholaris	Fl.	[37]
						Par. amapa	R.	[16]
						Wr. tinctoria	SP.	[53]
						Par. amapa	B.&La.	[19]
47	*β*-Amyrin acetate	**R₁**=Acetyl, **R₂**, **R₃**=H, **R₄**=CH_3				*Asp. illustre*	Le.&St.B.	[34]
						Ta. catharinensis	RB.	[21]
						Hi. sucuuba	La.	[22]
						Hi. sucuuba	Le.	[22]
						Par. amapa	R.	[16]
						Ta. markgrafiana	B.	[23]
						Th. neriifolia	Le.	[24]
						Hi. phagedaenica	St.	[25]
						Als. scholaris	La.	[3]
						Als. verticillosa	B.	[3]
48	*β*-Amyrin cinnamate	**R₁**=Cinnamoyl, **R₂**, **R₃**=H, **R₄**=CH_3				*Hi. sucuuba*	La.	[22]
						Hi. sucuuba	B.	[22]
						Hi. sucuuba	Le.	[22]
						Hi. sucuuba	R.	[22]
						Hi. sucuuba	Fl.	[22]
						Hi. articulata	La.	[27]
49	3*β*,27-Dihydroxy-12-oleanen-28-oic acid	**R₁**, **R₂**=H, **R₃**=OH, **R₄**=COOH				*Ne. oleander*	Le.	[15]
50	Olean-12-en-3*β*,27-diol	**R₁**, **R₂**=H, **R₃**=OH, **R₄**=CH_3				*Plum. obtusa*	Le.&St.B.	[38]

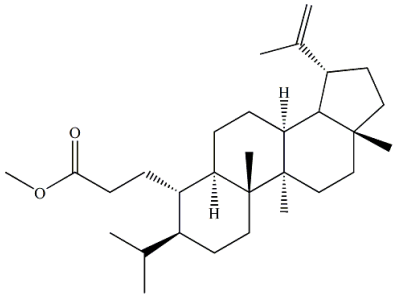
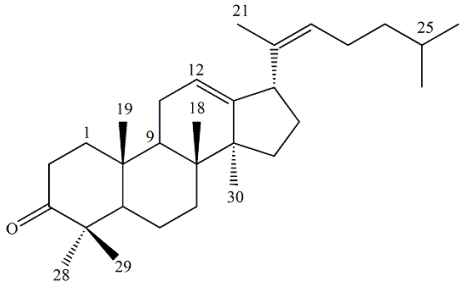
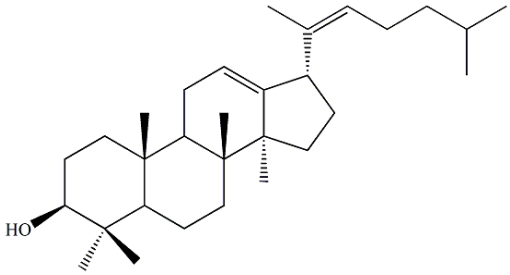
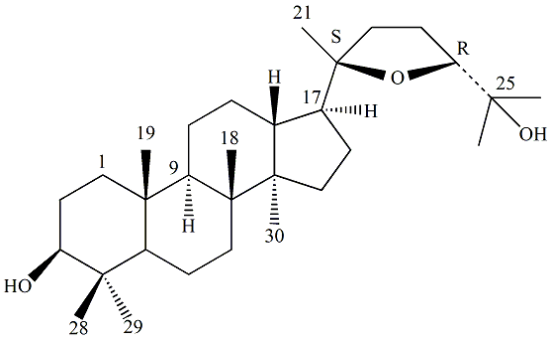
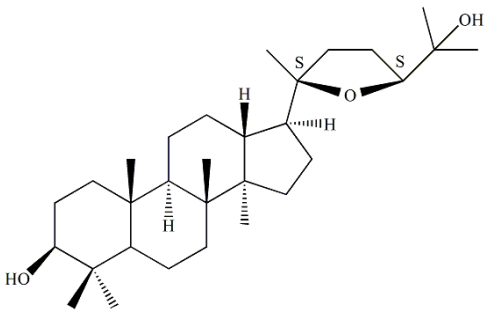
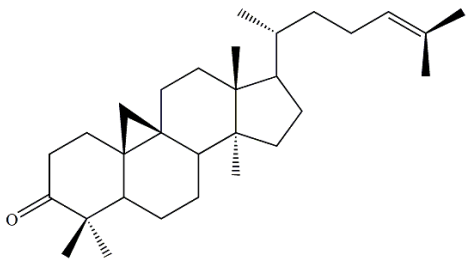
51	Olean-12-ene-28-hydroxy-3β-tetradecanoate	**R_1**=$CO(CH_2)_{12}CH_3$, **R_2**, **R_3**=H, **R_4**=CH_2OH	*Asp. illustre*	Le.&St.B.	[34]
52	Olean-12-ene-28-carboxy-3β-hexadecanoate	**R_1**=$CO(CH_2)_{14}CH_3$, **R_2**, **R_3**=H, **R_4**=COOH	*Asp. illustre*	Le.&St.B.	[34]
53	Alstoprenyol (3β-Hydroxy-28β-acetoxy-5-olea triterpene)	**R_1**, **R_2**, **R_3**=H, **R_4**=$COOCH_3$	*Als. scholaris*	Fl.	[8]
54	3β-[5-Phenyl-(2*E*,4*E*)-penta-2,4-dienoyloxy]-olean-12-ene	**R_1**=(2*E*,4*E*)-5-phenylpenta-2,4-dienoyloxy, **R_2**, **R_3**, **R_4**=H	*Pel. peltatus*	St.	[46]
55	Oleanolic acid (3β-Hydroxyolean-12-en-28-oic acid)	**R_1**, **R_2**, **R_3**=H, **R_4**=COOH	*Mu. duckei* *Plum. rubra* *Aly. buxifolia* *Aly. levinei* *Aly. sinensis* *Ama. yunnanensis* *Ams. grandiflora* *Apo. cannabinum* *Apo. venetum* *Be. grandiflora* *Cat. roseus* *Ich. frutescens* *Mel. australis* *Ne. indicum* *Ne. odorum* *Th. neriifolia* *Vi. rosea* *Wr. tinctoria* *Ne. oleander* *Ta. catharinensis* *Plum. obtusa* *Cari. carandas* *Aly. sinensis* *Plum. obtusa* *Plum. rubra* *Th. neriifolia*	Le. R. WP. Le.&St. St. WP. Le.&St. Rhi. St. Le.&St. Le. WP. AP. Le.&St. Le. Le. WP. Po. Le. RB. Le.&St.B. Le. St. Le. WP. Le.	[10] [30] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54] [54,35,15] [54,21] [38] [39] [40] [54,42] [54,42] [24]
56	Obtusilinin (3β-Hydroxy-27-P-(*Z*)-coumaroyloxy- olea-12-en-28-oic acid)	**R_1**, **R_2**=H, **R_3**=O-P-(*Z*)-Coumaroyl, **R_4**=COOH	*Plum. obtusa* *Plum. obtusa*	Le.&St.B. Le.	[38] [42]
57	Olean-12-ene-11α-methoxy-3β-acetate		*Asp. illustre*	Le.&St.B.	[34]
58	Oleanonic acid		*Plum. obtusa*	Le.	[18]

59	27-Hydroxyolean-12-en-3-one		*Plum. obtusa*	Le.&St.B.	[38]
60	3*β*-Acetoxyolean-11-ene		*Tr. lucidum*	Le.	[55]
61	Germanicol		*Hi. sucuuba*	Fl.	[22]
					
		R			
62	3-*β*-Hydroxy-plumerian-12-ene	H	*Plu. bicolor*	St.B.	[42]
63	3-*β*-Acetoxy-plumerian-12-ene	Acetyl	*Plum. bicolor*	St.B.	[42]
64	Oleanderolide (3*β*,12*α*-Dihydroxyoleanan-28,13*β*-olide)		*Ne. oleander*	Le.	[15]
65	6*α*-Hydroxy-3-epi-oleanolic acid		*Plum. rubra*	WP.	[56]
66	3*α*,27-Dihydroxy-olean-12-ene		*Plum. rubra*	WP.	[56]

67	2*α*,3*β*,24-Trihydroxy-olea-12-en-28-oic		*Cer. manghas*	St.	[57]
68	17-Hydroxy-11-oxo-nor-*β*-amyrone		*Cari. spinarum*	R.	[31]
69	Friedelin		*Ich. frutescens*	St.	[11]
III-Lupane type					
					
		R_1 **R_2** **R_3**			
70	Lupeol	**R_1**, **R_2**=H, **R_3**=CH_3	*Als. scholaris*	AP.	[20]
			Als. boonei	B.	[9]
			Cari. spinarum	R.	[31]
			Als. scholaris	Fl.	[9]
			Cyn. acutum	WP.	[12]
			Mu. duckei	Le.	[10]
			Plum. rubra	R.	[30]
			Ich. frutescens	St.	[11]
			Cara. buchardii	WP.	[58]
			Ma. guanabarica	Le.	[13]
			Ma. moricandiana	Le.	[13]
			Wr. tinctoria	St.	[59]
			Hi. drasticus	La.	[60]
			Asp. illustre	Le.&St.B.	[34]
			Hi. sucuuba	St.B.	[61]
			Ho. pubescens	Le.	[36]
			Hi. sucuuba	La.	[22]
			Hi. sucuuba	R.	[22]
			Als. scholaris	B.	[37]
			Als. scholaris	Fl.	[37]
			Ho. floribunda	St.B.	[62]
			Las. erecta	St.	[63]
			Aly. sinensis	St.	[40]
			Di. martiana	AP.	[41]
			Par. amapa	R.	[16]
			Plum. rubra	WP.	[42]
			Par. Amapa	B.&La.	[19]

71	Lupeol acetate	**R_1**=Acetate, **R_2**=H, **R_3**=CH_3	*Als. scholaris*	AP.	[20]
			Als. scholaris	Fl.	[8]
			Als. scholaris	R.&RB.	[9]
			Als. scholaris	St.B.	[9]
			Plum. acuminata	Le.	[30]
			Ich. frutescens	St.	[11]
			Cyn. acutum	WP.	[12]
			Cara. buchardii	WP.	[58]
			Asp. illustre	Le.&St.B.	[34]
			Ta. catharinensis	RB.	[21]
			Hi. sucuuba	Le.	[22]
			Hi. sucuuba	R.	[22]
			Hi. sucuuba	B.	[26]
			Par. amapa	R.	[16]
			Hi. sucuuba	La.	[17]
			Hi. articulate	La.	[27]
			Hi. articulate	B.	[27]
			Als. boonei	RB.	[64]
			Th. neriifolia	Le.	[24]
			Hi. phagedaenica	St.	[25]
			Als. verticillosa	La.	[3]
72	Lupeol cinnamate	**R_1=** Cinnamoyl, **R_2**=H, **R_3**=CH_3	*Hi. sucuuba*	Le.	[22]
			Hi. sucuuba	R.	[22]
			Hi. sucuuba	B.	[26]
			Hi. sucuuba	La.	[17]
			Hi. articulata	La.	[27]
			Hi. articulata	B.	[27]
73	Lupeol *β*-phenyl propionate	**R_1**=*β*-Phenyl propionate, **R_2**=H, **R_3**=CH_3	*Hi. sucuuba*	B.	[26]
74	Lupeol *β*-hydroxyhexad-ecanoate	**R_1**=Hydroxyhexad-ecanoate, **R_2**=H, **R_3**=CH_3	*Ho. pubescens*	Le.	[36]
75	Peltastine B (3*β*-[5-phenyl-(2*E*,4*E*)-penta-2,4-dienoyloxy]-lup-20(29)-ene)	**R_1**=5-Phenyl-(2*E*,4*E*)-penta-2,4-dienoyloxy, **R_2**=H, **R_3**=CH_3	*Pel. peltatus*	St.	[46]
76	3-O-(3'-Hydroxyeicosa-noyl) lupeol	**R_1**=3'-Hydroxyeicosanoyl, **R_2**=H, **R_3**=CH_3	*Ho. floribunda*	St.B.	[62]
77	3-O-[(2'-(Tetracosyloxy) acetyl] lupeol	**R_1**=2'-(Tetracosyloxy) acetyl, **R_2**=H, **R_3**=CH_3	*Ho. floribunda*	St.B.	[62]
78	3-O-[(1''-hydroxyoctad-ecyloxy)-2'-hydroxypropano-yl] lupeol	**R_1**=1''hydroxyoctad-ecyloxy)-2'-hydroxypropanoyl, **R_2**=H, **R_3**=CH_3	*Ho. floribunda*	St.B.	[62]
79	Betulin (Lup-20(29)-ene-3, 28-diol)	**R_1**, **R_2**=H, **R_3**=CH_2OH	*Als. scholaris*	Le.	[9]
			Ad. obesum	St.B.	[65]
			Ne. oleander	St.	[48]
			Ne. oleander	Le.	[15]
			Aly. sinensis	St.	[40]
80	Betulinic acid (3*β*-Hydroxylupan-29-en-28-oic acid)	**R_1**, **R_2**=H, **R_3**=COOH	*Als. scholaris*	Le.	[9]
			Mu. duckei	Le.	[10]
			Ne. oleander	Le.	[66]
			Ne. oleander	St.	[48]
			Ta. catharinensis	RB.	[21]
			Als. scholaris	Le.	[37]
			Ne. oleander	Le.	[15]
			Plum. obtusa	Le.	[67]
			Plum. obtusa	Le.&St.B.	[38]
			Plum. obtusa	Le.	[42]
81	3*β*,27-Dihydroxylupan-29-ene	**R_1**=H, **R_2**=OH, **R_3**=CH_3	*Plum. obtusa*	Le.&St.B.	[38]
82	Lupeol carboxylic acid		*Plum. acuminate*	Le.	[30]

83	Alphitolic acid		*Plum. obtusa*	Le.	[18]
84	Obtusalin (3*β*,27-Dihydroxy-lup-12-ene)		*Plum. obtusa*	Le.	[42]
85	Oleanderol		*Ne. oleander*	Le.	[68]
86	Guimarenol		*Cara. buchardii*	WP.	[58]
87	5,20(29)-Lupadien-3*β*-ol		*Ho. antidysenterica*	B.	[69]
88	Lupenone		*Cara. buchardii*	WP.	[58]

89	3,4-Seco-lup-20(29)-en-3-oic acid methyl ester		*Cara. buchardii*	WP.	[58]
IV-Dammarane type					
90	Dammara-12,20(22)-*Z*-dien-3-one		*Plum. obtusa*	Le.&St.B.	[38]
91	Dammara-12,20(22)-*Z*-dien-3*β*-ol		*Plum. obtusa*	Le.&St.B.	[38]
92	(20*S*,24*R*)-Epoxydammarane-3*β*,25-diol		*Ne. oleander*	Le.	[15]
93	(20*S*,24*S*)-Epoxydammarane-3*β*,25-diol		*Ne. oleander*	Le.	[15]
V-Cycolartane type					
94	Cycloartenone		*Wr. tinctoria*	SP.	[53]

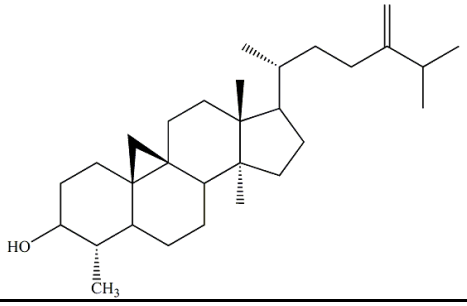
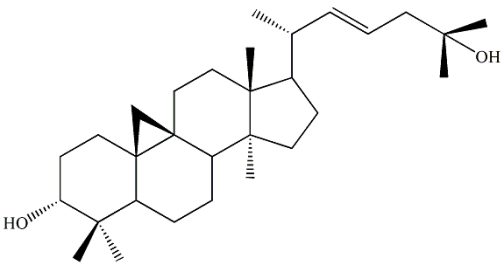
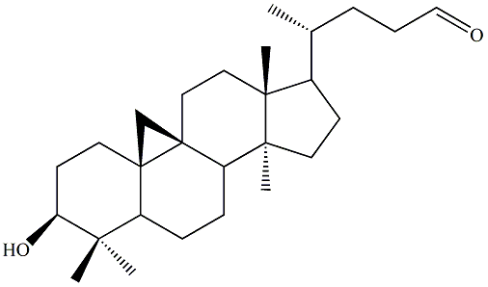
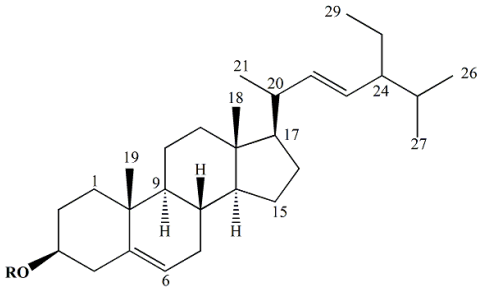
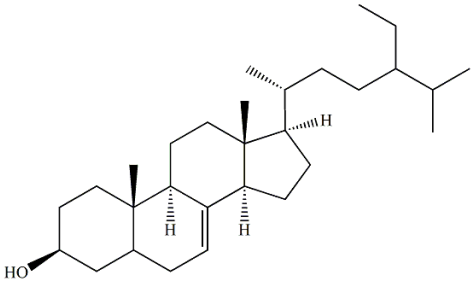
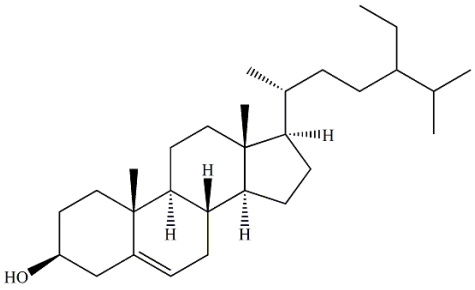
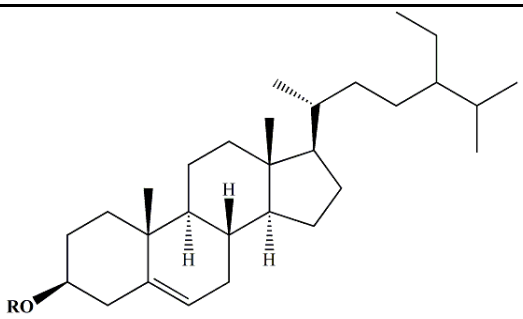
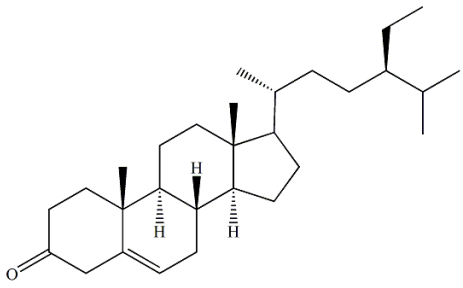
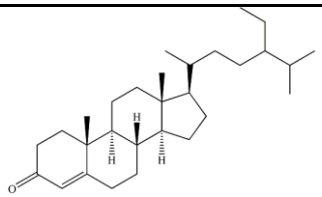
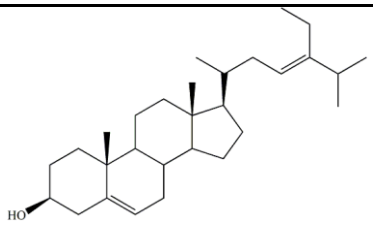
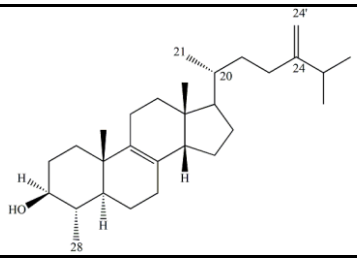
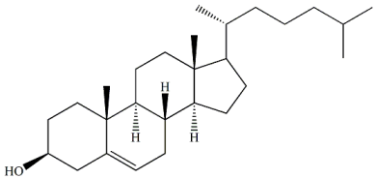
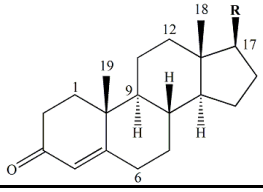
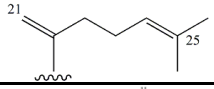
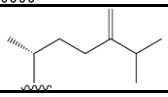
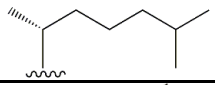
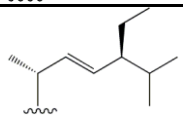
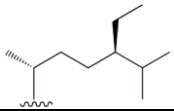
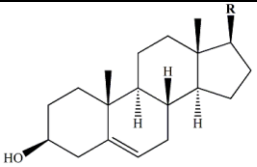
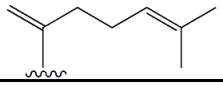
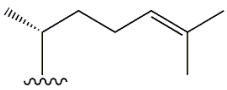
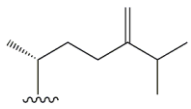
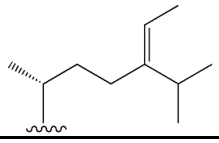
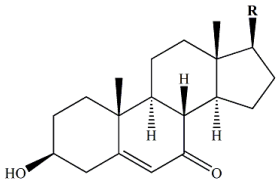
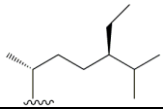
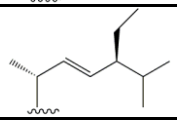
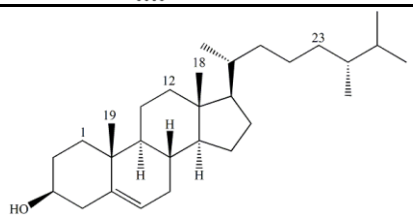
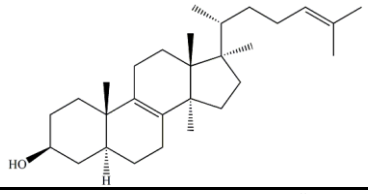
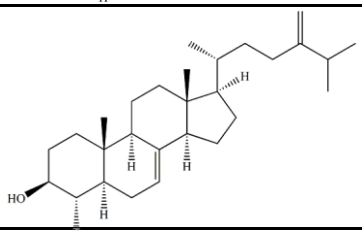
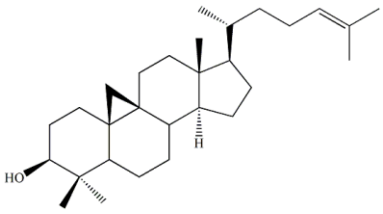
95	Cycloeucalenol		*Wr. tinctoria*	SP.	[53]
96	Cycloart-22-ene-3*α*,25-diol		*Plum. rubra*	WP.	[42]
97	Wrightial (24-Oxo-25,26,27-tris nor-3*β*-cycloartenol)		*Wr. tinctoria*	SP.	[70]

Table 2: A list of isolated sterols from family Apocynaceae.

No.	Name	Structure	Source	Organ	Reference
					
		R			
1	Stigmasterol	H	*Als. scholaris*	WP.	[20]
			Als. scholaris	Le.	[9]
			Als. scholaris	R.&RB.	[9]
			Plum. rubra	R.	[30]
			Cari. spinarum	R.	[31]
			Rha. stricta	Fr.	[32]
			Wr. tinctoria	St.	[59]
			Ne. oleander	St.	[48]
			Be. grandiflora	AP.	[14]
			Ta. catharinensis	RB.	[21]
			Aly. sinensis	St.	[40]
			Par. amapa	R.	[16]
			Hi. articulata	B.	[27]
			Plum. rubra	WP.	[42]
			Ta. markgrafiana	B.	[23]
2	Stigmasterol acetate	Acetyl	*Aly. sinensis*	St.	[40]

3	Stigmast-7-enol		*Plum. acuminata*	Le.	[30]
4	3β-Hydroxy-Δ^5-stigmastane		*Plum. obtusa*	Le.&St.B.	[38]
					
		R			
5	β-Sitosterol	H	*Als. scholaris*	AP.	[20]
			Cyn. acutum	WP.	[12]
			Als. scholaris	R.&RB.	[9]
			Als. scholaris	St.B.	[9]
			Plum. rubra	B.	[30]
			Rha. stricta	R.	[32]
			Ich. frutescens	St.	[11]
			Pen. andrieuxii	R.	[71]
			Be. grandiflora	AP.	[14]
			Ta. catharinensis	RB.	[21]
			Als. scholaris	B.	[37]
			Aly. sinensis	St.	[40]
			Ecd. rosea	St.	[72]
			Par. amapa	R.	[16]
			Hi. articulata	B.	[27]
			Wr. tinctoria	SP.	[53]
			Hi. phagedaenica	St.	[25]
6	β-Sitosterol-3-O-β-D-glucopyranoside	β-D-Glucose	*Als. scholaris*	AP.	[20]
			Be. grandiflora	AP.	[14]
			Ecd. rosea	St.	[72]
			Di. martiana	AP.	[41]
			Ech. hirsute	WP.	[44]
7	β-Sitosterol acetate	Acetyl	*Cara. buchardii*	WP.	[58]
			Aly. sinensis	St.	[40]
8	β-Sitosterone		*Par. amapa*	R.	[16]

9	Sitostenone		*Di. martiana*	AP.	[41]
10	Sitosta-5,23-dien-3β-ol		*Ho. antidysenterica*	B.	[69]
11	Triticusterol		*Cer. odollam*	St.B.	[73]
12	Cholesterol		*Pen. andrieuxii* *Be. grandiflora*	R. AP.	[71] [14]
					
		R			
13	Pentalinonsterol (Cholest-4,20,24-trien-3-one)		*Pen. andrieuxii*	R.	[71]
14	24-Methylcholesta 4,24(28)-dien-3-one		*Pen. andrieuxii*	R.	[71]
15	Cholest-4-en-3-one		*Pen. andrieuxii*	R.	[71]
16	Stigmast-4,22-dien-3-one		*Pen. andrieuxii*	R.	[71]
17	Stigmast-4-en-3-one		*Pen. andrieuxii*	R.	[71]
					
		R			
18	Cholest-5,20,24-trien-3β –ol		*Pen. andrieuxii*	R.	[71]
19	Demosterol (Cholest-5,24-dien-3β-ol)		*Pen. andrieuxii*	R.	[71]

20	24-Methylcholest-5,24(28)-dien-3β-ol		*Pen. andrieuxii*	R.	[71]
21	Isofucosterol		*Pen. andrieuxii*	R.	[71]
		 **R**			
22	7-Ketositosterol		*Pen. andrieuxii*	R.	[71]
23	7-Ketostigmasterol		*Pen. andrieuxii*	R.	[71]
24	Campesterol		*Als. scholaris* *Cari. spinarum* *Wr. tinctoria*	R.&RB. R. St.	[9] [31] [59]
25	14α–Methylzymosterol		*Wr. tinctoria*	Se.	[74]
26	24,25-Dehydrolophenol		*Fu. elastica*	Se.	[74]
27	Cycloartenol		*Hi. articulata*	La.	[27]

3. Results

All the studies being shown in the search results were 97 triterpenes and 27 sterols from 68 articles. Triterpenes are classified into two main classes; pentacyclic and tetracyclic. The pentacyclic triterpenes are classified into three subclasses: **I**-Ursane type, **II**-Oleanane type and **III**-Lupane type. While, the tetracyclic triterpenes are classified into two subclasses: **I**-Dammarane type and **II**-Cycolartane type.

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