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Review Article

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Ethnopharmacology, Biological Properties and Phytochemistry of Medicinally Important Plant of Arecaceae Family: A Comprehensive Review

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Abstract | **Ethnopharmacological Relevance:** The family *Arecaceae* is one of the largest plant families in the world. It is widely distributed in tropical regions (Brazil, Saudi Arabia, Middle Eastern countries and Egypt, Indonesia, Malaysia and Thailand). Traditionally, plants of this family were used to treat various disorders, like gastrointestinal ailments, diabetes, spasms, sexual dysfunction, nephritis, rheumatism, cough, diarrhea and hypertension. **Aim of the Review:** This review highlights the biological properties, phytochemistry and chemotaxonomic classification of the phytochemicals of different species of the family *Arecaceae*. **Materials and Methods:** The relevant information on the family *Arecaceae* was collected from scientific databases (Google Scholar, ScienceDirect, ACS Publications, PubMed, Wiley Online Library). Information was also collected from online databases and Books Theses. The literature cited in this review dates from 2001 to June 2022. **Result:** About 141 compounds have been isolated from different species of the family *Arecaceae*, including flavonoids, fatty acids, terpenoids, fatty acid esters, sugars, fatty alcohols, vitamins, carotenoids, tannins, ceramide derivatives, glyceryl derivatives, stilbenoid derivatives, simple phenolic glycosides, sterols, alkaloids, lignans, amino acids and phenolic compounds. Their structure and presence in each species of this family are presented in tabular form. In biological studies, the crude extracts and metabolites of the medicinally important species of the family *Arecaceae* have different biological activities, including, antioxidant, antimicrobial, analgesic, renal protective, antiparasitic, cardioprotective, antidiabetic, anti-mutagenic, antiinflammatory, anticancer, diuretic, hepatoprotective, antihyperlipidemic, antipalatelet, antiviral, antipyretic, antifungal, antidiarrheal, antitrichomonal, antiacetylcholinestrase and antihypertensive. This review examines folkloric uses, phytochemistry and biological activities of selected members of this family (Figure 1).

Key Words *Arecaceae,* Biological Properties, Phenolic Compounds, Flavonoids, Sterols, Phytochemicals, Alkaloids, Traditional Uses, Anticancer, Antimicrobial, Antioxidant

INTRODUCTION

Herbal remedies, which have been employed in both traditional and modern systems since ancient times, are the earliest medical supplies that are known to exist. The WHO stated that herbal medicines are defined as herbs, herbal preparations, herbal finished products and herbal ingredients [1]. Around 80% of the world's population relies on herbal medicine for their primary healthcare requirements [2]. Patients favor herbal remedies over traditional ones due to a persistent illness and dread of surgery, severe morbidity, rising medical expenses and the drawbacks of innovative drugs [3].

Using plant components in their purest form, either fresh or dried, is a common practice in traditional medicine for treating and preventing a wide range of illnesses [4]. Alkaloids, flavonoids, phenolics, terpenoids and glycosides are some of the major types of therapeutic phytochemicals synthesized by plants [5]. Medicinal plants are used to find and develop new therapeutic medications [6].

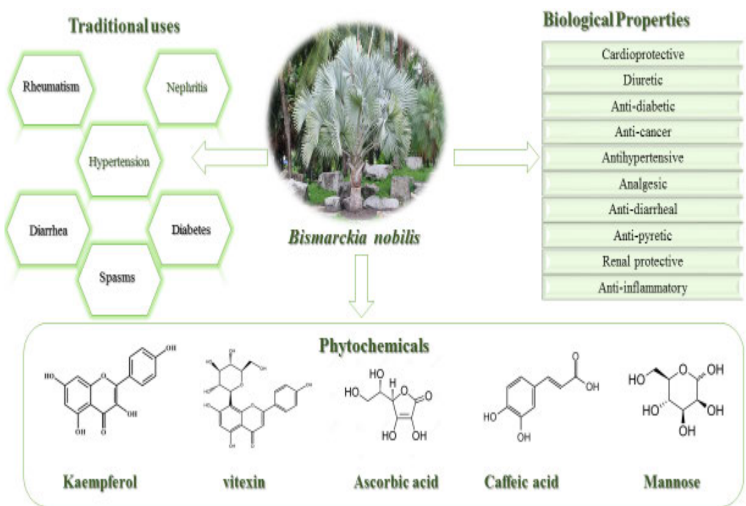


Figure 1: Graphical Abstract

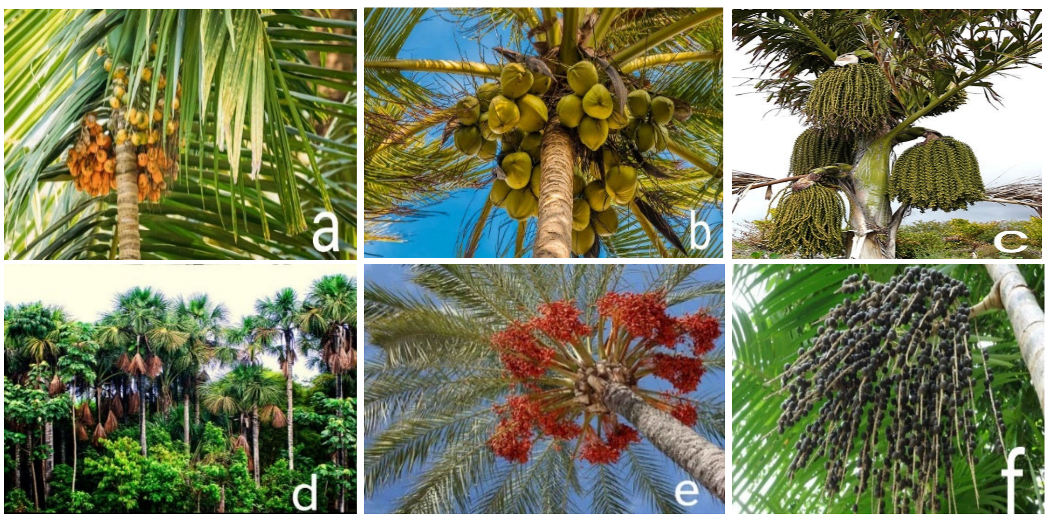


Figure 2: The Plants of *Arecaceae* Family, (a) *Areca catechu*, (b) *Cocos nucifera*, (c) *Caryota urens*, (d) *Mauritia flexuosa*, (e) *Phoenix dactylifera* and (f) *Euterpe oleracea*

The *Arecaceae*, also known as the Palm family (*palmeae*), is one of the most well-known plant families [7] (Figure 2). This family belongs to the monocot order *Arecales* of flowering plants [8]. It has 181 genera and 2600 species and it is one of the largest families in the world. Bush species, woody trees or even grasses are examples of the physical and functional diversity among this family's species. It is primarily found in tropical regions [9]. Species of this family are mostly present in Indonesia, Malaysia and Thailand [9-11].

According to previous phytochemical studies, this family contains anthocyanidins, lignans, benzenoids, benzoquinone, monoterpenoids and nor isoprenoids [12], fatty derivatives, sterols, phenolic acids and their derivatives, flavonoids and other classes [8].

Plants in this family have biological activities like hepatoprotective, anti-hyperlipidemic, anti-diabetic, anti-oxidant, anti-parasitic, antihypertensive, renal protective, cardioprotective, anti-microbial (antibacterial, antifungal and antiviral), anti-pyretic, anti-inflammatory, anti-mutagenic, anti-platelet, analgesic, anti-ulcer, neuropharmacological, anti-acetylcholinesterase, anti-Alzheimer [8] and anti-cancer activities [13].

Traditional Uses

The plants in this family are mostly used for medicinal purposes. According to a review of traditional medical practises, *Chamaerops humilis* is used as stipe or leaf extract for the treatment of gastrointestinal ailments, diabetes, spasms and digestive issues [14]. Regular use of *Phoenix* species has been traditionally used to treat sexual dysfunction, nephritis, rheumatism, burning feelings and cough [15]. Diarrhea is treated with a *C. nucifera* husk fibre extract in Brazil [16].

Herbal tea made from *Hyphae thebaica* is historically thought to be effective in treating hypertension [17]. Hypertension is treated with a decoction of the leaves of the *Acrocomia aculeata* plant [18].

The *Colocasia gigantea* tuber is used to alleviate drowsiness as well as to lessen "internal heat" (fever) [13].

Phyto-Constituents

Phytochemicals are biologically active, naturally occurring chemical substances that are present in plants and which enhance human health. Phytochemicals are plant compounds that shield plant cells from environmental dangers such dehydration, stress, UV exposure, pathogenic attack and pollution. Phytochemicals build up in a variety of plant tissues, including the roots, stems, leaves, flowers, fruits and seeds [19]. Tannins, anthraquinones, alkaloids, terpenoids, cardiac glycosides, steroids, flavonoids, phlobatannins, saponins and reducing sugars are the major phytochemical components found in therapeutic plants [20].

Compounds 1-142 were isolated from medicinally important genra of *Arecaceae* (Table 1). Commonly, phenolic compounds are the major constituents of this family. Many fatty acids, fatty alcohols, fatty acid esters, sterols, vitamins, carotenoids, tocopherols, phenolic compounds, amino acid, terpenoids, tannins, sugars, stilbenoid derivatives, glyceryl derivatives, alkaloids, lignan derivatives, ceramide derivatives and simple phenolic glycosides are reported in this family.

Flavonoids, including compounds 1-24, were isolated from *H. indica* (leaf extract), *M. flexuosa* (pulp and leaf extract), *H. thebaica* (fruit and epicarp extract), *A. alexandrae* (leaf extract), *D. album* (leaf extract), *Caryota mitis* (leaf extract), *S. repens* (pericarp extract), *L. australis* (leaf extract), *S. edulis* (peel extract), *A. catechu* (whole plant extract), *R. rivularis* (leaf extract), *D. lutescens* (whole plant extract), *H. verschaffeltii* (leaf extract), *A. alexandrae* (leaf extract), *C. urens* (Base leaf extract), *C. nucifera* (fiber extract), *P. dactylifera* (fruit and pollen grain extract), *B. armata* (fruit extract), *S. zalacca* (pulp extract) and *W. robusta* (leaf extract).

- **Fatty Acids:** Isolated from *S. wallichiana* (seeds), *A. catechu* (whole plant extract), *M. flexuosa* (pulp extract), *P. dactylifera* (whole plant), *P. loureiroi* (leaf extract), *E. oleracea* (fruit extract), *L. australis* (fruit extract) and *A. aculeate* (fruit extract) are numbered 25-35 in Table 1
- **Fatty Acid Esters:** Only one compound, numbered 36 was isolated from *P. loureiroi* (leaf extract)
- **Fatty Alcohols:** Only one compound, numbered 37 was isolated from *P. loureiroi* (leaf extract)
- **Sterols:** Isolated from *S. wallichiana* (root and fruit extract), *A. catechu* (whole plant extract), *M. flexuosa* (pulp extrcat), *P. loureiroi* (leaf extract), *P. dactylifera* (whole plant extract) and *P. paludosa* (leaf extract) are numbered 38-53 in Table 1
- **Vitamins:** Isolated from *C. nucifera* (liquid albumen extract), *L. australis* (pulp extract), *M. flexuosa* (pulp extract) and *P. dactylifera* (whole plant extract) are numbered 54-60 in Table 1
- **Carotenoids:** Isolated from *M. flexuosa* (fruit extrcat), numbered 61-63 in Table 1
- **Tocopherols:** Isolated from *M. flexuosa* (pulp extract), numbered 64-67 in Table 1
- **Phenolic Compounds:** Isolated from *M. flexuosa* (pulp extract), *S. repens* (pericarp extract), *S. edulis* (peel and pulp extract), *R. rivularis* (leaf extract), *S. zalacca* (pulp extract), *L. chinensis* (fruit extract), *H. thebaica* (fruit extract), *C. nucifera* (endocarp extract), *A. catechu* (whole plant extract), *W. robusta* (leaf extract), *P. paludosa* (leaf extract) and *B. armata* (fruit extract) are numbered 68-98 in Table 1
- **Amino Acids:** Only one compound, numbered 99 was isolated from *C. nucifera* (Liquid albumen/solid albumen extract)

Terpenoids, including compounds 100-104, were isolated from *R. rivularis* (leaf extract), *P. dactylifera* (leaf extract) and *P. paludosa* (leaf extract).

- **Tannins:** Isolated from *A. catechu* (whole plant extract), numbered 105 and 106 in Table 1
- **Stilbenoid Derivatives:** Isolated from *C. nucifera* (Endocarp extract), *P. dactylifera* (stem extract) and *A. aculeate* (seed extract), numbered 107-113 in Table 1
- **Glyceryl Derivatives:** Only one monoacylglycerols compound, numbered 114 was isolated from *L. chinensis* (root extrcat)
- **Alkaloids:** Isolated from *A. catechu* (whole plant extract), numbered 115-124 in Table 1
- **Lignan Derivatives:** Isolated from *C. quiquesetinervius* (stem extract), numbered 125-132 in Table 1
- **Ceramide Derivatives:** Isolated from *L. chinensis* (root extract), numbered 133 and 134 in Table 1
- **Sugars:** Isolated from *P. dactylifera* (fruit extract) and *P. paludosa* (leaf extract), numbered 135-139 in Table 1
- **Simple Phenolic Glycosides:** Isolated from *S. repens* (pericarp extract), numbered 140 and 141 in Table 1

This mentioned data revealed the chemotaxonomic classification of phytochemicals present in different genra of the family *Arecaceae*.

Biological Properties

The family *Arecaceae* has medicinal importance due to the presence of secondary metabolites such as glycosides, terpenoids, alkaloids, sterols, tannins, flavonoids, carotenoids and phenolic compounds. The biological activities of various species of the family *Arecaceae* are highlighted below in Table 2.

Antimicrobial Activity

In Vitro as well as *In Vivo* studies have shown that the leaf extract of *Elaeis guineensis* exhibits excellent antimicrobial activity, effective against both bacterial and

Table 1: Phytochemical Compounds of Family *Arecaceae*

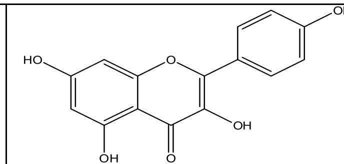
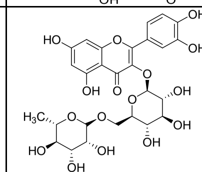
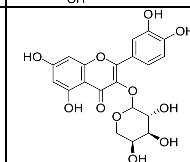
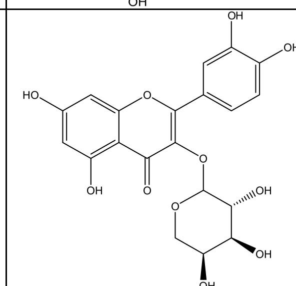
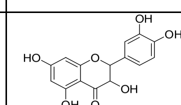
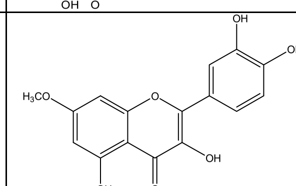
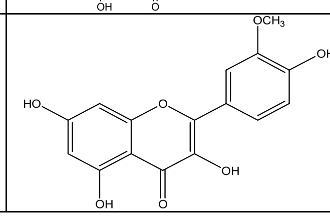
Structure No.	Compound Name	Sources	Part used	Reference	Structures
Flavonoids					
1: Flavonol					
1	Kaempferol	*Hyophorbe indica,* *Mauritia flexuosa,* *Hyphaene thebaica*	Leaf extract Pulp extract Epicarp extract	da Silva et al. [21] Pereira Freire et al. [22] Salib et al. [23]	
2	Rutin	*Archontophoenix alexandrae,* *Dictyosperma album,* *Mauritia flexuosa,* *Caryota mitis,* *Serenoa repens*	Leaf extract Leaf extract Leaf extract Leaf extract Pericarp extract	Afifi et al. [12] Afifi et al. [12] Nonato et al. [24] El-Akad et al. [25] Olennikov et al. [26]	
3	Avicularin	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
4	Myricetin	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
5	Quercetin	*Livistona australis,* *Salacca edulis*	Leaf extract Peel extract	Kassem et al. [27] Kanlayavattanakul et al. [28]	
6	Rhamnetin	*Hyphaene thebaica*	Fruit extract	Hussein et al. [29]	
7	Isorhamnetin	*Areca catechu*	Whole plant extract	Salehi et al. [30]	

Table 1: Continued

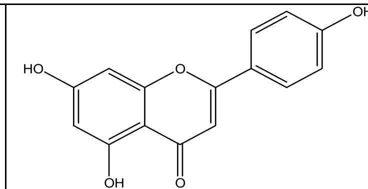
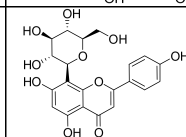
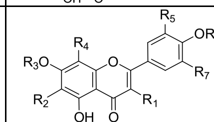
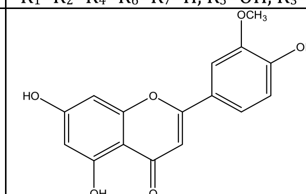
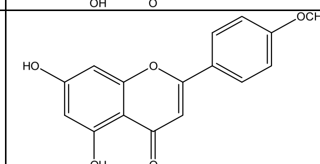
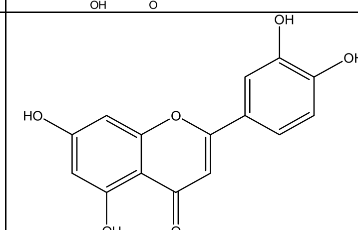
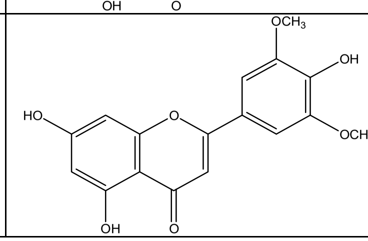
Structure No.	Compound Name	Sources	Part used	Reference	Structures
2: Flavone					
8	Apigenin	*Ravenea rivularis,* *Mauritia flexuosa,* *Hyphaene thebaica,* *Livistona australis*	Leaf extract Pulp extract Fruit extract Leaf extract	da Silva et al. [21] Nonato et al. [24] Hussein et al. [29] Kassem et al. [27]	
9	Vitexin	*Hyphaene thebaica,*	Epicarp extract	Salib et al. [23]	
10	Isovitexin	*Livistona australis,* *Hyphaene thebaica,* *Dypsis lutescens*	Leaf extract Epicarp extract Whole plant extract	Kassem et al. [27] Salib et al. [23] Almaatty et al. [13]	 R_1=R_2=R_4=R_6=R_7=H, R_5=OH, R_3=Glu
11	Chrysoeriol	*Areca catechu,* *Hyphaene thebaica,*	Whole plant extract Epicarp extract	Salehi et al. [30] Salib et al. [23]	
12	Acacetin	*Caryota urens*	Base leaf extract	Mohammed and Fouad [31]	
13	Luteolin	*Hyophorbe verschaffeltii,* *Archontophoenix alexandrae,* *Ravenea rivularis,* *Mauritia flexuosa,* *Areca catechu,* *Hyphaene thebaica,* *Livistona australis*	Leaf extract Leaf extract Leaf extract Pulp extract Whole plant extract Epicarp extract Leaf extract	Elgindi et al. [32] Afifi et al. [12] da Silva et al. [21] Pereira Freire et al. [22] Salehi et al. [30] Salib et al. [23] Kassem et al. [27]	
14	Tricin	*Archontophoenix alexandrae,* *Dictyosperma album,* *Livistona australis*	Leaf extract Leaf extract Leaf extract	Afifi et al. [12] Afifi et al. [12] Kassem et al. [27]	

Table 1: Continued

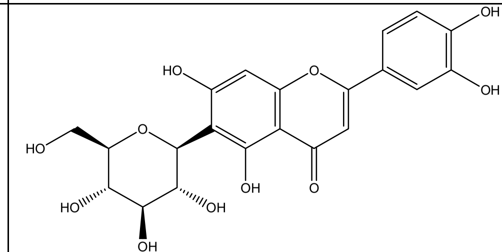
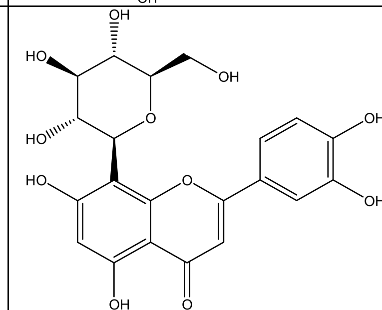
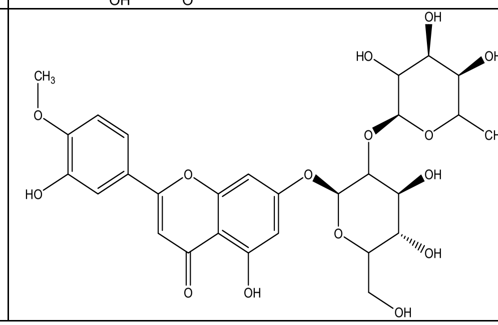
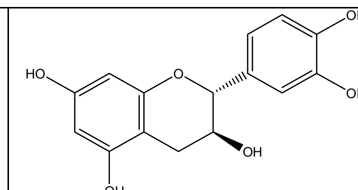
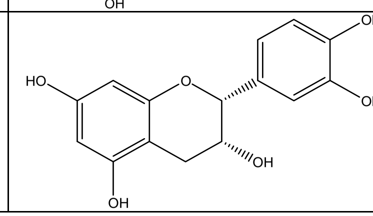
Structure No.	Compound Name	Sources	Part used	Reference	Structures
15	Isoorientin	*Mauritia flexuosa,* *Livistona australis*	Leaf extract Leaf extract	Pereira Freire et al. [22] Kassem et al. [27]	
16	Orientin	*Mauritia flexuosa,* *Dictyosperma album,* *Livistona australis*	Leaf extract Leaf extract Leaf extract	Pereira Freire et al. [22] Afifi et al. [12] Kassem et al. [27]	
17	Neodiosmin	*Phoenix dactylifera*	Fruit extract	Fathy et al. [33]	
3: Flavanol					
18	Catechin	*Mauritia flexuosa,* *Cocos nucifera,* *Hyophorbe indica,* *Brahea armata,* *Hyphaene thebaica*	Pulp extract Fiber extract Leaf extract Fruit extract Fruit extract	Nonato et al. [34] Lima et al. [16] da Silva et al. [21] Hussein et al. [36] Hussein et al. [29]	
19	Epicatechin	*Mauritia flexuosa,* *Hyophorbe indica,* *Salacca zalacca,* *Brahea armata*	Pulp extract leaf extract pulp extract Fruit extract	Pereira Freire et al. [22] da Silva et al. [21] Saleh et al. [10] Hussein et al. [29]	

Table 1: Continued

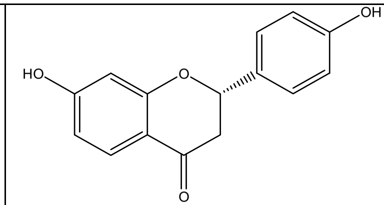
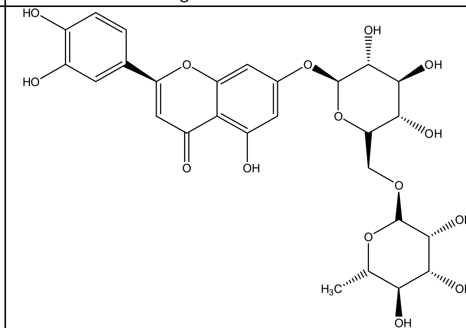
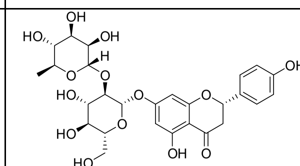
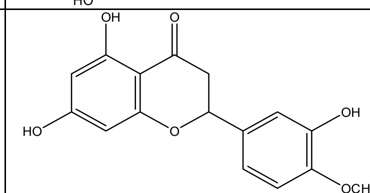
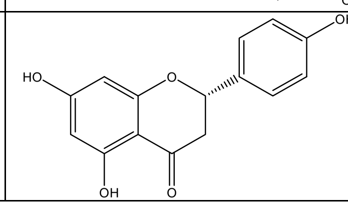
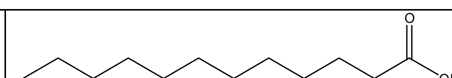
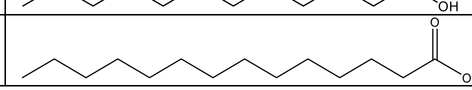
Structure No.	Compound Name	Sources	Part used	Reference	Structures
4: Flavanone					
20	Liquiritigenin	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
21	Eriocitrin	*Hyphaene thebaica*	Fruit extract	Hussein et al. [29]	
22	Naringin	*Phoenix dactylifera*	Pollen grain extract	Abbas and Ateya [37]	
23	Hesperetin	*Hyphaene thebaica*	Fruit extract	Hussein et al. [29]	
24	Naringenin	*Washingtonia robusta*	Leaf extract	Selim et al. [38]	
Fatty acids					
1: Saturated					
25	Lauric acid	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
26	Myristic acid	*Areca catechu*, *Mauritia flexuosa*	Whole plant extract Pulp extract	Salehi et al. [30] Pereira Freire et al. [22]	

Table 1: Continued

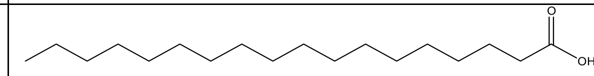
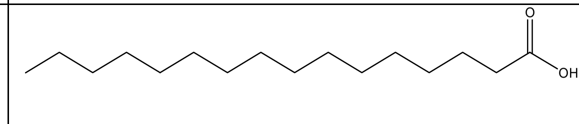
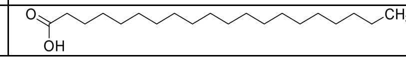
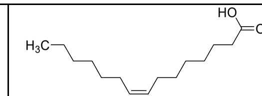
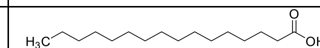
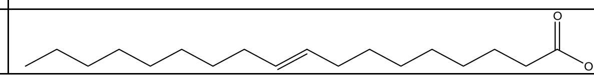
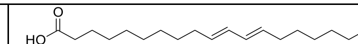
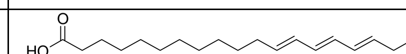
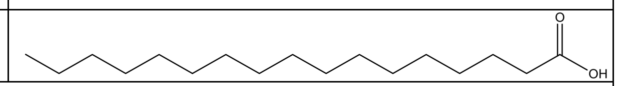
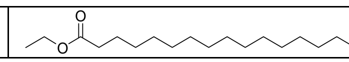
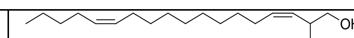
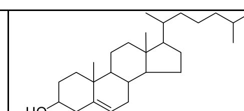
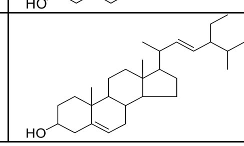
Structure No.	Compound Name	Sources	Part used	Reference	Structures
27	Stearic acid (Octadecanoic acid)	*Areca catechu,* *Mauritia flexuosa,* *Phoenix loureiroi*	Whole plant extract Pulp extract Leaf extract	Salehi et al. [30] Pereira Freire et al. [22] Mondal et al. [15]	
28	Palmitic acid (n- Hexadecanoic acid)	*Euterpe oleracea,* *Acrocomia aculeate,* *Livistona australis,* *Mauritia flexuosa,* *Phoenix loureiroi*	Fruit extract Fruit extract Fruit extract Pulp extract Leaf extract	da Silva et al. [21] da Silva et al. [21] Kassem et al. [39] Pereira Freire et al. [22] Mondal et al. [15]	
29	Arachidonic acid	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
2: Monounsaturated					
30	Oleic acid	*Euterpe oleracea,* *Acrocomia aculeate,* *Livistona australis,* *Phoenix dactylifera,* *Areca catechu,* *Mauritia flexuosa*	Fruit extract Fruit extract Fruit extract Whole plant extract Whole plant extract Pulp extract	da Silva et al. [21] da Silva et al. [21] Kassem et al. [39] Ahmed et al. [11] Salehi et al. [30] Pereira Freire et al. [22]	
31	Palmitoleic acid	*Phoenix dactylifera,* *Euterpe oleracea,* *Mauritia flexuosa*	Whole plant extract Fruit extract Pulp extract	Ahmed et al. [11] da Silva et al. [21] Pereira Freire et al. [22]	
32	Elaidic acid	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
3: Polyunsaturated					
33	Linoleic acid	*Euterpe oleracea,* *Acrocomia aculeate,* *Livistona australis,* *Salacca wallichiana,* *Phoenix dactylifera,* *Mauritia flexuosa*	Fruit extract Fruit extract Fruit extract Seeds extract Whole plant extract Pulp extract	da Silva et al. [21] da Silva et al. [21] Kassem et al. [39] Ragasa et al. [40] Ahmed et al. [11] Pereira Freire et al. [22]	
34	Linolenic acid	*Euterpe oleracea,* *Phoenix dactylifera,* *Mauritia flexuosa*	Fruit extract Whole plant extract Pulp extract	da Silva et al. [21] Ahmed et al. [11] Pereira Freire et al. [22]	
35	Margaric acid	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
4: Fatty Acid Esters					
36	Hexadecanoic acid ethyl ester	*Phoenix loureiroi,*	Leaf extract	Mondal et al. [15]	
5: Fatty Alcohols					
37	2- Methyl Z, Z- 3,13-octadecadienol	*Phoenix loureiroi,*	Leaf extract	Mondal et al. [15]	
Sterols					
38	Cholesterol	*Phoenix dactylifera*	Whole plant extract	Ahmed et al. [11]	
39	Stigmasterol	*Phoenix dactylifera,* *Mauritia flexuosa,* *Phoenix loureiroi,* *Salacca wallichiana*	Whole plant extract Pulp extract Leaf extract Root extract	Ahmed et al. [11] Pereira Freire et al. [22] Mondal et al. [15] Ragasa et al. [40]	

Table 1: Continued

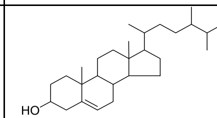
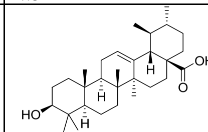
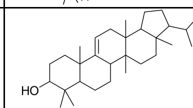
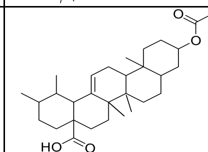
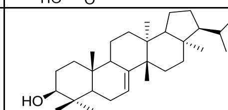
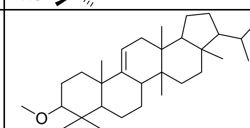
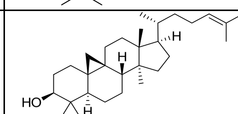
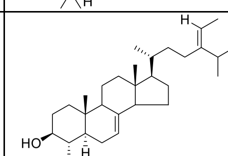
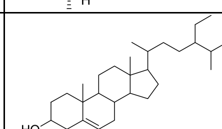
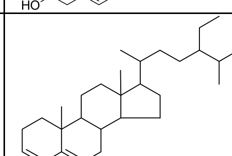
Structure No.	Compound Name	Sources	Part used	Reference	Structures
40	Campesterol	*Phoenix dactylifera,* *Mauritia flexuosa*	Whole plant extract Pulp extract	Ahmed et al. [11] Pereira Freire et al. [22]	
41	Ursonic acid	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
42	Arborinol	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
43	3-acetyl ursolic acid	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
44	Fernenol	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
45	Arundoin	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
46	Cycloartenol	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
47	*α*-sitosterol	*Phoenix dactylifera*	Whole plant extract	Ahmed et al. [11]	
48	*β*-sitosterol	*Mauritia flexuosa,* *Phoenix loureiroi,* *Phoenix paludosa,* *Salacca wallichiana*	Pulp extract Leaf extract Leaf extract Fruit extract	Pereira Freire et al. [22] Mondal et al. [15] Alam et al. [41] Ragasa et al. [40]	
49	stigmastan-3,5-diene	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	

Table 1: Continued

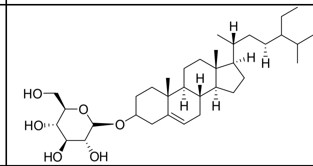
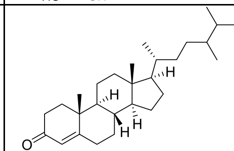
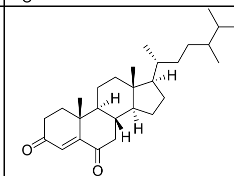
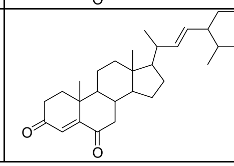
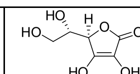
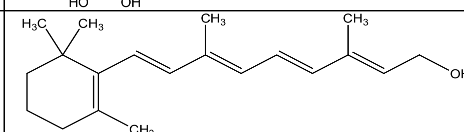
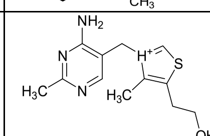
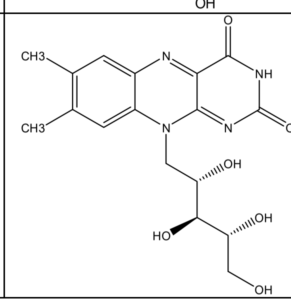
Structure No.	Compound Name	Sources	Part used	Reference	Structures
50	*β*-Sitosterol 3-*O*-*β*-D-glucoside	*Phoenix dactylifera*	Leaf extract	Suleiman et al. [42]	
51	Ergost-4-en-3-one	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
52	Ergost-4-ene-3,6-dione	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
53	Stigmasta-4,22-diene-3,6-dione	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
Vitamins					
54	Ascorbic acid (Vitamin C)	*Cocos nucifera*, *Mauritia flexuosa*	Liquid albumen extract Pulp extract	Lima et al. [16] Pereira Freire et al. [22]	
55	Vitamin A	*Phoenix dactylifera*	Whole plant extract	Ahmed et al. [11]	
56	Vitamin B1	*Phoenix dactylifera*	Whole plant extract	Ahmed et al. [11]	
57	Riboflavin (Vitamin B2)	*Phoenix dactylifera*, *Cocos nucifera*	Whole plant extract Liquid albumen extract	Ahmed et al. [11] Lima et al. [16]	

Table 1: Continued

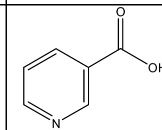
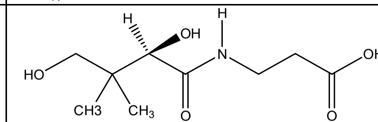
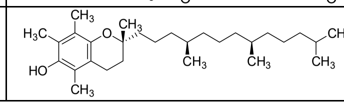
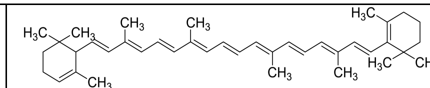
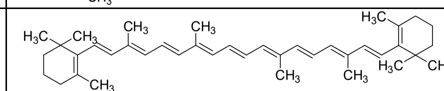
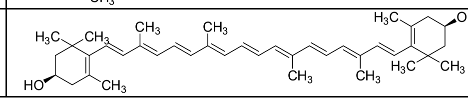
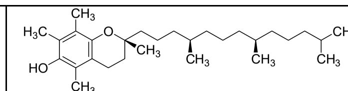
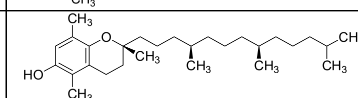
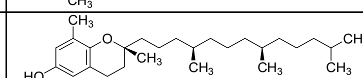
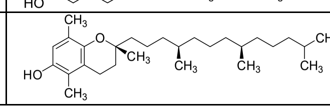
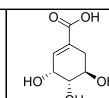
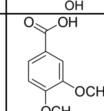
Structure No.	Compound Name	Sources	Part used	Reference	Structures
58	Nicotinic acid (vitamin B3)	*Cocos nucifera*	Liquid albumen extract	Lima et al. [16]	
59	Pantothenic Acid (vitamin B5)	*Cocos nucifera*	Liquid albumen extract	Lima et al. [16]	
60	Vitamin E	*Mauritia flexuosa,* *Livistona australis*	Pulp extract Pulp extract	Pereira Freire et al. [22] Kassem et al. [39]	
Carotenoids					
61	α-carotene	*Mauritia flexuosa*	Fruit extract	Pereira Freire et al. [22]	
62	β-carotene	*Mauritia flexuosa*	Fruit extract	Pereira Freire et al. [22]	
63	Lutein	*Mauritia flexuosa*	Fruit extract	Pereira Freire et al. [22]	
Tocopherols					
64	α-tocopherol	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
65	β-tocopherol	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
66	δ-tocopherol	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
67	γ -tocopherol	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
Phenolic Compounds					
68	Quinic acid	*Mauritia flexuosa*	Pulp extract	Pereira Freire et al. [22]	
69	Veratric acid	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	

Table 1: Continued

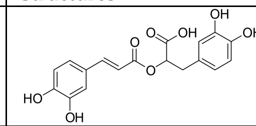
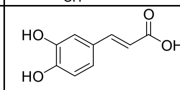
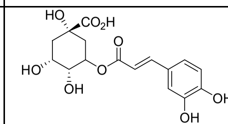
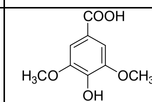
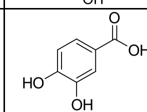
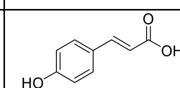
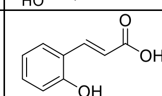
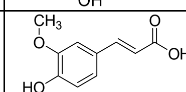
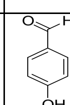
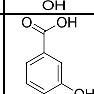
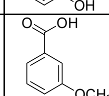
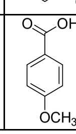
Structure No.	Compound Name	Sources	Part used	Reference	Structures
70	Rosmarinic acid	*Salacca edulis,*	Peel extract	Kanlayavattanakul et al. [28]	
71	Caffeic acid	*Mauritia flexuosa,* *Ravenea rivularis,* *Salacca edulis,* *Hyphaene thebaica*	Pulp extract Leaf extract Peel extract Fruit extract	Nonato et al. [24] da Silva et al. [21] Kanlayavattanakul et al. [28] Hussein et al. [29]	
72	Chlorogenic acid	*Mauritia flexuosa,* *Salacca edulis,* *Ravenea rivularis,* *Salacca zalacca*	Pulp extract Pulp extract Leaf extract Pulp extract	Pereira Freire et al. [22] Kanlayavattanakul et al. [28] da Silva et al. [21] Saleh et al. [10]	
73	Syringic acid	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
74	Protocatechuic acid (3,4-dihydroxybenzoic acid)	*Cocos nucifera ,* *Hyphaene thebaica,* *Livistona chinensis,* *Serenoa repens,* *Mauritia flexuosa*	Endocarp extract Fruit extract Fruit extract Pericarp extract Pulp extract	Elsbaey et al. [43] Hussein et al. [29] Zeng et al. [44] Olennikov et al. [26] Pereira Freire et al. [22]	
75	*p-Coumaric acid*	*Serenoa repens,* *Livistona chinensis,* *Mauritia flexuosa*	Pericarp extract Fruit extract Pulp extract	Olennikov et al. [26] Zeng et al. [44] Pereira Freire et al. [22]	
76	*O-Coumaric acid*	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
77	Ferulic acid	*Mauritia flexuosa,* *Ravenea rivularis,* *Areca catechu,* *Hyphaene thebaica,* *Serenoa repens,* *Salacca edulis*	Pulp extract Leaf extract Whole plant extract Fruit extract Pericarp extract Peel extract	Pereira Freire et al. [22] da Silva et al. [21] Salehi et al. [30] Hussein et al. [29] Olennikov et al. [26] Kanlayavattanakul et al. [28]	
78	4-hydroxybenzaldehyde	*Livistona chinensis,* *Serenoa repens*	Fruit extract Pericarp extract	Zeng et al. [44] Olennikov et al. [26]	
79	3-hydroxybenzoic acid	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
80	3-methoxybenzoic (*m*-anisic)	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
81	4-methoxybenzoic (*p*-anisic)	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	

Table 1: Continued

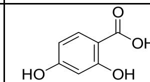
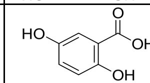
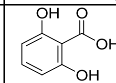
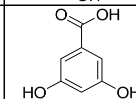
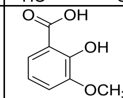
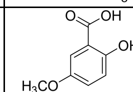
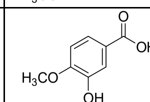
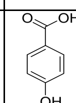
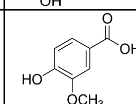
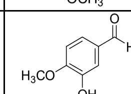
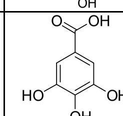
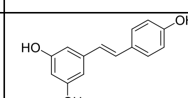
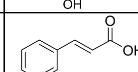
Structure No.	Compound Name	Sources	Part used	Reference	Structures
82	2,4-dihydroxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
83	2,5-dihydroxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
84	2,6-dihydroxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
85	3,5-dihydroxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
86	2-hydroxy-3-methoxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
87	2-hydroxy-5-methoxybenzoic	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
88	Isovanillic acid (3-hydroxy-4-methoxybenzoic acid)	*Livistona chinensis,* *Serenoa repens*	Fruit extract Pericarp extract	Zeng et al. [44] Olennikov et al. [26]	
89	4-hydroxybenzoic acid (p-hydroxybenzoic acid)	*Livistona chinensis,* *Serenoa repens*	Fruit extract Pericarp extract	Zeng et al. [44] Olennikov et al. [26]	
90	Vanillic acid (4-hydroxy - 3-methoxybenzoic acid)	*Livistona chinensis,* *Serenoa repens,* *Areca catechu,* *Hyphaene thebaica*	Fruit extract Pericarp extract Whole plant extract Fruit extract	Zeng et al. [44] Olennikov et al. [26] Salehi et al. [30] Hussein et al. [29]	
91	Isovanillin (3-hydroxy-4-methoxybenzaldehyde)	*Livistona chinensis,*	Fruit extract	Zeng et al. [44]	
92	Gallic acid	*Hyophorbe indica,* *Salacca edulis,* *Hyphaene thebaica,* *Washingtonia robusta,* *Serenoa repens*	Leaf extract Peel extract Leaf extract Leaf extract Pericarp extract	da Silva et al. [21] Kanlayavattanakul et al. [28] Eldahshan et al. [46] Selim et al. [38] Olennikov et al. [26]	
93	Resveratrol	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
94	Cinnamic acid	*Hyphaene thebaica*	Fruit extract	Hussein et al. [29]	

Table 1: Continued

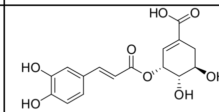
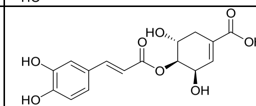
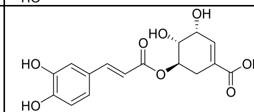
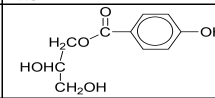
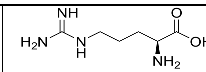
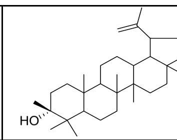
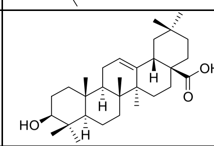
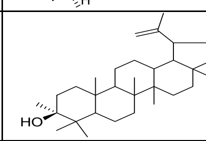
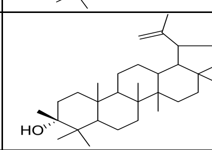
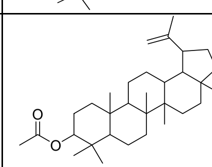
Structure No.	Compound Name	Sources	Part used	Reference	Structures
95	3-O-Caffeoylshikimic acid	*Phoenix paludosa,* *Livistona chinensis*	Leaf extract Fruit extract	Alam et al. [41] Zeng et al. [44]	
96	4-O-Caffeoylshikimic acid	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
97	5-O-caffeoylshikimic acid	*Livistona chinensis*	Fruit extract	Zeng et al. [44]	
98	1-p-Hydroxybenzoyl glycerol	*Brahea armata*	Fruit extract	Hussein et al. [36]	
Amino Acid					
99	L-arginine	*Cocos nucifera*	Liquid albumen/solid albumen extract	Lima et al. [16]	
Terpenoids					
1: Triterpenoid					
100	Betulinic acid	*Ravenea rivularis*	Leaf extract	Mohammed and Fouad [31]	
101	Oleanolic acid	*Phoenix dactylifera*	Leaf extract	Suleiman et al. [42]	
102	Lupeol	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
103	Epilupeol	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
104	Lupeol acetate	*Ravenea rivularis*	Leaf extract	Mohammed and Fouad [31]	

Table 1: Continued

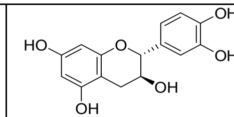
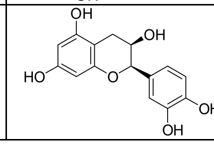
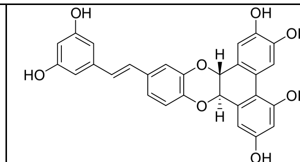
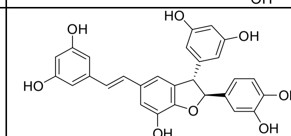
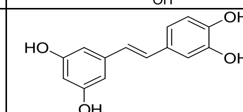
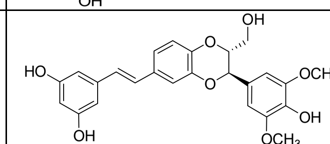
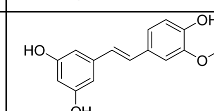
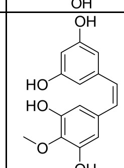
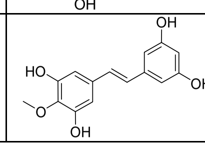
Structure No.	Compound Name	Sources	Part used	Reference	Structures
Tannins					
105	Catechins	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
106	Epicatechins	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
Stilbenoid Derivatives					
107	Cassigarol G	*Cocos nucifera*	Endocarp extract	Elsbaey et al. [43]	
108	Maackin A	*Cocos nucifera*	Endocarp extract	Elsbaey et al. [43]	
109	Piceatannol	*Cocos nucifera, Aiphanes aculeata*	Endocarp extract Seed extract	Elsbaey et al. [43] Lee et al. [47]	
110	Aiphanol	*Aiphanes aculeate*	Seed extract	Lee et al. [47]	
111	Isorhapontigenin	*Aiphanes aculeate*	Seed extract	Lee et al. [47]	
112	1-(3,5-Dihydroxyphenyl)-2-(3,4,5-trihydroxyphenyl) ethylene; (*Z*)-form, 4-methyl ether. (syn: (*Z*) 3,5,3',5'-Tetrahydroxy-4-methoxystilbene)	*Phoenix dactylifera*	Stem extract	Mohammed and Fouad [31]	
113	1-(3,5-Dihydroxyphenyl)-2-(3,4,5-trihydroxyphenyl) ethylene; (*E*)-form, 4-methyl ether (sy.: (*E*) 3,5,3',5'-Tetrahydroxy-4-methoxystilbene)	*Phoenix dactylifera*	Stem extract	Mohammed and Fouad [31]	

Table 1: Continued

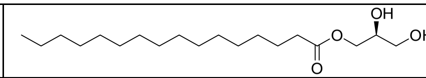
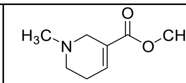
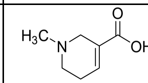
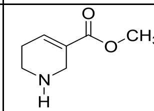
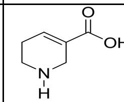
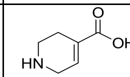
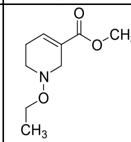
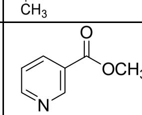
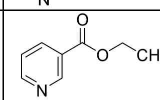
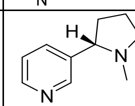
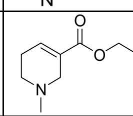
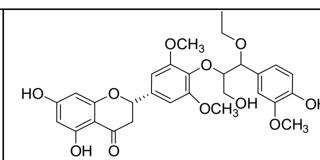
Structure No.	Compound Name	Sources	Part used	Reference	Structures
Glyceryl Derivatives					
1: Monoacylglycerol					
114	1-Hexadecanoyl-sn-glycerol	*Livistona chinensis*	Root extract	Zeng et al. [45]	
Alkaloids					
115	Arecoline	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
116	Arecaidine	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
117	guavacoline	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
118	guavacine	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
119	Isoguvacine	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
120	arecolidine	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
121	methyl nicotinate	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
122	Ethyl nicotinate	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
123	Nicotine	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
124	homoarecoline	*Areca catechu*	Whole plant extract	Salehi et al. [30]	
Lignan Derivatives					
125	Quiquelignan A	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	

Table 1: Continued

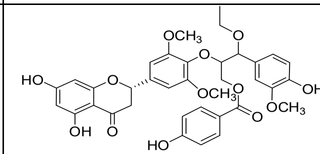
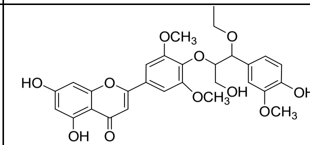
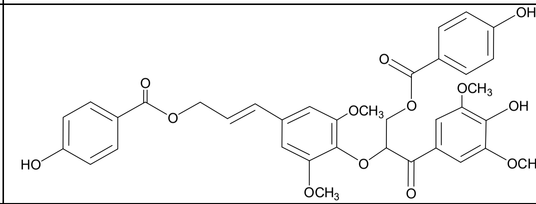
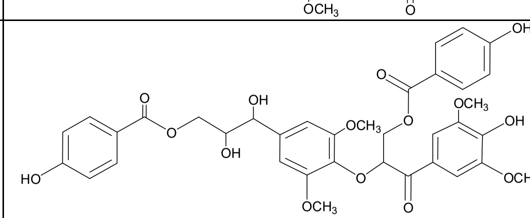
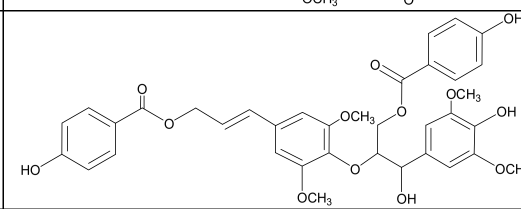
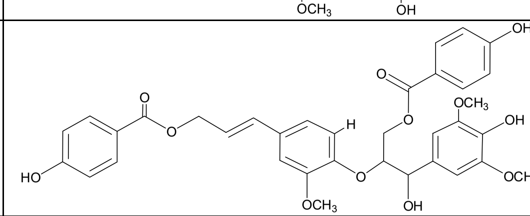
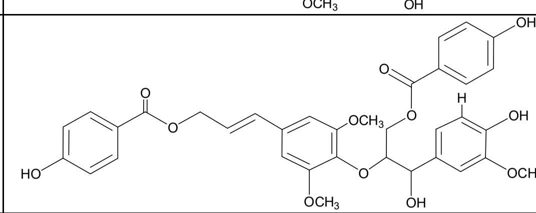
Structure No.	Compound Name	Sources	Part used	Reference	Structures
126	Quiquelignan B	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
127	Quiquelignan C	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
128	Quiquelignan D	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
129	Quiquelignan E	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
130	Quiquelignan F	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
131	Quiquelignan G	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	
132	Quiquelignan H	*Calamus quiquesetinervius*	Stem extract	Chang et al. [48]	

Table 1: Continued

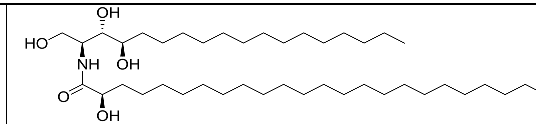
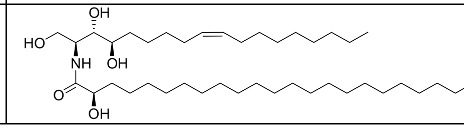
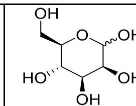
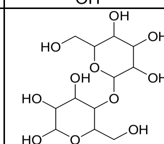
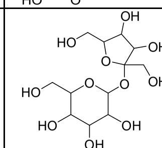
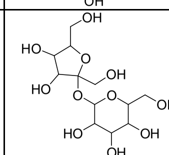
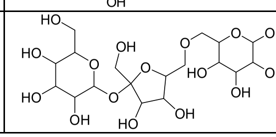
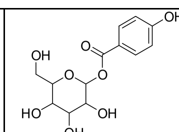
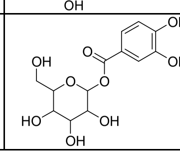
Structure No.	Compound Name	Sources	Part used	Reference	Structures
Ceramide Derivatives					
133	(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-Hydroxytricosanoylamino]-9-octadecene-1,3,4-triol	*Livistona chinensis*	Root extract	Mohammed and Fouad [31]	
134	1-*O*-*β*-D-Glucopyranosyl-(2*S*,3*S*,4*R*,9*Z*)-2-[(2*R*)-2-hydroxydocosanoylamino]-9-octadecene-1,3,4-triol	*Livistona chinensis*	Root extract	Mohammed and Fouad [31]	
Sugars					
135	Mannose	*Phoenix paludosa*	Leaf extract	Alam et al. [41]	
136	Maltose	*Phoenix dactylifera*	Fruit extract	Mohammed and Fouad [31]	
137	Sucrose	*Phoenix dactylifera*	Fruit extract	Mohammed and Fouad [31]	
138	*β*-D-Glucopyranosyl-(1→2)-*β*-D-fructofuranosyl-(6→6)-*α*-D-glucopyranoside	*Phoenix dactylifera*	Fruit extract	Mohammed and Fouad [31]	
139	Maltotriose	*Phoenix dactylifera*	Fruit extract	Mohammed and Fouad [31]	
Simple Phenolic Glycosides					
140	6'-*O*-(4-Hydroxybenzoyl)-*β*-glucose	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	
141	6'-*O*-(3,4-Dihydroxybenzoyl)-*β*-glucose	*Serenoa repens*	Pericarp extract	Olennikov et al. [26]	

Table 2: Biological Activity of Species of Family *Arecaceae*

Biological activity	Plant sources	Inferences	Reference
Antimicrobial activity	*Elaeis guineensis*	*In vitro* as well as *in vivo* studies have shown that the leaf extract exhibits excellent antimicrobial activity, effective against both the bacterial and fungal infections; especially against the yeast *Candida albicans*.	Vijayarathna *et al.* [49]
	Mauritia flexuosa	*M. flexuosa* induce susceptibility to conventional antibiotics in Gram-positive, Gram-negative and *Candida* species.	Nonato *et al.* [24]
	Areca catechu	The most efficient extract was methanolic extract of *A. catechu* methanolic extract (18<zone of inhibition<22 mm).	Negi and Dave [51]
	Cocos nucifera	*Escherichia coli* growth was prevented by a leaf extract from *C. nucifera.*	Joy *et al.* [52]
	Syagrus coronate	With minimal inhibitory concentrations ranging from 190 to 3120 g/mL, the extract exhibited bactericidal activity.	Hughes *et al.* [53]
	Oenacapus bataua	The PKnB kinase enzyme is inhibited by extract of *onecapaus bataua* but bacterial growth is unaffected. It has an IC_{50} of 60.9 g/mL.	Aranaga *et al.* [54]
	Attalea speciosa	*Staphylococcus aureus'* growth was entirely prevented by the extract of *Attalea speciosa* at its highest dose (500 mg/mL).	Barroqueiro *et al.* [55]
	Dypsis leptocheilos	Gram-positive and Gram-negative bacteria were moderately sensitive to the aqueous methanol extract and ethyl acetate fraction of *D. leptocheilos* leaves.	Ibrahim *et al.* [56]
	Borassus flabellifer	When 30 µl of aqueous fruit extract was used, a 23mm-diameter zone of inhibition was seen against *S. aureus*.	Rani *et al.* [57]
	Caryota mitis	Both *S. aureus* and *E. coli* were moderately susceptible to the mild bactericidal effects of aqueous fractions of *C. mitis.*	Abdelhakim *et al.* [58]
	Salacca edulis	*E. coli* growth was slowed down by a *S. edulis* extract. At 100% concentration, the maximum inhibition zone was found (average diameter 18.783 mm).	Ridho *et al.* [59]
	Hyophorbe verschaffeltii	*Bacillus subtillus, Escherichia coli, Pseudomonas aeruginosa and Candida albicans* were all susceptible to the antibacterial effects of aqueous methanol extract.	Aly *et al.* [60]
	Euterpe precatoria	The PKnB kinase enzyme is inhibited by *Euterpe precatoria* but bacterial growth is unaffected. It has an IC_{50} of 77.4 g/mL.	Aranaga *et al.* [54]
	Rhapis excels hookeri	When mixed with chloramphenicol, kanamycin, streptomycin, erythromycin and tetracycline, *Raphia hookeri* extract was able to reduce the antibiotic concentration by up to 50%.	Nguenang *et al.* [61]
	Chamaerops humilis	*Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa* are all susceptible to the antibacterial effects of oil of *Chamaerops humilis*.	Barroqueiro *et al.* [55]
	Hyphaene thebaica	Strong antibacterial activity was demonstrated by the ethanolic extract of *H. thebaica* fruits against *Salmonella typhi* and *Staphylococcus aureus*.	Aboshora *et al.* [62]
	Syagrus coronate	Antibiotic-resistant bacteria strains were able to be inhibited and killed by the oil from *Syagrus coronata*.	Cibele *et al.* [63]
	Phoenix dactylifera	*Staphylococcus aureus, Escherichia coli, Pseudomonas aerigunosa and Bacillus cereus* were all susceptible to methanolic extracts of leaves. Gram-positive bacteria showed to be more susceptible than gram-negative bacteria.	Laouini *et al.* [64]
Anti-parasitic activity	*Cocos nucifera*	Hamsters infected with *L. braziliensis* were examined for response to ethyl acetate extract of *Cocos nucifera*. After 14 days, skin lesions in hamsters infected were reduced by the ethanolic extract (300 mg/kg, 0.2 mL).	Lima *et al.* [35]
Hepatoprotective activity	*Phoenix dactylifera*	It has been demonstrated that the aqueous dates extract has hepatoprotective properties.	Gruca *et al.* [65]
	Elaeis guineensis	It has been demonstrated that methanol extract of leaves works well as a hepatoprotectant.	Gruca *et al.* [65]
	Phoenix dactylifera	According to this study, an aqueous flesh extract of *Phoenix dactylifera* can reduce the CCl_4-induced hepatotoxicity.	Ahmed *et al.* [11]
	Areca catechu	Aqueous extract provided significantly more protection against liver injury in rats at 2000 mg/kg (67-85%) compared to 500 and 1000 mg/kg (18-33%).	Pithayanukul *et al.* [66]
	Dypsis lutescens	D-galactosamine-induced histological alterations in liver were significantly inhibited by an ethanolic extract. The extract enhanced liver operations.	El-Ghonemy *et al.* [67]
Sexual dysfunction activity	*Phoenix dactylifera*	Both as an aphrodisiac and a cure for male impotence, date palm pollen can be used to manage sexual dysfunction.	Gruca *et al.* [65]
Antioxidant activity	*Hyophorbe verschaffeltii*	The serum increases of the liver function markers ALT and AST caused by CCl_4were greatly reduced and returned to normal ($P<0.001$ & $P<0.05$, respectively) following treatment with *H. verschaffeltii* leaf extract.	Elgindi *et al.* [32]
	Bactris guineensis	High radical scavenging activity is present in the hydro-alcoholic pulp extract of *B. guineensis* against DPPH.	López *et al.* [68]

Table 2: Continued

Biological activity	Plant sources	Inferences	Reference
	Dypsis leptocheilos	Strong antioxidant activity was demonstrated by the *D. leptocheilos* aqueous methanol extract and ethyl acetate fraction, with SC_{50} values of 12.8±0.56 µg/mL and 17±0.77 µg/mL, respectively.	Ibrahim *et al.* [56]
	Caryota urens	The leaf hydro-ethanolic extract has a significant antioxidant activity (21.25±4.51 mg/g).	Rani *et al.* [57]
	Borassus flabellifer	The antioxidant activity of extract was assessed every five minutes for the next thirty minutes. Thus, the DPPH's percentage of radical scavenging was (56.69, 62.20, 62.99, 64.57, 66.14, 66.93 and 67.72%), correspondingly.	Rani *et al.* [57]
	Rhapis excels	Ethyl acetate and butanol fractions demonstrated outstanding antioxidant activity in DPPH scavenging activity (86.2% and 75.6%, respectively).	Hassanein *et al.* [69]
	Hyphaene thebaica	107.6, 126.7, 172.7 and 196.3 g/mL were the IC_{50} values, respectively, for the methanol/ultrasonic (MU), methanol/water bath (MW), ethanol/ultrasonic (EU) and ethanol/water bath (EW) extracts.	Aboshora *et al.* [62]
	Livistona australis	Fruit of *L. australis* can help prevent oxidative damage to physiologically active compounds and lipid peroxidation.	Kassem *et al.* [39]
	Calamus erectus	For DPPH radical scavenging, the IC_{50} values of methanolic extracts of endocarp and mesocarp are 0.10 and 0.12 mg/mL respectively. When the concentration was raised, the antioxidant tests of both extracts improved.	Ghosal and Mandal [70]
	Dypsis lutescens	When compared to aqueous extract (IC_{50} =25 g/mL), methanolic extract of *Dypsis lutescens* had the highest level of radical scavenging activity (IC_{50} =18 g/mL).	Almaatty *et al.* [13]
	Euterpe precatoria	At 100.0 µg/mL, all extracts demonstrated significant radical scavenging activity.	Galotta *et al.* [71]
	Syagrus romanzoffiana	The inhibition rates of oxidation using 0.4 mL of extracts from the pulp and kernel cake of *S. romanzoffiana* were 97.00 0.43% and 95.13 0.7%, respectively.	De Lacerda Coriolano *et al.* [72]
	Elaeis guineensis	*E. guineensis* leaf methanol extract shows strong hepatoprotective effects against paracetamol-induced liver injury in mice.	Sasidharan *et al.* [73]
	Dictyosperma album	*Dictyosperma* album leaves have much higher antioxidant activity than *Archinto-phoenix alexandrae* leaves, with values of 243.51 and 129.40 g AECE/g (IC_{50}=60 and 108.5 g/mL, respectively).	Afifi *et al.* [12]
	Phoenix dactylifera	*Phoenix dactylifera* has been shown to have antioxidant and anti-mutagenic effects.	Ahmed *et al.* [11]
	Sabal palmetto	The ethyl acetate fraction demonstrated strong free radical scavenging, reducing, hydrogen peroxide, nitric oxide and lipid peroxidation inhibition abilities.	Ibrahim *et al.* [74]
	Bactris setosa	In comparison to its pulp, aqueous, methanolic and ethanolic extracts of peel of *tucum-do-cerrado* showed increased antioxidant activity.	Rosa *et al.* [75]
Analgesic activity	*Cocos nucifera*	When compared to a control group, the ethanolic extract significantly reduced writhing by 24%, 34% and 52.4% at doses of 50, 100 and 150 mg/kg, respectively.	Lima *et al.* [16]
	Phoenix loureiroi	At doses of 200, 400 and 600 mg/kg, p.o., of extract, the percentage inhibition of writhes is 33.34%, 57.04% and 66.62%, respectively.	Mondal *et al.* [15]
	Caryota mitis	At a dosage of 400 mg/kg, all the tested samples had variable substantial analgesic efficacy. The percentage of inhibition was higher in the entire ethanolic extract and EtOAc fraction than in the other samples (96.1% and 92.85%, respectively).	Abd Elhakim *et al.* [76]
	Phoenix sylvestris	In a hot plate test, oral administration of methanolic extract at dosages of 300 and 450 mg/kg at 120 min (6.60±0.28 and 8.88±0.55) significantly lengthened the latency period to thermal stimuli.	Shajib *et al.* [77]
	Calamus rotang	In a formalin-induced test, methanolic extract (500 mg/kg) resulted in 68.47% inhibition while indomethacin provided 70.72% inhibition.	Ripa *et al.* [78]
	Areca catechu	For dosages of 50, 100, 200 and 400 mg/kg, b.wt., respectively, the leaf extract showed greater antinociceptive action (55.8%, 57.7%, 86.5% and 88.5%) than the stem extract (30.8%, 36.6%, 40.9% and 59.6%).	Barman *et al.* [79]
	Borassus flabellifer	The amount of writhing caused by acetic acid decreased significantly at dosages of 150 and 300 mg/kg of ethanolic extract (30.67±2.84 and 19.33±1.56, respectively).	Paschapur *et al.* [80]
Renal protective activity	*Cocos nucifera*	In a Wistar rat model, treatment with 10% coconut water lowered crystal formation in renal tissue and decreased the amount of crystals in urine. Additionally, the extract protected the kidneys from oxidative stress buildup and renal function decline.	Gandhi, *et al.* [81]
	Phoenix dactylifera	Aqueous extract of date flesh effectively reduced the increases in plasma creatinine and urea brought on by GM nephrotoxicity and mitigated proximal tubular damage.	Al-Qarawi *et al.* [82]

Table 2: Continued

Biological activity	Plant sources	Inferences	Reference
Cardioprotective activity	*Cocos nucifera*	Cardiovascular markers (CK-MB and troponin-T) are decreased in the serum at doses of 50, 100 or 200 mg/100 g of *cocos nucifera.*	Chikku and Rajamohan. [83]
Anti-hyperlipidemic activity	*Livistona australis*	*L. australis* ether extract reduced blood cholesterol and triglycerides by 50% and 43.6%, respectively.	Kassem *et al*. [39]
Anti-hypertensive activity	*Phoenix sylvestris*	In-vivo experiments using methanolic extract and hydro-alcoholic extract show antihypertensive and anti-diabetic effects without producing toxicity.	Jain *et al*. [84]
	Cocos nucifera	At a dosage of 25 mg/kg, extract significantly reduced mean systolic blood pressure (from 185.3±4.7 to 145.6±6.1 mm Hg) in the deoxycorticosterone acetate salt-induced hypertension model.	Lima *et al*. [16]
Anti-platelet activity	*Areca catechu*	Adenosine diphosphate (ADP) and Ca^{+2} ionophore-induced aggregation were most effectively inhibited by *A. catechu.*	Ghayur *et al*. [85]
Anti-trichomonal activity	*Cocos nucifera*	*C. nucifera* husk fibre crude methanol extract showed significant antitrichomonal action (IC_{50} value of 5.8 mg/mL) and activity was lower than that of metronidazole.	Lima *et al*. [16]
Effects on bone structure	*Cocos nucifera*	Administration of virgin coconut oil significantly raised bone volume, avoided a decline in trabecular number and decreased trabecular separation.	Lima *et al*. [16]
Anti-diabetic activity	*Phoenix sylvestris*	According to this investigation, the methanolic extract inhibited both enzymes to varying degrees (26.45-78.48% for α-amylase and 38.28-76.07% for α-glucosidase).	Kannaian *et al*. [86]
	Phoenix roebelenii	At 400 g/mL, ethanolic and methanolic extracts showed the strongest inhibitory efficacy. The maximum inhibitory effect for both α-amylase (75.5±0.66%) and α-glucosidase (77.5±1.07%) was displayed by the ethanolic extract, whereas the activity of the methanolic extract was 70.4±0.62 % for α-amylase and 75.5±0.09 % for α-glucosidase.	Mahalingam [87]
	Phoenix dactylifera	The extract reduced 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 the blood at doses of 150, 300 and 600 mg/kg.	Ayatollahi *et al*. [88]
	Caryota urens	The percentage of α-amylase enzyme inhibition was 8.42±0.97% for concentrated *C. urens* flour up to 5 mg/mL, compared to 10.77±2.64% for cooked flour.	Wimalasiri *et al*. [89]
	Calamus erectus	Methanolic extracts of endocarp and mesocarp showed concentration-dependent inhibition of α-glucosidase (IC_{50} = 1.69 and 2.00 mg/mL) and α-amylase (IC_{50} = 2.74 and 3.30 mg/mL), respectively.	Ghosal and Mandal [70]
	Raphia gentiliana	A 0.2 g/kg oral dose of the extract decreased blood sugar levels.	Mpiana *et al*. [90]
Anti-cancer activity	*Phoenix dactylifera*	Although the components of dates have demonstrated anticancer effect, its precise mode of action in the prevention of tumours is unknown.	Ahmed *et al*. [11]
	Areca catechu	Methanolic extracts of *A. catechu* have anticancer effects on breast cancer and oral squamous carcinoma cell lines (HSC-2).	Almaatty *et al*. [13]
	Dypsis lutescens	Isovitexin, a component of *Dypsis lutescens,* has anti-cancer properties.	Chiduruppa *et al*. [91]
	Salacca edulis	*Salacca* fruit extract was cytotoxic to vero cells and a normal human fibroblast cell line.	Ridho *et al*. [59]
	Elaeis guineensis	The methanol extract significantly damaged MCF-7 cells in a dose-dependent manner.	Vijayarathna and Sasidharan [50]
	Borassus flabellifer	Colorectal cancer Her2/CT26 cell proliferation was suppressed by trans-scirpusin A compound of *Borassus flabellifer*.	Hong *et al*. [92]
	Medemia argun	*M. argun* seeds were recommended for patients with human colon cancer risk factors and as an adjuvant therapy to cancer chemotherapy because they had chemopreventive effects against hepatocarcinogenesis.	Abdel-Hamid *et al*. [93]
Anti-mutagenesis activity	*Phoenix dactylifera*	*Phoenix dactylifera* fruit extract was found to have strong anti-mutagenic properties.	Ahmed *et al*. [11]
Diuretic activity	*Borassus flabellifer*	At a dosage of 200 mg/kg, ethanol extract has significantly raised the urine levels of Na^+, K^+ and Cl.	Chinnaswamy *et al*. [94]
Anti-diarrheal activity	*Phoenix dactylifera*	*Phoenix dactylifera* aqueous extract can be used to treat diarrhoea by lowering the mean number of faeces compared to the saline control group.	Ahmed *et al*. [11]
Anti-viral Activity	*Phoenix dactylifera*	Extracts exhibit a potent capacity to reduce infectivity of *Pseudomonas* phage ATCC 14209-B1.	Jassim and Naji [95]
Anti-fungal activity	*Phoenix dactylifera*	*Phoenix dactylifera* possesses antifungal qualities in both its leaves and its pits.	Ahmed *et al*. [11]
	Borassus flabellifer	At a dosage of 100 g/mL, methanol extract of leaf demonstrated antifungal activity against a number of different fungal species, including *Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Candida albicans* and *Candida blanki.*	Jamkhande *et al*. [96]

Table 2: Continued

Biological activity	Plant sources	Inferences	Reference
Anti-pyretic activity	*Phoenix loureiroi*	The ethanol extract significantly reduced pyrexia in a dose-dependent manner.	Mondal *et al.* [15]
	Caryota mitis	Significant antipyretic efficacy was shown by n-hexane and aqueous fractions against yeast-induced hyperthermia.	Abd Elhakim *et al.* [76]
	Borassus flabellifer	Hyperthermia was significantly reversed by a *Borassus flabellifer* extract.	Paschapur *et al.* [80]
Delivery and labor relaxation activity	*Phoenix dactylifera*	Date fruit components have a substantial impact on pain relief and relaxation during labour.	Ahmed *et al.* [11]
Male Infertility and Testicular Dysfunction activity	*Phoenix dactylifera*	*Phoenix dactylifera* pollens can raise testosterone levels in cirrhotic patients, improving their sexual well-being.	Ahmed *et al.* [11]
Female infertilitily and harmone levels activity	*Phoenix dactylifera*	The herb *Phoenix dactylifera* can also be used to treat female infertility brought on by hormonal imbalance.	Ahmed *et al.* [11]
Anti-acetylcholinesterase (AChE) activity	*Areca catechu*	*In vitro* spectrophotometric analysis was used to determine the anti-AChE activity. The enzyme was nearly completely inhibited by the extract (90.1±0.4), demonstrating its high AChE inhibitory action.	Ghayur *et al.* [85]
Anti-inflammatory activity	*Cocos nucifera*	*C. nucifera* root extracts reduced activities of 15-LOX (IC_{50}= 24.57±1.16 and IC_{50}= 8.31±0.73), sPLA2 (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.	Wendkouni *et al.* [97]
	Acrocomia aculeata	The microencapsulated oil from *Acrocomia aculeata* fruits also presented anti-inflammatory in paw edema and pleural edema models, both induced by carrageenan.	Lescano *et al.* [18]
	Ravenea rivularis	Methanolic extract at a dose of 125 g/mL showed an anti-inflammatory effect (66% inhibition) in comparison with dexamethasone at a dose of 50 ng/mL (65% inhibition).	Elgindi *et al.* [32]
	Areca catechu	Aqueous extract inhibited 5-LOX with an IC_{50} of 25.07.	Almaatty *et al.* [13]
	Phoenix loureiroi	Mice's intestinal inflammation could be decreased by *P. loureiroi* extract when given orally at a dose of 5 mg/kg.	Murugan *et al.* [98]
	Euterpe oleracea	*In vivo* tests on paw edoema and ear erythema brought on by croton oil revealed anti-inflammatory efficacy in oil derived from *Euterpe oleracea* fruits. 1226.8 mg/kg was the typical effective dose.	Favacho *et al.* [99]
	Butia odorata	The activity of butyrylcholinesterase was reduced by *B. odorata* extract, suggesting that it may have anti-inflammatory effects.	Ramos *et al.* [100]
	Borassus flabellifer	At 800 µg, a root extract from *Borassus flabellifer* reduced hemolysis and denaturation by 50%.	Natarajan and Sangeetha [101]
	Dypsis lutescens	Ethanolic extract shows the ability to inhibit the pro-inflammatory enzymes hyaluronic acid (37.78±1.26 and 29.79±1.27) and matrix metallopeptidase (814.51±20.25 and 629.18±18.64), respectively, at two doses (250 and 500 mg/kg, p.o.).	El-Ghonemy *et al.* [67]
	Caryota mitis	Anti-inflammatory potential of *Caryota mitis*, its extract was able to attenuate the inflammatory response in mice paw edema induced by carrageenan at a concentration of 400 mg/kg.	Abd Elhakim *et al.* [102]
	Hyophorbe verschaffeltii	The methanolic extract (500 mg/kg) demonstrated continuous and significant suppression of edoema by 48.54% and 44.2% at 8th and 12th h, respectively, demonstrating longer-lasting anti-inflammatory efficacy than diclofenac sodium (100 mg/kg).	Aly *et al.* [60]

fungal infections, especially against the yeast *Candida albicans* [49]. *M. flexuosa* induce susceptibility to conventional antibiotics in Gram-positive, Gram-negative and *Candida* species [24]. The most efficient extract against bacteria was methanolic extract of *A. catec*hu (18<zone of inhibition< 22 mm) [51]. *Escherichia coli* growth was prevented by a leaf extract from *C. nucifera* [52]. With minimal inhibitory concentrations ranging from 190 to 3120 g/mL, the extract of *Syagrus coronata* exhibited bactericidal activity [53].

The PKnB kinase enzyme is inhibited by extract of *onecapaus bataua* but bacterial growth is unaffected. It has an IC_{50} of 60.9 g/mL [54]. *Staphylococcus aureus'* growth was entirely prevented by the extract of *Attalea speciosa* at its highest dose (500 mg/mL) [55]. Gram-positive and Gram-negative bacteria were moderately sensitive to the aqueous methanol extract and ethyl acetate fraction of *D. leptocheilos* leaves [56].

When 30 µL of aqueous fruit extract of *Borassus flabellifer* was used, a 23mm-diameter zone of inhibition was seen against *S. aureus* [57]. Both *S. aureus* and *E. coli* were moderately susceptible to the mild bactericidal effects of aqueous fractions of *C. mitis* [58]. *E. coli* growth was slowed down by a *S. edulis* extract. At 100% concentration, the maximum inhibition zone was found (average diameter 18.783 mm) [59]. *Bacillus subtillus, Escherichia coli, Pseudomonas aeruginosa and Candida albicans* were all susceptible to the antibacterial effects of aqueous methanol extract of *Hyophorbe verschaffeltii* [60].

The PKnB kinase enzyme is inhibited by *Euterpe precatoria* but bacterial growth is unaffected. It has an IC_{50} of 77.4 g/mL [54]. When mixed with chloramphenicol, kanamycin, streptomycin, erythromycin and tetracycline, *Raphia hookeri* extract was able to reduce the antibiotic concentration by up to 50% [61]. *Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa* are all susceptible to the antibacterial effects of oil of *Chamaerops humilis* [55]. Strong antibacterial activity was demonstrated by the ethanolic extract of *H. thebaica* fruits against *Salmonella typhi* and *Staphylococcus aureus* [62]. Antibiotic-resistant bacteria strains were able to be inhibited and killed by the oil from *Syagrus coronate* [63]. *Staphylococcus aureus, Escherichia coli, Pseudomonas aerigunosa and Bacillus cereus* were all susceptible to methanolic extracts of leaves of *Phoenix dactylifera*. Gram-positive bacteria showed to be more susceptible than gram-negative bacteria [64].

Anti-Parasitic Activity

Hamsters infected with *L. braziliensis* were examined for response to ethyl acetate extract of *Cocos nucifera*. After 14 days, skin lesions in infected hamsters were reduced by the ethanolic extract of *Cocos nucifera* (300 mg/kg, 0.2 mL) [35].

Hepatoprotective Activity

It has been demonstrated that the aqueous dates extract has hepatoprotective properties [65]. It has been demonstrated that methanol extract of leaves of *Elaeis guineensis* works well as a hepatoprotectant [65]. According to this study, an aqueous flesh extract of *Phoenix dactylifera* can reduce the CCl_4-induced hepatotoxicity [11]. Aqueous extract of *Areca catechu* provided significantly more protection against liver injury in rats at 2000 mg/kg (67-85%) compared to 500 and 1000 mg/kg (18-33%) [66]. D-galactosamine-induced histological alterations in liver were significantly inhibited by an ethanolic extract of *Dypsis lutescens*. The extract enhanced liver operations [67]. Both as an aphrodisiac and a cure for male impotence, date palm pollen can be used to manage sexual dysfunction [65].

Antioxidant Activity

The serum increases of the liver function markers ALT and AST caused by CCl_4 were greatly reduced and returned to normal ($p<0.001$ and $p<0.05$, respectively) following treatment with *H. verschaffeltii* leaf extract [32]. High radical scavenging activity is present in the hydro-alcoholic pulp extract of *B. guineensis* against DPPH [68]. Strong antioxidant activity was demonstrated by the *D. leptocheilos* aqueous methanol extract and ethyl acetate fraction, with SC_{50} values of 12.8±0.56 µg/mL and 17±0.77 µg/mL, respectively [56]. The leaf hydro-ethanolic extract of *Caryota urens* has a significant antioxidant activity (21.25±4.51 mg/g) [57].

The antioxidant activity of extract of *Borassus flabellifer* was assessed every five minutes for the next thirty minutes. Thus, the DPPH percentage of radical scavenging was (56.69, 62.20, 62.99, 64.57, 66.14, 66.93 and 67.72%), correspondingly [57]. Ethyl acetate and butanol fractions of *Rhapis excels* demonstrated outstanding antioxidant activity in DPPH scavenging activity (86.2 and 75.6%, respectively) [69]. 107.6, 126.7, 172.7 and 196.3 g/mL were the IC_{50} values, respectively, for the Methanol/Ultrasonic (MU), Methanol/Water bath (MW), Ethanol/Ultrasonic (EU) and Ethanol/Water bath (EW) extracts of *Hyphaene thebaica* [62].

Fruit of *L. australis* can help prevent oxidative damage to physiologically active compounds and lipid peroxidation [39]. For DPPH radical scavenging, the IC_{50} values of methanolic extracts of endocarp and mesocarp of *Calamus erectus* are 0.10 and 0.12 mg/mL, respectively. When the concentration was raised, the antioxidant tests of both extracts improved [70]. When compared to aqueous extract (IC_{50} = 25 g/mL), methanolic extract of *Dypsis lutescens* had the highest level of radical scavenging activity (IC_{50} = 18 g/mL) [13]. At 100.0 µg/mL, all extracts of *Euterpe precatoria* demonstrated significant radical scavenging activity [71]. The inhibition rates of oxidation using 0.4 mL of extracts from the pulp and kernel cake of *S. romanzoffiana* were 97.00, 0.43% and 95.13 0.7%, respectively [72].

E. guineensis leaf methanol extract shows strong hepatoprotective effects against paracetamol-induced liver injury in mice [73]. *Dictyosperma album* leaves have much higher antioxidant activity than *Archinto-phoenix alexandrae* leaves, with values of 243.51 and 129.40 g AECE/g (IC_{50} = 60 and 108.5 g/mL, respectively) [12]. *Phoenix dactylifera* has been shown to have antioxidant and anti-mutagenic effects [11]. The ethyl acetate fraction of *Sabal palmetto* demonstrated strong free radical scavenging, reducing, hydrogen peroxide, nitric oxide and lipid peroxidation inhibition abilities [74]. In comparison to its pulp, aqueous, methanolic and ethanolic extracts of peel of *tucum-do-cerrado* showed increased antioxidant activity [75].

Analgesic Activity

When compared to a control group, the ethanolic extract of *Cocos nucifera* significantly reduced writhing by 24, 34 and 52.4% at doses of 50, 100 and 150 mg/kg, respectively [16]. At doses of 200, 400 and 600 mg/kg, p.o., of extract of *Phoenix loureiroi*, the percentage inhibition of writhes is 33.34, 57.04 and 66.62%, respectively [15]. At a dosage of 400 mg/kg, all the tested samples had variable substantial analgesic efficacy. The percentage of inhibition was higher in the entire ethanolic extract and EtOAc fraction of *Caryota mitis* than in the other samples (96.1 and 92.85%, respectively) [76].

In a hot plate test, oral administration of extract of *Phoenix sylvestris* at dosages of 300 and 450 mg/kg at 120 min (6.60±0.28 and 8.88±0.55) significantly lengthened the latency period to thermal stimuli [77]. In a formalin-induced test, methanolic extract (500 mg/kg) of *Calamus rotang* resulted in 68.47% inhibition while indomethacin provided 70.72% inhibition [78]. For dosages of 50, 100, 200 and 400 mg/kg, b.wt., respectively, the leaf extract of *Areca catechu* showed greater antinociceptive action (55.8, 57.7, 86.5 and 88.5%) than the stem extract (30.8, 36.6, 40.9 and 59.6%) [79]. The amount of writhing caused by acetic acid decreased significantly at dosages of 150 and 300 mg/kg of ethanolic extract of *Borassus flabellifer* (30.67±2.84 and 19.33±1.56, respectively) [80].

Renal Protective Activity

In a Wistar rat model, treatment with 10% coconut water lowered crystal formation in renal tissue and decreased the amount of crystals in urine. Additionally, the extract protected the kidneys from oxidative stress buildup and renal function decline [81]. Aqueous extract of date flesh effectively reduced the increases in plasma creatinine and urea brought on by GM nephrotoxicity and mitigated proximal tubular damage [82].

Cardioprotective Activity

Cardiovascular markers (CK-MB and troponin-T) are decreased in the serum at doses of 50, 100 or 200 mg/ 100 g of *Cocos nucifer* [83].

Anti-Hyperlipidemic Activity

L. australis ether extract reduced blood cholesterol and triglycerides by 50 and 43.6%, respectively [39].

Anti-Hypertensive Activity

In Vivo experiments using methanolic extract (PSLME) and hydro-alcoholic extract of *Phoenix sylvestris* (PSLHAE) show antihypertensive and anti-diabetic effects without producing toxicity [84]. At a dosage of 25 mg/kg, extract of *Cocos nucifera* significantly reduced mean systolic blood pressure (from 185.3±4.7 to 145.6±6.1 mm Hg) in the deoxycorticosterone acetate salt-induced hypertension model [16].

Anti-Platelet Activity

Adenosine diphosphate (ADP) and Ca^{+2} ionophore-induced aggregation were most effectively inhibited by *A. catechu* [85].

Anti-Trichomonal Activity

C. nucifera husk fibre crude methanol extract showed significant antitrichomonal action (IC_{50} value of 5.8 mg/mL) and activity was lower than that of metronidazole [16].

Effects on Bone Structure

Administration of virgin coconut oil significantly raised bone volume, avoided a decline in trabecular number and decreased trabecular separation [16].

Anti-Diabetic Activity

According to this investigation, the methanolic extract of *Phoenix sylvestris* inhibited both enzymes to varying degrees (26.45-78.48% for α-amylase and 38.28-76.07% for α-glucosidase) [86]. At 400 g/mL, ethanolic and methanolic extracts of *Phoenix roebelenii* showed the strongest inhibitory efficacy. The maximum inhibitory effect for both α-amylase (75.5±0.66%) and α-glucosidase (77.5±1.07%) was displayed by the ethanolic extract, whereas the activity of the methanolic extract was 70.4±0.62% for α-amylase and 75.5±0.09% for α-glucosidase [87]. The extract of *Phoenix dactylifera* reduced 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 the blood at doses of 150, 300 and 600 mg/kg [88].

The percentage of α-amylase enzyme inhibition was 8.42±0.97% for concentrated *C. urens* flour up to 5 mg/mL, compared to 10.77±2.64% for cooked flour [89]. Methanolic extracts of endocarp and mesocarp of *Calamus erectus* showed concentration-dependent inhibition of α-glucosidase (IC_{50} = 1.69 and 2.00 mg/mL) and α-amylase (IC_{50} = 2.74 and 3.30 mg/mL), respectively [70]. A 0.2 g/kg oral dose of the extract of *Raphia gentiliana* decreased blood sugar levels [90].

Anti-Cancer Activity

Although the components of dates have demonstrated an anticancer effect, their precise mode of action in the prevention of tumours is unknown [11]. Methanolic extracts of *A. catechu* have anticancer effects on breast cancer and oral squamous carcinoma cell lines (HSC-2) [13]. Isovitexin, a component of *Dypsis lutescens,* has anti-cancer properties [91]. *Salacca* fruit extract was cytotoxic to vero cells and a normal human fibroblast cell line [59].

The methanol extract of *Elaeis guineensis* significantly damaged MCF-7 cells in a dose-dependent manner [50]. Colorectal cancer Her2/CT26 cell proliferation was suppressed by trans-scirpusin A compound of *Borassus flabellifer* [92]. *M. argun* seeds were recommended for patients with human colon cancer risk factors and as an adjuvant therapy to cancer chemotherapy because they had chemopreventive effects against hepatocarcinogenesis [93].

Anti-Mutagenic Activity

Phoenix dactylifera fruit extract was found to have strong anti-mutagenic properties [11].

Diuretic Activity

At a dosage of 200 mg/kg, ethanol extract of *Borassus flabellifer* has significantly raised the urine levels of Na^+, K^+ and Cl [94].

Anti-Diarrheal Activity

Phoenix dactylifera aqueous extract can be used to treat diarrhoea by lowering the mean number of faeces compared to the saline control group [11].

Anti-Viral Activity

Extracts of *Phoenix dactylifera* exhibit a potent capacity to reduce infectivity of *Pseudomonas* phage ATCC 14209-B1 [95].

Anti-Fungal Activity

Phoenix dactylifera possesses antifungal qualities in both its leaves and its pits [11]. At a dosage of 100 g/mL, methanol extract of leaf of *Borassus flabellifer* demonstrated antifungal activity against a number of different fungal species, including *Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Candida albicans* and *Candida blanki* [96].

Anti-Pyretic Activity

The ethanol extract of *Phoenix loureiroi* significantly reduced pyrexia in a dose-dependent manner [15]. Significant antipyretic efficacy was shown by n-hexane and aqueous fractions of *Caryota mitis* against yeast-induced hyperthermia [76]. Hyperthermia was significantly reversed by a *Borassus flabellifer* extract [80].

Delivery and Labor Relaxation Activity

Date fruit components have a substantial impact on pain relief and relaxation during labour [11].

Male Infertility and Testicular Dysfunction Activity

Phoenix dactylifera pollens can raise testosterone levels in cirrhotic patients, improving their sexual well-being [11].

Female Infertilitily and Harmone Levels Activity

The herb *Phoenix dactylifera* can also be used to treat female infertility brought on by hormonal imbalance [11].

Anti-Acetylcholinesterase (AChE) Activity

In Vitro spectrophotometric analysis was used to determine the anti-AChE activity. The enzyme was nearly completely inhibited by the extract of *Areca catechu* (90.1±0.4), demonstrating its high AChE inhibitory action [85].

Anti-Inflammatory Activity

C. nucifera root extracts reduced activities of 15-LOX (IC_{50} = 24.57±1.16 and IC_{50} = 8.31±0.73), sPLA2 (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 [97]. The microencapsulated oil from *Acrocomia aculeata* fruits also presented anti-inflammatory effects in paw edema and pleural edema models, both induced by carrageenan [18]. Methanolic extract of *Ravenea rivularis* at a dose of 125 g/mL showed an anti-inflammatory effect (66% inhibition) in comparison with dexamethasone at a dose of 50 ng/mL (65% inhibition) [32]. Aqueous extract of *Areca catechu* inhibited 5-LOX with an IC_{50} of 25.07 [13]. Mice's intestinal inflammation could be decreased by *P. loureiroi* extract when given orally at a dose of 5 mg/kg [98]. *In Vivo* tests on paw edoema and ear erythema brought on by croton oil revealed anti-inflammatory efficacy in oil derived from *Euterpe oleracea* fruits. 1226.8 mg/kg was the typical effective dose [99].

The activity of butyrylcholinesterase was reduced by *B. odorata* extract, suggesting that it may have anti-inflammatory effects [100]. At 800 µg, a root extract from *Borassus flabellifer* reduced hemolysis and denaturation by 50% [101]. Ethanolic extract of *Dypsis lutescens* shows the ability to inhibit the pro-inflammatory enzymes hyaluronic acid (37.78±1.26 and 29.79±1.27) and

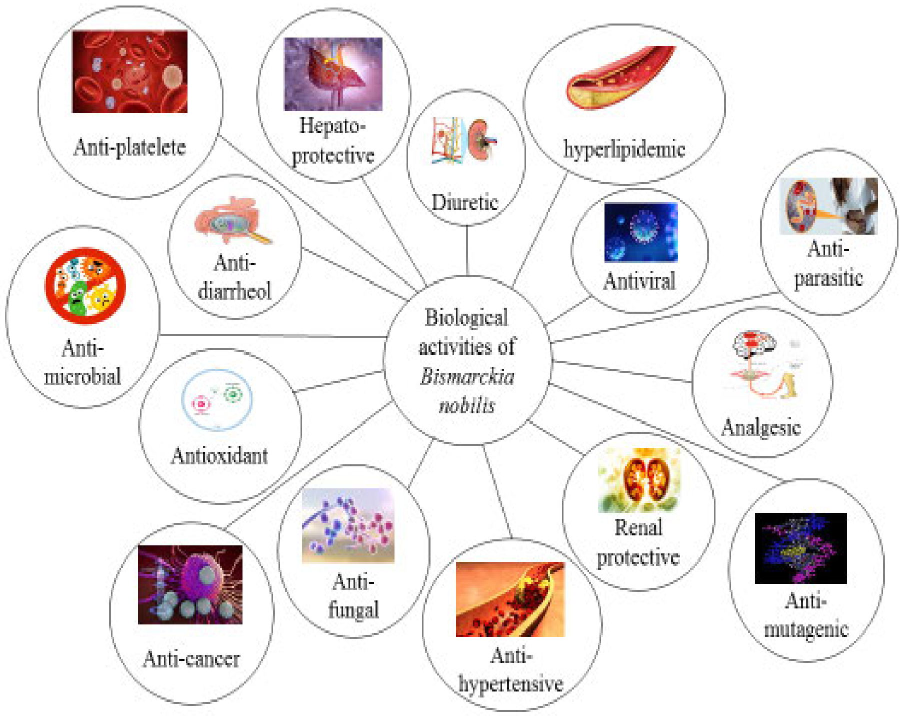


Figure 3: A Schematic Diagram of Biological Activities of *Bismarckia nobilis*

matrix metallopeptidase (814.51±20.25 and 629.18± 18.64), respectively, at two doses (250 and 500 mg/kg, p.o.) [67]. Anti-inflammatory potential of *Caryota mitis*, its extract was able to attenuate the inflammatory response in mice paw edema induced by carrageenan at a concentration of 400 mg/kg [102]. The methanolic extract (500 mg/kg) of *Hyophorbe verschaffeltii* demonstrated continuous and significant suppression of edoema by 48.54 and 44.2% at 8th and 12th h, respectively, demonstrating longer-lasting anti-inflammatory efficacy than diclofenac sodium (100 mg/kg) [60] (Figure 3).

CONCLUSIONS

The species of *Arecaceae* family are widely distributed in Indonesia, Malaysia and Thailand. This review summarizes the biological activities, phytochemical studies and traditional uses of species of *Arecaceae* family. A total of 141 compounds are mentioned in this review; these secondary metabolites are very effective for the treatment of several diseases, such as hypertension, diabetes, spasms, nephritis, rheumatism, cough and digestive issues. Species of this family shows biological activities like hepatoprotective, anti-diabetic, anti-oxidant, antihypertensive, renal protective, cardioprotective, anti-microbial, anti-inflammatory, analgesic and anti-cancer. On the basis of data collected in this review, it is evident that *Arecaceae* family comprises a wide range of biologically important plants.

Future Perspective

According to this review, the *Arecaceae* family contains a number of species that need additional study in terms of characterization and phytochemical studies. We hope that information from this review will facilitate future research initiates to develop new medicinal plant-based medication for treating different diseases such as hypertension, nephritis, rheumatism, diabetes and cancer. It is necessary to conduct the clinical study to gain a better understanding of their safety and efficacy to ensure that it can be beneficial to the humanity.

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