Journal of Advanced Biomedical and Pharmaceutical Sciences

Journal Homepage: http://jabps.journals.ekb.eg

Chemical and Biological Review on Various Classes of Secondary Metabolites and Biological Activities of Arecaceae (2021-2006)

Marwa Hassan Hussien Mohammed, Ashraf Nageeb Elsayed Hamed*, Mostafa Ahmed Fouad and Mohamed Salah Kamel

Department of Pharmacognosy, Faculty of Pharmacy, Minia University, 61519 Minia, Egypt

Received: March 9, 2022; revised: June 21, 2022; accepted: July 3, 2022

Abstract

Arecaceae is called palm trees. It is a flowering plant family including 181 genera and about 2600 species. The scientific researchers need to summarize phytochemical and biological studies on many genera of this family to help and orient them to carry out extensive studies on the uninvestigated plants. By reviewing the currently available literature (2021-2006), many classes of secondary metabolites of this family were determined, viz., flavonoids (59 compounds), phenolic acids and their derivatives (22 compounds), fatty derivatives (11 compounds), sterols (19 compounds) and other classes. Moreover, plants belonging to this family have been shown many biological activities such as anti-hyperlipidemic, anti-diabetic, anti-oxidant, anti-parasitic, anti-convulsant, renal protective, cardioprotective, cytotoxic, anti-microbial (antibacterial, antifungal and antiviral), anti-pyretic, anti-inflammatory, anti-mutagenic, hepatoprotective, antihypertensive, analgesic, anti-ulcer, neuropharmacological, anti-platelet, anti-acetylcholinesterase and anti-Alzheimer. Also, the most chemically investigated genus is *Phoenix*. While, *Aiphanes aculeate*, *Syagrus romanzoffiana*, *Areca catechu*, *Hyophorbe indica*, *Brahea armata*, *Attalea funifera*, *Wodyetia bifurcate*, and *Dypsis leptocheilos* need more phytochemical attention. Regarding the biological investigation, *Cocos* and *Phoenix* was the most investigated genera were the most investigated species. While, *Areca*, *Bactris*, *Borassus*, *Brahea*, *Calamus*, *Caryota*, *Dypsis*, *Euterpe*, *Elaeis*, *Hyophorbe*, *Hyphaene*, *Livistona*, *Lodoicea*, *Mauritia*, *Mauritiella*, *Orbignya*, *Rhapis*, Raphia, *Ravenea*, *Syagrus and Wodyetia* genera require more pharmacological attention from the researchers.

Keywords

Arecaceae, *Cocos*, *Phoenix*, Phytochemistry, Flavonoids, Biological activity

1. Introduction

Arecaceae is a family of dominant perennial trees commonly called palm trees. This is a flowering plant family of monocots order Arecales. It includes around 181 genera with 2600 species, which are distributed in tropical, subtropical, and warm climates [1,2]. Arecaceae has been reported to contain flavonoids [3], terpenoids, steroids, fatty acids, and tannins [4]. It was classified taxonomically as akingdom: Plantae, class: Magnoliopsida, Order: Arecales [5]. It is characterized by tall unbranched stems, or rarely by dichotomous branching stems of the same diameter from base to top. At the top of the stem, leaves are spirally arranged as palmately or pinnately compounds. Like all monocots, palms cannot form any secondary growth, so, no further increase in the width of the stem [6]. This review potentiates the scientific researchers to carry out more studies on uninvestigated plants of this family to isolate and develop new natural products with high relative safety and investigate their biological activities and possible mechanisms of action.

2. Methodology

From 2021 to 2006, we conducted a systematic search of the previous literature (117 peer-reviewed articles) in databases such as PubMed, Google Scholar, ACS Publications, SciFinder, DNP, The Plant List, Global Biodiversity Information Facility, and Scopus for reported compounds, chemistry, biological, and pharmacological properties of the Arecaceae family.

3. Results and discussion

3.1 Phytochemistry

Most of the characterized metabolites are flavonoidal derivatives (59 compounds, representing 36.42%), while other classes, such as lignan derivatives (8 compounds, representing 4.94%), stilbenoid derivatives (8 compounds, representing 4.94%), steroidal derivatives (19 compounds, representing 11.73%), triterpenoidal derivatives (5 compounds, representing 3.09%), simple phenolic glycosides (2 compounds, representing 1.23 %), phenolic acids, and their derivatives (22 compounds, representing 13.58%), fatty derivatives (11 compounds, representing 6.79%), sugars (5 compounds, representing 3.09%), ceramides derivatives (4 compounds, representing 2.47%), glyceryl derivatives (9 compounds, representing 5.55%) and miscellaneous compounds (10 compounds, representing 6.17%). These data are displayed in Table 1 and the chemical structures are demonstrated in Figures 1 and 2.

Leaves and fruits were the main parts used in 23 genera and 37 species. Moreover, other parts were used as *Areca catechu* L. (leaves, stems and seeds), and *Cocos nucifera* L. (roots, leaves and fruits). The main secondary metabolites in this review (2021-2006) are flavonoids (59). They are classified into (44 flavones, 8 flavanones, 6 flavanols and 1 chalcone). The most phytochemically investigated genus is *Phoenix*, while, *Aiphanes aculeate* Wild, *Syagrus romanzoffiana* Cham., *Areca catechu* L., *Hyophorbe indica* Gaertn., *Brahea armata* S.Watson, *Attalea*

Correspondence: Ashraf N. E. Hamed
Tel.: *+201091237437*
Email Address**:** ashrafnag@mu.edu.eg

funifera Mart., *Wodyetia bifurcate* A.K.Irvine and *Dypsis leptocheilos* Hodel need more phytochemical attention.

2.2 Biological activities

Regarding the biological investigations, *Cocos* and *Phoenix* was the most investigated genera. Whereas, *Areca*, *Bactris*, *Borassus*, *Brahea*, *Calamus*, *Caryota*, *Dypsis*, *Euterpe*, *Elaeis*, *Hyophorbe*, *Hyphaene*, *Livistona*, *Lodoicea*, *Mauritia*, *Mauritiella*, *Orbignya*, *Rhapis*, Raphia, *Ravenea*, *Syagrus and Wodyetia* genera require further biological attention from the researchers. In 23 genera and 33 species, fruits and leaves are the main biologically investigated parts. While, other parts (aerial parts, barks, flowers, seeds and roots) need more attention from the researchers. The biological activities are illustrated in Tables 2.

Table 1: A list of previously reported compounds of family Arecaceae (2021-2006).

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
			1) Flavonoids				
			1A) Flavone derivatives				
1	Apigenin	270.2	$C_{15}H_{10}O_5$	*Livistona decipiens Becc.*	Leaves	Ethanol	[7]
2	Acacetin	284.3	$C_{16}H_{12}O_5$	*Caryota urens* Linné	Base leaves	Methanol	[3]
3	Kaempferol	286.2	$C_{15}H_{10}O_6$	*Caryota mitis* Lour.	Leaves	Ethanol	[8]
				Wodyetia bifurcata A.K.Irvine	Aerial parts	Methanol	[9]
4	Luteolin	286.2	$C_{15}H_{10}O_6$	*Livistona decipiens Becc.*	Leaves	Ethanol	[7]
5	Chrysoeriol	300.3	$C_{16}H_{12}O_6$	*Hyphaene thebaica* L.	Epicarps	Acetone	[10]
6	Tricetin	302.2	$C_{15}H_{10}O_7$	*Attalea funifera* Mart.	Bee pollens	Ethanol	[11]
7	Quercetin	302.2	$C_{15}H_{10}O_7$	*Caryota mitis* Lour.	Leaves	Ethanol	[8]
				Livistona decipiens Becc.	Leaves	Ethanol	[7]
				Washingtonia robusta H.Wendl.	Leaves	Ethanol	[12]
8	Apigenin 7-*O*-*α*-D-apiofuranoside	402.4	$C_{20}H_{18}O_9$	*Phoenix dactylifera* L	Seeds	Methanol	[13]
9	Diosmetin 7-*O*-*β*-D-apiofuranoside	432.4	$C_{21}H_{20}O_{10}$	*Phoenix dactylifera* L	Epicarps	Acetone	[14]
10	Genistein 8-*C*-glucopyranoside	432.4	$C_{21}H_{20}O_{10}$	*Phoenix dactylifera* L.	Seeds	Methanol	[13]
11	Apigenin 7-*O*-*β*-D-glucopyranoside (syn.: Cosmosiin)	432.4	$C_{21}H_{20}O_{10}$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
12	Apigenin 6-*C*-*β*-D-glucopyranoside (syn.: Isovitexin)	432.4	$C_{21}H_{20}O_{10}$	*Dypsis leptocheilos* Hodel	Leaves	Methanol	[16]
				Hyphaene thebaica L.	Epicarps	Acetone	[10]
13	Apigenin 8-*C*-*β*-D-glucopyranoside (syn.: Vitexin)	432.4	$C_{21}H_{20}O_{10}$	*Dypsis leptocheilos* Hodel	Leaves	Methanol	[16]
				Hyphaene thebaica L.	Epicarps	Acetone	[10]
14	Kaempferin (syn.: Kaempferol-3-rhamnoside)	432.4	$C_{21}H_{20}O_{10}$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
15	Avicularin	434.3	$C_{20}H_{18}O_{11}$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
16	Astragalin (syn.: Kaempferol 3-glucoside)	448.4	$C_{21}H_{20}O_{11}$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
17	Luteolin 7-*O*-*β*-D-glucoside	448.4	$C_{21}H_{20}O_{11}$	*Hyphaene thebaica* L.	Leaves	Ethanol	[18]
18	Luteolin 6-*C*-*β*-D-glucopyranoside (syn.: Isoorientin)	448.4	$C_{21}H_{20}O_{11}$	*Dypsis leptocheilos* Hodel	Leaves	Methanol	[16]
				Livistona decipiens Becc.	Leaves	Ethanol	[7]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
19	Luteolin 8-*C*-*β*-D-glucopyranoside (syn.: Orientin)	448.4	$C_{21}H_{20}O_{11}$	*Dypsis leptocheilos* Hodel	Leaves	Methanol	[16]
				Livistona decipiens Becc.	Leaves	Ethanol	[7]
20	Quercitrin	448.4	$C_{21}H_{20}O_{11}$	*Hyphaene thebaica* L.	Edible parts	EtOAc	[19]
21	Isoquercitrin	464.4	$C_{21}H_{20}O_{12}$	*Hyphaene thebaica* L.	Leaves	Ethanol	[18]
22	6-*C*-Glucopyranosyl-3',4',5,7,8-pentahydroxyflavone; 3'-methyl ether (syn.: 8-Hydroxyisoscoparin)	478.1	$C_{22}H_{22}O_{12}$	*Washingtonia filifera* Lindl.	Aerial parts	Methanol	[20]
23	Isorhamnetin 3-*O*-glucoside	478.4	$C_{22}H_{22}O_{12}$	*Phoenix dactylifera* L.	Pollen grains	Methanol	[21]
24	Tricin 7-O-glucoside	492.4	$C_{23}H_{24}O_{12}$	*Livistona decipiens Becc.*	Leaves	Ethanol	[7]
25	Tricin 5-*O*-*β*-D-glucoside	508.4	$C_{23}H_{24}O_{13}$	*Hyphaene thebaica* L.	Leaves	Ethanol	[18]
26	Luteolin 7-*O*-glucoside 2''-sulfate	543.4	$C_{21}H_{19}O_{15}S^{-}$	*Washingtonia filifera* Lindl.	Aerial parts	Methanol	[20]
27	Luteolin 7-*O*-*β*-D-glucoside 4''-sulfate	543.4	$C_{21}H_{19}O_{15}S^{-}$	*Washingtonia filifera* Lindl.	Aerial parts	Methanol	[20]
28	Quiquelignan C	554.5	$C_{29}H_{30}O_{11}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
29	4',5,7-Trihydroxy-3'-methoxyflavone; 7-O-[*β*-L-arabinofuranosyl-(1→2)-*β*-D-apiofuranoside]	564.5	$C_{26}H_{28}O_{14}$	*Phoenix dactylifera* L	Fruit picarps	Acetone	[14]
30	Schaftoside	564.5	$C_{26}H_{28}O_{14}$	*Caryota mitis* Lour.	Leaves	Ethanol	[8]
				Livistona decipiens Becc.	Leaves	Ethanol	[7]
31	Apigenin 7-*O*-*α*-D-apiofuranosyl-(1→2)-*β*-D-glucopyranoside	580.5	$C_{26}H_{28}O_{15}$	*Phoenix dactylifera* L	Seeds	Methanol	[13]
32	Acacetin 7-*O*-*β*-D-neohesperopyranoside	592.5	$C_{28}H_{32}O_{14}$	*Phoenix dactylifera* L	Seeds	Methanol	[13]
33	Luteolin 7-*O*-*β*-D-neohesperopyranoside	594.5	$C_{27}H_{30}O_{15}$	*Phoenix dactylifera* L	Seeds	Methanol	[13]
34	Nicotiflorin	594.5	$C_{27}H_{30}O_{15}$	*Hyphaene thebaica* L.	Leaves	Ethanol	[18]
35	Luteolin 7-*O*-*β*-D-neohesperopyranoside 3-*O*-methylether	608.6	$C_{28}H_{32}O_{15}$	*Phoenix dactylifera* L	Seeds	Methanol	[13]
36	Neodiosmin	608.5	$C_{28}H_{32}O_{15}$	*Phoenix dactylifera* L.	Fruits	Ethanol	[23]
37	Rutin	610.5	$C_{27}H_{30}O_{16}$	*Caryota mitis Lour.*	Leaves	Ethanol	[8]
38	Isorhamnetin 3-O-rutinoside	624.5	$C_{28}H_{32}O_{16}$	*Phoenix canariensis Chabaud*	Pollen grains	Ethanol	[24]
39	Isorhamnetin 3-O-neohesperidoside	624.5	$C_{28}H_{32}O_{16}$	*Attalea funifera Mart.*	Bee pollens	Ethanol	[11]
40	Vicinine ll	626.5	$C_{27}H_{30}O_{17}$	*Caryota mitis Lour.*	Leaves	Ethanol	[8]
41	Rhamnazin 3-O-rutinoside	638.6	$C_{29}H_{34}O_{16}$	*Hyphaene thebaica L.*	Leaves	Ethanol	[18]
42	Kaempferol 3-sulfate-4'-O-α-rhamnosyl(1→6)-β-D-glucoside	674.5	$C_{27}H_{30}O_{18}S$	*Caryota mitis Lour.*	Leaves	Ethanol	[8]
43	Quercetin 3-sulfate-4'-O-α-rhamnosyl (1→6)-β-D-glucoside	690.5	$C_{27}H_{30}O_{19}S$	*Caryota mitis Lour.*	Leaves	Ethanol	[8]
44	Manghaslin	756.7	$C_{33}H_{40}O_{20}$	*Serenoa repens W.Bartram*	Fruits	Ethanol	[17]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
			1B) Flavan derivatives				
			1B-i) Flavanone derivatives				
45	Naringenin	272.3	$C_{15}H_{12}O_5$	*Washingtonia robusta* H.Wendl.	Leaves	Ethanol	[12]
46	Hesperetin	302.3	$C_{16}H_{14}O_6$	*Hyphaene thebaica* L.	Edible parts	EtOAc	[19]
47	Rhusflavone	542.5	$C_{30}H_{22}O_{10}$	*Attalea funifera* Mart.	Bee pollens	Ethanol	[11]
48	Quiquelignan A	556.6	$C_{29}H_{32}O_{11}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
49	Naringin	580.5	$C_{27}H_{32}O_{14}$	*Phoenix dactylifera* L.	Pollen grains	Methanol	[21]
50	Chrysoeriol 7-*O*-*β*-D-galactopyranosyl(1→2)-*α*-L-arabinofuranoside	596.5	$C_{27}H_{32}O_{15}$	*Hyphaene thebaica* L.	Epicarps	Acetone	[10]
51	Luteolin 7-*O*-[6"-*O*-*α*-L-rhamnopyranosyl]-*β*-D-galactopyranoside	596.5	$C_{27}H_{32}O_{15}$	*Hyphaene thebaica* L.	Epicarps	Acetone	[10]
52	Eriocitrin	596.5	$C_{27}H_{32}O_{15}$	*Hyphaene thebaica* L.	Edible parts	EtOAc	[19]
			1B-ii) Flavanol derivatives				
53	Catechin	290.3	$C_{15}H_{14}O_6$	*Brahea armata* S.Watson	Fruits	Ethanol	[25]
54	Epicatechin	290.2	$C_{15}H_{14}O_6$	*Brahea armata* S.Watson	Fruits	Ethanol	[25]
55	Procyanidin B1	578.5	$C_{30}H_{26}O_{12}$	*Hyophorbe indica* Gaertn.	Leaves	Ethanol	[26]
56	Arecatannin A1	866.8	$C_{45}H_{38}O_{18}$	*Areca catechu* L.	Seeds	Methanol	[27]
57	Arecatannin B1	866.8	$C_{45}H_{38}O_{18}$	*Areca catechu* L.	Seeds	Methanol	[27]
58	Arecatannin A2	1154.3	$C_{60}H_{50}O_{24}$	*Areca catechu* L.	Seeds	Methanol	[27]
			1C) Chalcone				
59	4',6'-Dimethoxy-*β*,4,2'-trihydroxy chalcone [syn.: (*Z*)-3-Hydroxy-1-(2-hydroxy-4,6-dimethoxyphenyl)-3-(4-hydroxyphenyl)prop-2-en-1-one]	316.0	$C_{17}H_{16}O_6$	*Brahea armata* S.Watson	Fruits	Ethanol	[25]
			2) Lignan derivatives				
60	Quiquelignan C	554.5	$C_{29}H_{30}O_{11}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
61	Quiquelignan A	556.6	$C_{29}H_{32}O_{11}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
62	Quiquelignan G	646.6	$C_{35}H_{34}O_{12}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
63	Quiquelignan H	646.6	$C_{35}H_{34}O_{12}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
64	Quiquelignan D	674.6	$C_{36}H_{34}O_{13}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
65	Quiquelignan B	676.7	$C_{36}H_{36}O_{13}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
66	Quiquelignan F	676.7	$C_{36}H_{36}O_{13}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
67	Quiquelignan E	708.7	$C_{36}H_{36}O_{15}$	*Calamus quiquesetinervius* Burret	Stems	Ethanol	[22]
			3) Stilbenoid derivatives				
68	Piceatannol	244.2	$C_{14}H_{12}O_4$	*Aiphanes aculeata* Wild.	Seeds	Methanol	[28]
				Cocos nucifera L.	Endocarps	EtOAc	[29]
69	Isorhapontigenin	258.3	$C_{15}H_{14}O_4$	*Aiphanes aculeata* Wild.	Seeds	Methanol	[28]
70	1-(3,5-Dihydroxyphenyl)-2-(3,4,5-trihydroxyphenyl) ethylene; (*Z*)-form, 4-methyl ether. (syn: (*Z*) 3,5,3',5'-Tetrahydroxy-4-methoxystilbene)	274.3	$C_{15}H_{14}O_5$	*Phoenix dactylifera* L.	Stems	Methanol	[30;31]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
71	1-(3,5-Dihydroxyphenyl)-2-(3,4,5-trihydroxyphenyl) ethylene; (*E*)-form, 4-methyl ether (sy.: (*E*) 3,5,3',5'-Tetrahydroxy-4-methoxystilbene)	274.3	$C_{15}H_{14}O_5$	*Phoenix dactylifera* L.	Stems	Methanol	[30;31]
72	Aiphanol	452.5	$C_{25}H_{24}O_8$	*Aiphanes aculeata* Wild.	Seeds	Methanol	[28]
73	Aiphanol; 5-hydroxy	468.5	$C_{25}H_{24}O_9$	*Syagrus romanzoffiana* Cham.	Seeds	Ethanol	[32]
74	Cassigarol G	484.5	$C_{28}H_{20}O_8$	*Cocos nucifera* L.	Endocarps	EtOAc	[29]
75	Maackin A	486.5	$C_{28}H_{22}O_8$	*Cocos nucifera* L.	Endocarps	EtOAc	[29]
	4) Steroidal derivatives						
76	Estrone	270.4	$C_{18}H_{22}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
77	Estradiol	272.4	$C_{18}H_{24}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
78	Cholesterol	386.7	$C_{27}H_{46}O$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
79	Ergost-4-en-3-one	398.7	$C_{28}H_{46}O$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
80	Ergost-4-ene-3,6-dione	412.6	$C_{28}H_{44}O_2$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
81	*β*-Sitosterol	414.7	$C_{29}H_{50}O$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
82	5*α*-Campestan-3,6-dione	414.7	$C_{28}H_{46}O_2$	*Phoenix dactylifera* L.	Stems	*n*-Hexane	[33]
83	Stigmasta-4,22-diene-3,6-dione	424.7	$C_{29}H_{44}O_2$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
84	5*α*-Stigmast-22-en-3,6-dione	426.7	$C_{29}H_{46}O_2$	*Phoenix dactylifera* L.	Stems	*n*-Hexane	[33]
85	Clionasterol acetate	456.7	$C_{31}H_{52}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
86	*β*-Sitosterol acetate	456.7	$C_{31}H_{52}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
87	24,24,27-Trimethylcycloart-25-en-3-ol; 3*β*-form, 3-ketone (syn.: Isoskimmiwallinone)	466.4	$C_{33}H_{54}O$	*Cocos nucifera* L.	Epicut. wax	*n*-Hexane	[34]
88	25-Ethyl-24-methylenecycloartan-3-ol; 3*β*-form, 3-ketone (syn.: Skimmiwallinone)	466.4	$C_{33}H_{54}O$	*Cocos nucifera* L.	Epicut. wax	*n*-Hexane	[34]
89	24,24,27-Trimethylcycloart-25-en-3-ol; 3*β*-form, Ac (syn.: Isoskimmiwallinol acetate)	510.4	$C_{35}H_{58}O_2$	*Cocos nucifera* L.	Epicut. wax	*n*-Hexane	[34]
90	25-Ethyl-24-methylenecycloartan-3-ol; 3*β*-form, Ac (syn.: Skimmiwallinol acetate)	510.4	$C_{35}H_{58}O_2$	*Cocos nucifera* L.	Epicut. wax	*n*-Hexane	[34]
91	*β*-Sitosterol 3-*O*-*β*-D-glucoside	576.8	$C_{35}H_{60}O_6$	*Phoenix dactylifera* L.	Leaves	*n*-Butanol	[35]
92	*β*-Sitosterol caproate	568.9	$C_{39}H_{68}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
93	Dioscin	869.0	$C_{45}H_{72}O_{16}$	*Phoenix canariensis* Chabaud	Poll. grains	Ethanol	[24]
94	Methylprotodioscin	1063.2	$C_{52}H_{86}O_{22}$	*Phoenix canariensis* Chabaud	Poll. grains	Ethanol	[24]
	5) Triterpenoidal derivatives						
	5A) Oleanane skeleton						
95	Oleanolic acid	456.7	$C_{30}H_{48}O_3$	*Phoenix dactylifera* L.	Leaves	*n*-Butanol	[35]
	5B) Lupane skeleton						
96	Lupeol	426.7	$C_{30}H_{50}O$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
97	Epilupeol	426.7	$C_{30}H_{50}O$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
98	Betulinic acid	456.7	$C_{30}H_{48}O_3$	*Ravenea rivularis* Jum. & H.Perrier	Leaves	Methanol	[36]
99	Lupeol acetate	468.8	$C_{32}H_{52}O_2$	*Ravenea rivularis* Jum. & H.Perrier	Leaves	Methanol	[36]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
	6) Simple phenolic glycosides						
100	6'-*O*-(4-Hydroxybenzoyl)-*β*-glucose	300.3	$C_{13}H_{16}O_8$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
				Serenoa repens W.Bartram	Fruits	Ethanol	[17]
101	6'-*O*-(3,4-Dihydroxybenzoyl)-*β*-glucose	316.3	$C_{13}H_{16}O_9$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
	7) Phenolic acids and their derivatives						
102	3-Hydroxybenzoic acid	138.1	$C_7H_6O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
103	4-Hydroxybenzoic acid	138.1	$C_7H_6O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
104	Cinnamic acid	148.2	$C_9H_8O_2$	*Hyphaene thebaica* L.	Edible parts	EtOAc	[19]
105	Hydroxychavicol (syn.: 4-Allylbenzene-1,2-diol)	150.1	$C_9H_{10}O_2$	*Areca catechu* L.	Fruits	Methanol	[37]
106	4-Vinylguaiacol (syn.: 2-Methoxy-4-vinylphenol)	150.1	$C_9H_{10}O_2$	*Cocos nucifera* L.	Coir	Acetone	[38]
107	3-Methoxybenzoic acid (syn.: *m*-Anisic)	152.2	$C_8H_8O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
108	4-Methoxybenzoic acid (syn.: *p*-Anisic)	152.2	$C_8H_8O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
109	Pyrocatechuic acid	154.1	$C_7H_6O_4$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
110	Protocatechuic acid	154.1	$C_7H_6O_4$	*Cocos nucifera* L.	Endocarps	EtOAc	[29]
111	*O*-Coumaric acid	164.2	$C_9H_8O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
112	*p*-Coumaric acid	164.2	$C_9H_8O_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
113	Isovanillic acid	168.2	$C_8H_8O_4$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
114	Gallic acid	170.1	$C_7H_6O_5$	*Hyphaene thebaica* L.	Leaves	Ethanol	[18]
				Washingtonia robusta H.Wendl.	Leaves	Ethanol	[12]
115	Caffeic acid	180.2	$C_9H_8O_4$	*Ravenea rivularis* Jum. & H.Perrier	Leaves	Methanol	[36]
116	Ferulic acid	194.2	$C_{10}H_{10}O_4$	*Ravenea rivularis* Jum. & H.Perrier	Leaves	Methanol	[36]
117	Syringic acid	198.2	$C_9H_{10}O_5$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
118	1-*p*-Hydroxybenzoyl glycerol	212.2	$C_{10}H_{12}O_5$	*Brahea armata* S.Watson	Fruits	Ethanol	[25]
119	5-*O*-Caffeoylshikimic acid	336.3	$C_{16}H_{16}O_8$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
				Livistona chinensis Jacq.	Fruits	Ethanol	[39]
120	3-*O*-Caffeoylshikimic acid	336.3	$C_{16}H_{16}O_8$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
				Livistona chinensis Jacq.	Fruits	Ethanol	[39]
121	4-*O*-Caffeoylshikimic acid	336.3	$C_{16}H_{16}O_8$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
122	Chlorogenic acid	354.3	$C_{16}H_{18}O_9$	*Ravenea rivularis* Jum. & H.Perrier	Leaves	Methanol	[36]
123	4-*O*-Caffeylquinic acid	354.3	$C_{16}H_{18}O_9$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
	8) Fatty derivatives compounds						
	8A) Fatty acids						
124	Palmitic acid (syn.: Hexadecanoic acid)	256.4	$C_{16}H_{32}O_2$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
125	Docosanoic acid (syn.: Behenic acid)	340.6	$C_{22}H_{44}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
126	Tetracosanoic acid (syn.: Lignoceric acid)	368.6	$C_{24}H_{48}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
127	Hexacosanoic acid (syn.: Cerotic acid)	396.7	$C_{26}H_{52}O_2$	*Phoenix dactylifera* L.	Poll. grains	Methanol	[21]
128	Octacosanoic acid (syn.: Montanic acid)	424.7	$C_{28}H_{56}O_2$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
	8B) Fatty alcohol						
129	Dotriacontanol	466.9	$C_{32}H_{66}O$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
	8C) Hydroxylated fatty acids						
130	16-Hydroxyhexadecanoic (syn.: Juniperic acid)	272.4	$C_{16}H_{32}O_3$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
131	18-Hydroxyoctadecanoic acid	300.5	$C_{18}H_{36}O_3$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
132	26-Hydroxyhexacosanoic	412.7	$C_{26}H_{52}O_3$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
133	28-Hydroxyoctacosanoic acid	440.7	$C_{28}H_{56}O_3$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
134	Heptacosane	380.7	$C_{27}H_{56}$	*Livistona australis* R.Br.	Fruits	Pet. ether	[40]
				Copernicia cerifera Mill.	Waxes	*n*-Hexane	[41]
	9) Sugars						
135	Mannose	180.2	$C_6H_{12}O_6$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
136	Maltose	342.3	$C_{12}H_{22}O_{11}$	*Phoenix dactylifera* L.	Fruits	Ethanol	[23]
137	Sucrose	342.3	$C_{12}H_{22}O_{11}$	*Phoenix dactylifera* L.	Fruits	Ethanol	[23]
138	*β*-D-Glucopyranosyl-(1→2)-*β*-D-fructofuranosyl-(6→6)-*α*-D-glucopyranoside	504.5	$C_{18}H_{32}O_{16}$	*Phoenix dactylifera* L.	Fruits	Ethanol	[23]
139	Maltotriose (syn.: Pullulan)	504.4	$C_{18}H_{32}O_{16}$	*Phoenix dactylifera* L.	Fruits	Ethanol	[23]
	10) Ceramide derivatives						
140	(2*S*,3*S*,4*R*)-2-[(2*R*)-2-Hydroxytetracosanoylamino]-1,3,4-octadecanetriol	684.1	$C_{42}H_{85}NO_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
141	(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-Hydroxytricosanoylamino]-9-octadecene-1,3,4-triol	668.1	$C_{41}H_{81}NO_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
142	1-*O*-*β*-D-Glucopyranosyl-(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-hydroxydocosanoylamino]-9-octadecene-1,3,4-triol	816.2	$C_{46}H_{89}NO_{10}$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
143	1-*O*-*β*-D-Glucopyranosyl-(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-hydroxytetracosanoylamino]-1,3,4-octadecanetriol	846.3	$C_{48}H_{95}NO_{10}$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
	11) Glyceryl derivatives						
	11A) Monoacylglycerols						
144	1-Hexadecanoyl-sn-glycerol	330.5	$C_{19}H_{38}O_4$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
145	1-[Octadec-(9*Z*)-enoyl]-sn-glycerol	356.5	$C_{21}H_{40}O_4$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
146	1-[Nonadeca-(9*Z*,12*Z*)-dienoyl]-sn-glycerol	368.4	$C_{22}H_{40}O_4$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]

No.	Name	Mol. weight	Mol. formula	Plant	Organ	Extract	Ref.
147	1-(26-Hydroxyhexacosanoyl)-sn-glycerol	486.8	$C_{29}H_{58}O_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
148	1-Octacosanoyl-sn-glycerol	498.8	$C_{31}H_{62}O_4$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
149	1-(34-Hydroxytetratriacontanoyl)-sn-glycerol	598.9	$C_{37}H_{74}O_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
150	1-[12-Hydroxypentatriaconta-(13*E*,15*Z*)-dienoyl]-sn-glycerol	608.9	$C_{38}H_{72}O_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
	11B) Diacylglycerols						
151	1-(Heptadeca-6*Z*,9*Z*-dienoyl)-3-(octadeca-6*Z*,9*Z*,12*Z*-trienoyl)-sn-glycerol	600.3	$C_{38}H_{64}O_5$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
152	1-Octadecanoyl-2-nonadecanoyl-3-*O*-(6-amino-6-deoxy)-*β*-D-glucopyranosyl-sn-glycerol	800.2	$C_{46}H_{89}NO_9$	*Livistona chinensis* Jacq.	Roots	Ethanol	[42]
	12) Miscellaneous compounds						
153	4-Hydroxybenzaldehyde	122.1	$C_7H_6O_2$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
154	Vanillyl alcohol	154.2	$C_8H_{10}O_3$	*Phoenix dactylifera* L.	Leaves	*n*-Butanol	[35]
155	3-Hydroxy-2-(4-hydroxyphenyl)-6-methyl-4*H*-pyran-4-one	220.2	$C_{12}H_{12}O_4$	*Livistona australis* R.Br.	Leaves	Methanol	[43]
156	7-Hydroxy-5,4'-dimethoxy-2-arylbenzofuran	270.2	$C_{16}H_{14}O_4$	*Livistona chinensis* Jacq.	Fruits	Ethanol	[39]
157	2-(3'-Hydroxy-5'-methoxyphenyl)-3-hydroxymethyl-7-methoxy-2,3-dihydrobenzofuran-5-carboxylic acid	346.3	$C_{18}H_{18}O_7$	*Livistona chinensis* Jacq.	Fruits	Ethanol	[39;44]
158	Protocatechoic acid	370.7	$C_{16}H_{30}O_4Si_3$	*Serenoa repens* W.Bartram	Fruits	Ethanol	[17]
159	Rhipocephalin	376.4	$C_{21}H_{28}O_6$	*Phoenix paludosa* Roxb.	Leaves	Methanol	[15]
160	5-Hydroxyaiphanol	468.5	$C_{25}H_{24}O_9$	*Syagrus romanzoffiana* Cham.	Seeds	Ethanol	[32]
161	Scirpusin A	470.5	$C_{28}H_{22}O_7$	*Cocos nucifera* L.	Endocarps	EtOAc	[29]
162	Jezonofol	482.4	$C_{28}H_{18}O_8$	*Cocos nucifera* L.	Endocarps	EtOAc	[29]

Table 2: Biological activities of family Arecaceae (2021-2006).

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
		1) Antioxidant activity	
Cocos nucifera L./ Roots	Aqueous and methanolic extracts	Both extracts were evaluated using four methods (inhibition of LPO, FRAP, DPPH and ABTS assays). The extracts demonstrated antioxidant capacity, LPO percentage of inhibition (55.99 ± 1.3 and 42.61 ± 2.36 µg/mL), FRAP (87.71 ± 1.42 and 70.26 ± 1.98), DPPH IC_{50} (1.4 ± 0.08 and 1.4 ± 0.05 µg/mL), ABTS IC_{50} (4.79 ± 0.06 and 8.00 ± 0.08 µg/mL) for methanolic and aqueous extracts, respectively.	[45]
Mauritia flexuosa L. f. and Mauritiella armata Mart./ Leaves, roots and petioles	Hydroethanolic extracts	Antioxidant activity was performed by spectrophotometric method. They possessed antioxidant activities.	[46]
Cocos nucifera L./ Outer shell fiber	Aqueous extract	In DPPH, the possibility of lowering power was assessed. As compared to BHT, the results demonstrated promising DPPH scavenging (51.87% at 100 µg/mL) and lowering power activity (0.165 at 100 µg/mL) of the silver nanoparticles in a concentration-dependent manner.	[47]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Bactris guineensis L./ Fruits	Methanolic extract	The extract IC_{50} for DPPH was 3.3 ± 0.2 µg/mL and for generated intracellular reactive oxygen species was 153 ± 13 µg/mL, as determined by chemical and biological techniques.	[48]
Dypsis leptocheilos Hodel/ Leaves	EtOAc fraction and aqueous methanolic extract (80%)	The antioxidant activity of EtOAc fraction and aqueous methanolic extract (80%) was determined using the DPPH assay, with SC_{50} = 12.8 ± 0.56 µg/mL and SC_{50} = 17.0 ± 0.77 µg/mL, respectively, when compared to ascorbic acid (SC_{50} = 14.2 ± 0.355 µg/mL)	[16]
Caryota urens Linné (Fruits, leaves and barks)	Hydroethanolic extract (70%)	The antioxidant activity was evaluated using *in vitro* phosphomolybdenum reduction. The high antioxidant activity of leaf hydroethanolic extract (21.25 ± 4.51 mg/g similar to that of ascorbic acid indicates antioxidant activity.	[49]
Borassus flabellifer L./ Fruits	Aqueous extract	An antioxidant assay was carried out using DPPH. The antioxidant activity of the extract was measured in a time interval of 5 min each until 30 min. Thus the percentage of radical scavenging of DPPH was (56.69, 62.20, 62.99, 64.57, 66.14, 66.93 and 67.72%), respectively.	[50]
Mauritia flexuosa L. f./ Fruits	Chloroform (FCB), EtOAc (FAB) and ethanolic (FEB) fractions	The antioxidant capacity of the fractions was determined by the sequestration of the free radical ABTS and iron chelating activity. The FCB showed the most activity in ABTS, followed by FEB and FAB. There were no significant differences in iron chelating activity, with a maximum percentage of 78.2% for FCB, 72.9% for FAB and 80.9% for FEB.	[51]
Cocos nucifera L./ Fruits	Shell methanolic extract	Total antioxidant activity ranged from 92.32% to 94.20%, when tested utilizing DPPH radical scavenging assay.	[52]
Caryota urens Linné/ Leaves	Crude ethanolic extract (CLEE), chloroform fraction (CLF), EtOAc fraction (LEAF) and methanolic fraction (LMF).	Determined by total antioxidant activity, the DPPH radical scavenging assay and hydroxyl radical scavenging assay. The CEE of the *C. urens* leaves showed the highest total antioxidant activity compared to CLF, LEAF and LMF. In DPPH scavenging assay and the hydroxyl radical scavenging assay, CEE showed the highest scavenging activity (42.36% and 53.36%) having IC_{50} of 472.14 and 374.81 µg/mL respectively with respect to other fractions.	[53]
Caryota urens Linné/ Starch extracted from "*Kithul* flour"	Methanolic extract	Different *in vitro* assays, such as ABTS, FRAP antioxidant power, oxygen radical absorbance capacity and ferrous ion chelating assay, were used to assess the results. *C. urens* flour has free radical scavenging activity (raw 0.02 ± 0.01 and boiled 0.04 ± 0.01 mg Trolox equivalent (TE)/g flour), electron-donating reducing power (raw 0.10 ± 0.03 and boiled 0.36 ± 0.11 mg TE/g flour), oxygen radical absorbance capacity (raw 2.29 ± 0.71 and boiled 192.3 ± 57.71 mg TE/1 g flour) and metal ion chelating capacity (raw 0.03 ± 0.01 and boiled 0.14 ± 0.04 mg EDTA equivalents /g flour) exhibiting its antioxidant potential.	[54]
Hyophorbe verschaffeltii H.Wendl./ Leaves	Methanolic extract	The levels of serum liver enzymes Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) were determined *in vivo* using the CCl_4-induced hepatic damage approach. When compared to the CCl_4-treated group, the treatment with extract of Hyophorbe verschaffeltii leaves resulted in a significant reduction in high serum AST and ALT levels of 64.15% and 40.53%, respectively, at dose levels of 200 mg/kg, b.wt. When compared to the CCl_4-treated group, the silymarin (25 mg/kg) treated group showed a 36.48% and 32.89% reduction in blood AST and ALT levels, respectively.	[55]
Rhapis excels Thunb./ Leaves	EtOAc and butanol fractions	EtOAc and butanol fractions showed exceptional antioxidant activity when tested in DPPH scavenging activity (86.2% and 75.6%, respectively), when compared with the standard compound (Trolox, 98.2%). The EC_{50} values of both were 30 ± 1.06 and 32 ± 1.26 µg/mL, respectively.	[56]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Cocos nucifera L./ Endocarp	Ethanolic (cold and hot percolation), dry-distilled and aqueous extracts	Ethanolic (cold and hot percolation), dry-distilled and aqueous extracts of endocarp had significant antioxidant activity (4.18, 3.31, 20.83 and 1.02 µg/mL, respectively) comparable to that of standard ascorbic acid, when tested in DPPH radical scavenging, nitric oxide radical scavenging and alkaline dimethyl sulfoxide methods.	[57]
Hyphaene thebaica L./ Fruits	Methanol/ultrasonic (MU), methanol/water bath (MW), ethanol/ultrasonic (EU) and ethanol/water bath (EW) extracts	The antioxidant potential of the extracts was investigated using DPPH. IC_{50} values of MU, MW, EU and EW extracts were 107.6, 126.7, 172.7 and 196.3 µg/mL, respectively.	[58]
Livistona australis R.Br./ Fruit pulps	The lipophilic fraction	Glutathione levels in the blood of CCl_4-treated rats were lowered by the lipophilic fraction (39.9%), when compared to the vehicle-treated group in CCl_4-induced oxidative stress in rats.	[40]
Borassus flabellifer (Linn.)/ Fruits	Aqueous extract	The extract was tested for antioxidant activity *in vitro* using DPPH and ABTS assays. Antioxidant properties DPPH and ABTS free radical scavenging methods were utilised on various concentrations of effective antiulcer concentration (100, 200, 300, 500, 600, 700, 800, 900 and 1000 µg/mL), from which the aqueous extract demonstrated antioxidant activity in a concentration-dependent manner.	[59]
Calamus erectus Roxb./ Fruits (mesocarp and endocarp)	Methanolic extract (ME)	DPPH, reducing power, metal chelating, nitric oxide, superoxide, hydroxyl radical scavenging capability and anti-lipid peroxidation assays were used to evaluate the antioxidant activity of ME. The IC_{50} values of MEs of endocarp and mesocarp for DPPH radical scavenging are 0.10 and 0.12 mg/mL fresh weight tissue, respectively. The antioxidant assays of both MEs were improved, when the concentration was increased.	[60]
Dypsis lutescens (H.Wendl.) Beentje & J.Dransf./ Fruits	Aqueous and methanolic extracts	DPPH free radical scavenging assay and reducing power assay were used to determine the antioxidant activity. For both analyses, ascorbic acid was employed as a positive control. In DPPH scavenging assay, the highest radical scavenging activity was observed for methanolic extract (IC_{50} =18 µg/mL), when compared to aqueous extract (IC_{50} =25 µg/mL). The two extracts displayed reducing power activity and it was concentration dependent.	[61]
Livistona australis R.Br./ Leaves	Methanolic extract and tricin 7-*O*-*β*-glucopyranoside-2"-sulphate sodium salt	*In vivo* the antioxidant activity was assessed by measuring blood GSH levels. The glycoside and the methanolic extract significantly recovered the diabetic rats' decreased GSH levels (the percent of change was 3.1% and 18.4%, respectively, compared to 37.46% for the untreated diabetic rats group).	[62]
Cocos nucifera L./ Fruits (green and yellow)	Water and Pet. ether extracts	By using the DPPH assay, high scavenger activity was found in the water extracts (0.19 and 0.24 µg/µL) and moderate activity was observed in the Pet. ether extracts (>1.0 and >1.0 µg/µL) for green and yellow fruits, respectively.	[63]
Euterpe precatoria Mart./ Roots and leaf stalks	Ethanol roots extract (ERE), *n*-butanol extract from ERE (*n*-BuOHE), leaf stalks ethanol extract (LSEE), residue obtained from the soluble fraction of LSEE with methanol/chloroform 1:1 (LSEE-1) and flavonoids (quercetin, catechin, epicatechin, rutin and astilbin)	In a spectrophotometric bioassay, *β*-carotene in TLC plates and DPPH radical scavenging were investigated. All extracts and pure compounds had strong radical scavenging activity at 100.0 µg/mL. The reference substance was BHT and the catechin, epicatechin, *n*-BuOHE and LSEE-1 extracts had the highest activity at 1.0 µg/mL. The sequence of IC_{50} values for scavenging activity is LSEE-1 (3.33 ± 4.11)> quercetin (3.73 ± 1.31) > catechin = epicatechin (5,15 ± 2.42) > *n*-BuOHE (8.83 ± 5.55) > rutin (12.44 ±1.99) > BHT = astilbin (16.56 ± 2.66)> LSEE (24.74 ± 11.72)> ERE (43.54 ± 5.60). BHT was only more active than astilbin, the less active flavonoid.	[64]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Phoenix dactylifera L./ Fruits	Aqueous extract (PFAE)	The PFAE was tested in a dose-dependent suppression of superoxide and hydroxyl radicals. In the riboflavin photoreduction method, the amount of fresh extract required to scavenge 50% of superoxide radicals was equivalent to 0.8 mg/mL of date fruit. In the deoxyribose degradation procedure, 2.2 mg/mL of PFAE was required to achieve 50% hydroxyl-radical-scavenging activity. Superoxide and hydroxyl radicals were suppressed at concentrations of 1.5 and 4.0 mg/mL, respectively. In a dose-dependent way, PFAE was also demonstrated to reduce lipid peroxidation and protein oxidation. In a Fe^{2+}/ascorbate system, 1.9 mg/mL of PFAE was required to reduce lipid peroxides by 50%. At a 2.0 mg/mL concentration of PFAE, there was a complete inhibition of TBARS generation in the early stages of the incubation period that increased throughout the later stages of the incubation period in a time course inhibition study of lipid peroxide. PFAE (2.3 mg/mL) suppressed carbonyl production determined by the DNPH reaction by 50% in the high Fe^{2+} ascorbate induction setup. Furthermore, PFAE (4.0 mg/mL) fully suppressed the development of lipid peroxide and protein carbonyl.	[65]
		2) Anti-gastric ulcer activity	
Dypsis lutescens H.Wendl./ Leaves	Ethanolic extract	There were five groups of six rats each. The duration of experiment 8 days. The first group (the normal control group) was given 5 mL/kg, p.o. of distilled water. The second group D-galactosamine (D-GaIN-group) as the model group) was injected with 200 mg/kg, i.p. The third group (positive treatment group) was given silymarin at a dose of 100 mg/kg, p.o. The extract (250 and 500 mg/kg) was supplied orally in the fourth and fifth groups (the D-GaIN group + low dose of *D. lutescens* extract). On the eighth day (final day), the third, fourth and fifth groups received a single dose of D-GaIN group (200 mg/kg i.p.) after 1 h of extract delivery. When compared to the control group, D-GaIN group significantly raised GOT, GPT, ALP, total protein, total bilirubin, NO, MDA, hyaluronic acid and MMP1 enzyme levels, while decreasing PON1 levels. Similar to silymarin, *D. lutescens* efficiently corrected these modifications in dosage dependence.	[66]
Phoenix loureiroi Kunth/ Fruits	Methanolic extract (PFME)	Indomethacin (s.c.), acetic acid (i.c.) and dextran sulphate sodium (DSS) induced models of inflammatory bowel disease (IBD) were examined in Wistar albino rats. Consumption of PFME on a regular basis may help to avoid IBD and lends credence to the fruit's folkloric use in the treatment of digestive illnesses The PFME significantly inhibited the ulcerative inflammatory damage score in the indomethacin (15.50 to 11.26), acetic acid (20.33 to 12.00) and DSS (5.00 to 3.50) induced groups compared to standards treated groups at doses 50, 100 and 200 mg/kg.	[67]
Phoenix dactylifera L./ Leaves	Chloroform extract (PLCE)	Pylorus ligation in Wistar rats was utilized to test two dosages of PLCE: 200 and 400 mg/kg. PLCE showed a significant inhibition of mean ulcer score and ulcer index, as well as a marked decrease in gastric content, free and total acidity levels and an increase in pH in a dose-dependent manner, it possessed gastroprotective activity. The ulcer inhibition values were 26.36% and 25.54% for extract doses 200 and 400 mg/kg, respectively when compared to the control group which was 51.63%.	[68]
Areca catechu L./ Nuts	Ethanolic extract	Ethanol-induced gastric mucosal injury in rats revealed that A. catechu nut ethanolic extract increased ulcer production, as evidenced by significant increases in ulcer area and histologically by comparatively increased ulcer areas (1094.17 ± 59.45, 1253.33 ± 40.65 mm2) for doses 250 and 500 mg/kg, respectively, compared to an ulcer control group (856.67 ± 9.89 mm^2).	[69]
		3) Hepatoprotective activity	
Phoenix dactylifera L./ Fruits	Methanolic extract	In two doses (300 and 600 mg/kg), *P. dactylifera* demonstrated hepatoprotective activity against thioacetamide-induced liver damage in male albino Wistar rats at a dose (200 mg/kg s.c.). Normal group, the values for ALT, AST, ALP, bilirubin and albumin were 36.40 ± 4.28 U/L, 43.20 ± 4.31 U/L, 62.55 ± 5.8 U/L, 8.12 ± 0.52 mol/L and 49.84 ± 4.42 g/L, respectively. The low dose group had respective values that were significantly different from it, whereas the high dose group values were not significantly different from the normal group values.	[70]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Phoenix dactylifera L./ Fruits	Aqueous date extract (ADE)	Oral administration of the ADE to male Wistar rats intoxicated with dichloroacetic acid at 0.5 and 2 g/L as drinking water for two months showed a significant protective effect by lowering hepatic marker enzymes (AST, ALT, LDH and GGT) and conjugated bilirubin levels, as well as improving the histological architecture of the rat liver.	[71]
Elaeis guineensis Jacq./ Leaves	Methanolic extract	Mice given the *E. guineensis* leaf methanolic extract (200 mg/kg) showed a substantial reduction in ALT, AST and bilirubin levels, which were all raised in the paracetamol-treated group.	[72]
Areca catechu L./ Seeds	Aqueous extract (ASAE)	The percent protection of ASAE (67-85%) at 2000 mg/kg was substantially higher than that of ASAE at 500 and 1000 mg/kg (18-33%) and silymarin (50-75%) when they were tested against liver injury caused by carbon tetrachloride (CCl_4) in rats.	[73]
Elaeis guineensis Jacq./ Red palm oil	The supernatant fluid of African red palm oil (ARPO)	ARPO at dose (1.5 mL/kg) was tested in acute hepatic injuries caused by 800 mg/kg of acetaminophen (APAP). The results suggest that when given up to 2 h after APAP induction, ARPO reduces the consequences of APAP-induced hepatotoxicity, but does not have preventive efficacy.	[74]
		4) Anti-diabetic activity	
Phoenix sylvestris (L.) Roxb./ Leaves	Methanolic and hydro-methanolic extracts	The *in-vitro* anti-diabetic activity was evaluated by α-amylase and α-glucosidase inhibitory assays. This study revealed different ranges of inhibition of both enzymes; hydro-methanolic extract (26.45-78.48% *α*-amylase and 29.14-72.30% *α*-glucosidase) and methanolic extract (26.45-78.48% *α*-amylase and 38.28-76.07% *α*-glucosidase) and had comparable anti-hyperglycemic activity in comparison to control (34.73-92.18% *α*-amylase and 42.24-86.44% *α*-glucosidase).	[75]
Phoenix dactylifera L./ Seeds	Methanolic extract	Alloxan-induced diabetic rats (150 mg/kg, i.p.) were studied. Diabetic rats were given this extract. They showed significant reductions in LDL, cholesterol and blood glucose levels, when compared to the control group. Diabetic rats given the extract at doses (150, 300 and 600 mg/kg) exhibited improvement in glucose tolerance, as well as lowering in the levels of creatinine (0.95±0.1, 0.92±0.5 and 0.86±0.4 mg/dl, urea (52.33±0.1, 45.9±1.4 and 36.54±1.3 mg/dl) and alkaline phosphatase (212.39±3.2, 191.11±1.9 and 182.91±2.3 mg/dl), respectively in their blood.	[76]
Phoenix roebelenii O'Brien/ Leaves	Ethanolic, methanolic, water, acetone and Pet. ether extracts	*In-vitro*, anti-diabetic activity was evaluated by inhibitory activity of two enzymes (*α*-amylase and *α*-glucosidase). Also, glucose diffusion inhibition assay was investigated. The study tested five extracts at two doses 200 and 400 µg/mL. Among them, ethanolic and methanolic extracts have demonstrated the highest inhibitory activity at 400 µg/mL. The ethanolic extract displaed the highest inhibitory action for both *α*-amylase (75.5 ± 0.66%) and *α*-glucosidase (77.5 ± 1.07%) in a concentration-dependent manner. while, the activity of the methanolic extract was extremely similar 70.4 ± 0.62% for *α*-amylase and 75.5 ± 0.09% for *α*-glucosidase. For acarbose, the maximum inhibition was 80.7 ± 0.74% for *α*-amylase and 80.2 ± 0.23% for *α*-glucosidase at the same dose of the extracts. Regarding glucose diffusion inhibition assay. Also, maximum glucose inhibition was shown by ethanolic extract (69.77 ± 1.00%) at 400 µg/mL. Moreover, the methanolic extract also displayed a significant inhibition (64.87 ± 0.9%) after 180 min at the same dose. Whereas, the acetone and Pet. ether extracts illustrated moderate inhibition at both 200 and 400 µg/mL. Finally, the aqueous extract demonstrated poor inhibition.	[77]
Caryota urens Linné/ Starch extracted from *"Kithul flour"*	Methanolic extract	Inhibition assays for *α*-amylase and *α*-glucosidase enzymes were used to assess the results. Up to 5 mg/mL of concentrated *C. Urens* flour, the percentage inhibition of *α*-amylase enzyme was 8.42 ± 0.97%, while for boiled flour was 10.77 ± 2.64%. Neither raw nor boiling *C. Urens* flour showed significant *α*-glucosidase enzyme inhibitory activity.	[54]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Calamus erectus Roxb./ Fruits (mesocarp and endocarp)	Methanolic extract	*In-vitro* antidiabetic activity was evaluated by *α*-glucosidase and *α*-amylase inhibition. The methanolic extract of distinct fruit portions (endocarp and mesocarp) demonstrated concentration dependent α-glucosidase (IC_{50} = 1.69 and 2.00 mg/mL) and α-amylase (IC_{50} = 2.74 and 3.30 mg/mL) inhibitory activity, respectively.	[60]
Raphia gentiliana De Wild./ Fruits	Aqueous extract (RFAE)	*In vivo anti-diabetic assay in mice and humans was evaluated. Fasting (18 h) hyperglycemic induced* The Naval Medical Research Institute *mice were given a dose of 0.2 g/kg, p.o. of* RFAE, *which resulted in a considerable reduction in blood sugar levels. After 1 and 2 h* RFAE, *there was a decrease of 27% and 56%, respectively. The observed glycemic index and load for human subjects were -3.1% and -1.36%, respectively.*	[78]
Cocos nucifera L.	Hydro-methanolic extract	Anti-diabetic activity was evaluated in streptozotocin-induced diabetic rats at a dose (50 mg/kg, b.wt. i.p.), The anti-hyperglycemic efficacy (% of protection) of the *C. nucifera* hydro-methanolic extract at a dose of 250 mg/kg and 500 mg/kg b.wt. p.o. 21.51 and 30.96, respectively were found to be comparable to glibenclamide at a dose of 0.5 mg/kg p.o. which was 45.34%.	[79]
Cocos nucifera L./ Coconut kernel	Coconut kernel protein (CKCP)	Alloxan-induced diabetes (150 mg/kg body weight, i.p) was studied. CKCP has a significant amount of arginine, according to the findings. In diabetic rats, CKCP feeding reduced the rise in glucose and insulin levels. When compared to control diabetic rats, the levels of glycogen in the liver and the activity of carbohydrate metabolizing enzymes in the serum of treated diabetic rats were restored to normal levels.	[80]
Lodoicea sechellarum (J.F.Gmel.) Pers. (Sea cocount)/ Fruits	Powdered sea coconut (LFPSC)	In normal and diabetic volunteers, the effects of oral administration of LFPSC on blood glucose and lipid profile were examined. Oral therapy with 2, 3 and 4 g of LFPSC and repaglinide (1 mg) significantly reduced blood glucose in normal (166.2 ± 5.6, 159.0 ± 4.5, 141.2 ± 4.7 and 165.8 ± 4.7) and diabetic patients (212.3 ± 10.2, 220.0 ± 8.3, 218.7 ± 6.6 and 194.5 ± 6.8), respectively.	[81]
		5) Renal protective activity	
Cocos nucifera L.	Coconut water extract	Ethylene glycol in drinking water (0.75%) can induce urolithiasis in male Wistar rats. Treatment with 10% coconut water decreased crystal formation in renal tissue and reduced the quantity of crystals in urine in a Wistar rat model. Furthermore, the extract shielded the kidneys against deterioration in renal function and the formation of oxidative stress.	[82]
Phoenix dactylifera L./ Fruits	Flesh and pits aqueous extracts	The animals were given either date flesh aqueous extract combined with food (50% w/w) or pits aqueous extract mixed in drinking water (2:1 w/v), with GM (80 mg/kg/day intramuscularly for 6 days) administered during the final 6 days of treatment. Other groups of rats were administered GM at the same time as the date flesh extract or the date pits extract at the same doses. GM treatment dramatically increased plasma creatinine and urea concentrations and caused renal proximal tubule necrosis. They were efficient in lowering the elevations in plasma creatinine and urea caused by GM nephrotoxicity, as well as ameliorating proximal tubular damage.	[83]
		6) Cardioprotective activity	
Cocos nucifera L.	Dietary coconut sprout	Myocardial infarction was caused by isoproterenol in rats at a dose of 20 mg/100 g, b.wt. The levels of cardiac markers (CK-MB and troponin-T) in the serum of the group given coconut sprout (50, 100, or 200 mg/100 g, b.wt., p.o.) for 45 days showed a decrease. The activities of these cardiac marker enzymes in serum were lowest in rats fed 100 mg/100 g, b.wt. sprout (533.2 ± 51.2 and 0.7 ± 0.1, respectively), indicating superior cardioprotection among the coconut sprout doses investigated.	[84]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Cocos nucifera L.	Tender coconut water (TCW)	Isoproterenol-induced myocardial infarction in rats at adose of 20 mg/100 g, b.wt. Rats fed TCW had a considerably greater survival rate than control rats after isoproterenol-induced myocardial infarction. The TCW fed group had a survival rate of 91%, whereas the control group had a survival rate of 66%.	[85]
7) Anti-hyperlipidemic activity			
Livistona australis R.Br./ Fruit pulps	The lipophilic fraction and Oleic acid	Thirty adult male rats were distributed into three groups of six randomly. The animals were fed a high-fat diet for two months that included a basal diet supplement with 1% cholesterol, 0.2% cholic acid and 10% fat. The antihyperlipidemic effect of a Pet. ether extract of *L. australis* fruit pulps was examined *in vitro*. For 8 weeks, hypercholesterolaemic rats were given 100 mg/kg, b.wt. of palm oil once a day, The reduction in serum cholesterol and triglycerides were 50% and 43.6%, respectively while the reduction in LDL-C was 71.2% with a significant increase in HDL-C by 101%.	[40]
8) Anti-hypertensive activity			
Phoenix sylvestris (L.) Roxb./ Leaves	Methanolic extract (PLME) and hydro-methanolic extract (PLHME)	Evaluated by fructose-induced hypertension method (10% w/v in drinking water) in male Wistar rat. The antihypertensive activity of PLME (35.59-89.65%) and PLHME (33.36-78.47%) in vitro was equivalent to the control (45.62-91.69%), indicating that the plant extracts displayed antihypertensive capabilities.	[75]
Cocos nucifera L./ Endocarp	Ethanolic extract (CEEE)	CEEE significantly lowered mean systolic blood pressure (from 185.3 ± 4.7 to 145.6 ± 6.1 mm Hg) in the deoxycorticosterone acetate salt-induced hypertension model at a dose of 25 mg/kg, b.wt.	[57]
9) Anti-platelet activity			
Areca catechu L./ Betel nut	Aqueous-methanolic extract (70%) Catechin	A Lumi-aggregometer was used to assess the concentration of platelets in human platelet-rich plasma. Arachidonic acid, adenosine diphosphate (ADP), platelet-activating factor, adrenaline and $Ca(^{+2})$-ionophore suppressed platelet aggregation. *A. catechu* was the most effective inhibitor of aggregation caused by ADP and $Ca(^{+2})$-ionophore. The antiplatelet activity was measured in human platelet-rich plasma by using a Lumi-aggregometer. Catechin was significantly less potent than *A. catechu*, indicating a presence of additional compound(s) with antiplatelet activity.	[86]
10) Cytotoxic activity			
10A) *In vitro*			
Phoenix dactylifera L. (Date palm)/ Fruits	Ethanolic extract	The MTT colorimetric assay was used to assess the viability of the extract PEGylated nanoemulsion against MCF-7 and Hep-G2 cells. The PEGylated nanoemulsion of the extract showed considerable suppression of cancer cell viability, with IC_{50} values of 18.6 ± 2.4 and 13.5 ± 1.8 µg/mL for MCF-7 and Hep-G2 cell lines, respectively.	[87]
Cocos nucifera L./ Outer shell fibers	Aqueous extract	The cytotoxicity of the synthesised silver nanoparticles of the extract was tested on Hep-G2 cells. It had a significant cytotoxicity potential against Hep-G2 cells, with an effective concentration IC_{50} of 15.28 µg/mL.	[47]
Syagrus coronate (Mart.) Becc.	Fixed oil extract	It was evaluated using the tetrazolium reduction assay in three cell lines: HEK-293 kidney embryonic cells, J774.A1 macrophages and the tumor line Sarcoma-180. The highest concentrations of the oil showed low levels of cytotoxicity.	[88]
Phoenix dactylifera L./ Fruits	Aqueous extract	The most effective concentration was 100 mg/mL, as determined by the MTT assay. after 24 h of treatment with date palm fruit extracts, MCF-7 cell viability decreased sharply and dose-dependently with IC_{50} values of 12 ± 0.02 mg/mL.	[89]
Dypsis leptocheilos Hodel/ Leaves	EtOAc fraction and aqueous-methanolic extract (80%)	MTT cell viability assay was used to assess cytotoxicity. The EtOAc fraction had a stronger cytotoxic activity on MCF-7 cells, with an IC_{50} of 12.3 ± 1.82 µg/mL, when compared to vinblastine sulfate.	[16]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Bactris guineensis L./ Fruits	The phenolic compounds	For colon and liver adenocarcinomas, MTT cytotoxic experiments show IC_{50} values ranging from 16.6 to 24.9 µg/mL, with strong selectivity for cancer cells compared to non-tumor cells. A 20 to 50% early apoptotic effect was demonstrated in cancer cells lines by staining (Annexin/PI).	[48]
Caryota mitis Lour. *and Caryota urens* Linné/ Leaves	Pet. ether, chloroform, EtOAc and ethanol (70%) extracts	NQO1 enzyme was selected as a marker for tracing the cancer chemopreventive effect of *C. mitis* and *C. urens* successive leaf extracts via mechanism-based kinetic colorimetric assay using DCPIP assay. Pet. ether leaf extract of *C. urens* showed the most potent induction of NQO1 enzyme activity (4.79 times to vehicle control) via DCPIP assay and a significant difference was observed at a concentration of 25 µg/mL via NQO1 western blot analysis.	[90]
Hyophorbe verschaffeltii H.Wendl./ Leaves	Methanolic extract (70%)	The maximum activity was measured against MCF-7 cells using the MTT cell viability assay, with viability of 7.33% for a concentration of 1000 µg/mL of the extract. It is required to achieve 50% inhibition is 323.6 µg/mL.	[91]
Ravenea rivularis Jum. & H.Perrier/ Leaves	Methanolic extract	Using the MTT cell viability assay, the methanol extract showed a strong cytotoxic effect against MCF-7 cells, with an IC_{50} value of 70.85 µg/mL, while it displayed no significant cytotoxic effect on Hep-G2, with an increase in cell proliferation as sample concentration was increased.	[36]
Borassus flabellifer L./ Fresh palm sugar	Ethanolic extracts of young fruits, ripe seed coat and cotyledon	All extracts of *B. flabellifer* were tested *in vitro* for cytotoxicity against human dermal fibroblast neonatal (HDFn) cell lines and Caco-2 cell lines by Resazurin microplate assay. All extracts were inactive against HDFn cell lines and Caco-2 cell lines, with the exception of palm sugar at 10% v/v in distilled water, which showed 67.31% HDFn cell line survival.	[92]
Wodyetia bifurcata A.K.Irvine/ Aerial parts	*n*-Butanol extract	Cytotoxicity measured against Hep-G2 cells using MTT cell viability assay. *n*-Butanol extract had weak cytotoxicity activity against Hep-G2 cells, IC_{50} = 568.5 µg/mL	[9]
Livistona australis R.Br./ Leaves	Methanolic extract and tricin 7-*O*-*β*-glucopyranoside-2"-sulphate sodium salt	MTT cell viability assay was used to assess cytotoxicity. Three human cancer cell lines were examined *in vitro* for cytotoxic activity: colon carcinoma HCT-116, breast carcinoma MCF-7 and liver carcinoma Hep-G2. Tricin 7-*O*-*β*-glucopyranoside-2"-sulphate sodium salt revealed the highest antiproliferative activity with IC_{50} values of 13.5, 15.2 and 16.5 µg/mL against Hep-G2, MCF-7 and HCT-116, respectively, while the extract exhibited less activity against Hep-G2 and MCF-7 cell lines with IC_{50} values of 21.9 and 22 µg/mL, respectively and the weakest activity against colon carcinoma HCT-116 with IC_{50} values of 45.8 µg/mL.	[62]
Livistona chinensis Jacq./ Roots	1-O-*β*-D-Glucopyranosyl-(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-hydroxydocosanoylamino]-9-octadecene-1,3,4-triol 1-octadecanoyl-2-nonadecanoyl-3-*O*-(6-amino-6-deoxy)-*β*-D-glucopyranosyl-sn-glycerol	The cytotoxicity assay was performed according to the MTT method in 96-well microplates. It showed significantly antiproliferative effects against the human tumor cell lines (K562, HL-60, Hep-G2 and CNE-1) with the IC_{50} of 10-65 µM.	[42]
Borassus aethiopum Mart./ Male inflorescences	DCM-methanol extract (50:50)	Cell proliferation was determined by MTT assay. The human colon cancer HT29 cells were used. Incubation of HT29 cells with DME showed significant inhibition of proliferation from the first h with a 100 µg/mL compared to the control group. This inhibition was observed from 2 h of incubation with 1 µg/mL. This inhibition was dose-dependent.	[93]
Phoenix dactylifera L. (Date palm)/ Fruits	Aqueous extract (FAE)	Investigated by hydrogen peroxide H_2O_2 induced cytotoxicity in Hep-G2, A172, U937 and PC12 cell lines The 1.47 mM H_2O_2 induced damage was greatly prevented by the 10% FAE, notably in the A172 cells. Furthermore, 10% FAE blocked 29.4 mM H_2O_2 induced damage. Simultaneously, in the presence of 10% FAE, U937 cell proliferation was considerably increased compared to control cells. Cells treated with 2.94 mM H_2O_2 showed many apoptotic features, whereas cells exposed to H_2O_2 and FAE concurrently demonstrated total suppression of apoptotic features.	[94]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Euterpe precatoria Mart./ Roots	Ethanol standard extract (ESE), *n*-butanol extract from ESE (*n*-BuOH), leaf stalk ethanol extract (LSE), LSE soluble fraction obtained by treatment with methanol/chloroform 1:1 (LSE-2) and flavonoids (quercetin, catechin, epicatechin, rutin and astilbin)	Extracts were evaluated by the brine shrimp (*Artemia salina*) larvicide bioassay, LSE-2 [LC_{50}= 271.0 (111.73-658.11)], LSE [LC_{50} = 523.0 (84.85-977.59)], *n*-butanol [LC_{50}= 481.0 (154.58-898.75)] and ESE [LC_{50}= 1010.0 (342.05-1186.65)] were lower than that of lapachol [LC_{50} = 68.0 (57.10-79.05)] used as control.	[64]
Orbignya speciose Mart./ Epicarp and mesocarp	Ethanolic extract	A viability assay was performed to evaluate the permeability of the cells to the trypan blue dye. Investigated against several cell lines, including the leukaemic cell lines HL60 and K562 (and its multidrug-resistant counterpart K562-Lucena 1), MCF-7, the mouse fibroblast cell line 3T3-L1 and fresh human lymphocytes yielded ID_{50} values of (9.3 ± 0.8, 33.9 ± 4.3, 55.0 ± 6.1, 48.8 ±5.7, 127.0 ± 14.3, 141.2 ± 15.4), respectively.	[95]
Cocos nucifera L./ Husk fibers	Molecular weight fractions of husk fiber aqueous extracts	Lucena 1, a multidrug-resistant (MDR) and vincristine-resistant derivative of K562 was tested on human erythroleukemia cell line K562. The results demonstrated that both variations have nearly identical antitumoral activity against the K562 leukaemia cell line (60.1 ± 8.5 and 47.5 ± 11.9%, respectively, for the usual A and common types). The crude extracts were separated with Amicon membranes into fractions with molecular weights ranging from 1-3 kDa (fraction A) to 3-10 kDa (fraction B) and more than 10 kDa (fraction C). MTT was used to assess cytotoxicity after cells were treated with 500 µg/mL of these fractions. The cytotoxicity of fractions with molecular weights ranging from 1 to 10 kDa was increased. *C. nucifera* extracts were also found to be effective against Lucena 1, a drug-resistant leukaemia cell line. Their cytotoxicity against this cell line was around 50% (51.9 3.2 and 56.3 2.9, respectively, for types typical A and common). Lucena 1 cells' viability and anti-MDR activity were reduced by 50% as compared to K562 cells.	[96]
Brahea armata/ Fruits	Fractions of the aqueous ethanolic extract	The inhibitory activity of the different extracts on 5*α*-reductase type II (prostate cancer) was determined using a cell line (HEK293-5aII), that expressed the human recombinant enzyme. The most active extract was kernel ethanolic extract-2 which showed 59% inhibition at a concentration of 1 mg/mL.	[25]
		10B) *In vivo*	
Euterpe oleracea Mart./ Fruit's oil	Oil	Male Wistar rats were treated with oil by gavage at doses of 30, 100 and 300 mg/kg, for 14 days, within a 24 h interval. Showed that animals exposed to oil presented alterations in the liver cells, where the integrity of the liver tissue was increasingly lost as oil doses increased.	[97]
Orbignya phalerata Mart./ Mesocarp flour	Aqueous extract	Investigated the effect of *babassu* mesocarp flour aqueous extract (BM) on C3H/HePas mice peritoneal cellular migration and macrophage activation by measuring the nitric oxide (NO), hydrogen peroxide (H_2O_2) and tumor necrosis factor (TNF) release, spreading activity and major histocompatibility complex (MHC) class II expression. Demonstrate that BM injected once ip in mice at 10 and 20 mg/kg increased the cellular influx to the peritoneal cavity, the MHC class II expression and the spreading ability and also induced the production of NO (15 ± 4 and 20 ± 5), TNF (8 and 16) and H_2O_2 (40 ± 5 and 50 ± 10).	[98]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
		11) Anti-mutagenic activity	
Phoenix dactylifera L./ Fruits	Aqueous extract	On *Salmonella* tester strains TA-98 and TA-100 with metabolic activation, date fruit extract produced a dose-dependent inhibition of benzo(a)pyrene-induced mutagenicity. Extract from 3.6 mg/plate and 4.3 mg/plate was found to be required for 50% inhibition of his revertant formation in TA-98 and TA-100, respectively. demonstrate that date fruit has a high level of anti-mutagenic action.	[65]
		12) Neuropharmacological activity	
Phoenix sylvestris (L.) Roxb./ Fruits	Methanolic extract (MEPS)	Sleeping time test using sodium thiopental. MEPS dosages of 50, 150, 300 and 450 mg/kg resulted in a significant decrease in sleep start (174.31 ± 4.49, 156.6 ± 2.31, 103.83 ± 5.74 and 92.15 ± 5.02) and an increase in sleep duration (40.01 ± 1.11 , 50.67 ± 1.30, 71.30 ± 1.81 and 88.73 ± 4.48 min), respectively.	[99]
Calamus rotang L./ Seeds	Methanolic extract	In hole cross and open field tests, maximum suppression of locomotor activity was 81.42% and 86.61%, respectively, with the larger dose (500 mg/kg) of extract, whereas inhibition rates for the conventional drug diazepam (1 mg/kg) were 87.14% and 91.86%.	[100]
Phoenix dactylifera L./ Fruits	Methanolic extract	Elevated plus-maze test. The subgroups treated with *P. dactylifera* extract at doses of 100 and 300 mg/kg, as well as diazepam at a dose of 1.0 mg/kg i.p., showed a substantial decrease in time spent in the open arm (83.27 ± 11.60 and 92.05 ± 7.55), as well as a significant rise in time spent in enclosed arms (155.70 ± 17.35 and 150.68 ± 17.43), although the extract at 30 mg/kg was found ineffective.	[101]
		13) Anti-convulsant activity	
Coccos nucifera L./ Roots	Ethanolic extract (REE)	In pentylenetetrazole-induced seizure models, 60.7% of the mice given 25 mg/kg, ip, REE developed seizures and died 30 min later no animals developed seizures or died in the group that got REE at 80 mg/kg, i.p, even after 24 h.	[102]
		14) Anti-acetylcholinesterase (AChE) activity	
Areca catechu L./ Betel nut	Aqueous-methanolic extract (70%)	The anti-AChE activity was measured spectrophotometrically *in vitro*. The extract showed significant AChE inhibitory activity with almost complete inhibition percentage of the enzyme (90.1 ± 0.4).	[86]
		15) Anti-alzheimer activity	
Caryota urens Linné	Ethanolic extract	Evaluated in Alzheimer's induced mice using various memory retention experiments such as Y maze and Morris water maze (MWM). The selected doses of *C. urens*, 200 mg/kg and 400 mg/kg had a substantial effect on memory and learning processes, however, the larger dose 400 mg/kg had a better effect (39.65%) and escape latency of MWM (15.33 ± 1.25) than the lower dose of 200 mg/kg (36.71%) and escape latency of MWM (19.17 ± 1.57).	[103]
		16) Anti-pyretic activity	
Phoenix loureiroi Kunth/ Leaves	Ethanolic extract	The ethanolic extract confirmed its beginning of action at doses of 200 mg/kg in 2 h (38.42 ± 0.04) and EEPLL 400 (38.42 ± 0.11) and 600 mg/kg (38.23 ± 0.09) in 60 min when tested using the yeast induced hyperpyrexia method at dose 10 mL/kg of 20% aqueous suspension of Brewer's yeast below the neck's nap s.c.	[104]
Caryota mitis Lour./ *Leaves*	Ethanolic extract, *n*-hexane, chloroform, EtOAc, ethanol and aqueous fractions	*n*-Hexane and aqueous fractions at dose 400 mg/kg showed considerable antipyretic effect against yeast-induced hyperthermia (10 mL/kg of 20% w/v of aqueous suspension of yeast) when tested in rats. The effect peaked at 3rd h (37.14 ± 0.178 and 37.17 ± 0.186, respectively) and lasted until the 5th h.	[105]
Borassus flabellifer L./ Male Flowers	Ethanolic extract (BFEE)	Using yeast-induced pyrexia. BFEE at doses of 150 and 300 mg/kg, b.wt. significantly reversed hyperthermia at both doses after 60 min (36.72 ± 0.10 and 36.37 ± 0.10), respectively.	[106]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
		17) Anti-inflammatory activity	
		17A) *In vitro*	
Cocos nucifera L./ Roots	Aqueous and methanolic extracts	*In vitro* testing the ability of aqueous and methanolic extracts to inhibit key inflammation enzymes such as 15-lipoxygenase, phospholipase A_2 and cyclooxygenases 1 and 2. *C. nucifera* root extracts inhibited the activity of 15-LOX (IC_{50}= 24.57 ± 1.16 and IC_{50}= 8.31 ± 0.73), $sPLA_2$ (not determind (nd) and 24.68 ± 0.08), COX-1 (nd and 27.21 ± 1.66) and COX-2 (nd and 39.41 ± 1.36), respectively.	[45]
Ravenea rivularis Jum. & H.Perrier/ Leaves	Methanolic extract	*In vitro* by Nitric oxide technique, methanolic extract at dose 125 µg/mL showed anti- inflammatory effect (66% inhibition) in comparison with dexamethasone at dose 50 ng/mL (65% inhibition).	[36]
Areca catechu L./ Seeds	Aqueous extract	Determining *in vitro* anti-inflammatory activity against 5-lipoxygenase. Aqueous extract exhibited 5-LOX inhibitory action, with IC_{50} 25.07. The positive reference, NDGA (IC_{50} = 59.50 ± 1.04 µg/mL), had a value that was two-fold lower.	[73]
		17B) *In vivo*	
Phoenix loureiroi Kunth/ Leaves	Ethanolic extract	Carrageenan-induced rat paw edema method was used. The ethanolic extract showed maximum inhibition of 32.24%, 38.16% and 45.4% at doses of 200, 400 and 600 mg/kg, p.o., respectively, after 3 h of medication administration, whereas the therapeutic drug ibuprofen (10 mg/kg, p.o.) illustrated 46.72% inhibition.	[104]
Dypsis lutescens H.Wendl./ Leaves	Ethanolic extract (DLEE)	In five groups of six rats, two doses (250 and 500 mg/kg, p.o.) of DLEE were tested. Anti-inflammatory mediators were tested and found to have the ability to inhibit pro-inflammatory enzymes as following hyaluronic acid (37.78 ± 1.26 and 29.79 ± 1.27) and matrix metallopeptidase (814.51 ± 20.25 and 629.18 ± 18.64) for low and high dose, respectively.	[66]
Caryota mitis Lour./ *Leaves*	Ethanolic extract, *n*-hexane, chloroform, EtOAc, *n*-butanol and aqueous fractions	Carrageenin-induced rat hind paw edema was studied. The anti-inflammatory action of the various extracts begins within the first h, increases in strength in the 2nd and 3rd h and lasts until the 5th h. The aqueous fraction had the highest percentage of anti-inflammatory activity (42.67%), while the *n*-butanol fraction had the lowest (17.09%) at 2nd h.	[105]
Hyophorbe verschaffeltii H.Wendl./ Leaves	Methanolic extract	The methanolic extract (500 mg/kg) exhibited long-term anti-inflammatory activity than diclofenac sodium (100 mg/kg) as it showed continuous and significant inhibition of edema by 48.54% and 44.2% at 8th and 12th h, respectively when tested *in vivo* using carrageenan-induced rat hind paw edema model 0.1 mL, 1% carrageenan suspension injected sub-planter into the rat's hind paw.	[91]
Calamus rotang L./ Seeds	Methanolic extract	In carrageenan-induced paw edema the sub-plantar administration of 0.1 mL of 1% carrageenan, it showed a significant reduction in paw edema at doses of 250 and 500 mg/kg after 30 min (10.11% and 12.68%, respectively) and after 240 min (11.24% and 16.27%, respectively), when compared to indomethacin at dose 10 mg/kg [17.46% (after 30 min) and 20.34% (after 240 min)].	[100]
Cocos nucifera var. *typica* L./ Husk fiber	Aqueous crude extract	Inflammation models (formalin-induced licking and subcutaneous air pouch) were tested using *C. nucifera* aqueous crude extract (10, 50 and 100 mg/kg) and the standard medicines morphine (1 mg/kg) and acetylsalicylic acid (100 mg/kg). Firstly, formalin-induced licking model, the extract treatment induced dose-dependent inhibition, indicating an anti-inflammatory effect. Secondly, the subcutaneous air pouch, pre-treatment with 10 mg/kg of the extract was not able to significantly decrease the number of leukocytes. Nevertheless, pre-treatment with the other doses of extract (50 or 100 mg/kg) significantly inhibited the cell migration. The extract also suppressed the inflammatory process by reducing protein extravasation, cell migration and TNF-α production with 100 mg/kg extract.	[57]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Acrocomia aculeate Jacq.	Pulp oil	*A. aculeata* oil exhibited anti-inflammatory properties, which resulted in a significant reduction in carrageenan-induced hind paw edema (67% versus 7% after 2 h). Furthermore, oral administration of *A. aculeata* oil at 300 and 700 mg/kg dosages effectively prevented leukocyte migration to the pleural cavity produced by carrageenan in rats. Inhibition levels were 91 ± 3% and 81 ± 16%, respectively.	[107]
Borassus flabellifer L./ Male Flowers	Ethanolic extract	Acute inflammation model, such as carrageenan induced paw edema in mice with 0.1 mL of 1% carrageenan (in 1% CMC) solution into the sub-plantar region of the right hind paw. In comparison to control, the extract at dosages of 150 and 300 mg/kg, b.wt., as well as diclofenac sodium 100 mg/kg, b.wt. (standard), exhibited maximum anti-inflammatory activity at 6^{th} h (1.498 ± 0.007032 and 1.288 ± 0.007923), respectively.	[106]
		18) Analgesic activity	
Phoenix loureiroi Kunth/ Leaves	Ethanolic extract (PLEE)	Writhing test by single i.p. injection of 10 mL/kg of 0.6% acetic acid in mice was used. The percentage inhibition of writhes is 33.34%, 57.04% and 66.62% were obtained at doses of 200, 400 and 600 mg/kg, p.o., of PLEE, respectively, whereas the percentage inhibition of writhes for standard drug aspirin (69.02%) was obtained at a dose of 100 mg/kg, p.o.	[104]
Caryota mitis Lour./ *Leaves*	Ethanolic extract, *n*-hexane, chloroform, EtOAc, *n*-butanol and aqueous fractions	Induction of inflammation by the acetic acid (10 mL/kg of 0.7% v/v) induced writhing in mice. All the tested samples at a dose of 400 mg/kg showed varying significant analgesic activity. The total ethanolic extract and EtOAc fraction showed a higher percentage of inhibition than the other samples (96.1% and 92.85%), respectively.	[105]
Phoenix sylvestris (L.) Roxb./ Fruits	Methanolic extract (PSFME)	In a hot plate test, oral administration of PSFME resulted in a substantial increase in latency period to thermal stimuli at dosages of 300 and 450 mg/kg at 120 min (6.60 ± 0.28 and 8.88 ± 0.55), respectively.	[99]
Calamus rotang L. / Seeds	Methanolic extract (CSME)	Acetic acid-induced writhing (0.7% v/v i.p.) and formalin-induced pain procedures (20 µL 5% into the dorsal surface of the right hind paw) were used to assess the analgesic activity. At a dose of 500 mg/kg, it inhibited acetic acid-induced pain by 51.27%, while indomethacin (10 mg/kg) inhibited acetic acid-induced pain by 58.86%. CSME (500 mg/kg) caused 68.47% inhibition in a formalin-induced test, while indomethacin produced 70.72% inhibition.	[100]
Cocos nucifera L./ Crude husk-fiber	Ethanolic extract	Analgesic activity was evaluated by acetic acid (10 mL/kg of 2% v/v, i.p.)-induced abdominal writhing, test in mice. The ethanolic extract at doses (50, 100 and 150 mg/kg) significantly inhibited writhing by 24%, 34% and 52.4%, respectively, when compared with a control group.	[57]
Areca catechu L./ Leaves and stems	Methanolic extract	Induction of inflammation by acetic acid-induced gastric pain writhing model in Swiss albino mice at a dose of 10 mL/kg (1% acetic acid v/v). The leaf extract demonstrated higher antinociceptive activity (55.8%, 57.7%, 86.5% and 88.5%) than the stem extract (30.8%, 36.6%, 40.9% and 59.6%) for doses (50, 100, 200 and 400 mg/kg, b.wt.), respectively.	[108]
Borassus flabellifer L./ Male Flowers	Ethanolic extract	Using of acetic acid (10 mL/kg of 6% v/v, i.p.) caused writhing in mice. At doses of 150 and 300 mg/kg, b.wt. of ethanolic extract a significant reduction in the number of writhes induced by acetic acid (30.67 ± 2.84 and 19.33 ± 1.56), respectively.	[106]
		19) Antimicrobial activity	
Dypsis leptocheilos Hodel/ *L*eaves	EtOAc fraction (EAF) and aqueous methanolic extract (80%, AME)	The agar diffusion method was used to assess antimicrobial activity. It revealed significant activity against Gram-positive *S. aureus* (10.00 and 12.00), *Bacillus subtilis* (8.50 and 7.50) and Gram-negative *S. typhimurium* (no activity and 10.50), *E. coli* (9.50 and 11.50) microorganisms for AME and EAF, respectively.	[16]
Cocos nucifera L./ Dorsal side of the leaves	Water, ethanolic (70%), chloroform and diethyl ether extracts	On Müller Hinton agar medium, evaluated using the disc diffusion method. Ethanolic and water extracts were shown to have antibacterial activity among the four extracts. In comparison to ciprofloxacin 10 mm and control, the ethanolic (70%) and aqueous extract revealed inhibition zones (5.0 mm and 3.5 mm) against *E. coli*, respectively.	[109]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Borassus flabellifer L./ Fruits	Aqueous extract (BFAE)	Using the agar disc diffusion method on Müller Hinton agar, BFAE was evaluated against pathogenic bacteria *B. cereus, B. subtilis, S. aureus, P. aeruginosa* and *E. coli.* When, BFAE (30 µL) was added, a 23 mm diameter zone of inhibition was found against *S. aureus*. BFAE demonstrated IZs of about 24 and 28 mm in diameter against 20 and 30 µL of *B. subtilis.*	[50]
Mauritia flexuosa L. f./ Fruits	Chloroform, EtOAc and ethanolic fractions	The micro dilution method was used to test antibacterial and antifungal activities (*B. cereus, S. aureus, E. coli, S. choleraesuis, C. albicans, C. krusei and C. tropicalis*). The fractions have significant antimicrobial activity against Gram-positive and *Candida* strains. The most expressive result was obtained from the association of the chloroform fraction with cefotaxime, which produced a synergistic effect, reducing the MIC of the antibiotic from 1,024 to 256 µg/mL.	[51]
Caryota mitis Lour./ Leaves	Ethanolic extract, *n*-hexane, chloroform, EtOAc, *n*-butanol and aqueous fractions	In comparison to the positive controls, the ethanolic extract and aqueous fraction had moderate bactericidal activity against *S. aureus* and *E. coli*, causing IZs (7-10 mm) and MIC (2.5 and 5 mg/mL). The EtOAc fraction had the strongest bactericidal activity against *S. aureus* when compared to the positive control (Ampicillin), causing IZ (20 mm) and MIC (2.5 mg/mL) and moderate activity against *E. coli* when compared to the positive control (Gentamycin), causing IZ (11 mm) and MIC (2.5 mg/mL). In comparison to positive controls, the *n*-butanol fraction showed high bactericidal activity against both *S. aureus* and *E. coli*, with IZs (17-19 mm) and MIC (2.5 mg/mL). The antifungal investigation against *C. albicans* strains demonstrated that the *n*-butanol and aqueous fractions had a considerable antifungal activity with IZ (12 mm) and MIC (5 mg/mL), while the other extracts had no antifungal activity.	[110]
Hyophorbe verschaffeltii H. Wendl./ Leaves	Methanolic extract (70%)	Antimicrobial activity against the microbial strains; *B. subtilis*, *S. aureus*, *E. coli*, *P. aeruginosa*, *A. niger* and *C. albicans* was evaluated using the standard agar well diffusion technique. Antibacterial activity of this extract (100 mg/mL) revealed that moderate bactericidal activity against *B. subtilis*, *E. coli* and strong bactericidal activity against *P. aeruginosa* with IZs of 16, 16, 13.5 mm diameter, respectively, relative to positive control (Ampicillin: 5 mg/mL). Furthermore, it showed antifungal effectiveness with the same concentration against *C. albicans* (IZ 22 mm), when compared to fluconazole (5 mg/mL) with IZ 40 mm, , but both of them had no inhibition against *A. niger*.	[91]
Cocos nucifera L./ *Fruits*	Crude ethanolic, Chloroform, EtOAc, methanol and water extracts	Antifungal activities of the extracts were determined using the strip dilution method using Sabouraud dextrose agar. They were evaluated against *A. flavus, A. fumigatus, A. niger, M. canis, M. gypseum, T. mentagrophytes, T. rubrum* and *T. vercossum*. Mycosis clinically isolated from *Tinea corporis* (ringworm)-infected patients. All measurements were recorded at 30 °C after 72 h. The percentage of inhibition activity was observed with methanolic extract from 90% to 77%. Moreover, the percentage of inhibition activity was recorded with EtOAc extract from 90% to 72%. Furthermore, the percentage of inhibition activity was observed with chloroform extract from 72.5% to 62%. Furthermore, the percentage of inhibition activity was documented with aqueous extract from 74% to 65%. Finally, the crude ethanolic extract was highly effective against these dermal fungi with the MIC ranging from 1.4 mm to 2.145 mm. The IZ increased when increasing the concentration and the inhibition activity was higher in methanolic and EtOAc extracts.	[52]
Cocos nucifera L./ Mesocarp	Acetone, benzene, chloroform, diethyl ether, ethanolic and formaldehyde extracts	The antibacterial activity against *E. coli* was stronger with the benzene solvent (IZ = 18 mm), but bioactivity against *S. typhi* was higher with the diethyl ether extract (IZ = 20 mm) when tested using the disc diffusion method.	[57]
Cocos nucifera L./ Endocarp	Ethanolic and aqueous extracts	The endocarp extracts showed substantial antibacterial action against *B. subtilis, P. aeruginosa*, *S. aureus* and *M. luteus*, when tested using the Kirby-Bauer disc diffusion method, but did not affect on *E. coli.*	[57]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Rhapis excels Thunb./ Leaves	Methanolic extract	The extract was tested against a variety of *S. aureus* strains, including methicillin-resistant *S. aureus* (MRSA) by the disc diffusion method. It had little antibacterial action on its own, but it did show the ability to enhance the antibacterial activity of ciprofloxacin, tetracycline and oxacillin IZs (29.9 ± 2.3, 10.3 ± 0.6 and 20.0 ± 0.0).	[56]
Cocos nucifera L./ Husk	Alcoholic and hydro-alcoholic extracts	The antibacterial activity of husk extracts increased with increasing concentration and was found to be more efficient against Gram-negative (*P. vulgaris*) than Gram-positive (*S. aureus*) organisms using the disc diffusion method. *P. vulgaris* was shown to be more resistant to extracts with IZ 12 mg/mL as in the standard streptomycin.	[111]
Hyphaene thebaica L./ Fruits	Methanolic /ultrasonic (MU), methanol/water bath (MW), ethanol/ultrasonic (EU) and ethanol/water bath (EW) extracts	The extracts were tested *in vitro* against *S. aureus*, *L. monocytogenes*, *E. coli* and *S. typhi* using an agar disc diffusion assay. The extracts showed strong antibacterial activity against *S. aureus* and *S. typhi*, while the MU extract inhibited the growth of all pathogenic bacteria used in this study with IZs (*S. aureus*: 14.2± 0.72, *L. monocytogenes*: 8.2 ± 0.56, *E. coli*: 4.6 ± 0.53 and *S. typhi*:15.5± 0.81).	[58]
Syagrus coronate (Mart.) Becc./ Leaves, inflorescences, nut-shell, liquid and solid endosperm nuts	Aqueous and methanolic extracts	The aqueous extract was effective against *B. cereus* and the three *S. aureus* strains by agar diffusion test and the associated MIC and MCB values were lower (0.19, 0.78, 0.78 and 0.78) and (0.78, 3.12, 3.12 and 3.12) than those of the dichloromethane, EtOAc and butanol fractions of the same extract. The MIC and MBC values of the methanolic extract were greater (0.78 and 0.78) than those of EtOAc (1.56 and 6.25) and butanol (1.56 and 3.12) fractions of the same extract against *B. cereus*.	[112]
Elaeis guineensis Jacq./ Leaves	Methanolic extract	The antimicrobial activity was investigated using the disc diffusion method. The methanolic extract demonstrated high antibacterial efficacy *in vitro* against Gram-positive (*S. aureus* and *B. subtilis*), Gram-negative (*E. coli*, *Klebsiella pneumonia*, *Proteus mirabilis*, *P. aeruginosa and S. typhi*) and yeast (*C. albicans* and *Saccharomyces cerevisiae*) bacteria, as well as fungi (*Fusarium sp., Fusarium oxysporium, A. niger, A. flavus, M. canis, Penicillium sp., Mucor sp., Rhizophus sp., Trichoderma viride and T. mentagrophytes*), with IZs ranging from 11 to 15 mm.	[113]
Phoenix dactylifera L./ Spathe	Essential oil	The antibacterial activity of the essential oil was tested using the broth microdilution method against a variety of human infections, where a low inhibitory was observed (MIC 1000 µg/mL). The oil was evaluated further for antifungal activity against the strawberry anthracnose-causing fungal plant pathogens *C. acutatum*, *C. fragariae* and *C. gloeosporioides* using the direct overlay bioautography assay. As a result, the essential oil showed no antifungal activity at 80 and 160 µg/spot concentrations compared to standard antifungal agents.	[114]
Virgin coconut oil	Oil	The agar-well diffusion technique was used to investigate 52 recent *Candida* species with virgin coconut oil and fluconazole. *C. albicans* (17 isolates) was the most common isolate from clinical specimens, followed by *C. glabrata* (9 isolates), *C. tropicalis* (7 isolates), *C. parapsilosis* (7 isolates), *C. stellatoidea* (6 isolates) and *C. krusei* (6 isolates). Coconut oil had the maximum susceptibility (100%) with an MIC of 25% (1:4 dilution), while fluconazole had 100% susceptibility with an MIC of 64 µg/mL (1:2 dilution). With an MIC of 100% (undiluted), *C. krusei* demonstrated the most resistance to coconut oil, while fluconazole had a MIC of 128 µg/mL. When compared to fluconazole, coconut oil was effective against *Candida* species at 100% concentration.	[115]
		20) Anti-parasitic activity	
Cocos nucifera L./ Husk fiber waste	EtOAc extract (CHEE)	Administration of CHEE (300 mg/kg, 0.2 mL) to *Leishmania braziliensis*-infected hamsters for 21 days did not reduce infected footpad edema or lymph node drainage weight, but decreased skin lesions after 14 days.	[57]

Plant name/ part used	Extract or fraction or compound	Method/ Result	Ref.
Cocos nucifera L./ White flesh parts of the coconut	Methanolic extract	Several doses of methanolic extracts (50, 100, 200 and 400 mg/kg, p.o.) were tested in mice for antimalarial effectiveness against *Plasmodium berghei* (NK65) during early, established and residual infections. The reference medications were chloroquine (20 mg/kg) and pyrimethamine (1.2 mg/kg). In all three *in vivo* assessment experiments, the extract considerably reduced parasitaemia at 200 and 400 mg/kg dosages (2.00 ± 0.45 and 1.20 ± 0.20, respectively). On the other hand, it had no effect on the survival time of sick mice.	[116]
Cocos nucifera L./ Bark of the green coconut	Liquid and *n*-butanol extracts	Liquid extract of the green coconut bark did not reveal anthelmintic activity against the mouse intestinal worm burden nematodes *in vivo*, when compared to the negative control group. However, the *n*-butanol extract at 500 and 1000 mg/kg, demonstrated mean efficacy of 62.72% and 98.36%, respectively.	[117]

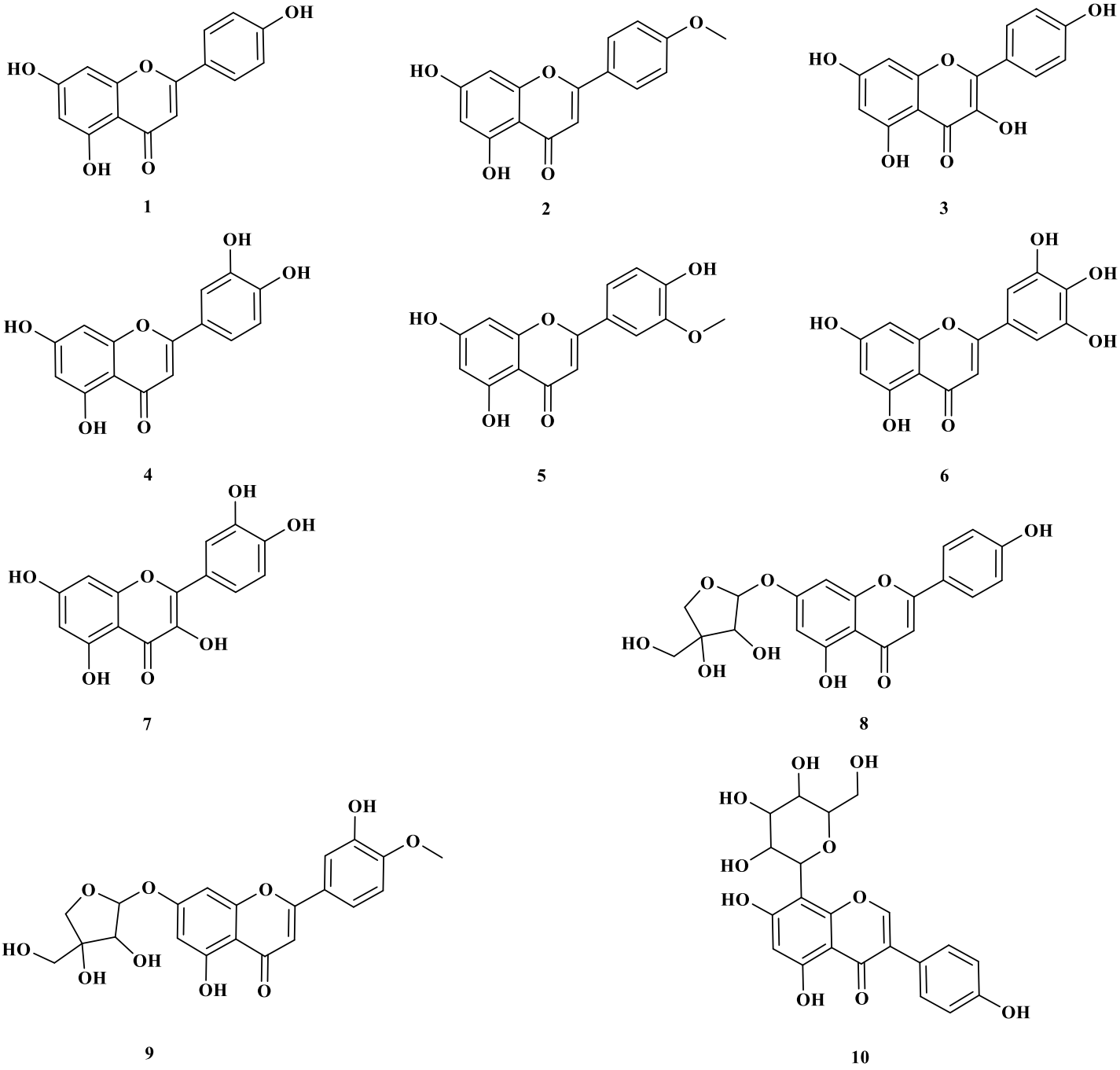
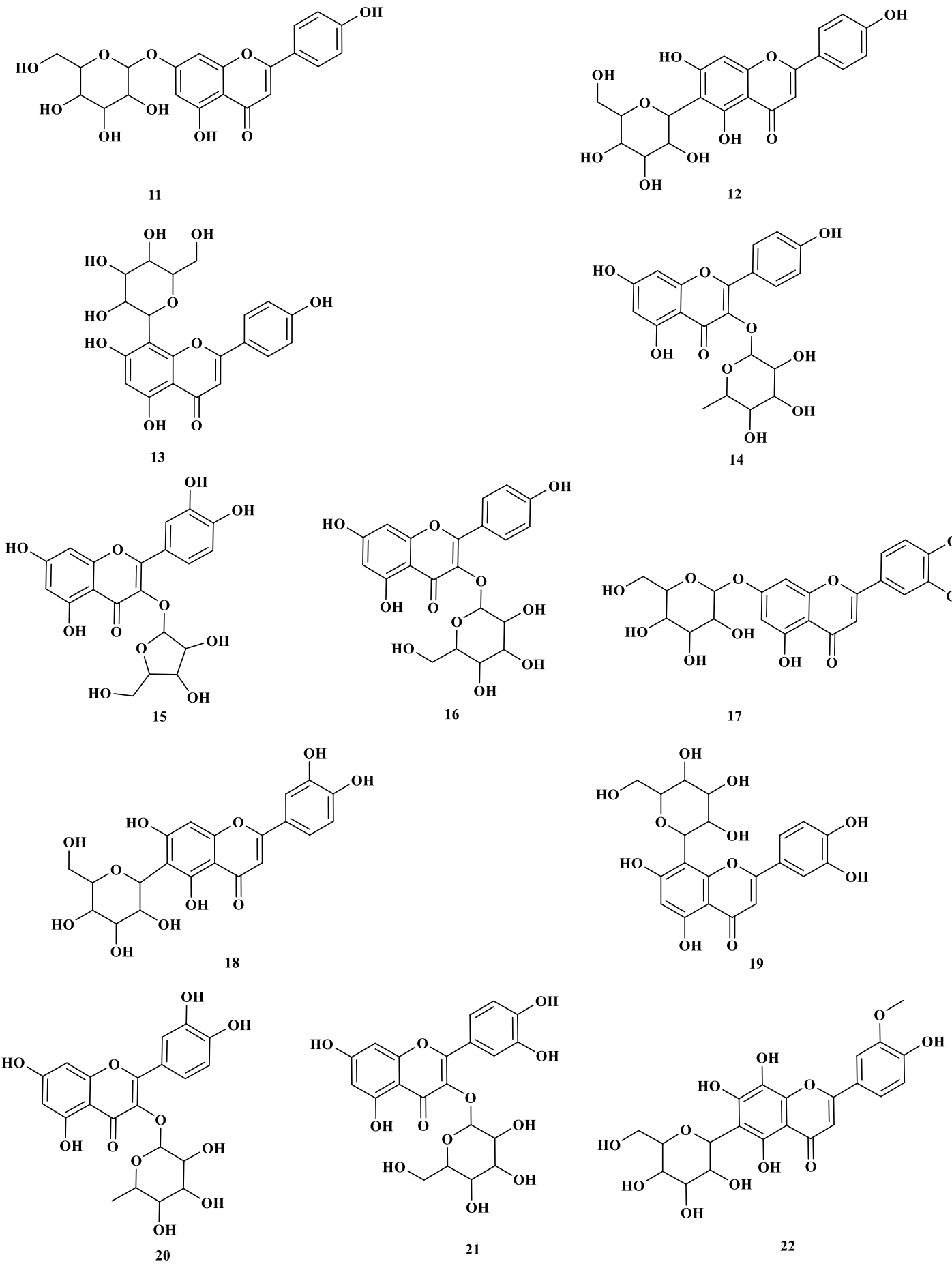


Figure 1: Chemical structures of previously reported compounds of family Arecaceae (2021-2006).



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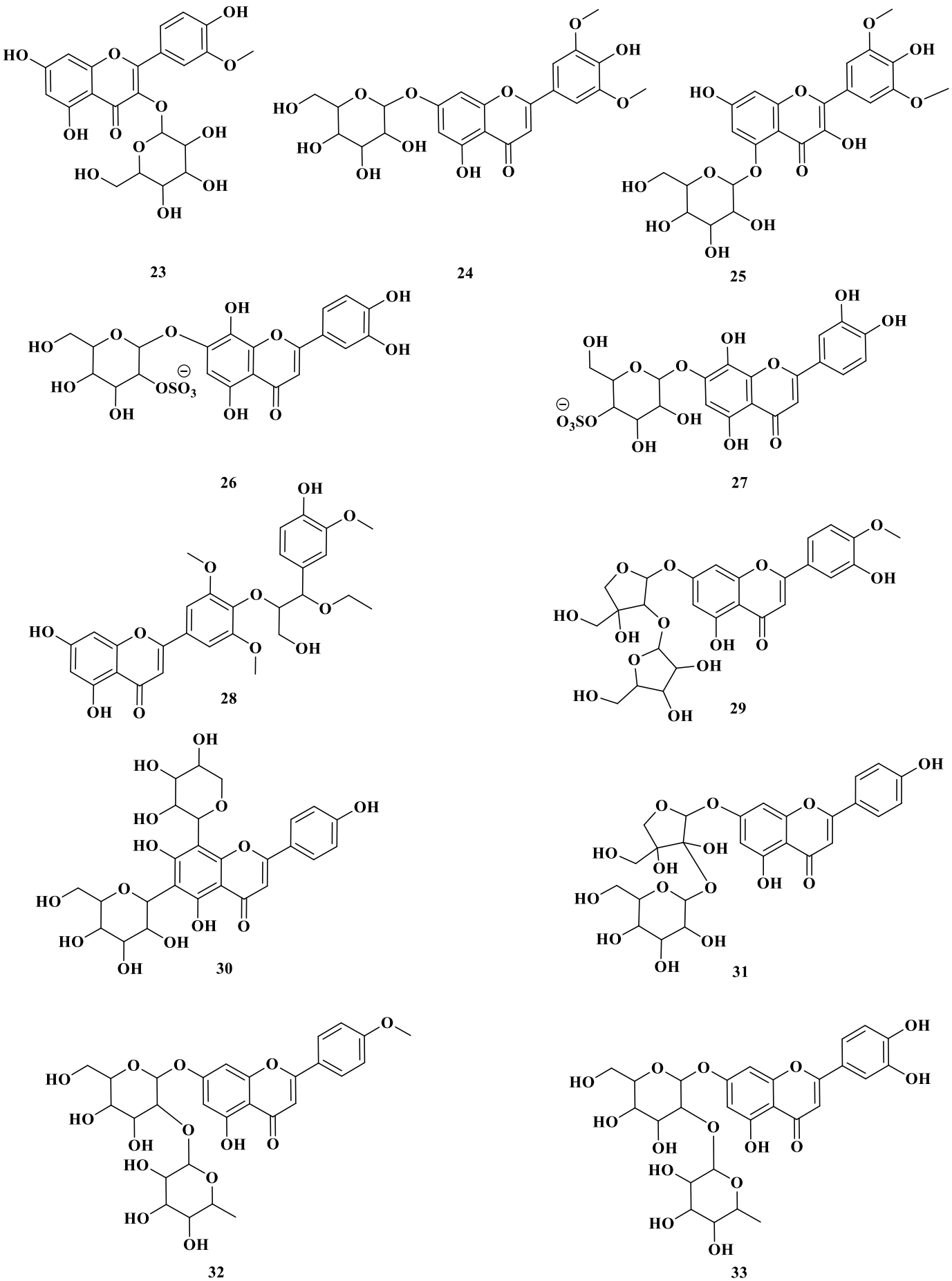

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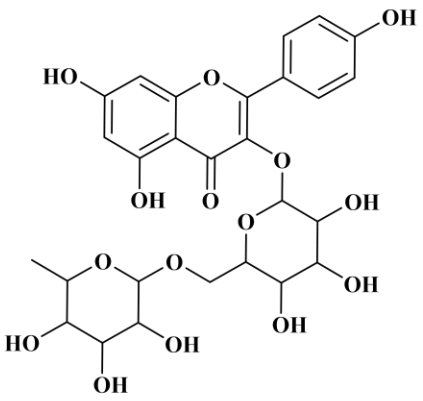

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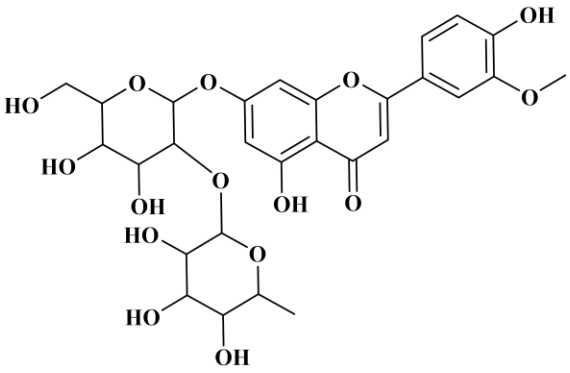

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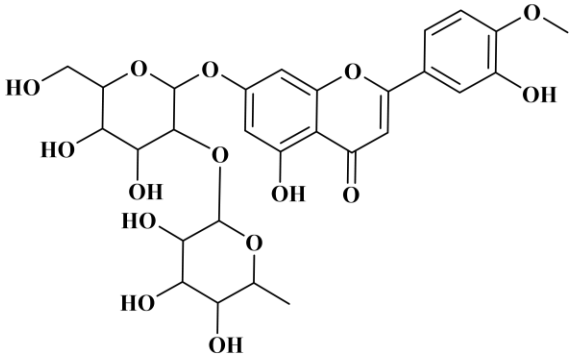

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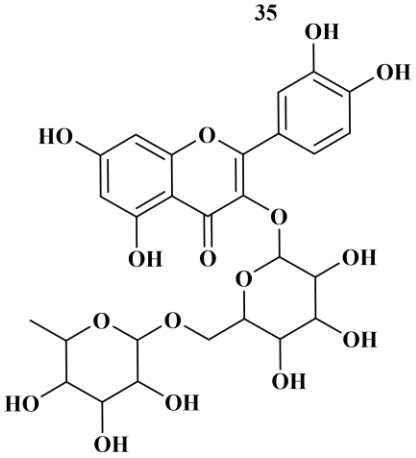

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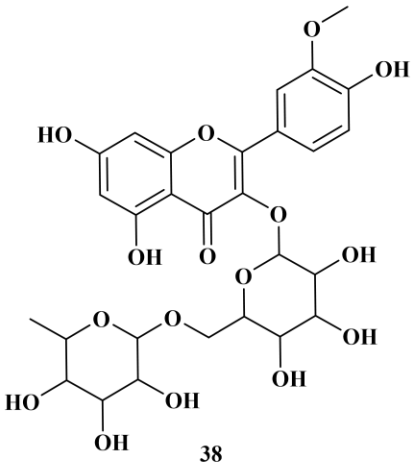

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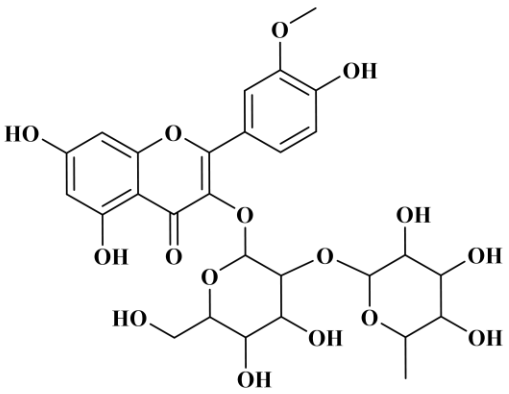

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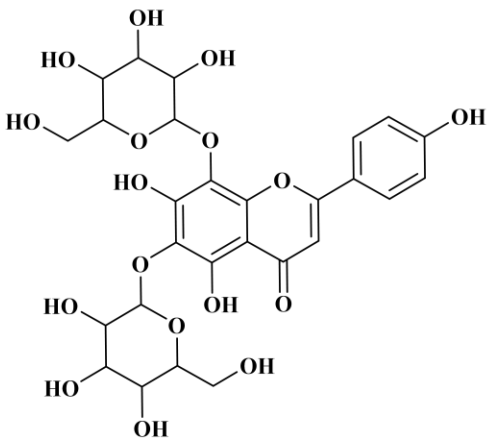

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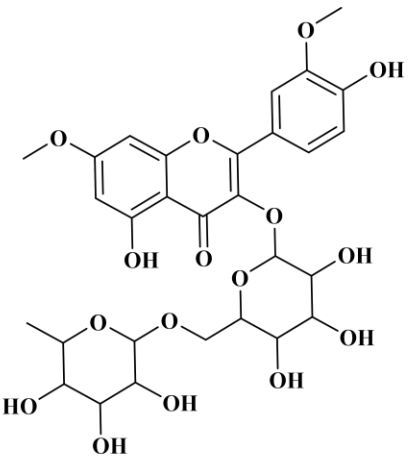

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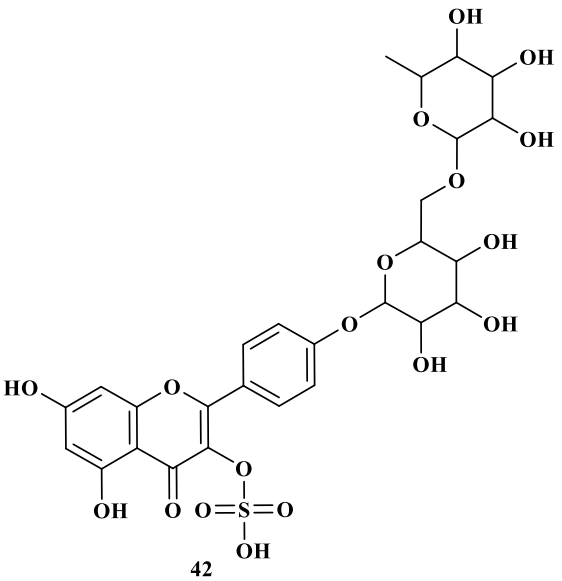

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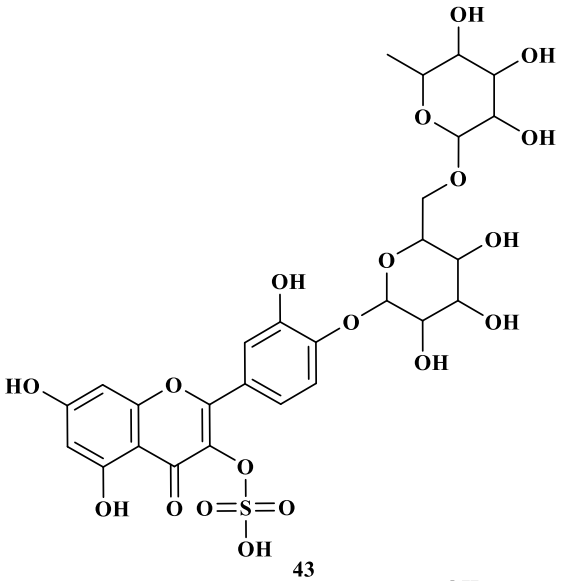

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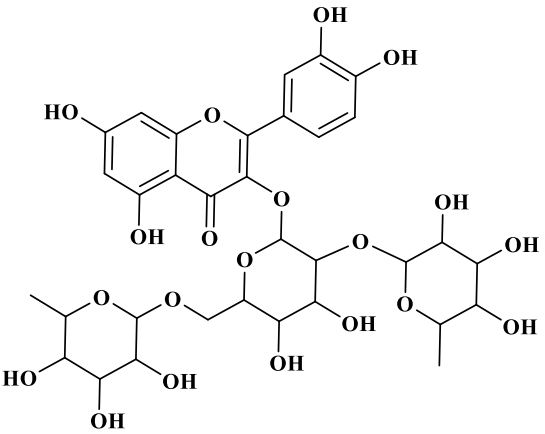

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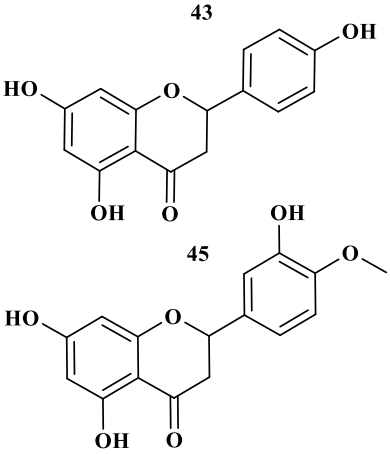

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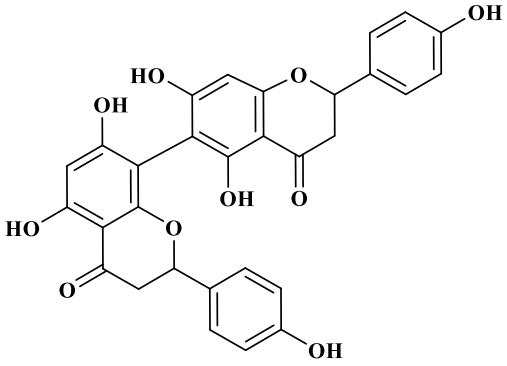

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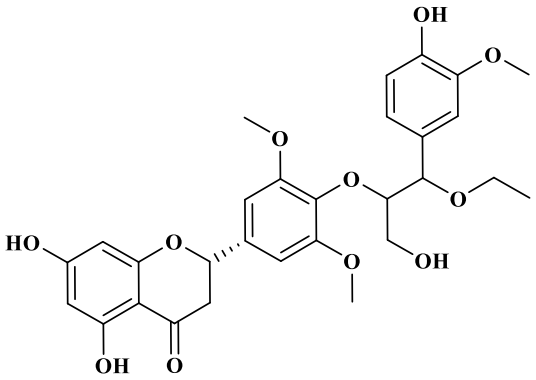

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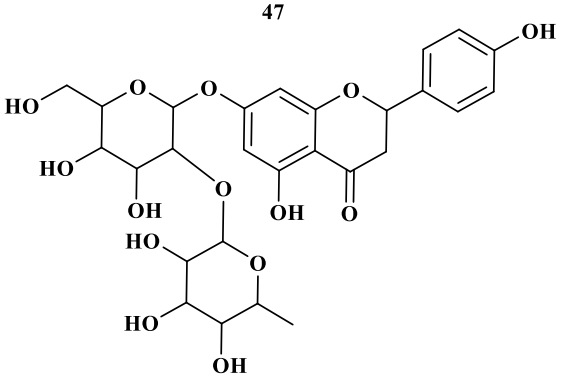

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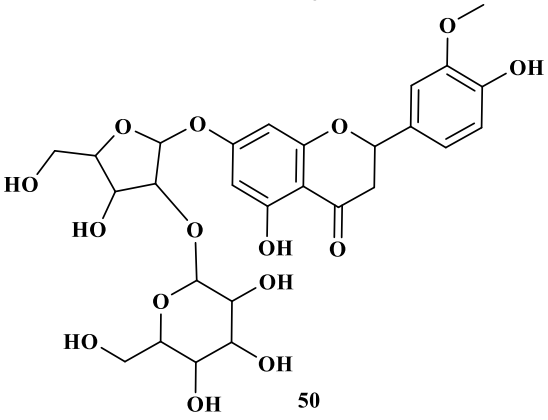

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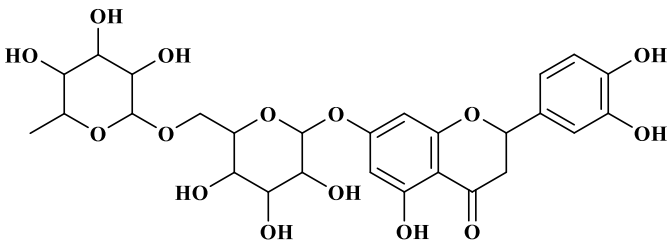

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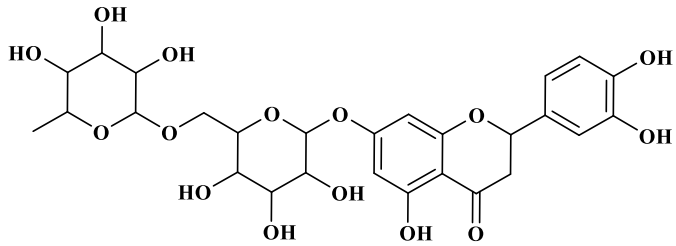

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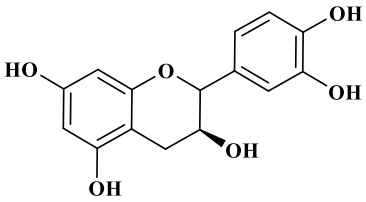

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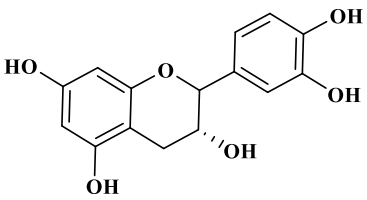

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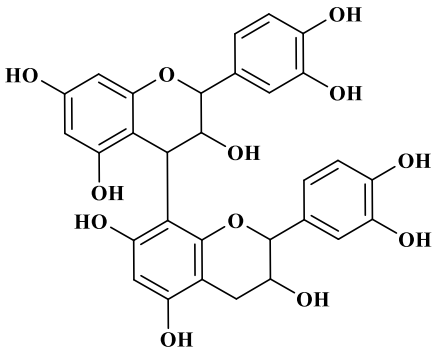

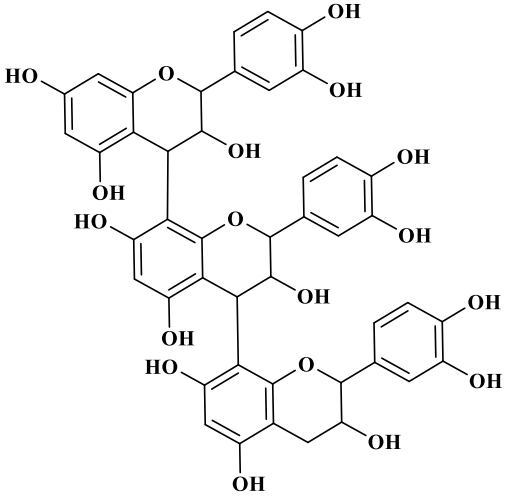

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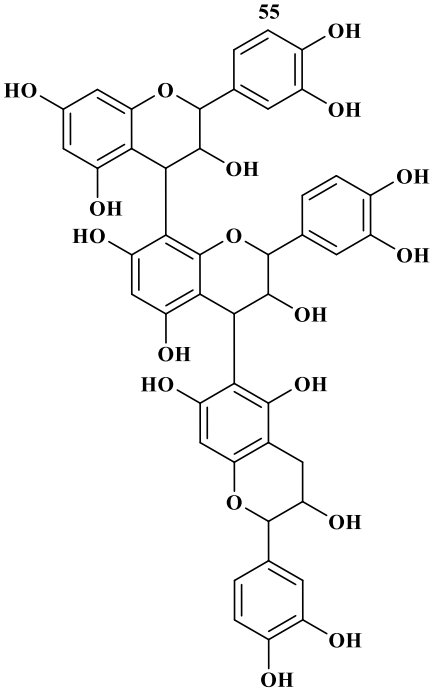

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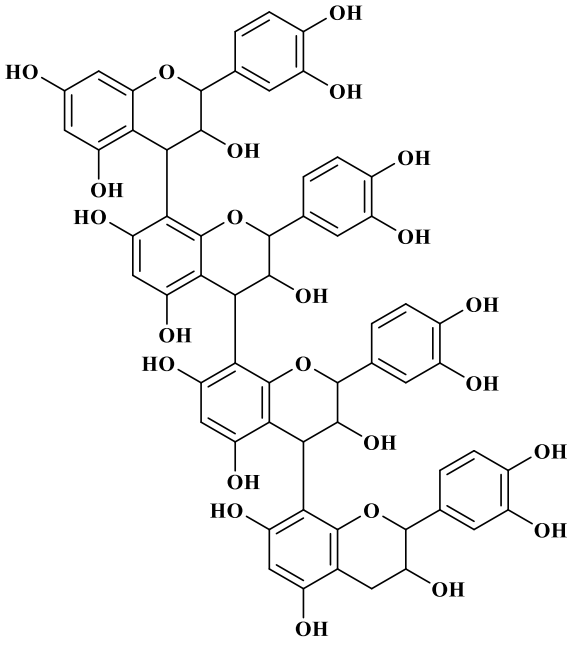

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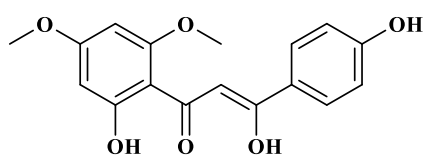

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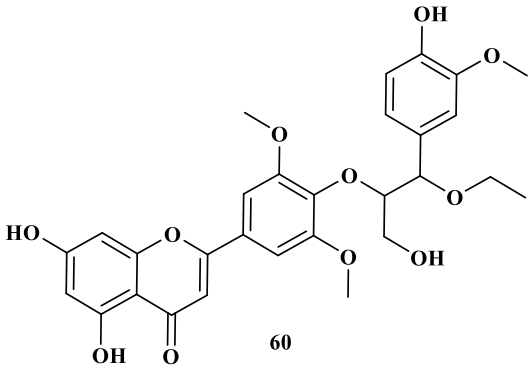

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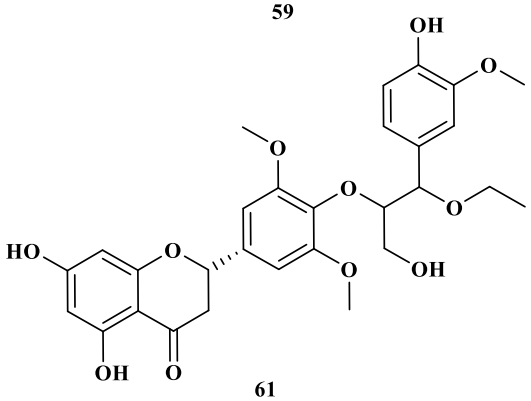

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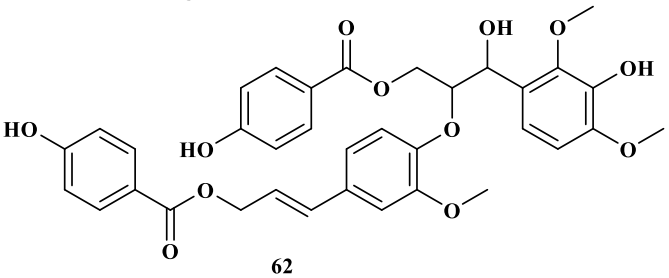

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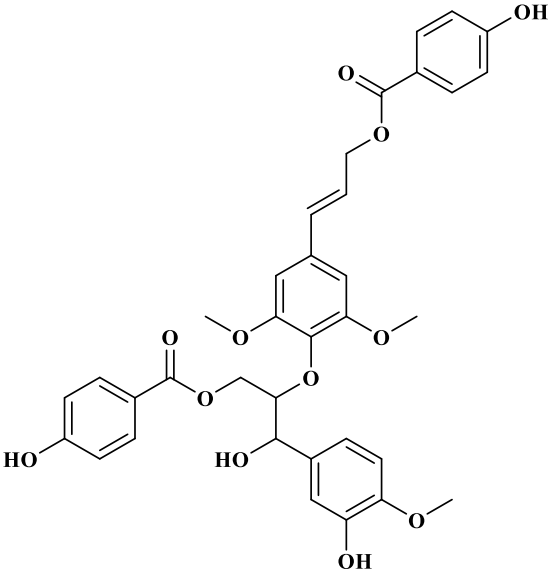

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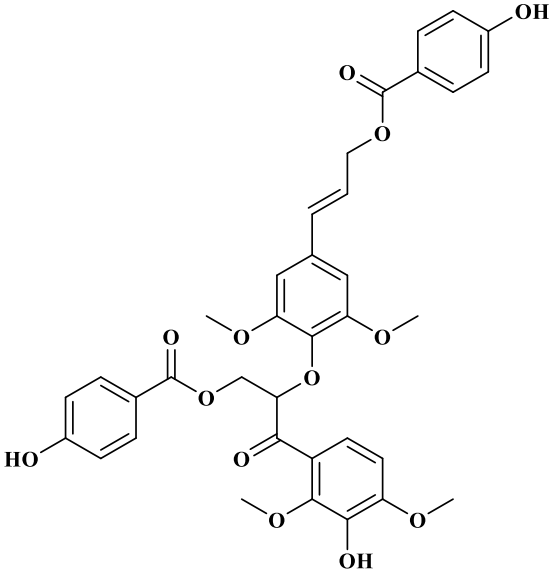

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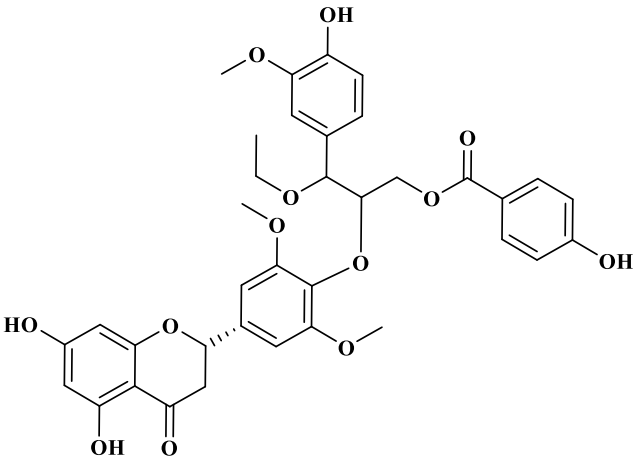

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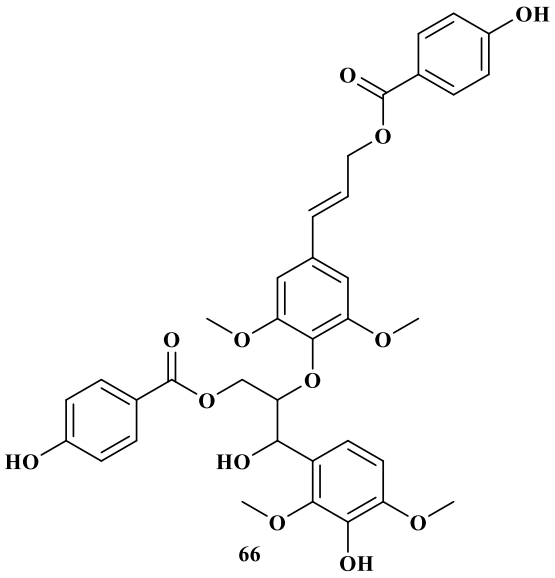

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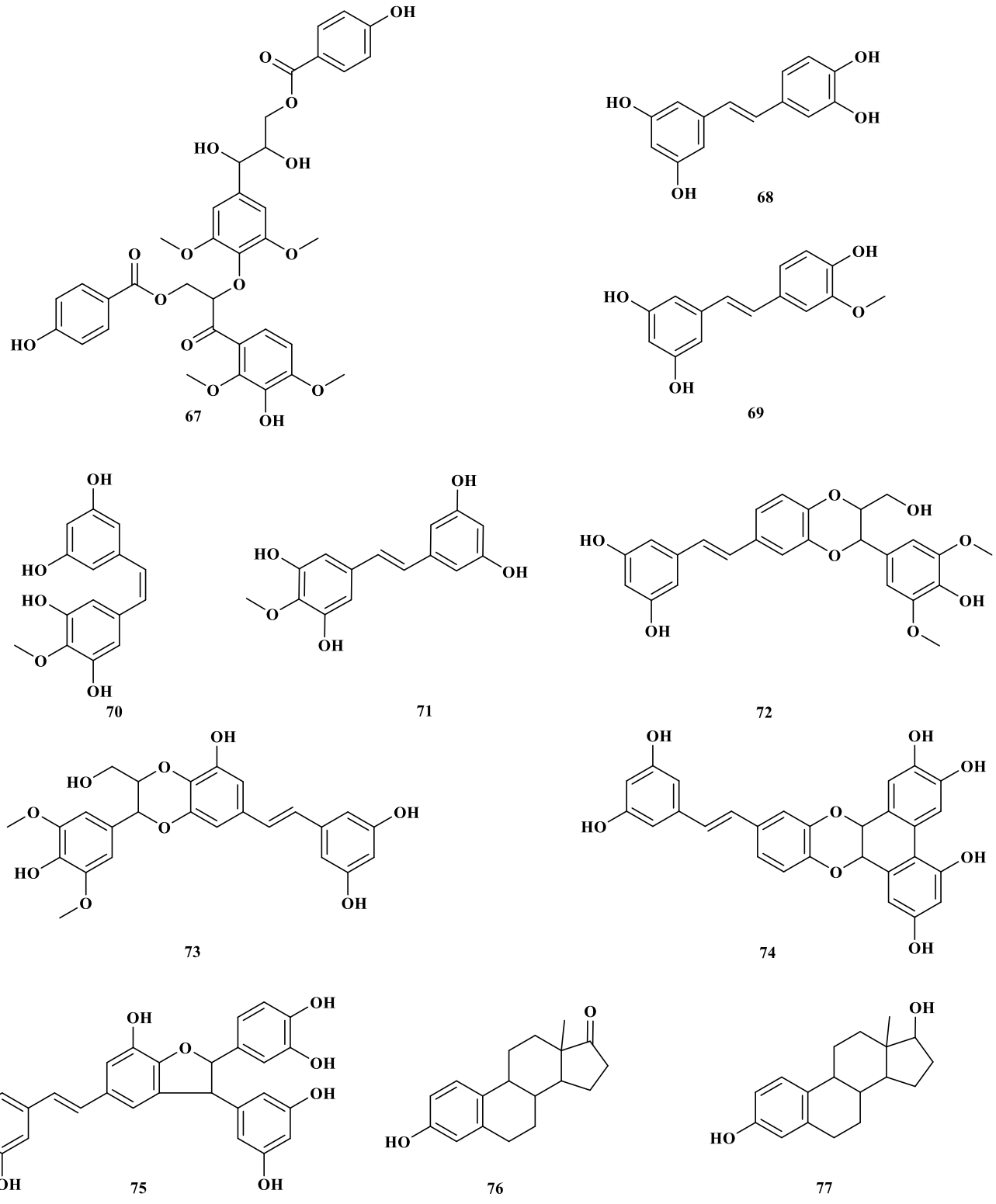

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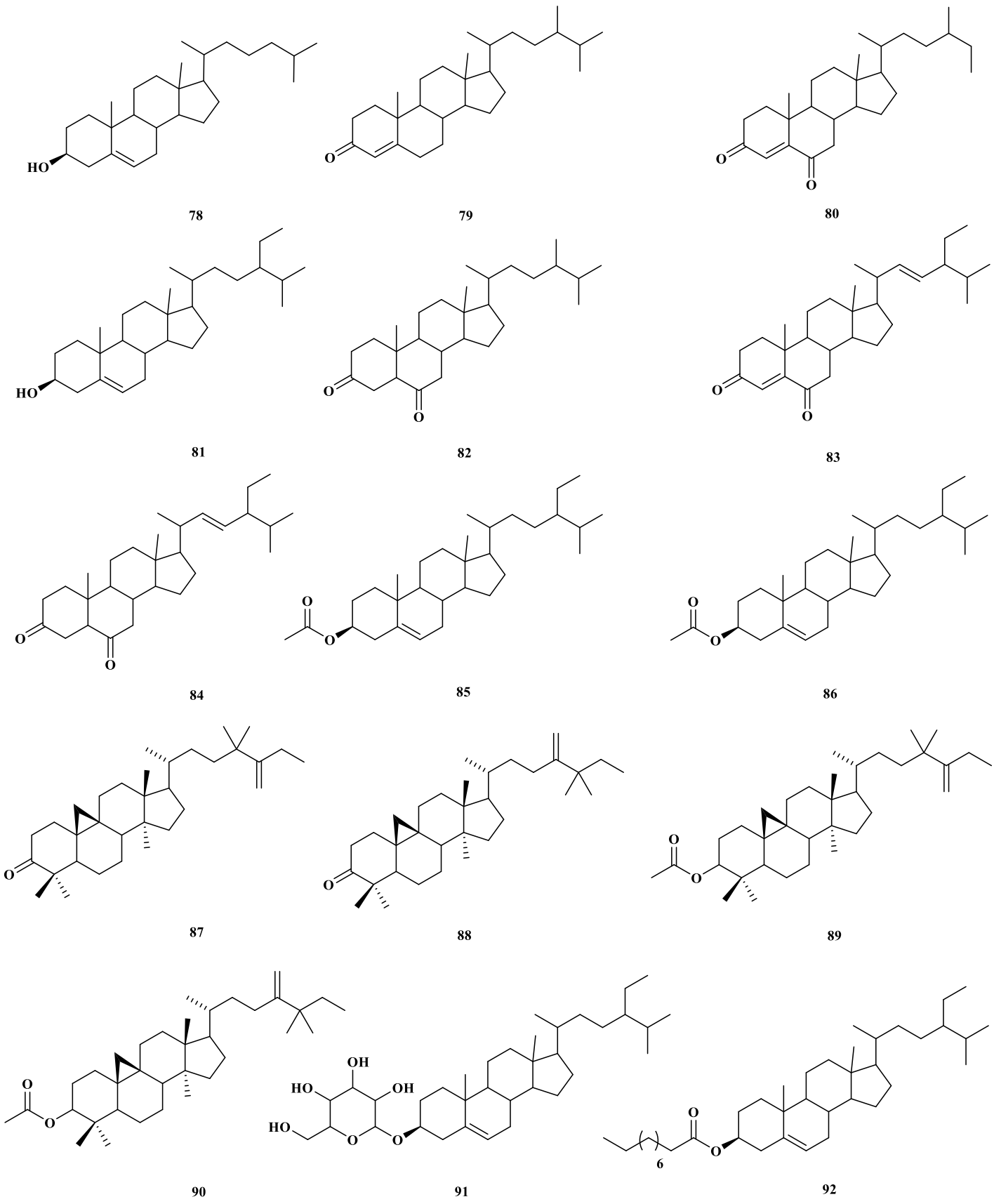

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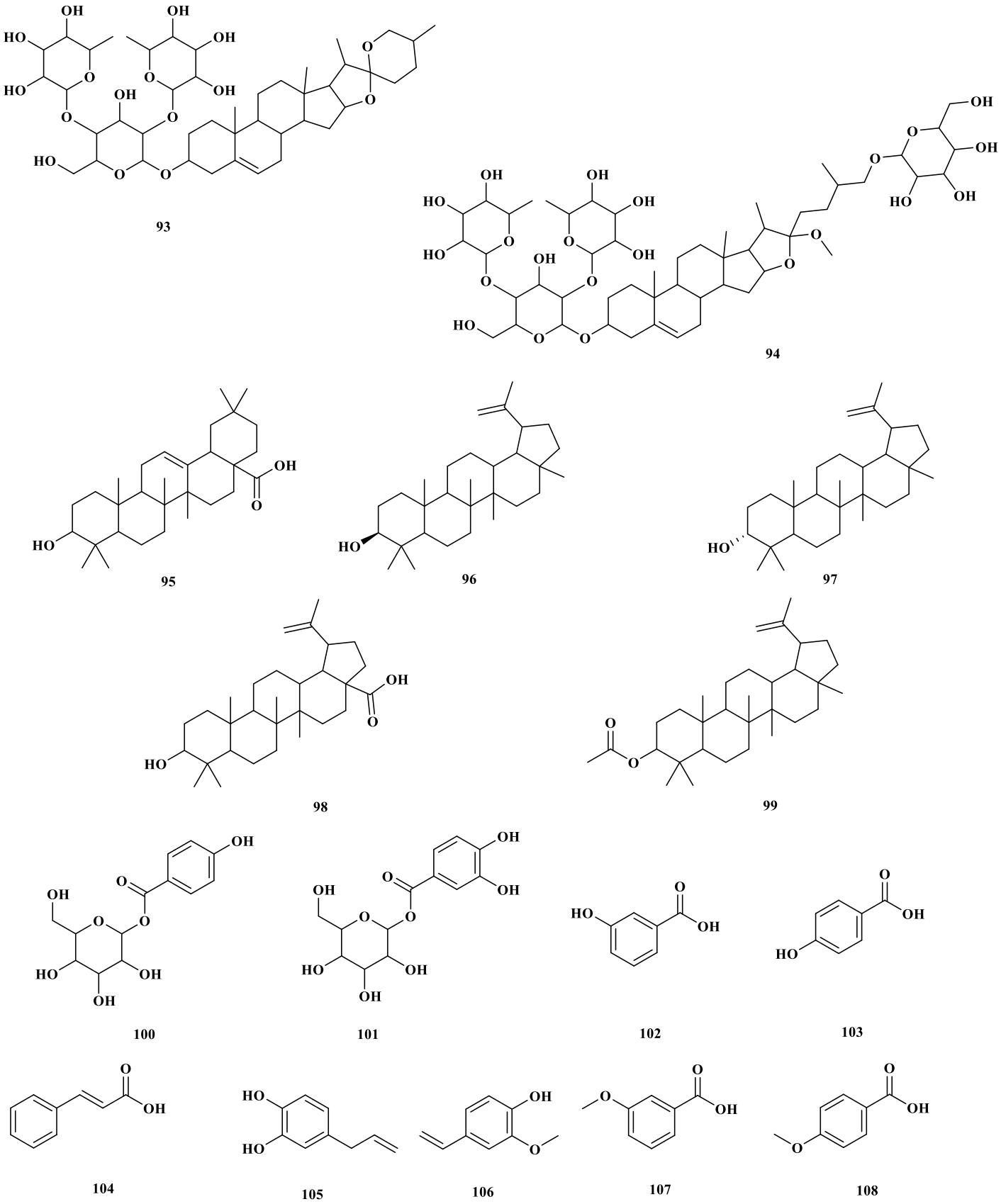

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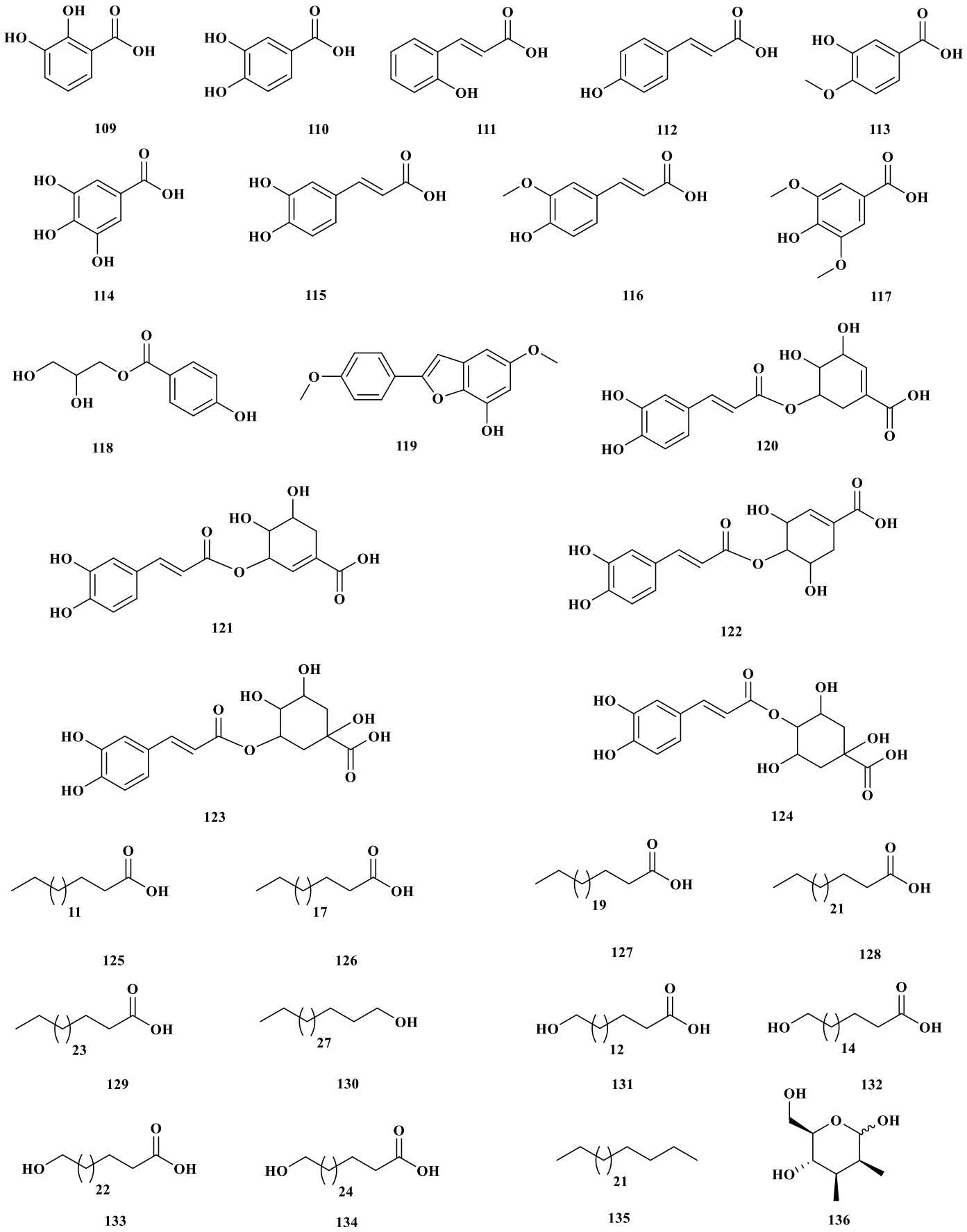

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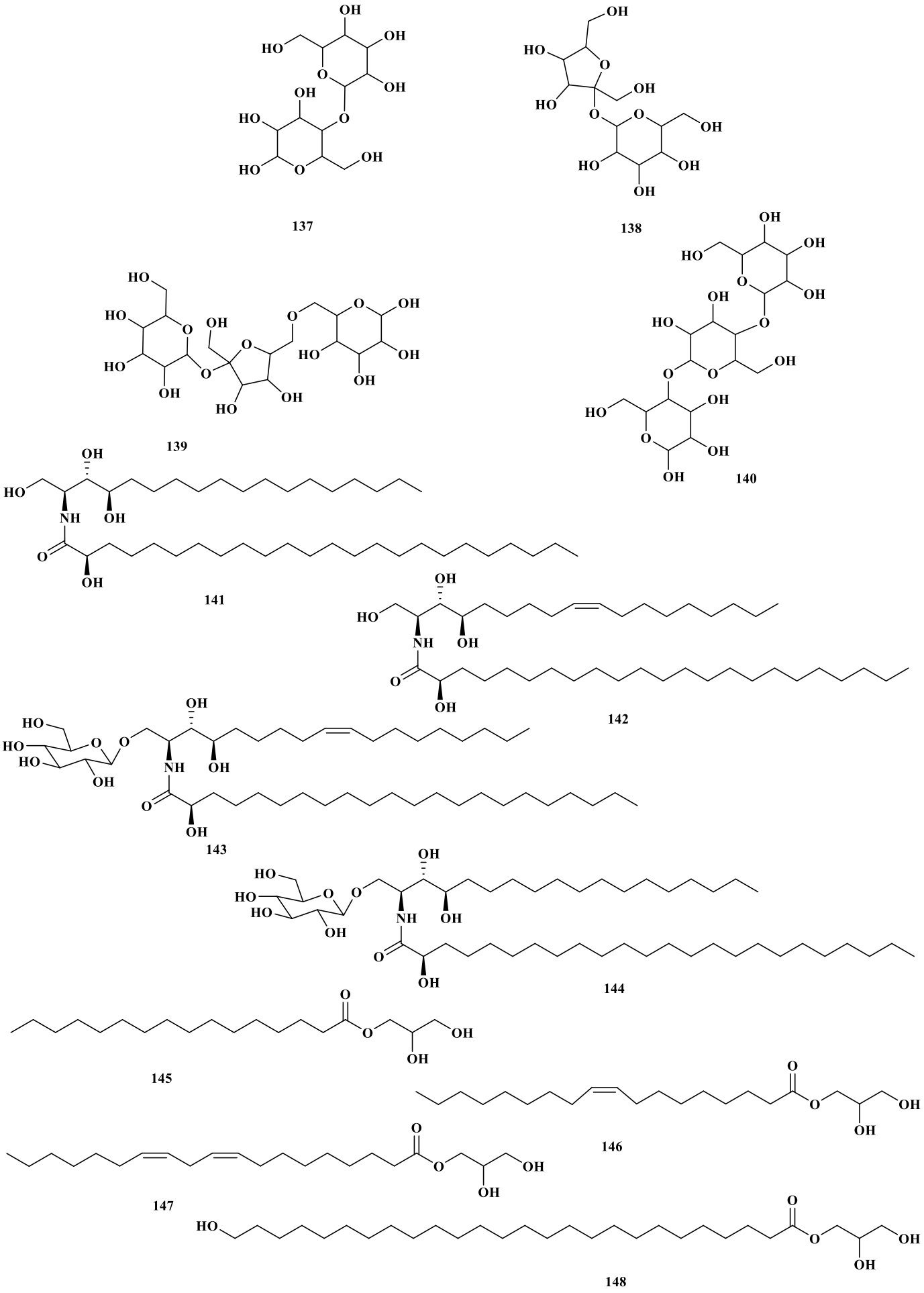

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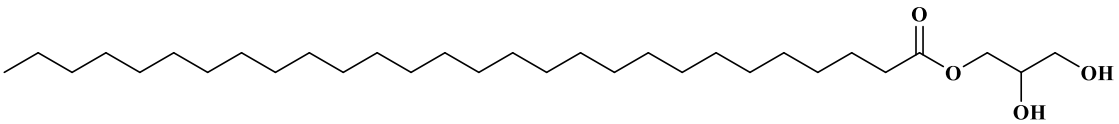

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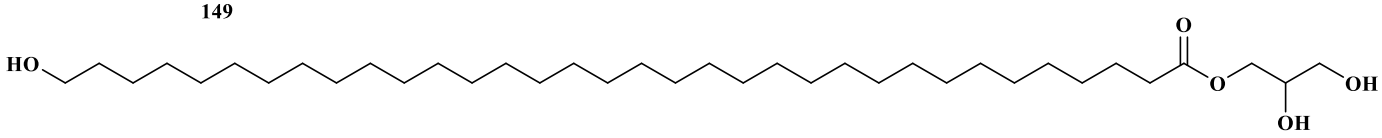

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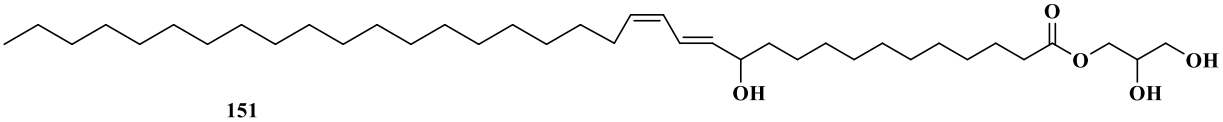

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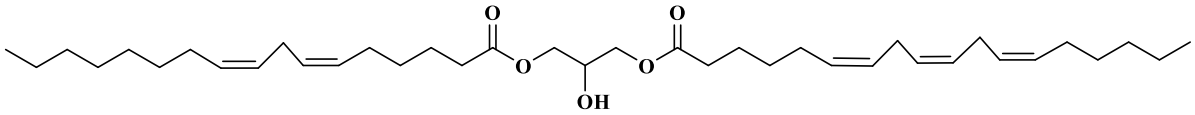

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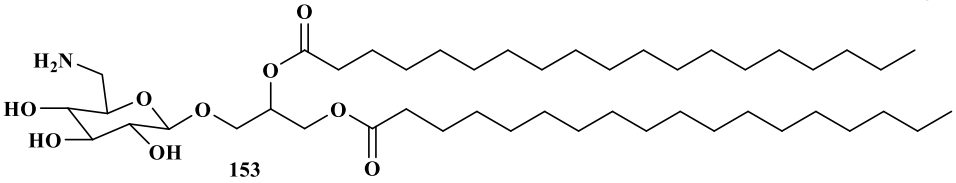

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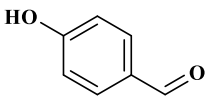

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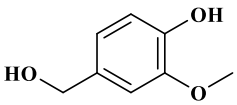

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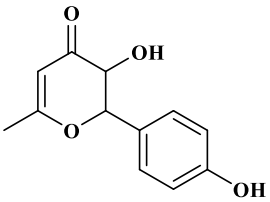

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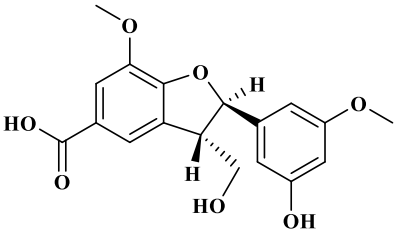

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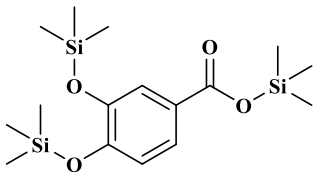

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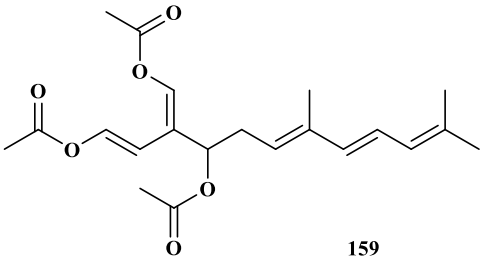

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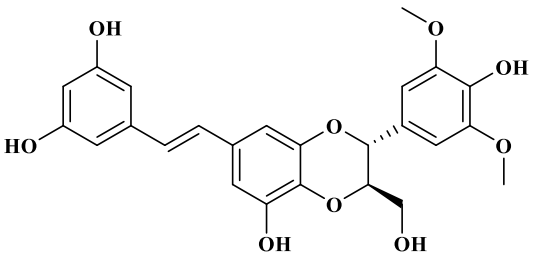

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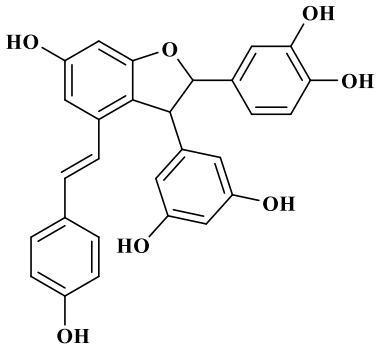

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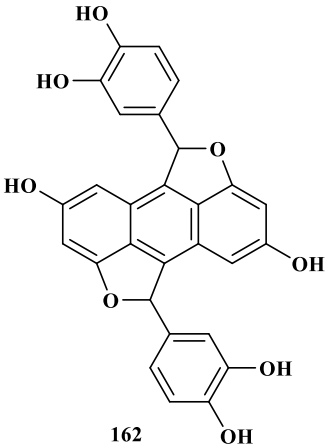

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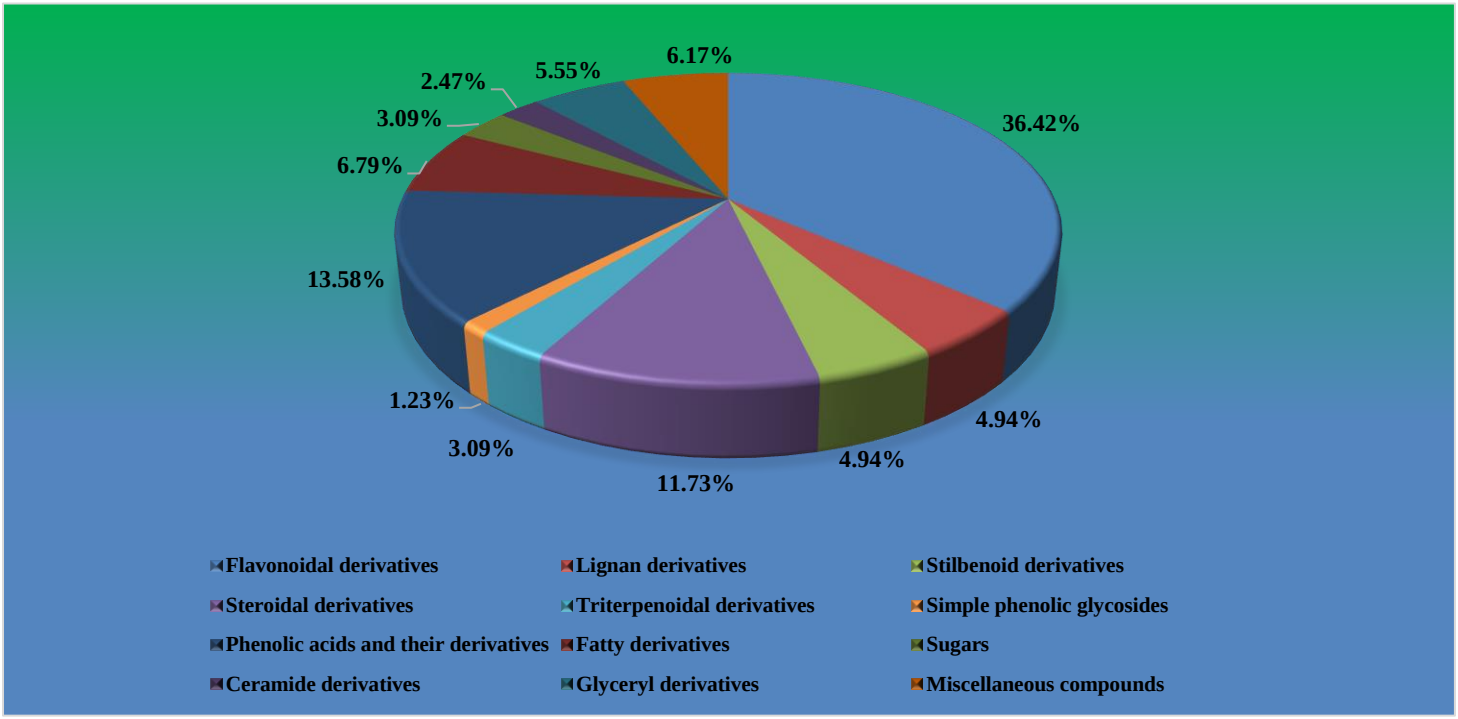

Figure 2: Distribution of the reported secondary metabolites of family Arecaceae (2021-2006).

3. Conclusion

This review affords valuable information about the different phytoconstituents and biological activities of the family "Arecaceae" including 29 genera, and 49 species from 117 peer-reviewed articles. It is reported that "Arecaceae" plants contain different classes of chemical constituents including flavonoids, lignans, stilbenes, sterols, triterpenes, simple phenolic glycosides, phenolic acids, and their derivatives, fatty derivative compounds, sugars, miscellaneous compounds, together with several medicinal benefits such as anti-hyperlipidemic, anti-diabetic, anti-oxidant, anti-parasitic, anti-convulsant, renal protective, cardioprotective, cytotoxic, anti-microbial (antibacterial, antifungal and antiviral), anti-pyretic, anti-inflammatory, anti-mutagenic, hepatoprotective, antihypertensive, analgesic, anti-ulcer, neuropharmacological, anti-platelet, anti-acetylcholin-esterase, and anti-alzheimer. According to the present review, many genera of the family "Arecaceae" are considered to be good points of interest that need more studies to isolate many classes of secondary metabolites as derivatives of (lignan, stilbenoid and triterpenoidal), simple phenolic glycosides and to explore the mechanisms of action of their pharmacological activities assisting the development and discovery of new or novel natural products.

Abbreviations

ALT: Alanine aminotransferase; ALP: Alkaline phosphatase; AST: Aspartate aminotransferase; *A. flavus*: *Aspergillus flavus*; *A. fumigatus*: *Aspergillus fumigatus*; *A. niger*: *Aspergillus niger*; ABTS: (2,2-Azinobis-(3-ethylbenzo-thiazoline-6-sulfonic acid); *B. cereus*: *Bacillus cereus*; *B. subtilis*: *Bacillus subtilis*; b.wt.: Body weight; BHT: Butylated Hydroxytoluene; *C. albicans*: *Candida albicans*; *C. acutatum*: *Colletotrichum acutatum*; *C. fragariae*: *Colletotrichum fragariae*; *C. gloeosporioides*: *Colletotrichum gloeosporioides*; CK-MB: Creatine kinase-MB; DCM: Dichloromethane; DCPIP: 2,6-Dichlorophenolindophenol redox dye; DPPH: (2,2-Diphenyl-1 picryl hydrazyl); Epicut. wax: Epicuticular wax; *E. coli*: *Escherichia coli*; EtOAc: Ethyl acetate; EDTA: Ethylenediamine tetraacetic acid; FRAP: Ferric reducing ability of plasma; GGT: Gamma-glutamyl tansferase; GM: Gentamicin; GOT: Glutamate oxaloacetate transaminase; GPT: Glutamate pyruvate transaminase; GSH: Glutathione; IZs: Inhibition zones; IC_{50}: Inhibitory concentration 50%; i.c.: Intracerebral injection; i.p.: Intraperitoneal injection; LDH: Lactate dehydrogenase; LC_{50}: Lethal Concentration 50%; LPO: Lipid peroxidation; *L. monocytogenes*: *Listeria monocytogenes*; LDL: Low-density lipoprotein; MDA: Malondialdhyde; MMP1: Matrix metallopeptidase 1; *M. luteus*: *Micrococcus luteus*; *M. canis*: *Microsporum canis*; *M. gypseum*: *Microsporum gypseum*; MBC: Minimum Bactericidal Concentration; MIC: Minimum Inhibitory Concentration; NO: Nitric oxide; NDGA: Nordihydroguaiaretic acid; PON1: Paraoxinase; p.o.: Per oral; Pet. ether; Petroleum ether; PBS: Phosphate buffered saline; *P. vulgaris*: *Pneumonia vulgaris*; *P. aeruginosa*: *Pseudomonas aeruginosa*; Poll. grains Pollen grains; *S. choleraesuis*: *Salmonella choleraesuis*; *S. typhi*: *Salmonella typhi*; SC_{50}: Scavenging capacity 50%; *S. aureus*: *Staphylococcus aureus*; s.c.: Subcutaneous injection; TLC: Thin layer chromatography; TBARS: Thiobarbituric acid reactive substances; *T. mentagrophyte*: *Trichophyton mentagrophytes*; *T. rubrum*: *Trichophyton rubrum* and *T. verrucosum*: *Trichophyton verrucosum.*

Conflict of Interests

The authors declare that there is no conflict of interests regarding this review.

Orcid:

Ashraf N. E. Hamed orcid.org/0000-0003-2230-9909

Mostafa Ahmed Fouad orcid.org/0000-0002-3909-3537

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