

## Phytochemical Constituents of Plant Species of *Pterocarpus* (F: Leguminosae): A Review

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### ABSTRACT

Fabaceae (Leguminosae) is a large important family of flowering plants, commonly known as the legume, bean, or pea family. It comprises about 18,000 species classified into around 650 genera. Amongst them, plant species of the genus *Pterocarpus* have been shown to produce valuable phytochemical classes including flavonoids, isoflavonoids, pterocarpans, auronones, lignans, stilbenes, sterols, triterpenes and sesquiterpenes. A wide spectrum of health benefits and potential biological activities of *Pterocarpus* plants have been reported, including antioxidant, antidiabetic, antimicrobial, anticancer, and anti-inflammatory properties, and protective effects on the liver, gastric mucosa, and nervous system. This review describes the structural diversity of the chemical constituents of *Pterocarpus* plants which could be a guide for further research aspects.

**Keywords:** Fabaceae, *Pterocarpus*, constituents, review.

### INTRODUCTION

Compounds from natural sources have played and still playing a major role as extremely important medicinal agents<sup>1</sup>. Many natural compounds are approved for use as obtained from nature. The naturally occurring compounds have good reputation as therapeutics because of its good patient tolerance, fewer side effects and an acceptable therapeutic index<sup>2</sup>. On the other hand, large number of natural compounds serve as chemical masters for the laboratory synthesis, and semi synthesis of analogous substances for curing or preventing chronic and degenerative diseases<sup>3</sup>.

Pea family or Leguminosae has been extensively investigated and thousands of natural products with a considerable diversity in their chemical structures have been reported<sup>4</sup>. The genus *Pterocarpus* comprises 35 species of trees and woody climbers distributed throughout three tropical regions, Neotropics, Tropical Africa and Indomalaya<sup>5</sup>. Many species of *Pterocarpus* are used in ethnomedicinal pattern in treatment of various ailments as diarrhea, toothache, fever, urinary tract and skin infections and to control blood sugar<sup>6</sup>. The bark and resin decoction of many species are used for the treatment of gland tumors, urethral discharges, ringworm of the scalp and chronic ulcers<sup>6-9</sup>. The heartwoods of some species have been reported as anti-inflammatory, anthelmintic, clear jaundice and relieve ulcer besides the controlling of elephantiasis, leucoderma, rectalgia, cough, and greyness of hair<sup>6-9</sup>. From other investigations, the antifungal<sup>10, 11</sup>, antioxidant<sup>12-15</sup>, analgesic, anti-inflammatory<sup>16-18</sup>, hepatoprotective<sup>19, 20</sup>, cardiotoxic<sup>21</sup> and cytotoxic activities<sup>22-25</sup> have been also reported. These wide arrays

of biological effects certainly attributed to richness of *Pterocarpus* with flavonoids, isoflavonoids, pterocarpans, auronones, lignans, stilbenes, sterols, triterpenes and sesquiterpenes, as listed below, which known for their effectiveness in treatment of such diseases.

The isoflavonoids, a major phytochemical classe in *Pterocarpus* genus, have multi-biological activities on cell functions, including activation of estrogen receptors, anti-inflammatory, chemopreventive, antioxidant, antiproliferative, antihemolytic, xenobiotic metabolism modulator<sup>26-28</sup>. Another important phytochemical class in this genus is the pterocarpans which has antiviral, cytotoxic, antimitotic activities<sup>29-33</sup>. This study aims to describe the structural diversity of the chemical constituents isolated from *Pterocarpus* genus that could be useful for the health professionals, scientists and scholars in the field of pharmacology and therapeutics to explore alternative medicine to cure different diseases in human and animals.

### MATERIAL AND METHOD

The available literatures in scientific search data bases, ScienceDirect, PubMed, Ebscohost, Medline, Scielo, Scialert, Web of Science, ProQuest, Springer Link, Google Scholar and Google, were used for reviewing data on the genus *Pterocarpus*.

### TAXONOMICAL CLASSIFICATION OF THE GENUS PTEROCARPUS<sup>34, 35</sup>

The genus *Pterocarpus* was classified taxonomically as follow:

- Domain: Eukaryote

- Kingdom: Plantae
- Subkingdom: Viridaplantae
- Phylum: Magnoliophyte
- Subphylum: Euphyllophyte
- Class: Magnoliopsida
- Subclass: Rosidae
- Order: Fabales
- Family: Fabaceae
- Genus: *Pterocarpus*

The Genus *Pterocarpus* consists of about 35 species; *P. acapulcensis*, *P. albopubescens*, *P. mildbraedii*, *P. amazonum*, *P. angolensis*, *P. antunesii*, *P. brenanii*, *P. claessensii*, *P. dalbergioides*, *P. erinaceus*, *P. echinatus*,

*P. gillettii*, *P. hockii*, *P. homblei*, *P. indicus*, *P. lucens*, *P. macrocarpus*, *P. marsupium*, *P. mutondo*, *P. officinalis*, *P. orbiculatus*, *P. osun*, *P. rohrii*, *P. rotundifolius*, *P. santalinoideis*, *P. santalinus*, *P. soyauxii*, *P. ternatus*, *P. tessmannii*, *P. tinctorius*, *P. velutinus*, *P. villosus*, *P. violaceus*, *P. zehntneri* and *P. zenkeri*<sup>36</sup>.

#### PHYTOCHEMICAL CONSTITUENTS

Phytochemical investigations of different morphological parts of plants of the genus *Pterocarpus* indicated that flavonoids, isoflavonoids, pterocarpanes, auronones, lignans, stilbenes, sterols, triterpenes and sesquiterpenes are the secondary metabolites commonly isolated from these investigated parts as listed in Table 1.

Table 1: List of the compounds isolated from *Pterocarpus* genus

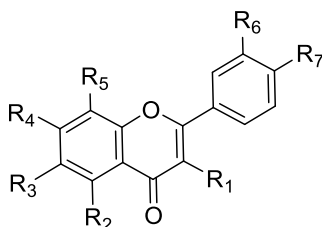
No.	Compound name	Plant Source	Part	Ref.
<b>Flavonoids</b>				
1	Liquiritigenin	<i>Pterocarpus</i> spp.	Wood	37-40
		<i>P. marsupium</i>	Root	41
		<i>P. soyauxii</i>	Wood	42
		<i>P. santalinus</i>	Wood	43
2	6-Hydroxy-3,5,7,4'-tetramethoxyflavone -6-O-rhamnopyranoside	<i>P. marsupium</i>	Root	44
3	5-Deoxykaempferol	<i>P. marsupium</i>	Root	41
			Wood	38
4	Vijayoside	<i>P. marsupium</i>	Wood	45
5	8-C- $\beta$ -D-Glucopyranosyl-3,4',7-trihydroxyflavone	<i>P. marsupium</i>	Wood	40
6	8-C- $\beta$ -D-Glucopyranosyl-3,7,3',4'-tetrahydroxyflavone	<i>P. marsupium</i>	Wood	40
7	7,4'-Dihydroxyflavone	<i>P. marsupium</i>	Wood	38
8	Garbanzol	<i>P. marsupium</i>	Root	41
9	Naringenin	<i>P. marsupium</i>	-	46
10	5,7,4'-Trihydroxy-3-(3-methyl butyl) flavone	<i>P. marsupium</i>	Bark	47
11	7-Hydroxy-6,8-dimethylflavanone-7-O- $\alpha$ -L-arabinopyranoside	<i>P. marsupium</i>	-	48
12	7,8,4'-trihydroxy-3',5'-dimethoxyflavanone-4'-O- $\beta$ -D-glucopyranoside	<i>P. marsupium</i>	-	48
13	5,7,3,5-tetrahydroxy-flavanone	<i>P. soyauxii</i>	Wood	42
14	Hetranthin A	<i>P. soyauxii</i>	Wood	42
15	7,3',4'-Trihydroxyflavanone	<i>P. soyauxii</i>	Wood	42
16	Bianol	<i>P. marsupium</i>	Wood	49
17	Pterocarpinol	<i>P. marsupium</i>	Wood	49
18	(2S)-7-Hydroxyflavanone	<i>P. marsupium</i>	Wood	38
<b>Isoflavonoids</b>				
19	Prunetin	<i>P. angolensis</i>	Wood	37, 50
		<i>P. soyauxii</i>	Wood	40
20	Muningin	<i>P. angolensis</i>	Wood	37, 51
21	Formononetin	<i>P. indicus</i>	Wood	37, 52
		<i>P. soyauxii</i>	Wood	40
22	3'-Hydroxy formononetin	<i>P. dalbergioides</i>	Wood	37
23	Pseudobaptigenin	<i>P. erinaceus</i>	Wood	37
		<i>P. marsupium</i>	Root	41
24	Santal	<i>P. santalinus</i>	Wood	37
		<i>P. osun</i>	Wood	37
		<i>P. soyauxii</i>	Wood	40
25	3',7-Di-O-methylorobol	<i>P. soyauxii</i>	Wood	40
26	5,4'-Dimethoxy-8-methylisoflavone-7-O- $\alpha$ -L-rhamnopyranoside	<i>P. marsupium</i>	Wood	53

27	7- <i>O</i> - $\alpha$ -L-rhamnopyranosyl-oxy-4'-methoxy-5-hydroxy isoflavone	<i>P. marsupium</i>	-	54
28	5,7-Dihydroxy-6- methoxyisoflavone-7-rhamnoside	<i>P. marsupium</i>	Wood	55
29	Irisolidone- <i>O</i> - $\alpha$ -L-rhamnoside	<i>P. marsupium</i>	Wood	55
30	Retusin-7- <i>O</i> -glucoside	<i>P. marsupium</i>	Wood	55
31	Retusin-8- <i>O</i> - $\alpha$ -L-arabinopyranoside	<i>P. marsupium</i>	-	46
32	Pterosonin A	<i>P. soyauxii</i>	Wood	42
33	Pterosonin B	<i>P. soyauxii</i>	Wood	42
34	Pterosonin C	<i>P. soyauxii</i>	Wood	42
35	Khrinone C	<i>P. soyauxii</i>	Wood	42
36	7,3'-Dihydroxy-8,2',4'-trimethoxyisoflavone	<i>P. soyauxii</i>	Wood	42
37	Khrinone E	<i>P. soyauxii</i>	Wood	42
38	6,7-Dihydroxy-2',4'-dimethoxy-3'-hydroxyisoflavone	<i>P. soyauxii</i>	Wood	42
39	6-Hydroxy-7,2',4',5'-tetramethoxyisoflavone	<i>P. santalinus</i>	Wood	43
40	4'.5-Dihydroxy 7- <i>O</i> -methyl isoflavone -3'- <i>O</i> - $\beta$ -D-glucoside.	<i>P. santalinus</i>	Wood	56
41	4',5-Dihydroxy-7- <i>O</i> -methyl isoflavone 3'- <i>O</i> - $\beta$ -D-(3''-E-cinnamoyl) glucoside	<i>P. santalinus</i>	Wood	57
42	Pterosonin D	<i>P. soyauxii</i>	Wood	42
43	Pterosonin E	<i>P. soyauxii</i>	Wood	42
44	8-Hydroxy-4',7-dimethoxyisoflavone	<i>P. soyauxii</i>	Wood	42
45	Khrinone A	<i>P. soyauxii</i>	Wood	42
46	Cyclosin	<i>P. soyauxii</i>	Wood	42
47	Syanedin	<i>P. soyauxii</i>	Wood	42
48	8-Hydroxy-4'-methoxy isoflavanone-7- <i>O</i> -glucopyranoside	<i>P. marsupium</i>	Wood	39
49	Macrocarposide	<i>p. macrocarpus</i>	Wood	58
50	(3 <i>S</i> )-Vestitol	<i>P. soyauxii</i>	Wood	40
51	( <i>R</i> )-Mucronulatol	<i>P. soyauxii</i>	Wood	40
52	Pteromarsupone	<i>P. marsupium</i>	Wood	39
53	Marsupol (4,4'-dihydroxy- $\alpha$ -methylhydrobenzoin)	<i>P. marsupium</i>	Wood	59
54	(3 <i>R</i> )-Claussequinone	<i>P. soyauxii</i>	Wood	40
55	Dalbergin	<i>P. santalinus</i>	Wood	60
56	Melannein	<i>P. santalinus</i>	Wood	23
57	Pterolinus J	<i>P. santalinus</i>	Wood	23
58	Pterolinus F	<i>P. santalinus</i>	Wood	23
59	Pterolinus G	<i>P. santalinus</i>	Wood	23
60	S-3'-Hydroxy-4,4'-dimethoxydalbergione	<i>P. santalinus</i>	Wood	23
61	Pterolinus Ha	<i>P. santalinus</i>	Wood	23
62	Pterolinus Hb	<i>P. santalinus</i>	Wood	23
63	Pterolinus I	<i>P. santalinus</i>	Wood	23
<b>Epicatechins</b>				
64	(-)-Epicatechin	<i>P. marsupium</i>	Bark	37, 61
		<i>P. angolensis</i>	Stem bark	62
		<i>P. erinaceus</i>	Stem bark	63
65	Epicatechin-3- <i>O</i> -galate	<i>P. angolensis</i>	Stem bark	62
66	Epicatechin (4b-8)-epicatechin (B2)	<i>P. angolensis</i>	Stem bark	62
67	Hexamer of epicatechin	<i>P. angolensis</i>	Stem bark	62
<b>Chalcones</b>				
68	Isoliquiritigenin	<i>Pterocarpus spp.</i>	Wood	37-40
		<i>P. marsupium</i>	Root	41
		<i>P. indicus</i>	Wood	52
		<i>P. santalinus</i>	Wood	43
69	Pterolinus L	<i>P. santalinus</i>	Wood	60
70	Pterosupin	<i>P. marsupium</i>	Root	41
71	$\alpha$ ,2'-Dihydroxy-4,4'-di-methoxychalcone	<i>P. angolensis</i>	Wood	64
72	Coatline A	<i>P. marsupium</i>	Wood	40, 65, 66

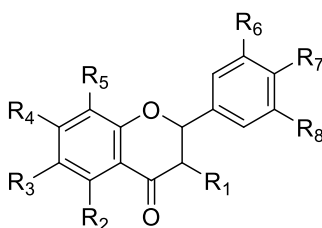
73	Bijayasaline	<i>P. marsupium</i>	Wood	67
<b>Pterocarpan</b>				
74	3 <i>S</i> -violanone	<i>P. soyauxii</i>	Wood	42
75	Bryaflavan	<i>P. soyauxii</i>	Wood	42
76	Kushenin	<i>P. soyauxii</i>	Wood	42
77	7,4'-Dimethoxypterocarpan	<i>P. soyauxii</i>	Wood	42
78	3,8-Dihydroxy-9-methoxypterocarpan	<i>P. soyauxii</i>	Wood	42
79	(-)-Homopterocarpan	<i>Pterocarpus spp.</i>	Wood	49
		<i>P. soyauxii</i>	Wood	40
		<i>P. erinaceus</i>	Stem bark	68
		<i>p. macrocarpus</i>	Wood	69
80	(-)-Hydroxy-homopterocarpan	<i>p. macrocarpus</i>	Wood	69
81	(-)-Pterocarpan	<i>Pterocarpus spp.</i>	Wood	49
		<i>P. indicus</i>	Wood	52
		<i>p. macrocarpus</i>	Wood	69
82	(-)-Maackiain	<i>P. dalbergioides.</i>	Wood	49
<b>Aurones</b>				
83	Carpusin	<i>P. marsupium</i>	Wood	70
84	Marsupsin	<i>P. marsupium</i>	Wood	38
85	2- $\alpha$ -Hydroxy-2- <i>p</i> -hydroxybenzyl-3(2 <i>H</i> ) benzofuranone-7- <i>C</i> - $\beta$ -D-glucopyranoside (Marsuposide)	<i>P. marsupium</i>	Wood	45, 71, 72
86	2 $\beta$ -Hydroxy-2- <i>p</i> -hydroxybenzyl-3(2 <i>H</i> ) benzofuranone-7- <i>C</i> - $\beta$ -D-glucopyranoside	<i>P. marsupium</i>	Wood	71, 72
87	6,4'-Dihydroxy-7-methylaurone-6- <i>O</i> - $\alpha$ -L- rhamnopyranosid	<i>P. marsupium</i>	Wood	73
88	4,6,3',4'-Tetrahydroxyaurone- 6- <i>O</i> - $\alpha$ -L- rhamnopyranoside	<i>P. marsupium</i>	Wood	73
89	6,4' Dihydroxyaurone 4- <i>O</i> -rutinoside	<i>P. santalinus</i>	Wood	74
90	6-Hydroxy-5-methyl 3',4',5' trimethoxyaurone 4- <i>O</i> - $\alpha$ -L-rhamnopyranoside	<i>P. santalinus</i>	Wood	74
<b>Isoaurones</b>				
91	Pterocarposide	<i>P. marsupium</i>	Wood	75
92	Pteroisoaurosode	<i>P. marsupium</i>	Wood	45
<b>Arylcoumarins</b>				
93	Pterosonin F	<i>P. soyauxii</i>	Wood	42
94	Santalin AC	<i>P. santalinus</i>	Wood	76
<b>Lignans</b>				
95	Savinin	<i>P. santalinus</i>	Wood	77
96	Calocedrin	<i>P. santalinus</i>	Wood	77
97	Pteroside	<i>P. marsupium</i>	Wood	45
98	Pterolinus A	<i>P. santalinus</i>	Wood	23
99	Pterolinus B	<i>P. santalinus</i>	Wood	23
100	Dehydromelanoxin	<i>P. santalinus</i>	Wood	23
101	Pterolinus C	<i>P. santalinus</i>	Wood	23
102	Melanoxin	<i>P. santalinus</i>	Wood	23
103	Pterofuran	<i>P. indicus</i>	Wood	37, 52
104	Piyaline	<i>P. marsupium</i>	Wood	65, 66, 72
105	Piyaline methyl ester	<i>P. marsupium</i>	Wood	72
106	Metlaline	<i>P. marsupium</i>	Wood	72
<b>Xanthenes</b>				
107	Santalins A	<i>P. osun</i>	Wood	78
		<i>P. soyauxii</i>		78
		<i>P. santalinus</i>		76
108	Santalins B	<i>P. osun</i>	Wood	78
		<i>P. soyauxii</i>		78
		<i>P. santalinus</i>		76
109	<i>per-O</i> -methylsantalin	<i>P. osun</i>	Wood	78
		<i>P. soyauxii</i>		78

110	Santarubins A	<i>P. osun</i>	Wood	78
		<i>P. soyauxii</i>		78
111	Santarubins B	<i>P. osun</i>	Wood	78
		<i>P. soyauxii</i>		78
Phenyl propanoids				
112	Propterol	<i>P. marsupium</i>	Wood	39, 79
113	Propterol B	<i>P. marsupium</i>	Wood	80
Benzophenones				
114	Melanoxoin	<i>P. santalinus</i>	Wood	23
115	Cearoin	<i>P. santalinus</i>	Wood	60
Deoxybenzoin				
116	Angolensin	<i>P. angolensis</i>	Wood	37, 81
		<i>P. indicus</i>	Wood	37, 52
		<i>P. erinaceus</i>	Wood	49
117	( $\alpha$ S)-4-O-methylangolensin	<i>P. angolensis</i>	Wood	82
118	( $\alpha$ R,1"R,4"S,4"αR,8"αR)-4-O-α-cadinylangolensin	<i>P. angolensis</i>	Wood	82
119	( $\alpha$ R,1"S,4"S,4"αR,8"αR)-4-O-T-cadinylangolensin	<i>P. angolensis</i>	Wood	82
Anthracenedione				
120	Santalin	<i>P. santalinus</i>	Wood	49
Phenanthrenedione				
121	Pterolinus K	<i>P. santalinus</i>	Wood	60
Stilbene				
122	Pterostilbene	<i>P. santalinus</i>	Wood	49
		<i>P. marsupium</i>	Wood	37-39, 72, 83
		<i>P. soyauxii</i>	Wood,	40
Sesquiterpenes				
123	$\beta$ -eudesmol	<i>P. indicus</i>	Wood	49
		<i>P. marsupium</i>	Root wood	83
		<i>P. santalinus</i>	Wood	84
124	Selin-4(15)-en-1- $\beta$ ,11-diol	<i>P. marsupium</i>	Root wood	83
			Wood	45
125	(+)-Pterocarpol	<i>P. macrocarpus</i>	Wood	37, 69
		<i>P. santalinus</i>	Wood	37, 84, 85
		<i>P. marsupium</i>	Wood	86
126	ent-4(15)-Eudesmen-1 $\alpha$ ,11-diol	<i>P. santalinus</i>	Wood	85
127	Isopterocarpolone	<i>P. santalinus</i>	Wood	84, 85
128	Pterocarpdione	<i>P. santalinus</i>	Wood	84
129	Canusesnol K	<i>P. santalinus</i>	Wood	85
130	Cryptomeridiol	<i>P. santalinus</i>	Wood	84
131	Canusesnol L	<i>P. santalinus</i>	Wood	85
132	Pterocarptriol	<i>P. santalinus</i>	Wood	84
Triterpenes				
133	3-Ketooleanane	<i>P. santalinus</i>	Stem callus	87
134	$\beta$ -Amyrone	<i>P. santalinus</i>	Bark	88
135	Lupenone	<i>P. santalinus</i>	Bark	88
136	Lupeol	<i>P. santalinus</i>	Bark	88
		<i>P. marsupium</i>	-	46
		<i>P. erinaceus</i>	Stem bark	63
		<i>P. indicus</i>	Leaf	89
137	<i>epi</i> -Lupeol	<i>P. santalinus</i>	Bark	88
138	2 $\alpha$ -Hydroxy- <i>epi</i> -lupeol	<i>P. santalinus</i>	Bark	88
139	Lup-20(29)-en-2 $\alpha$ ,3 $\beta$ -diol	<i>P. santalinus</i>	Bark	90
140	3-Ketooleanane	<i>P. santalinus</i>	Stem callus	87
141	Acetyloleanolic acid	<i>Pterocarpus spp.</i>	Wood	49
142	Erythrodiol-3-monoacetate	<i>P. marsupium</i>	Root wood	83
143	Paniculatadiol	<i>P. indicus</i>	Leaf	89
144	Friedelin	<i>P. santalinoides</i>	Leaf	91

		<i>P. erinaceus</i>	Stem bark	63
<b>Alkaloids</b>				
145	(L)-Hypaphorine	<i>P. officinalis</i>	Seed	92
<b>Miscellaneous</b>				
146	Pterolinus D	<i>P. santalinus</i>	Wood	23
147	Pterolinus E	<i>P. santalinus</i>	Wood	23
148	Vijayosin	<i>P. marsupium</i>	Wood	45
149	Loliolide	<i>P. indicus</i>	Leaf	89
150	2-(3-Glucosyl-2,4-dihydroxyphenyl)-2-oxoacetic acid	<i>P. marsupium</i>	Wood	65, 66
151	1-(2,4-Dihydroxyphenyl) propan-2-ol	<i>P. marsupium</i>	Wood	39
152	<i>p</i> -Hydroxybenzaldehyde	<i>P. marsupium</i>	Root	41
			Wood	38
153	(2 <i>R</i> )-3-( <i>p</i> -Hydroxyphenyl)-lactic acid	<i>P. marsupium</i>	Wood	38
154	(-)- <i>p</i> -Hydroxyhydratropic acid	<i>P. indicus</i>	Wood	52
155	1-(2',6'-Dihydroxyphenyl)- $\beta$ -D-glucopyranoside	<i>P. marsupium</i>	Wood	45, 93
156	( $\pm$ )-2-Hexanol	<i>P. indicus</i>	Leaf	94
157	12,15-Dihydroxycurcumene	<i>P. santalinus</i>	Wood	85

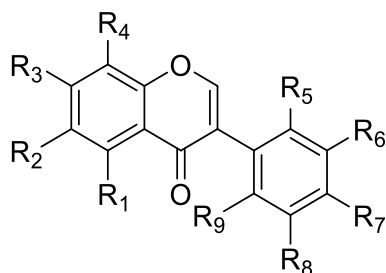


	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>
1	H	H	H	OH	H	H	OCH <sub>3</sub>
2	OCH <sub>3</sub>	OCH <sub>3</sub>	<i>O</i> -Rha.	OCH <sub>3</sub>	H	H	OCH <sub>3</sub>
3	OH	H	H	OH	H	H	OH
4	H	H	H	OH	Glc.	OH	OH
5	OH	H	H	OH	Glc.	H	OH
6	OH	H	H	OH	Glc.	OH	OH
7	H	<i>H</i>	H	OH	H	H	OH

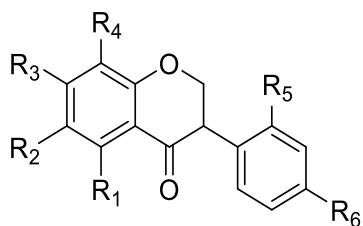


	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>
8	OH	H	H	OH	H	H	OH	H
9	H	OH	H	OH	H	H	OH	H
10	H	OH	H	OH	H	3-methyl butyl	OH	H
11	H	H	CH <sub>3</sub>	<i>O</i> -Ara.	CH <sub>3</sub>	H	H	H
12	H	H	H	OH	OH	OCH <sub>3</sub>	<i>O</i> -Glc.	OCH <sub>3</sub>
13	H	OH	H	OH	H	OH	H	OH
14	H	H	H	OCH <sub>3</sub>	H	OH	OH	H
15	H	H	H	OH	H	OH	OH	H
16	OH	H	H	OH	OH	OH	OH	H

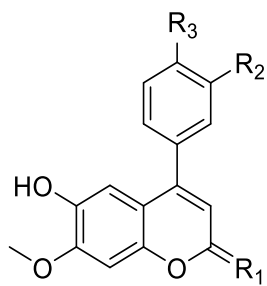
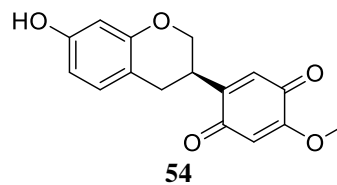
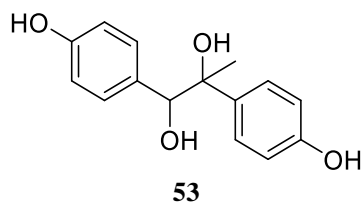
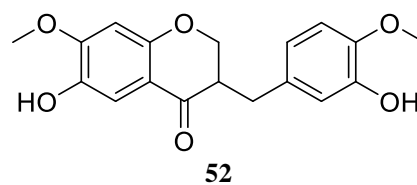
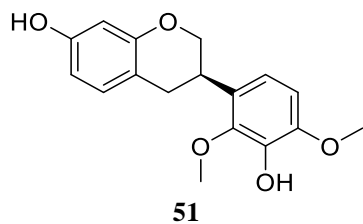
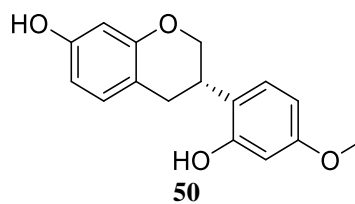
17	OH	CH <sub>3</sub>	CH <sub>3</sub>	OH	H	H	OH	H
18	H	H	H	OH	H	H	H	H



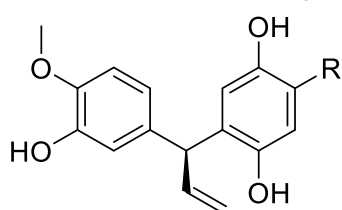
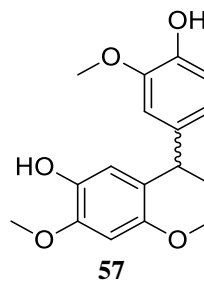
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>	R <sub>9</sub>
19	OH	H	OCH <sub>3</sub>	H	H	H	OH	H	H
20	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H	H	OH	H	H
21	H	H	OH	H	H	H	OCH <sub>3</sub>	H	H
22	H	H	OH	H	H	OH	OCH <sub>3</sub>	H	H
23	H	H	OH	H	H	-O-CH <sub>2</sub> -O-		H	H
24	OH	H	OCH <sub>3</sub>	H	H	OH	OH	H	H
25	OH	H	OCH <sub>3</sub>	H	H	OCH <sub>3</sub>	OH	H	H
26	OCH <sub>3</sub>	H	<i>O</i> - $\alpha$ -L-Rha.	CH <sub>3</sub>	H	H	OCH <sub>3</sub>	H	H
27	OH	H	<i>O</i> - $\alpha$ -L-Rha.	H	H	H	OCH <sub>3</sub>	H	H
28	OH	OCH <sub>3</sub>	<i>O</i> - $\alpha$ -L-Rha.	H	H	H	H	H	H
29	OH	OCH <sub>3</sub>	<i>O</i> - $\alpha$ -L-Rha.	H	H	H	H	H	H
30	H	H	<i>O</i> -Glc.	OH	H	H	OCH <sub>3</sub>	H	H
31	H	H	OH	<i>O</i> - $\alpha$ -L-Ara.	H	H	OCH <sub>3</sub>	H	H
32	H	H	OH	OH	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
33	H	H	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
34	H	OCH <sub>3</sub>	OH	H	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
35	OH	H	H	H	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
36	H	H	OH	OCH <sub>3</sub>	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
37	OH	H	H	H	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
38	H	OH	OH	H	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	H	H
39	H	OH	OCH <sub>3</sub>	H	OCH <sub>3</sub>	OCH <sub>3</sub>	OCH <sub>3</sub>	H	H
40	OH	H	OCH <sub>3</sub>	H	H	<i>O</i> -Glc..	CH <sub>3</sub>	H	H
41	OH	H	OCH <sub>3</sub>	H	H	<i>O</i> - $\beta$ -D-(3-E-cinnamoyl) Glc.	OH	H	H
42	H	H	OCH <sub>3</sub>	OH	H	OH	H	OCH <sub>3</sub>	H
43	H	H	OH	H	H	OH	H	OCH <sub>3</sub>	H
44	H	H	OCH <sub>3</sub>	OH	H	H	OCH <sub>3</sub>	H	H
45	H	H	OH	H	H	OH	OCH <sub>3</sub>	H	OH
46	H	H	OH	H	H	OH	OCH <sub>3</sub>	H	H
47	H	H	OCH <sub>3</sub>	H	H	OCH <sub>3</sub>	OH	H	H



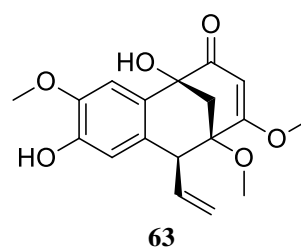
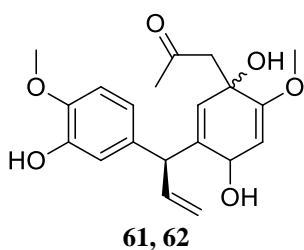
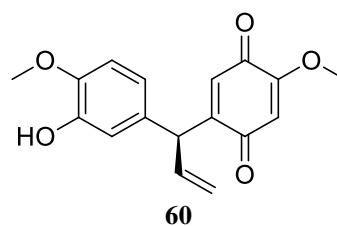
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>
48	H	H	<i>O</i> -Glc.	OH	H	OCH <sub>3</sub>
49	OH	Glc.	OH	H	OH	OH



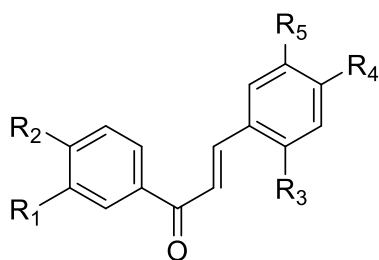
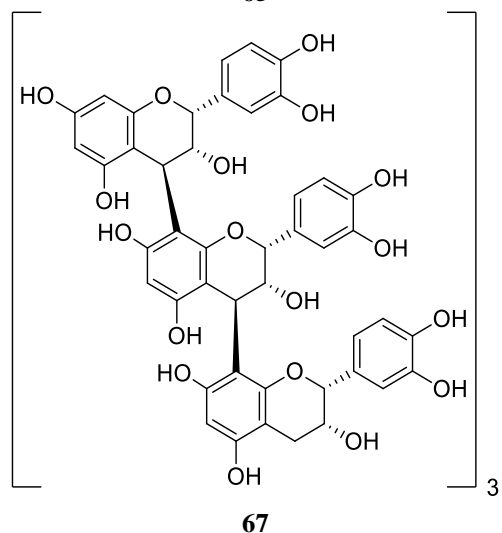
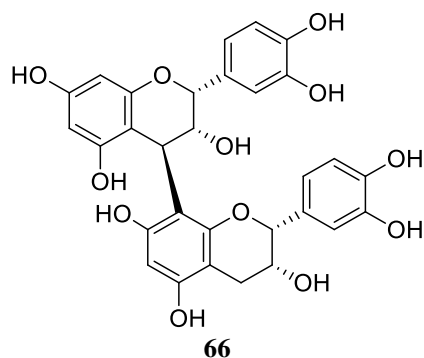
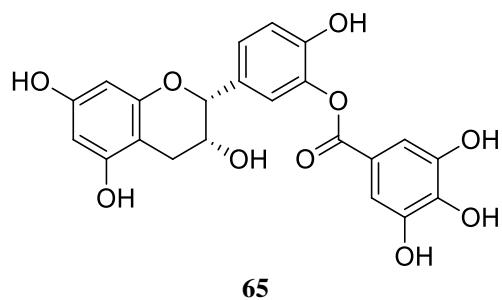
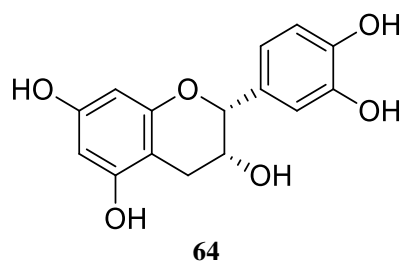
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>
55	O	H	H
56	CH <sub>2</sub>	OH	OCH <sub>3</sub>



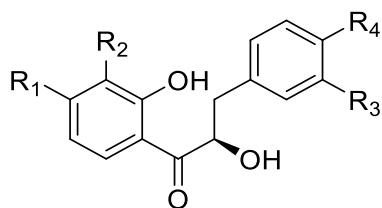
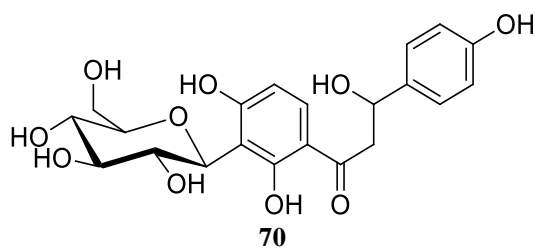
58	R = COOCH <sub>3</sub>
59	R = OCH <sub>3</sub>



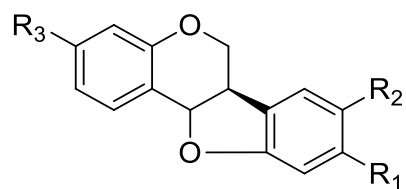




	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>
<b>68</b>	H	H	H	OH	H
<b>69</b>	OH	OCH <sub>3</sub>	OH	OCH <sub>3</sub>	OH



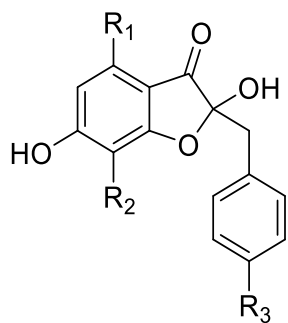
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>
<b>71</b>	OCH <sub>3</sub>	H	H	OCH <sub>3</sub>



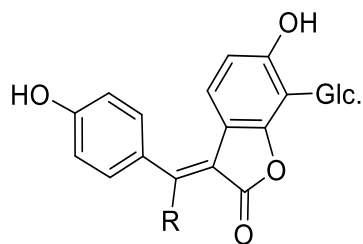
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>
<b>74</b>	-OCH <sub>2</sub> O-		OCH <sub>3</sub>
<b>75</b>	OCH <sub>3</sub>	H	OCH <sub>3</sub>
<b>76</b>	OH	OCH <sub>3</sub>	OH
<b>77</b>	OH	OH	OCH <sub>3</sub>
<b>78</b>	OCH <sub>3</sub>	OH	OH

<b>72</b>	OH	Glc.	H	OH
<b>73</b>	OH	Glc.	OH	OH

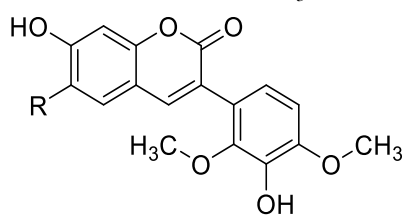
<b>79</b>	OCH <sub>3</sub>	H	OCH <sub>3</sub>
<b>80</b>	OCH <sub>3</sub>	OH	OCH <sub>3</sub>
<b>81</b>	-OCH <sub>2</sub> O-		OCH <sub>3</sub>
<b>82</b>	-OCH <sub>2</sub> O-		OH



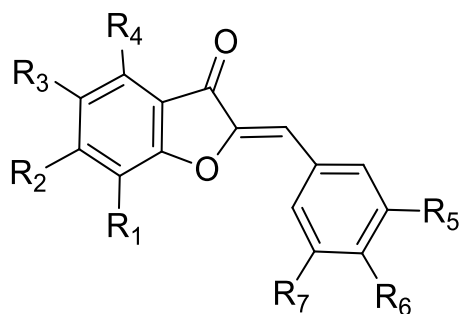
	<b>R<sub>1</sub></b>	<b>R<sub>2</sub></b>	<b>R<sub>3</sub></b>
<b>83</b>	OCH <sub>3</sub>	H	OH
<b>84</b>	OCH <sub>3</sub>	H	CH <sub>3</sub>
<b>85</b>	H	<i>O</i> -Glc.	OH
<b>86</b>	H	<i>O</i> -Glc.	OH



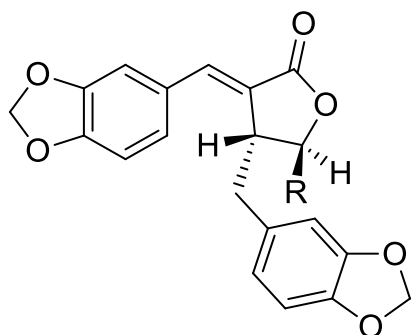
<b>91</b>	<b>R = H</b>
<b>92</b>	<b>R = OCH<sub>3</sub></b>



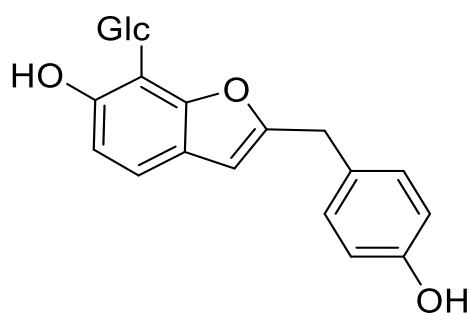
<b>93</b>	<b>R = H</b>
<b>94</b>	<b>R = OH</b>



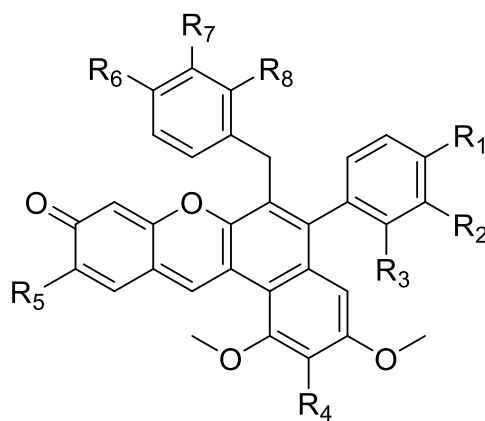
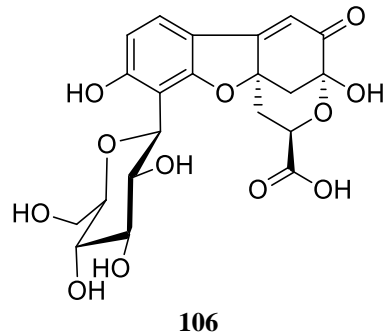
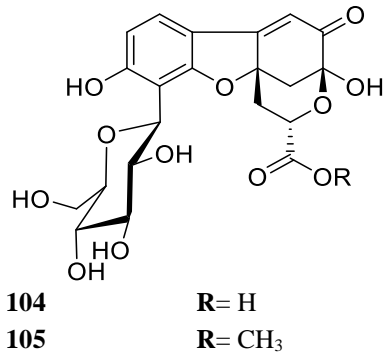
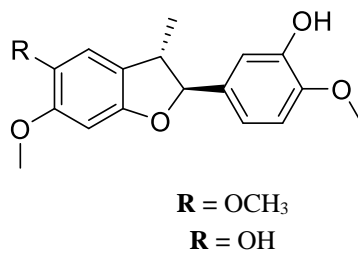
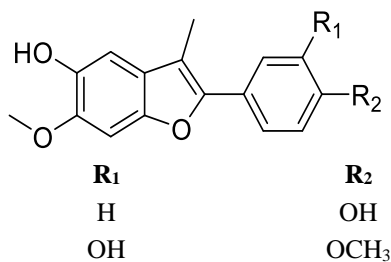
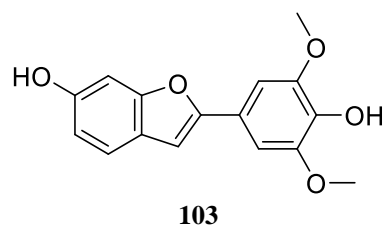
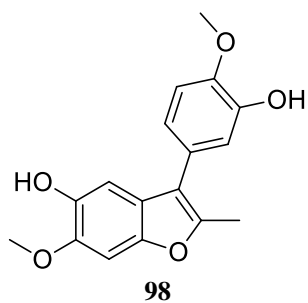
	<b>R<sub>1</sub></b>	<b>R<sub>2</sub></b>	<b>R<sub>3</sub></b>	<b>R<sub>4</sub></b>	<b>R<sub>5</sub></b>	<b>R<sub>6</sub></b>	<b>R<sub>7</sub></b>
<b>87</b>	CH <sub>3</sub>	OH	<i>O</i> -Rha.	H	H	OH	H
<b>88</b>	H	<i>O</i> -Rha.	H	OH	OH	OH	H
<b>89</b>	H	OH	H	<i>O</i> -Rut.	H	OH	H
<b>90</b>	H	OH	CH <sub>3</sub>	<i>O</i> -Rha.	OCH <sub>3</sub>	OCH <sub>3</sub>	OCH <sub>3</sub>



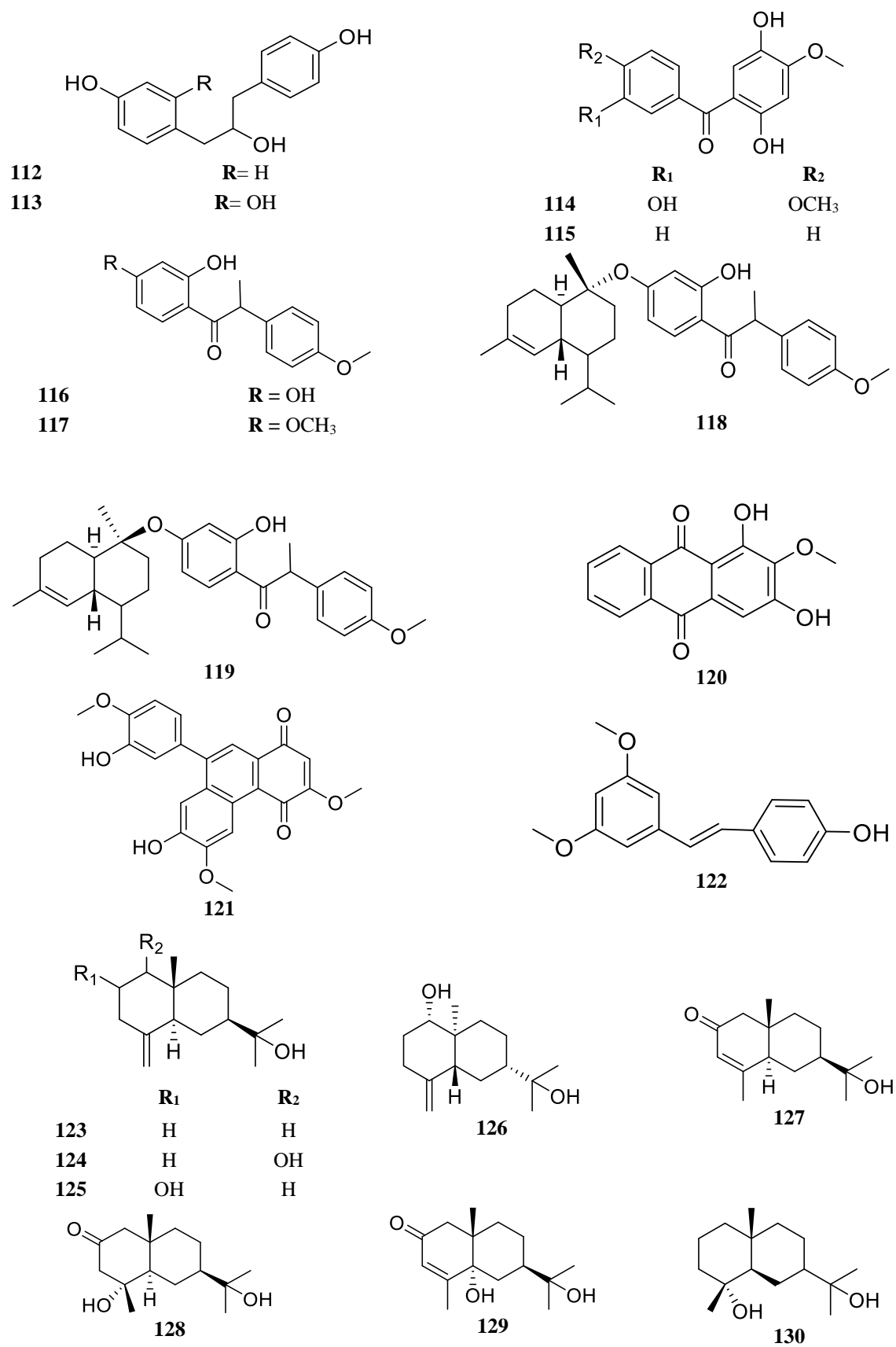
<b>95</b>	<b>R = H</b>
<b>96</b>	<b>R = OH</b>

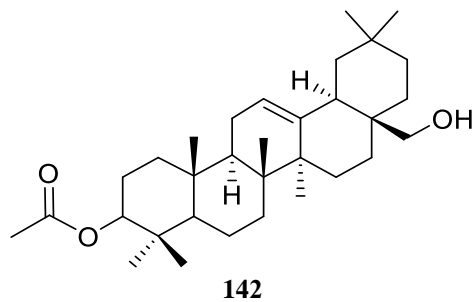
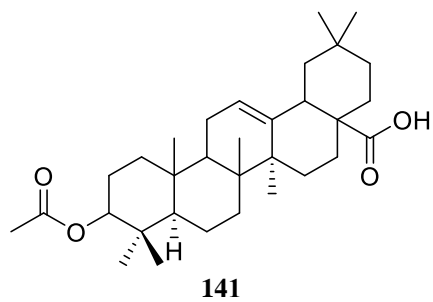
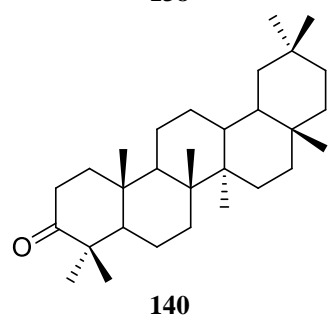
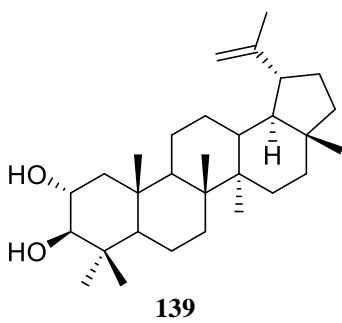
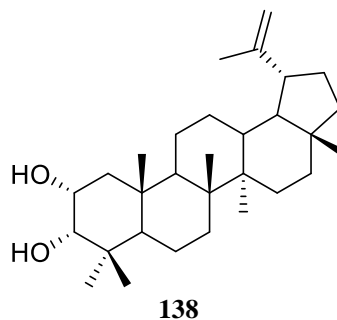
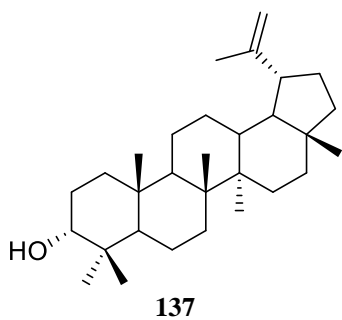
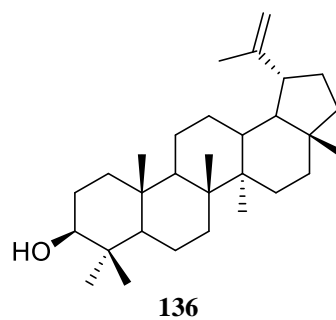
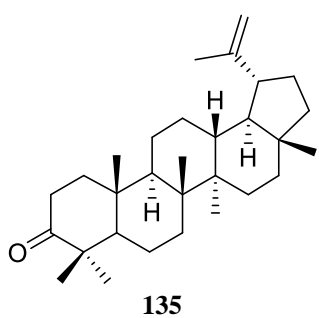
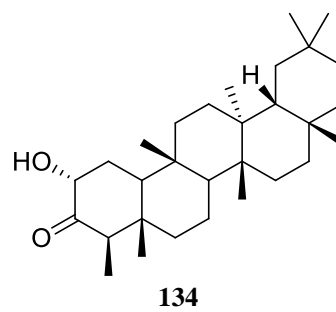
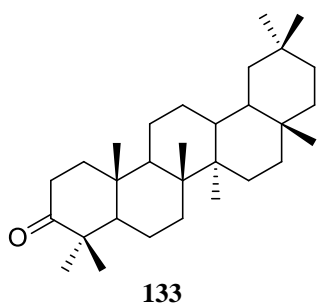
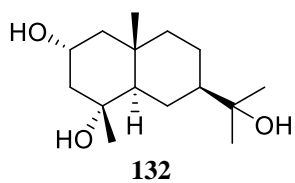
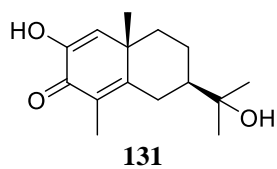


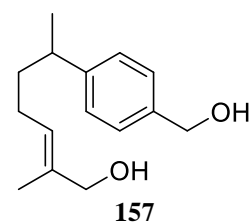
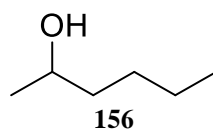
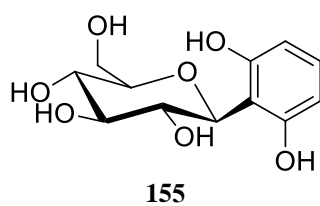
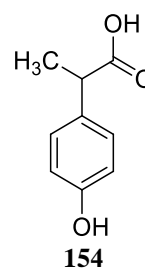
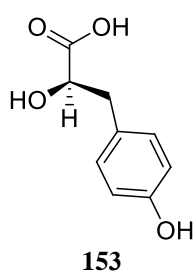
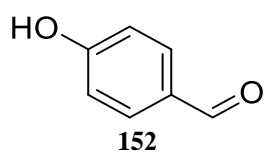
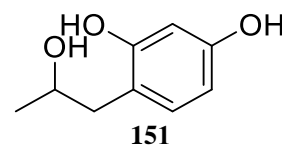
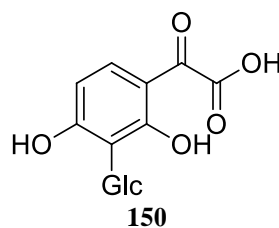
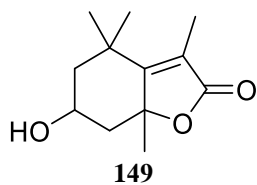
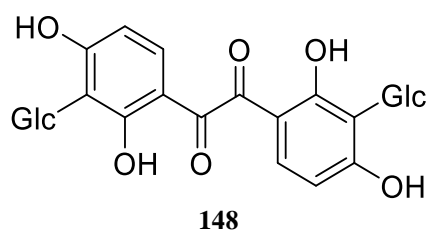
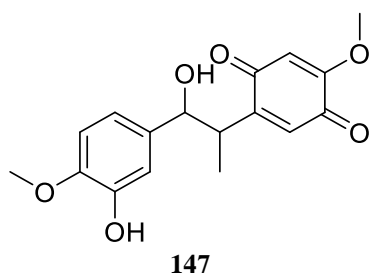
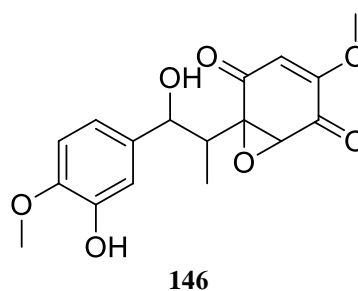
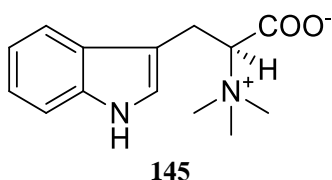
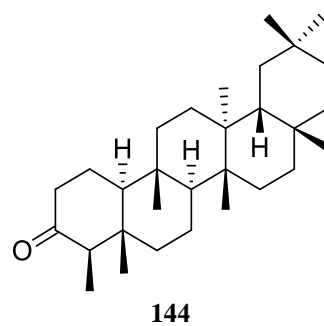
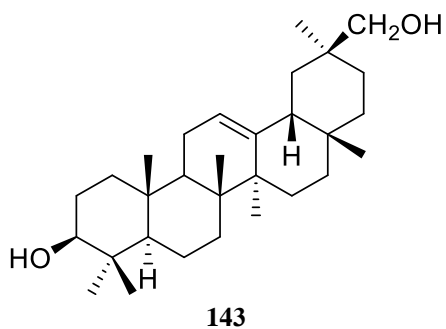
**97**



	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>
<b>107</b>	OH	H	OCH <sub>3</sub>	OH	OH	OH	H	H
<b>108</b>	OH	H	OCH <sub>3</sub>	OH	OH	OH	CH <sub>3</sub>	H
<b>109</b>	OCH <sub>3</sub>	H	OCH <sub>3</sub>	OCH <sub>3</sub>	OCH <sub>3</sub>	OCH <sub>3</sub>	CH <sub>3</sub>	H
<b>110</b>	OH	OCH <sub>3</sub>	H	OH	OH	OCH <sub>3</sub>	H	OCH <sub>3</sub>
<b>111</b>	OH	OH	H	OH	OH	OCH <sub>3</sub>	H	OCH <sub>3</sub>







## CONCLUSION

Despite the reviews on metabolites of individual *Pterocarpus* species<sup>7, 8, 95, 96</sup>, it is the first one on the entire

genus. Compiling the data, revealed that only 11 out of 35 species were phytochemically investigated. The species, *P. marsupium* and *P. santalinus* have been extensively

investigated. The wood, root, bark and stem are the most studied morphological parts for majority of the investigated plants. In turn, only leaves of *P. indicus* and *P. santalinoides* were investigated.

The phytoconstituents characteristics for the investigated wood, stem, root and bark are isoflavonoids and pterocarpanes, while the leaves constituents are majorly triterpenes. The compounds liquiritigenin, isoliquiritigenin, homopterocarpin, pterocarpin, angolensin, santal, santalins A and B, pterostilbene, pterocarpol,  $\beta$ -eudesmol, epicatechin and lupeol have been isolated from more than two member of the investigated *Pterocarpus* species, indicating their chemotaxonomic importance.

The ongoing phytochemical studies should focus on the uninvestigated *Pterocarpus* species to explore new phytomolecules that may possess more promising medical benefits.

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