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Phytochemistry and biological activity of family "Urticaceae": a review (1957-2019)

Hamdy K. Assaf[1], Alaa M. Nafady[1], Ahmed E. Allam[1], Ashraf N. E. Hamed[2*], Mohamed S. Kamel[2,3]

[1] Department of Pharmacognosy, Faculty of Pharmacy, Al-Azhar University, Assiut Branch, 71524 Assiut, Egypt
[2] Department of Pharmacognosy, Faculty of Pharmacy, Minia University, 61519 Minia, Egypt
[3] Department of Pharmacognosy, Faculty of Pharmacy, Deraya University, 61111 New Minia, Egypt

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Abstract

Family Urticaceae is a major family of angiosperms comprises 54 genera and more than 2000 species of herbs, shrubs, small trees and a few vines distributed in the tropical regions. Family Urticaceae has many biological importance of angiosperms due to its various phytoconstituents and valuable medicinal uses. Reviewing the current available literature showed many reports about the phytoconstituents present in many plants of the family Urticaceae. These constituents include triterpenes, sterols, flavonoids, lignans, sesquiterpenes, alkaloids, simple phenolic compounds and miscellaneous compounds which are responsible for its biological activities such as cytotoxic, antimicrobial (antibacterial, antifungal and antiviral) anti-inflammatory, antidiabetic, anti-benign prostatic hyperplasia, hepatoprotective, antioxidant as well as wound healing. Genus Urtica is the most investigated (phytochemically and biologically) in all genera of family "Urticaceae". Very few literature was found in phytochemical and biological studies on many genera of family "Urticaceae". This provoked the researchers to carry out extensive studies on these plants.

Key words
Urticaceae, phytochemistry, biological activity

1. Introduction

Natural products have widespread important consideration in the current years because of its medicinal value. Many families of medicinal plants have biological importance *viz.*, Urticaceae, Bignoniaceae,…etc. [1-3]. Urticaceae (syn.: Urticeae) includes about 2000 species in 54 genera، most of which in the tropical regions [4]. Family "Urticaceae" was classified taxonomically as; Kingdom: Plantae, Phylum: Tracheophyta, Class: Magnoliopsida, Order: Rosales [5]. Urticaceous plants are herbs and shrubs, but some are trees in which the xylem is very soft due to the presence of unlignified parenchyma. Stems of Urticaceous plants are often fibrous, sometimes succulent, sometimes armed with stinging hairs. The stinging hairs occurs in some of the other genera, but not universally present throughout the family. The heads of these hairs are easily detached, liberating an irritating fluid, of uncertain chemical composition [5]. Urticaceae have opposite or alternate simple leaves. Plants are mostly anemophilous and dioecious, monoecious or polygamous. Flowers are unisexual, small and individually inconspicuous, mainly in axillary or terminal spike-like cymose inflorescences. Male flowers contain four to five stamens and the female flowers present four, sometimes five sepals, or no perianth and an ovary superior. Fruits are achenes [6].

This review potentiates the researchers for carrying out further studies on this family to isolate and develop new drugs from natural sources with wide margin of safety and understanding their effects and possible mechanism of actions. The literature was collected from 1957 to 2019 using various databases including Dictionary of Natural Products (DNP), PubMed, Science Direct, ChemWeb and Google Scholar.

2. Results and discussion

2.1 Phytochemistry

On reviewing the current available literature, family Urticaceae contained various phytochemical constituents such as triterpenes, sterols, flavonoids, lignans, sesquiterpenes, alkaloids, simple phenolics and miscellaneous compounds. Their isolated compounds as well as their chemical structures are shown in **(Table 1)** and **(Figure 1)**.

Results of chemical review [Table 1 and Figures (1&2)] showed the following:

1- Genus Urtica is the major genus in family Urticaceae and showed 69 isolated compounds, classified as (2 triterpenes, 12 sterols, 14 flavonoids, 9 lignans, one alkaloid, 25 simple phenolics and 6 miscellaneous compounds).

2- Genus Boehmeria showed 35 isolated compounds, classified as (5 triterpenes, one sterol, 11 flavonoids, 8 alkaloids, one simple phenolic and 9 miscellaneous compounds).

3- Genus Cecropia showed 33 isolated compounds, classified as (14 triterpenes, 2 sterols, 8 flavonoids, 4 simple phenolics and 5 miscellaneous compounds).

**** Correspondence: Ashraf N. E. Hamed***
Tel.: *+2 01091237437****; Fax:*** *+20 862369075*
Email Address: *ashrafnag@mu.edu.eg*

Table 1: Isolated compounds from family "Urticaceae".

No.	Name	Plant source	Organ	Ref.
		I-Triterpenes		
1	2-*α*-Acetoxy-3*β*,19*α*-di-hydroxy-11*α*,12*α*-epoxy-ursan-28,13*β*-olide	*Cecropia pachystachya* Trecul.	Roots	[7]
2	3*β*-Acetoxy-2*α*,19*α*-di-hydroxy-11*α*,12*α*-epoxy-ursan-28,13*β*-olide	*Cecropia pachystachya* Trecul.	Roots	[7]
3	2-Acetyl methyl tormentate	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
4	2-Acetyl tormentic acid	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
5	3-Acetyl methyl tormentate	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
6	3-Acetyl tormentic acid	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
7	Arjunolic acid	*Cecropia schreberiana* Miq.	Leaves	[9]
8	*α*-Amyrin	*Cecropia schreberiana* Miq.	Leaves	[9]
9	*β*-Amyrin	*Urtica dioica* L. *Forsskaolea tenacissima* L.	Whole plant Whole plant	[10] [11]
10	*β*-Amyrinone	*Cecropia obtusa* Trecul.	Leaves	[12]
11	Boehmerone	*Boehmeria excels* Wedd.	Stem barks	[13]
12	3*β*,19*α*-Dihydroxy-urs-12-ene	*Debregeasia salicifolia* (D.Don)	Whole plant	[14]
13	3*β*-19*α*-Dihydroxy-30-norurs-12-ene	*Debregeasia salicifolia* (D.Don)	Stems	[15]
14	Euscaphic acid	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
15	Friedelin	*Forsskaolea tenacissima* L.	Whole plant	[11]
16	Goreishic acid I	*Cecropia telenitida* Cuatrec.	Roots	[16]
17	Hederagenin	*Boehmeria nivea* L.	Roots	[17]
18	20-Hydroxy ursolic acid	*Cecropia telenitida* Cuatrec.	Roots	[16]
19	2*α*-Hydroxy ursolic acid	*Boehmeria nivea* L.	Roots	[17]
20	Isoarjunolic acid	*Cecropia pachystachya* Trecul.	Roots	[7]
21	Lupeol	*Forsskaolea tenacissima* L. *Forsskaolea tenacissima* L.	Aerial parts Whole plant	[18] [11]
22	Maslinic acid	*Forsskaolea tenacissima* L. *Boehmeria nivea* L.	Aerial parts Roots	[18] [17]
23	Methyl arjunolate	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
24	Methyl triacetyl arjunolate	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
25	Myrianthic acid	*Myrianthus arboreus* P. Beauv.	Root-wood	[8]
26	2-*O*-Acetyl-euscaphic acid	*Cecropia pachystachya* Trecul.	Roots	[7]
27	Oleanolic acid	*Urtica dioica* L.	Whole plant	[10]
28	Oxo-oleanolic acid	*Pilea mongolica* Wedd.	Aerial parts	[19]
29	2*α*,3*β*,21*β*,23,28-Penta hydroxyl 12-oleanene	*Laportea crenulata* Gaud.	Roots	[20]
30	Pomolic acid	*Cecropia schreberiana* Miq. *Debregeasia salicifolia* (D.Don)	Leaves Whole plant	[9] [14]
31	Pomolic acid methyl ester	*Debregeasia salicifolia* (D.Don)	Whole plant	[14]
32	Serjanic acid	*Cecropia telenitida* Cuatrec.	Roots	[16]
33	Spergulagenic acid A	*Cecropia telenitida* Cuatrec.	Roots	[16]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
34	Tormentic acid	*Cecropia schreberiana* Miq.	Leaves	[9]
		Debregeasia salicifolia (D.Don)	Whole plant	[14]
		Boehmeria nivea L.	Roots	[17]
35	3*β*-(*E*)-cinnamoyl-oxy)-19-*α*-hydroxy-urs-12-ene	*Debregeasia salicifolia* (D.Don)	Whole plant	[14]
36	Ursolic acid	*Debregeasia salicifolia* (D.Don)	Whole plant	[14]
37	Uvaol	*Debregeasia salicifolia* (D.Don)	Whole plant	[14]
38	Yarumic acid	*Cecropia telenitida* Cuatrec.	Roots	[16]
		II-Sterols		
39	Campesterol	*Urtica dioica* L.	Roots	[21]
		Girardinia heterophylla Decne.	Leaves	[22]
40	Cholesterol	*Urtica pilulifera* L.	Herbs	[23]
41	4,22-Cholestadien-3-one	*Cecropia obtusifolia* Bertol.	Leaves	[7]
42	4-Cholestene-3,24-dione	*Cecropia obtusifolia* Bertol.	Leaves	[7]
43	24*R*-Ethyl-5*α*-cholestane-3*β*,6*α*-diol	*Urtica dioica* L.	Roots	[24]
44	7*β*-Hydroxy sitosterol	*Urtica dioica* L.	Roots	[24]
45	*β*-Sitosterol	*Boehmeria nivea* L.	Leaves	[25]
		Urtica fissa E. Pritz.	Roots	[26]
		Forsskaolea tenacissima L.	Aerial parts	[18]
		Urtica dioica L.	Whole plant	[10]
		Forsskaolea tenacissima L.	Whole plant	[11]
		Urtica dioica L.	Roots	[24]
		Urtica pilulifera L.	Herbs	[23]
		Girardinia heterophylla Decne.	Roots	[27]
		Girardinia heterophylla Decne.	Leaves	[22]
46	7*α*-Hydroxy sitosterol-3-*O*-*β*-D-glucopyranoside	*Urtica dioica* L.	Roots	[24]
47	7*β*-Hydroxy-sitosterol-3-*O*-*β*-D-glucopyranoside	*Urtica dioica* L.	Roots	[24]
48	6'-*O*-Palmitoyl-sitosterol-3-*O*-*β*-D-glucopyranoside	*Urtica dioica* L.	Roots	[24]
49	*β*-Sitosterol-3-O-*β*-D-glucopyranoside	*Urtica fissa* E. Pritz.	Roots	[26]
		Forsskaolea tenacissima L.	Aerial parts	[18]
		Urtica dioica L.	Roots	[24]
		Urtica pilulifera L.	Herbs	[23]
50	Stigmasterol-3-*O*-*β*-D-galactoside	*Urtica pilulifera* L.	Herbs	[23]
51	Stigmasterol-3-*O*-*β*-D-glucopyranoside	*Urtica fissa* E. Pritz.	Roots	[26]
		Urtica pilulifera L.	Herb	[23]
52	*γ*-Sitosterol	*Girardinia heterophylla* Decne.	Roots	[22]
53	*α*-Spinasterol	*Urtica fissa* E. Pritz.	Roots	[26]
		III-Flavonoids		
54	Afzelin	*Urtica cannabina* L.	Fruits	[28]
55	Apigenin 6,8-di-C-*β*-D-glucopyranoside	*Urtica cannabina* L.	Leaves	[26]
		Urtica laetevirens Maxim.	Aerial parts	[29]
56	Apigenin-7-*O*-glucoside	*Pilea microphylla* L.	Leaves	[30]
57	Apigenin-7-*O*-rutinoside	*Pilea microphylla* L.	Whole plant	[30]
58	Astragalin	*Urtica dioica* L.	Seeds	[26]
		Urtica cannabina L.	Fruits	[28]
59	Catechin	*Cecropia schreberiana* Miq.	Leaves	[9]
60	Chalcone-6'-hydroxy-2',3,4-tri-methoxy-4'-*O*-*β*-D-glucopyranoside	*Boehmeria rugulosa* Wedd.	Leaves	[31]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
61	Cinchonain Ia	*Cecropia schreberiana* Miq.	Leaves	[9]
62	Cinchonain Ib	*Cecropia schreberiana* Miq.	Leaves	[9]
63	Epicatechin	*Boehmeria nivea* L. *Cecropia schreberiana* Miq.	Leaves Leaves	[32] [9]
64	Epicatechin gallate	*Boehmeria nivea* L.	Leaves	[32]
65	(-)-Epiafzelechin-(-)-epicatechin-(4,8)-dimer	*Boehmeria tricuspis* Hance.	Roots	[32]
66	(-)-Epicatechin-(-)-epicatechin-(4,8)-dimer	*Boehmeria tricuspis* Hance.	Roots	[32]
67	Isoorientin	*Cecropia schreberiana* Miq.	Leaves	[9]
68	Isoquercitrin	*Urtica cannabina* L.	Fruits	[28]
69	Isovitexin	*Urtica cannabina* L. *Phenax angustifolius* Wedd.	Fruits Leaves	[28] [33]
70	Isorhamnetin	*Urtica dioica* L.	Seeds	[26]
71	Kaempferol	*Urtica dioica* L.	Seeds	[26]
72	Luteolin	*Urtica artichocaulis*Hand.-Mazz *Urtica dioica* L.	Aerial parts Aerial parts	[26] [20]
73	Luteolin-7-*O*-neohesperidoside	*Urtica laetevirens* Maxim.	Aerial parts	[29]
74	Luteolin-7-*O*-*β*-D-glucopyranoside	*Urtica laetevirens* Maxim.	Aerial parts	[29]
75	5-Methoxy-4'-hydroxy-2",2"-di methylpyrano (3",4",7,8) isoflavone	*Pouzolzia indica* L.	Leaves	[34]
76	5-Methoxy-luteolin-7-*O*-*β*-D-glucopyranoside	*Urtica laetevirens* Maxim.	Aerial parts	[29]
77	Procyanidins B2	*Cecropia schreberiana* Miq.	Leaves	[9]
78	Procyanidins B5	*Cecropia schreberiana* Miq.	Leaves	[9]
79	Quercetin	*Urtica artichocaulis* Hand-Mazz. *Urtica cannabina* L. *Boehmeria rugulosa* Wedd. *Urtica dioica*.L.	Aerial parts Fruits Leaves Aerial parts	[26] [28] [31] [20]
80	Quercetin-3-*O*-*α*-L-rhamnopyranoside	*Phenax angustifolius* Wedd.	Leaves	[33]
81	Quercetin-7-*O*-*β*-D-glucopyranoside	*Boehmeria rugulosa* Wedd.	Leaves	[31]
82	Rutin	*Boehmeria nivea* L. *Urtica artichocaulis*Hand-Mazz. *Boehmeria nivea* L. *Urtica laetevirens* Maxim.	Leaves Aerial parts Roots Aerial parts	[25] [26] [17] [29]
83	Scutellarein-7-*O*-*α*-L-rhamnoside	*Urtica cannabina* L.	Leaves	[26]
84	3',4',5,6-Tetrahydroxy-7-*O*-[*β*-D-glucopyranosyl-(1→6)-*β*-D-glucopyranosyl-(1→6)-*β*-D-gluco-pyranosyl-(1→3)-*α*-L-rhamno-pyranoside] isoflavone	*Boehmeria rugulosa* Wedd.	Leaves	[31]
85	3',4',5,6-Tetra-hydroxy-7-*O*-[*β*-D-gluco-pyranosyl-(1→3)-*α*-L rhamno-pyranoside] isoflavone	*Boehmeria rugulosa* Wedd.	Leaves	[31]
86	2,4,4'-Trihydroxy chalcone	*Boehmeria nivea* L.	Roots	[17]
87	Vitexin	*Cecropia schreberiana* Miq. *Phenax angustifolius* Wedd.	Leaves Leaves	[9] [33]
		IV-Lignans		
88	Citrusin A	*Pilea cavaleriei* Levl.	Whole plant	[35]
89	Citrusin B	*Pilea cavaleriei* Levl.	Whole plant	[35]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
90	Cyclo-olivil-9-*O*-*β*-glucopyranoside	*Urtica triangularis* Hand-Mass.	Roots	[36]
91	Dehydrodiconiferyl alcohol	*Urtica dioica* L.	Roots	[37]
92	Dehydrodiconiferyl alcohol-4-*O*-*β*-D-glucopyranoside	*Pilea cavaleriei* Levl.	Whole plant	[35]
93	Dihydrodiconiferyl alcohol-4-*O*-*β*-D-glucopyranoside	*Pilea cavaleriei* Levl.	Whole plant	[35]
94	3,4-Divanillyl tetrahydrofuran	*Urtica dioica* L.	Roots	[37]
95	2-Hydroxy-2-(3',4' dihydroxyphenyl) methyl-3-(3",4" dimethoxy phenyl) methyl-*γ*-butyro-lactone (Phenaxo-lactone 1)	*Phenax angustifolius* Wedd.	Leaves	[33]
96	2-Hydroxy-2-(4'-*O*-*β*-D-gluco-pyranosyl-3'-hydroxyphenyl)methyl-3-(3",4"-dimethoxy phenyl) methyl-*γ*-butyro-lactone(Phenaxolactone 2)	*Phenax angustifolius* Wedd.	Leaves	[33]
97	Isolariciresinol-4-*O*-*β*-D-glucopyranoside	*Pilea cavaleriei* Levl.	Whole plant	[35]
98	Lariciresinol-4-*O*-*β*-D-glucopyranoside	*Pilea cavaleriei* Levl.	Whole plant	[35]
99	(-)-4-Methoxy-8'-acetyl olivil	*Urtica triangularis* Hand-Mass.	Roots	[36]
100	(-)-4-Methoxy-8'-acetylolivil 4-*O*-*α*-arabinopyronsyl-(1→6)-*β*-gluco- pyranoside	*Urtica triangularis* Hand-Mass.	Roots	[36]
101	(+)-Neo-olivil	*Urtica dioica* L.	Roots	[37]
102	(-)-Olivil-9-*O*-*β*-glucopyranoside	*Urtica triangularis* Hand-Mass.	Roots	[36]
103	Phenaxolactone 4	*Phenax rugosus* Wedd.	Leaves	[38]
104	Phenaxolactone 5	*Phenax rugosus* Wedd.	Leaves	[38]
105	Pinoresinol	*Urtica dioica* L. *Urtica dioica* L.	Herbs Roots	[26] [37]
106	Pouzolignan B	*Pouzolzia zeylanica* L.	Aerial parts	[39]
107	Pouzolignan F	*Pouzolzia zeylanica* L.	Aerial parts	[39]
108	Pouzolignan G	*Pouzolzia zeylanica* L.	Aerial parts	[39]
109	Pouzolignan H	*Pouzolzia zeylanica* L.	Aerial parts	[39]
110	Pouzolignan I	*Pouzolzia zeylanica* L.	Aerial parts	[39]
111	Pouzolignan J	*Pouzolzia zeylanica* L.	Aerial parts	[39]
112	(-)-Secoiso-lariciresinol	*Urtica dioica* L.	Roots	[37]
113	(-)(7*S*,8*R*,8'*R*) Lariciresinol-9-*O*-*α*-L rhamnopyranosyl (1→2)- *β*-D-glucopyranoside	*Pilea cavaleriei* Levl.	Whole plant	[35]
	V-Sesquiterpenes			
114	(1*E*,4*R*,5*R*,8*R*)-8-*O*-[(*E*)-*p*-Coumar-oyl]-4,5-epoxy-humula-1(10)-en-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
115	(1*E*,4*R*,5*R*,8*R*)-8-*O*-[(*Z*)-*p*-Coumar-oyl]-4,5-epoxy-humula-1(10)-en-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
116	(1*E*,5*E*,8*R*)-8-*O*-[(*E*)-*p*-Coumaroyl] humula-1(10),4(5)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
117	(1*E*,5*E*,8*R*)-8-*O*-[(*Z*)-*p*-Coumaroyl] humula-1(10),4(5)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
118	(1*E*,5*E*,8*R*)-Humula-1(10),4(5)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
119	(1*E*,5*R*,8*R*)-5-Hydroxyhumula-1(10),4-(15)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
120	(1*E*,5*R*,8*R*)-8-*O*-[(*E*)-*p*-Coumaroyl]-5-hydroperoxy humula-1(10),4-(15)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
121	(1*E*,5*R*,8*R*)-8-*O*-[(*E*)-*p*-Coumaroyl]-5-hydroxyhumula-1(10),4-(15)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
122	(1*E*,5*R*,8*R*)-8-*O*-[(*Z*)-*p*-Coumaroyl]-5-hydroperoxy humula-1(10),4-(15)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
123	(1*E*,5*R*,8*R*)-8-*O*-[(*Z*)-*p*-Coumaroyl]-5-hydroxyhumula-1(10),4-(15)-dien-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
124	(1*R*,4*E*,8*R*,10*R*)-8-*O*-[(*E*)-*p*-Coumar-oyl]-1,10-epoxy-humula-4(5)-en-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
125	(1*R*,4*E*,8*R*,10*R*)-8-*O*-[(*Z*)-*p*-Coumar-oyl]-1,10-epoxy-humula-4(5)-en-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
126	(1*S*,4*E*,8*R*,10*S*)-8-*O*-[(*E*)-*p*-Coumar-oyl]-1,10-epoxy-humula-4(5)-en-8-ol	*Pilea cavaleriei* Levl.	Aerial parts	[40]
127	1-*O*-*p*-Coumaroyl-copaborneol	*Pilea cavaleriei* Levl.	Whole plant	[41]
128	8-*O*-(3-Nitro-*p*-coumaroyl)-1(10)*E*,4(15)-humuladien-5*β*,8*α*-diol	*Pilea cavaleriei* Levl.	Whole plant	[41]
129	8-*O*-(*p*-Coumaroyl)-5*β*-hydroperoxy-1(10)*E*,4(15)-humuladien-8*α*-ol	*Pilea cavaleriei* Levl.	Whole plant	[41]
130	8-*O*-(*p*-Coumaroyl)-1(10) *E*,4(5)*E*-humuladien-8-ol	*Pilea cavaleriei* Levl.	Whole plant	[41]
131	8-*p*-Coumaroyl-*α*-santalene	*Pilea cavaleriei* Levl.	Whole plant	[42]
132	8-*β*-*p*-Coumaroyl oplopanone	*Pilea cavaleriei* Levl.	Whole plant	[42]
	VI-Alkaloids			
133	Boehmeriasin A	*Boehmeria siamensis* L.	Whole plant	[43]
134	Boehmeriasin B	*Boehmeria siamensis* L.	Whole plant	[43]
135	Cryptopleurine	*Boehmeria cylindrica* L.	Whole plant	[44]
136	Cypholophine	*Cypholophus friesianus* H.J.P.	Leaves	[45]
137	3,4-Dimethoxy-**ω**-(2'-piperidyl) acetophenone	*Boehmeria cylindrica L.*	Whole plant	[44]
138	3-(4-Hydroxy phenyl)-4-(3-methoxy-4-hydroxyphenyl)-3,4-dehydro- quinolizidine	*Boehmeria siamensis* L.	Whole plant	[46]
139	(-)-(15*R*)-Hydroxy cryptopleurine	*Boehmeria pannosa* Nakai & Satake	Roots	[47]
140	Indole-3-carbox-aldehyde	*Urtica dioica* L.	Roots	[48]
141	Ruspolinone	*Boehmeria holosericea* Blume	Fruits	[49]
142	Secophenanthro-quinolizidine	*Boehmeria cylindrica* L.	Whole plant	[44]
	VII-Simple phenolic compounds			
143	Caffeic acid	*Urtica artichocaulis* Hand.-Mazz. *Urtica dioica* L.	Aerial parts Roots	[26] [50]
144	3,4-Dimethoxy-acetophenone	*Boehmeria holosericea* Blume	Fruits	[49]
145	2,6-Dimethoxy hydroquinone	*Urtica dioica* L.	Roots	[48]
146	Diocanol	*Urtica dioica* L.	Whole plant	[10]
147	Ferulic acid	*Urtica dioica* L.	Stems and Leaves	[50]
148	Gallic acid	*Urtica dioica* L.	Leaves	[50]
149	Gentisic acid	*Urtica dioica* L.	Leaves	[26]
150	Homovanillic acid	*Urtica dioica* L.	Stems	[50]
151	Homovanillyl alcohol	*Urtica dioica* L.	Whole plant	[51]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
152	1-(4-Hydroxy-3-methoxy phenyl)- propane-1,2-diol	*Urtica dioica* L.	Roots	[48]
153	1-Hydroxy-1-(4-hydroxy-3-methoxy phenyl) propan-2-one	*Urtica dioica* L.	Roots	[48]
154	1-Hydroxy-1-(4-hydroxyphenyl)propan-2-one	*Urtica dioica* L.	Roots	[48]
155	2-Hydroxy cinnamic acid	*Urtica dioica* L.	Stems	[50]
156	2-Hydroxy-imino-3-phenyl propionic acid	*Forsskaolea tenacissima* L.	Aerial parts	[18]
157	2-Hydroxy-1-(4-hydroxy-3-methoxy phenyl) propan-1-one	*Urtica dioica* L.	Roots	[48]
158	4-Hydroxy-cinnamic acid	*Urtica dioica* L.	Stems	[50]
159	4-Hydroxy-3-meth-oxybenzaldehyde	*Urtica dioica* L.	Roots	[48]
160	4-Hydroxy-3-methylaceto-phenone	*Urtica dioica* L.	Roots	[48]
161	4-Hydroxybenzyl alcohol	*Urtica dioica* L.	Roots	[48]
162	4-Hydroxyphen-ethyl alcohol	*Urtica dioica* L.	Roots	[48]
163	(*E*)-4-(3-Hydroxy-prop-1-en-1-yl)-2-methoxy phenol	*Urtica dioica* L.	Roots	[48]
164	3-Methoxy-acetophenone	*Cecropia obtusifolia* Bertol.	Leaves	[7]
165	2-Methoxy-4-vinyl phenol	*Cecropia obtusifolia* Bertol.	Leaves	[7]
166	2-Methyl-benzaldehyde	*Cecropia obtusifolia* Bertol.	Leaves	[7]
167	Protocatecheuic acid	*Urtica dioica* L.	Leaves	[26]
168	Protocatecheuic aldehyde	*Urtica artichocaulis* Hand.-Mazz.	Aerial parts	[26]
169	Salicylic acid	*Urtica artichocaulis* Hand.-Mazz.	Aerial parts	[26]
170	Salicylic alcohol	*Urtica dioica* L.	Roots	[48]
171	Syringic acid	*Urtica dioica* L.	Leaves	[50]
172	Vanillic acid	*Cecropia obtusifolia* Bertol. *Urtica dioica* L.	Leaves Stems	[7] [50]
	VIII-Miscellaneous compounds			
173	Adenine	*Boehmeria holosericea* Blume	Fruits	[49]
174	Adenosine	*Boehmeria holosericea* Blume	Fruits	[49]
175	Aesculetin	*Urtica dioica* L.	Leaves	[26]
176	Aloe-emodin	*Cecropia obtusifolia* Bertol.	Leaves	[7]
177	Benzyl-*β*-D-glucopyranoside	*Boehmeria holosericea* Blume	Fruits	[49]
178	(+)-Blumenol A	*Urtica cannabina* L.	Fruits	[28]
179	(+)-Dehydrovomi-foliol	*Urtica cannabina* L.	Fruits	[28]
180	Chlorogenic acid	*Urtica artichocaulis* Hand.-Mazz. *Pipturus albidus* Hook. & Arn.	Aerial parts Leaves	[26] [52]
181	Chrysophanol	*Cecropia obtusifolia* Bertol.	Leaves	[7]
182	2,3-Dihydro-benzofuran	*Cecropia obtusifolia* Bertol.	Leaves	[7]
183	Emodin-8-*O*-*β*-glucoside	*Boehmeria nivea* L.	Leaves	[32]
184	Kiwiionoside	*Boehmeria nivea* L.	Leaves	[32]
185	Laportomide A	*Laportea ovalifolia* Schum.	Leaves	[53]

Table 1: Isolated compounds from family "Urticaceae" (cont.)

No.	Name	Plant source	Organ	Ref.
186	Laportoside A	*Laportea ovalifolia* Schum.	Leaves	[53]
187	Forsskamide	*Forsskaolea tenacissima* L.	Aerial parts	[2]
188	Pellioniareside	*Pellionia repens* Lour.	Whole plant	[54]
189	3-*O*-Caffeoyl quinic acid	*Pilea microphylla* L.	Whole plant	[30]
190	1-Methylene-1*H*-indene	*Pilea trinervia* L.	Leaves	[55]
191	Oreolactone	*Oreocnide frutescens* Thunb.	Rhizomes	[56]
192	Physcion	*Cecropia obtusifolia* Bertol.	Leaves	[7]
193	Pyrimidinedione	*Boehmeria nivea* L.	Leaves	[25]
194	Polydatin	*Boehmeria nivea* L.	Leaves	[32]
195	Quinic acid	*Urtica dioica* L.	Leaves	[26]
196	Rhein	*Cecropia obtusifolia* Bertol.	Leaves	[7]
197	Scopoletin	*Urtica dioica* L. *Urtica dioica* L.	Leaves Roots	[26] [51]
198	Uracil	*Pellionia repens* Lour.	Whole plant	[54]
199	Uridine	*Boehmeria holosericea* Blume	Fruits	[49]
200	(-)-Loliolide	*Boehmeria nivea* L.	Leaves	[25]

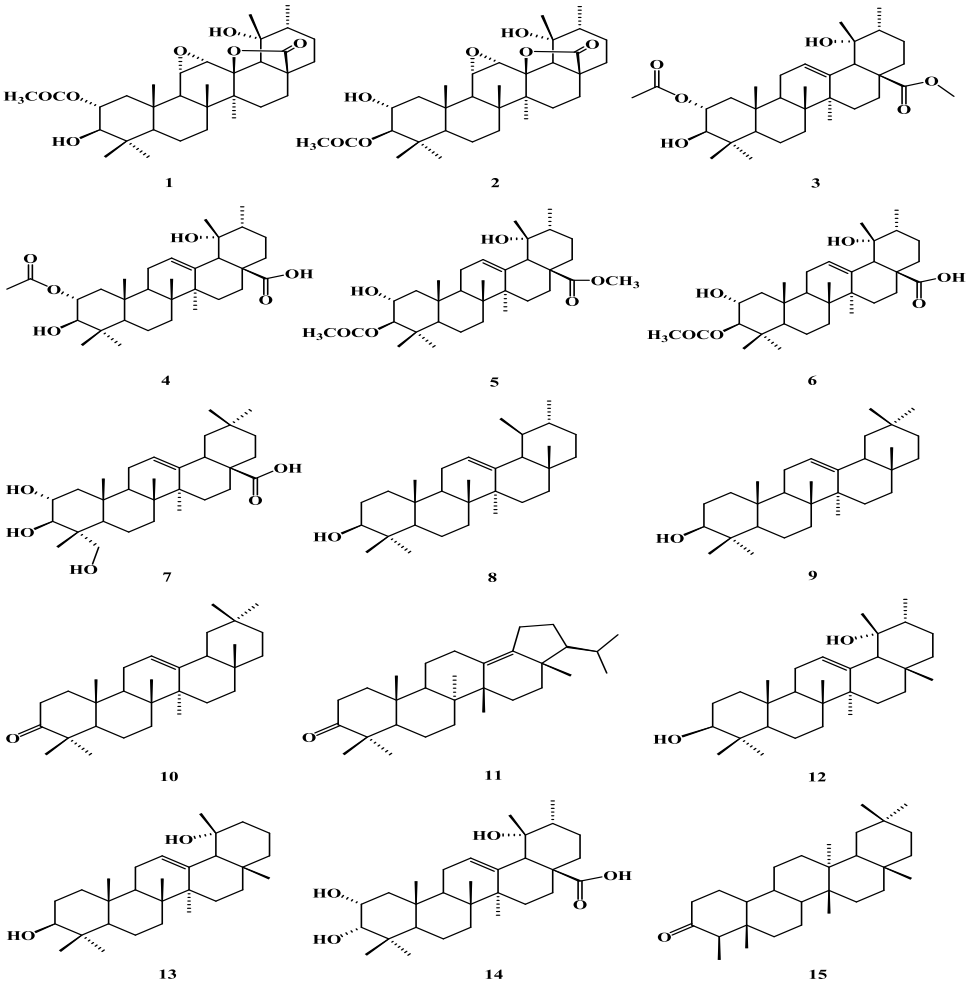

Figure 1: Isolated compounds from family "Urticaceae".

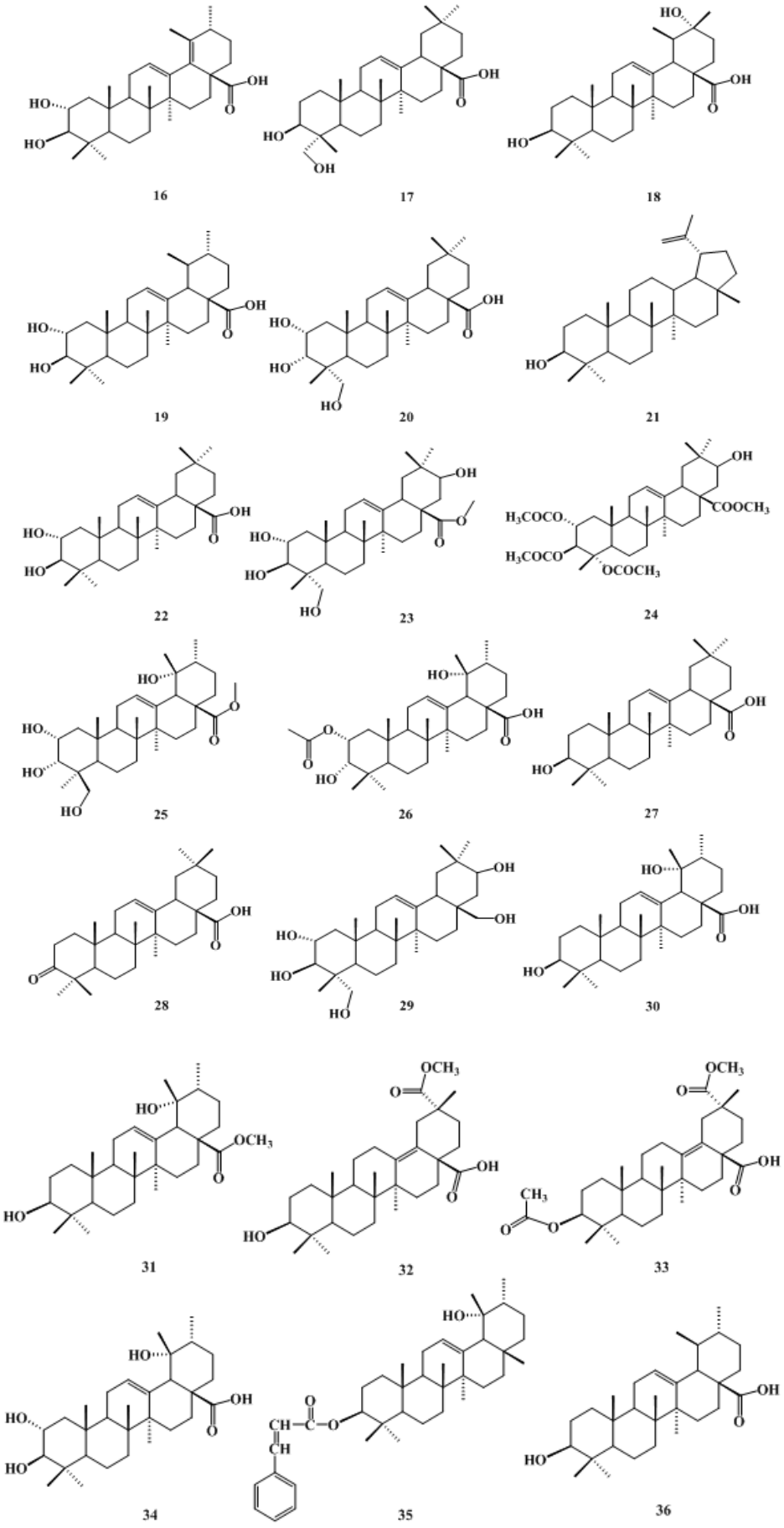

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

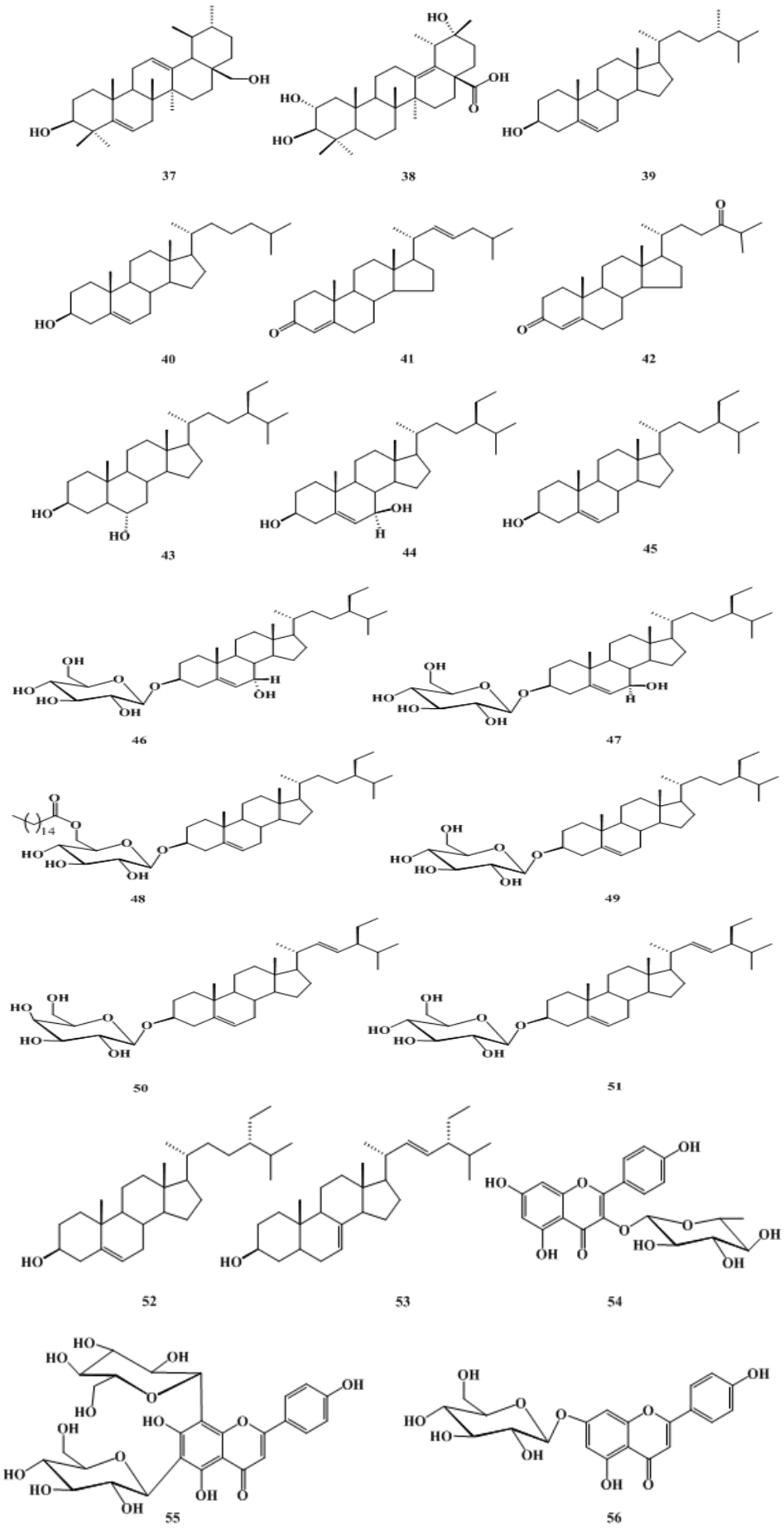

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

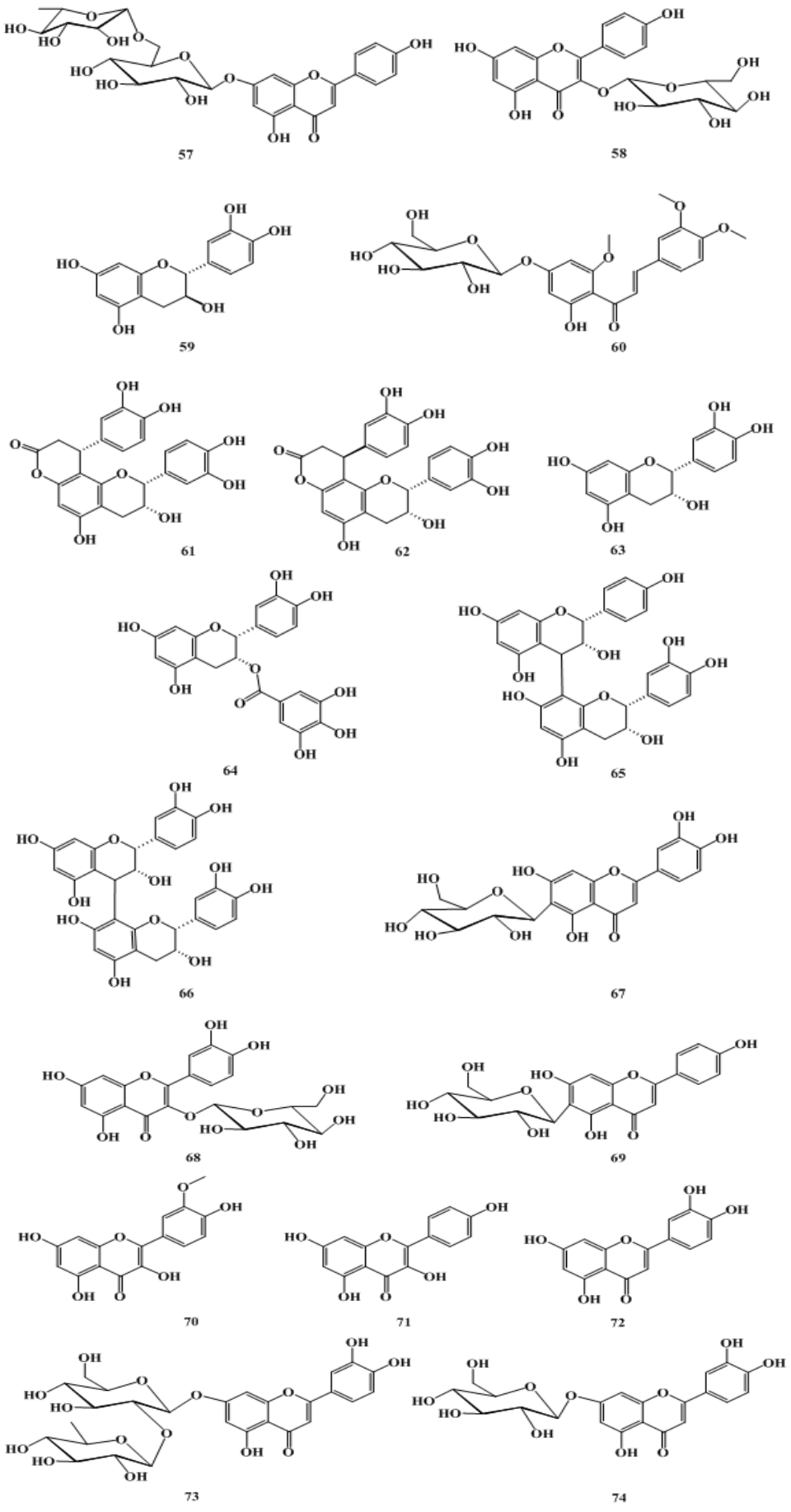

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

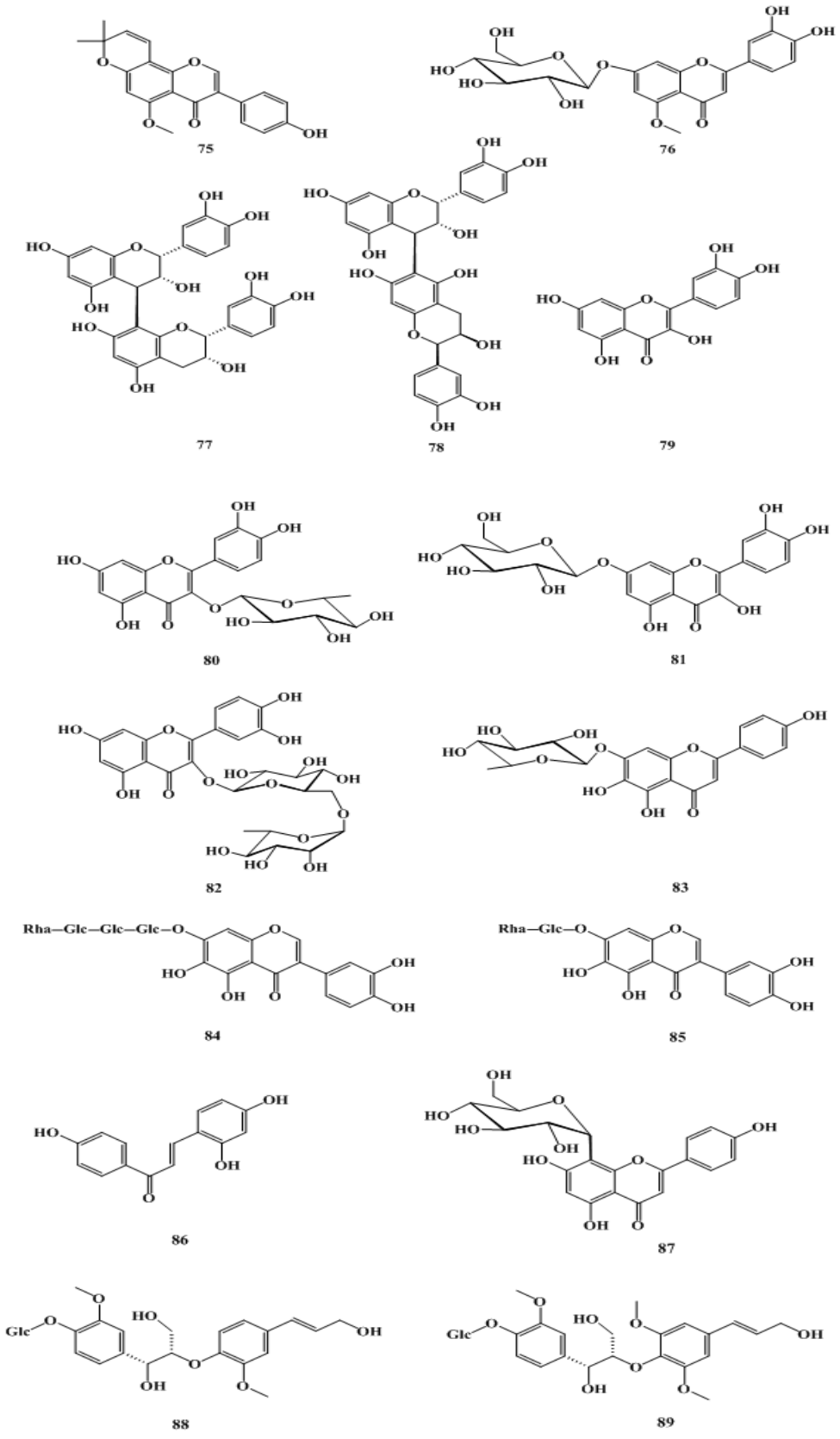

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

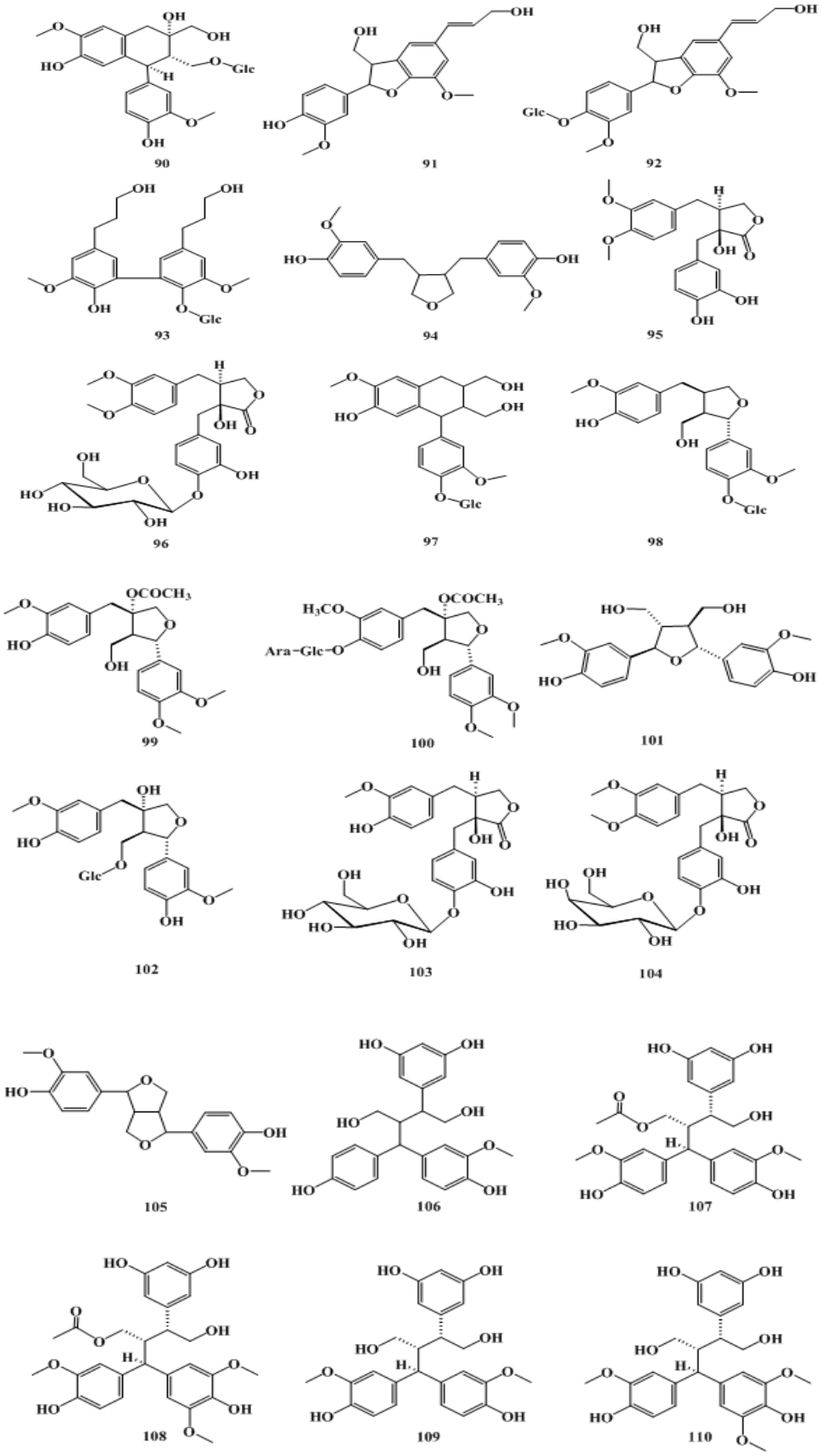

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

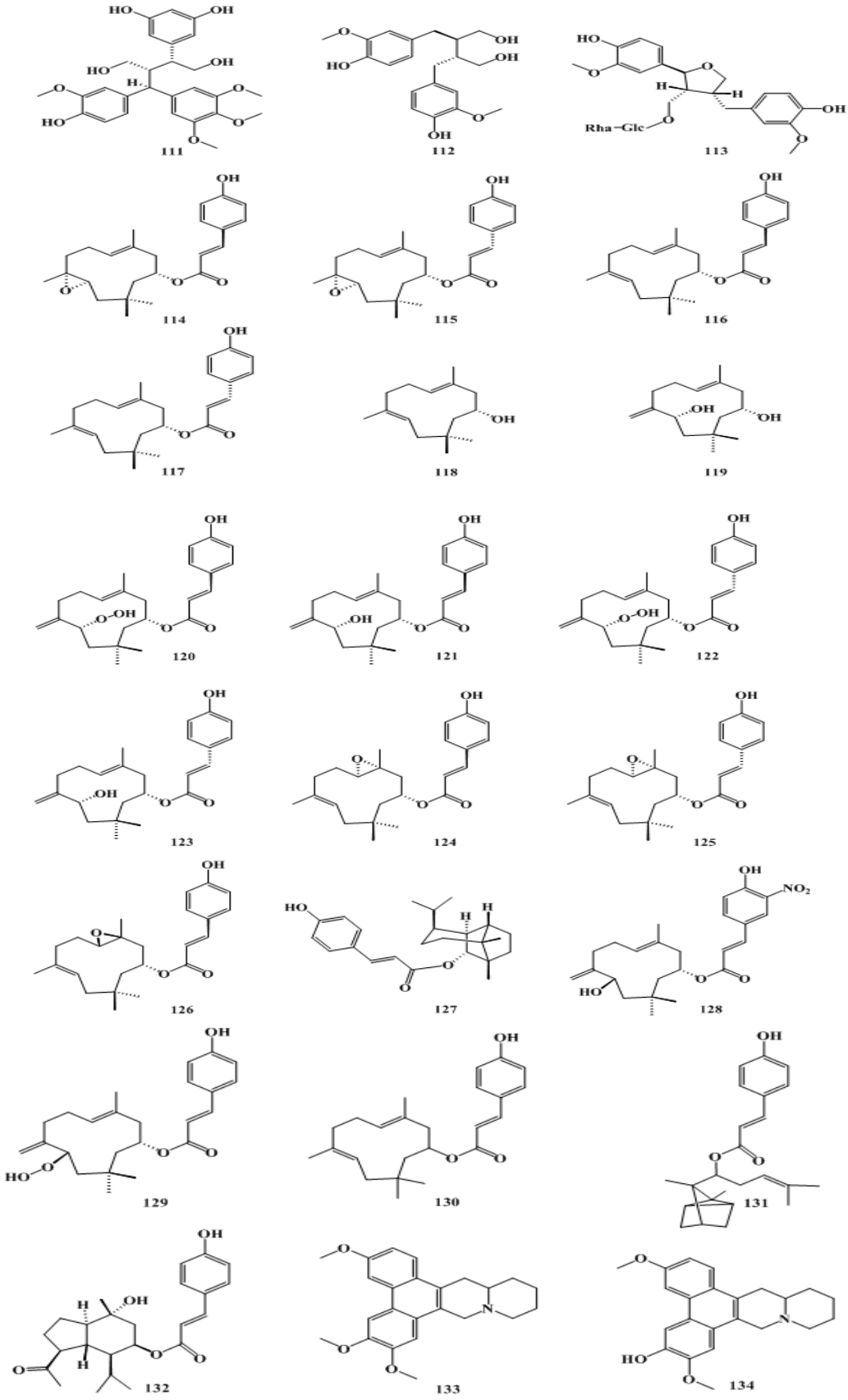

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

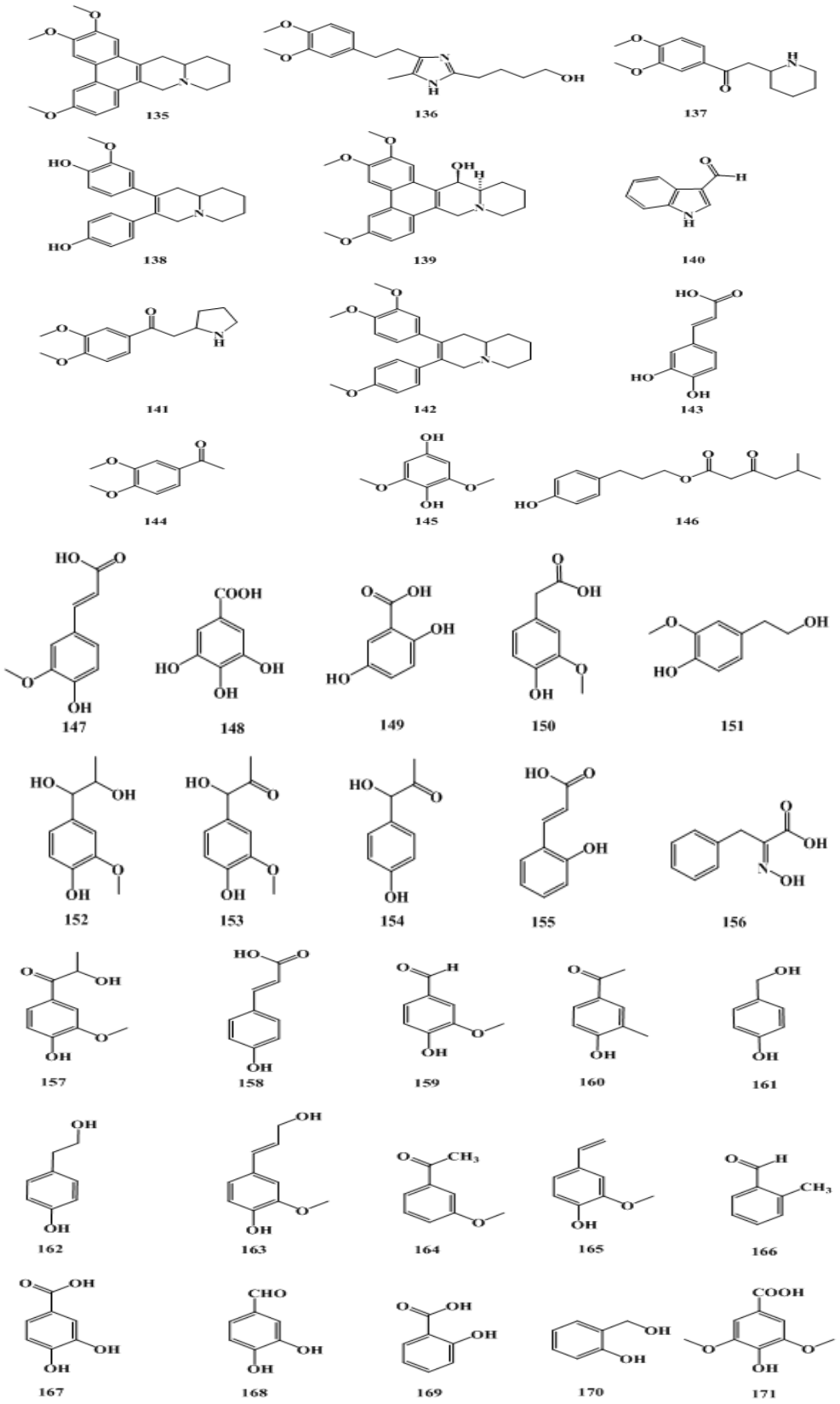

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

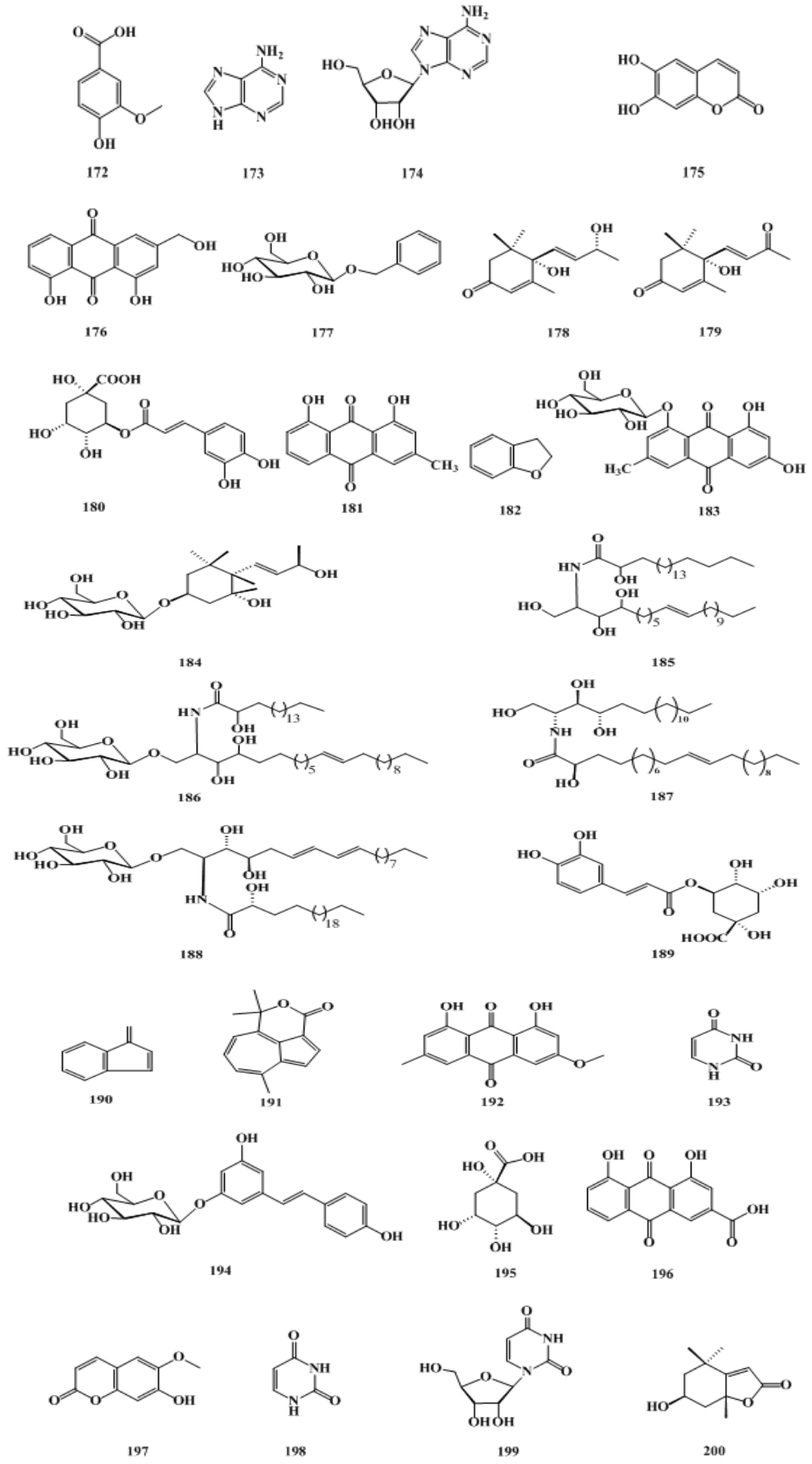

Figure 1: Isolated compounds from family "Urticaceae" (cont.).

4- Genus Pilea showed 31 isolated compounds, classified as (one triterpene, 2 flavonoids, 7 lignans, 19 sesquiterpenes and 2 miscellaneous compounds).

5- Genus Forsskaolea showed 8 isolated compounds, classified as (4 triterpenes, 2 sterols, one simple phenolic and one miscellaneous compound).

6- Genus Debregeasia showed 8 isolated triterpene compounds.

7- Genus Pouzolzia showed 7 isolated compounds, classified as (one flavonoid and 6 lignans).

8- Other genera showed minor isolated compounds.

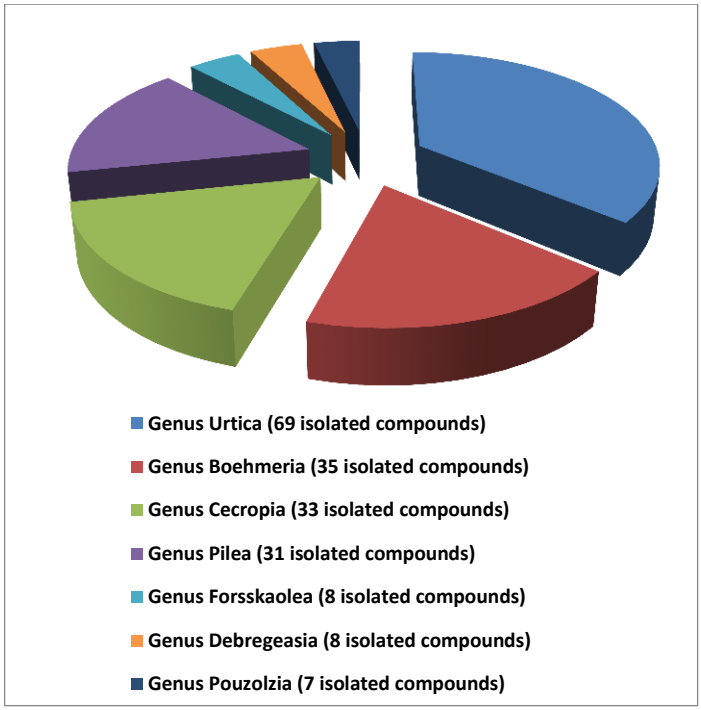

Figure 2: Distribution of isolated compounds in various genera of Family "Urticaceae".

2.2. Biological activities

On reviewing the current available literature, many researchers studied various biological activities of many plants of the family Urticaceae. These biological activities included *viz*., cytotoxic, antimicrobial (antibacterial, antifungal and antiviral) anti-inflammatory, antidiabetic, anti-benign prostatic hyperplasia, hepatoprotective, antioxidant as well as wound healing.

Results of biological review (Table 2 and Figure 3) showed the following:

1- Genus Urtica is the major genus in family Urticaceae and showed 28 published biological activities, classified as (5 cytotoxicity, one antimicrobial, 5 anti-inflammatory, 5 antidiabetic, 4 anti-benign prostatic hyperplasia, 3 hepatoprotective and 5 antioxidant).

2- Genus Forsskaolea showed 13 published biological activities, classified as (3 cytotoxicity, 4 antimicrobial, one antidiabetic, one hepatoprotective, 3 antioxidant and one wound healing).

3- Genus Boehmeria showed 8 published biological activities, classified as (4 cytotoxicity, 2 antimicrobial, one anti-inflammatory and one antidiabetic).

4- Genus Cecropia showed 8 published biological activities, classified as (one cytotoxicity, one antimicrobial, 4 anti-inflammatory, one antidiabetic and one antioxidant).

5- Genus Urera showed 6 published biological activities, classified as (one cytotoxicity, 2 antimicrobial and 3 anti-inflammatory).

6- Genus Laportea showed 6 published biological activities, classified as (one cytotoxicity, 3 antimicrobial, one antidiabetic and one antioxidant).

Table 2: Biological activities of family "Urticaceae".

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
			I-Cytotoxic activity		
1	*Forsskaolea tenacissima* L.	Aerial parts	Forsskamide	It displayed a moderate cytotoxic activity against human colorectal carcinoma cell line (HCT-116) with IC_{50} 33.25 µM in comparison with 5-fluorouracil IC_{50} 26.42 µM using (MTT) method.	[2]
2	*Forsskaolea tenacissima* L.	Whole plant	Hexane, dichloromethane, ethyl acetate and methanol extracts	They showed very weak activity towards lymphoblastic leukemia CCRF-CEM tumor cells at a fixed concentration of 10 mg/mL as determined by the resazurin reduction assay.	[57]
3	*Urtica diocia* L.	Leaves	Aqueous extract	It showed inhibition activity for Adenosine deaminase (ADA) enzyme in cancerous gastric tissues significantly but does not affect the enzyme in colon tissue using cancerous and noncancerous human gastric and colon tissues removed by surgical operations.	[58]
4	*Forsskaolea tenacissima* L.	Aerial parts	2-Hydroxy imino 3-phenyl propionic acid	It showed weak activity against normal cell line (Vero) and cancer cell lines (MCF-7, Caco-2 and HepG-2) by MTT Assay.	[18]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
5	*Urtica diocia* L.	Leaves	Aqueous extract	It showed cytotoxic activity in LNCaP treated prostrate carcinoma cell line by MTT Assay.	[26]
6	*Urtica pilulifera* L.	Leaves	Methanol extract	It showed a maximum cytotoxic activity (IC_{50}=63 µg/mL), it inhibited the proliferation of (MCF-7) and it increase protein concentration and reduces the lipids in lipidemic liver and remodels phospholipids compositions using the MTT assay.	[26]
7	*Urtica diocia* L.	Roots	Aqueous extract	It showed cytotoxic activity by affecting on proliferation reduction of myelogenous leukemia cell line by activating the apoptotic pathway against acute myelogenous leukemia cell line using the MTT assay.	[26]
8	*Urtica pilulifera* L.	Aerial parts	Methanol extract	It showed highest cytotoxicity against breast cancer, about 85% of the cells were found dead at the concentration of 500 µg/mL using the MTT assay.	[26]
9	*Cecropia lyratiloba* Miq.	Roots	Euscaphic, 2*α*-tormentic and 3*β*-acetyltormentic acid	It showed cytotoxic activity against leukemia cell line K562 and multidrug resistant leukemia cell line Lucena-1, euscaphic (76.71a/83.79b µM), 2*α*-tormentic (89.36a / 80.25b µM), 3*β*-acetyltormentic acids (56.61a/72.87b µM) using the MTT assay.	[12]
10	*Boehmeria siamensis* L.	Whole plant	Boehmeriasin A and B	Boehmeriasin A possesses cytotoxic activity against 12 cell lines from six panels of cancer including lung cancer, colon cancer, breast cancer, prostate cancer, kidney cancer and leukemia between 0.2 and 100 µg/mL, whereas boehmeriasin B showed lower activity.	[43]
11	*Boehmeria siamensis* L.	Whole plant	Boehmeriasin A	It inhibited the proliferation of breast cancer cell MDA-MB-231 *via* the G1 phase cell cycle arrest and differentiation induction, it considered as candidate chemotherapeutic agent for breast cancer.	[59]
12	*Laportea crenulata* Gaud.	Roots	Total extract and 2*α*,3*β*,21*β*,23, 28-penta-hydroxyl-12-oleanene	They showed cytotoxic activities observed by brine shrimp bioassay and IC_{50} of the compound was found to be 27.54 µg/mL.	[60]
13	*Pilea cavaleriei* Levl.	Whole plant	8-*O*-(*p*-Coumaroyl)-1(10)*E*, 4(5)*E*-humuladien-8-ol	It exhibited weak cytotoxic activity against proliferation of seven human tumor cell lines, K562 (IC_{50}=12.01 µg/mL), AGZY (IC_{50}=27.82 µg/mL) and A549 (IC_{50}=25.60 µg/mL) cell lines using the MTT assay.	[41]
14	*Boehmeria pannosa* Nakai & Satake	Roots	Methanol extract, (-)-cryptopleurine and (-)-(15*R*)-hydroxy-cryptopleurine	They inhibited the hypoxia-induced expression of a reporter gene under the control of a hypoxiaresponse element (HRE) with IC_{50} values of 8.7 and 48.1 nM, respectively, which could be an important target of cancer chemotherapy using a HIF-1-mediated reporter gene assay	[47]
15	*Urera baccifera* L.	Roots and Leaves	Total hydro-ethanol extract and its fractions (chloroform, ethyl acetate and *n*-butanol)	They showed weak cytotoxic activity against Herpes virus type 1, using the MTT assay.	[61]
16	*Pilea mongolica* Wedd.	Aerial parts	Epi-oleanolic acid and oxo-oleanolic acid	They exhibited cytotoxicity against cultured human tumor cell lines, non-small cell lung adenocarcinoma, ovarian, skin melanoma, CNS and colon.	[19]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
17	*Pouzolzia indica* L.	Aerial parts	Methanol extract	It inhibited the acute promyelocytic leukemia cell lines NB4 and HT93A with the IC_{50} values of 28.5 and 49.8 µg/mL, respectively using the MTT assay.	[62]
18	*Boehmeria cylindrica* L.	Whole plant	Ethanol extract and cryptopleurine alkaloid	They showed cytotoxic action against Eagle's 9KB carcinoma of the nasopharynx in cell culture.	[63]
19	*Pipturus arborescens* C.B. Rob	Leaves	1-Hexacosene and a terpene	They exhibited moderate toxicity towards the brine shrimp bioassay.	[64]
20	*Pouzolzia indica* L.	Whole plant	5-Methoxy-4'-hydroxy-2",2" dimethyl pyrano (3",3",7,8) isoflavone	It showed moderate cytotoxic activity, LC_{50} of the compound was found to be 24.92 µg/mL against brine shrimp bioassay.	[34]
			II-Antimicrobial activity		
			IIA-Antibacterial and antifungal activities		
21	*Dendrocnide sinuata* (Blume) Chew.	Leaves	Aqueous extract	It showed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Microccocus luteus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter aerogenes* and *Candida albicans* using agar diffusion method.	[65]
22	*Laportea ovalifolia* (Schum.) Chew	Leaves	Methanol extract	It showed antimicrobial activity against *Pseudomonas aeruginosa*, *Escherichia coli*, *Staphylococcus aureus*, *Bacillus subtilis*, *Enterococcus faecalis*, *Streptococcus pyogenes*, *Salmonella typhiand*, *Klebsiella pneumonia* with erythromycin and ciprofloxacin using micro-dilution technique.	[66]
23	*Dendrocnide microstigma* (Wedd.) Chew.	leaves	Ethanol extract	It showed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans*، *Aspergillus niger* and *Microsporum gypseum* by using agar diffusion assay and micro broth dilution.	[67]
24	*Elatostema repens* (Lour.) Hallier f.	Aerial parts	Ethanol extract	It showed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans*، *Aspergillus niger* and *Microsporum gypseum* by using agar diffusion assay and micro broth dilution.	[67]
25	*Villebrunea scabra* (Blume) Wedd.	Leaves and bark	Ethanol extract	It showed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans*، *Aspergillus niger* and *Microsporum gypseum* by using agar diffusion assay and micro broth dilution.	[67]
26	*Forsskaolea tenacissima* L.	Leaves	Ethanol, aqueous and *n*-hexane extracts	They showed antimicrobial activity against *Escherichia coli*, *Xanthomonas maltophilia*, *Bacillus subtilis*, *Clavibacter michiganense*, *Staphylococcus aureus*, *Aspergillus niger*, *Trichoderma reesei*, *Rhizopus stolinifer* and *Acromonium alternatum* using well diffusion method.	[68]
27	*Forsskaolea tenacissima* L.	Whole pant	Methanol extract	It showed antimicrobial activity against *Escherichia coli*, *Salmonella typhi*, *Pseudomonas aeruginosa*, *Providencia sp.*, *Proteus mirabilis*, *Shigella sonnei*, *Citrobacter sp.*, *Aspergillus fumigatus*, *Penicillium chrysogenum* and *Rhizopus sp.* using disc diffusion method.	[69]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
28	*Forsskaolea tenacissima* L.	Aerial parts	Total methanol extract, *n*-hexane, dichloromethane, ethyl acetate and methanol fractions	Ethyl acetate fraction showed significant antimicrobial activity against both Gram-negative bacteria as *Escherichia coli* and *Pseudomonas aeruginosa* and Gram-positive bacteria as *Staphylococcus aureus* and *Bacillus subtilis* while, both the total extract and different fractions did not show antifungal activity against *Aspergillus niger* and *Candida albicans* using agar cup diffusion method.	[18]
29	*Pouzolzia indica* L.	Whole plant	5-Methoxy-4'-hydroxy-2",2" dimethyl-pyrano (3",3",7,8) isoflavone	It showed the minimum inhibitory concentration (MIC) to be 32 µg/mL against *Escherichia coli* using serial dilution technique.	[34]
30	*Debregeasia salicifolia* (D.Don)	Whole plant	3*β*-(*E*)-cinnamoyl-oxy-19-*α* hydroxy-urs-12-ene, 3*β*, 19*α*-dihydroxy-urs-12-ene and pomolic acid methyl ester	It exhibited significant activities against Gram-positive (*Bacillus subtilis*, *Staphylococcus aureus*, *Streptococcus pyogenes*) and Gram-negative (*Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella boydi*) bacteria using agar well diffusion method.	[14]
31	*Laportea crenulata* Gaud.	Roots	2*α*,3*β*,21*β*,24*β*,28-penta-hydroxy-olean-12-ene	It showed significant activity against (*Bacillus subtilis*, *Streptococcus β-haemolyticus*, *Escherichia coli* and *Shigella dysenteriae*) bacteria and (*Aspergillus flavus*, *Aspergillus niger*, *Candida albicans* and *Rhizopus aurizae*) fungi using disc diffusion method.	[60]
32	*Laportea crenulata* Gaud.	Roots	Total extracts and 2*α*,3*β*,21*β*,23, 28-penta hydroxyl 12-oleanene	They exhibited moderate antifungal activity against *Aspergillus flavus*, *Aspergillus niger*, *Candida albicans* and *Rhizopus aurizae* using disc diffusion method.	[70]
33	*Boehmeria rugulosa* Wedd.	Leaves	Ethanol extract and chalcone-6'-hydroxy-2',3,4-trimethoxy-4'-O-*β*-D-glucopyranoside, isoflavone-3',4',5,6-tetra-hydroxy-7-O-[*β*-D-glucopyranosyl-(1→3)-*α*-L-rhamno-pyranoside] and iso-flavone-3',4',5,6-tetrahydroxy-7-O-[*β*-D-glucopyranosyl-(1→6)-*β*-D-glucopyranosyl-(1→6)-*β*-D-glucopyranosyl-(1→3)-*α*-L-rhamnopyranoside]	They showed potent antimicrobial activity against two bacterial species (*Staphylococcus aureus* and *Streptococcus mutans*) and three fungus pathogens (*Microsporum gypseum*, *Microsporum* canis and *Trichophyton rubrum*) using disc diffusion method.	[31]
34	*Pouzolzia zeylanica* L.	Whole plant	Ethanol extract	It showed antibacterial activity against both Gram-positive and Gram-negative organisms such as *Bacillus subtilis*, *Bacillus megaterium*, *Staphylococcus aureus*, *pseudomonas aeruginosa*, *Escherichia coli*, *Shigella dysentariae*, *Salmonella typhi*, using agar cup plate method.	[71]
35	*Urera baccifera* L.	Roots and Leaves	Total hydro-ethanol extract and its fractions (chloroform, ethyl acetate and *n*-butanol)	They showed antimicrobial activity against *Aspergillus flavus*, *Candida parapsilosis*, *Candida tropicalis*, *Candida glabrata*, *Candida dubliniensis*, *Candida albican*, *Saccharomyces cerevisiae*, *Cryptococcus neoformans*, *Cryptococcus gattii*, *Malassezia pachi*, *Prototheca zopfii*, *Micrococcus* sp., *Proteus mirabilis*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Aeromonas* sp., *Enterococcus faecalis*, *Staphylococcus aureus*, *Staphylococcus agalactiae* and *Escherichia coli* using broth microdilution method.	[61]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
36	*Elatostema parasiticum* Blume.	Aerial parts	Total ethanol extract	It exhibited antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans*, *Aspergillus niger* and *Microsporum gypseum* using disc diffusion method.	[67]
37	*Girardinia diversifolia* Link.	Roots and Stems	Total methanol extract	It showed antimicrobial activity against *Bacillus pumilus*, *Staphylococcus aureus*, *Escherichia coli*, *Aspergillus niger*, *Candida albicans* and *Saccharomyces cerevisiae* using disc diffusion method.	[72]
38	*Urtica dioica* L.	Leaves	Methanol extract and phenolic fraction of plant extract	They showed antimicrobial activity against *Escherichia coli*, *Salmonella enteridis*, *Staphylococcus aureus*, *Listeria monocytogenes*, *Pseudomonas putida* and *Bacillus cereus* using disk diffusion technique.	[73]
			IIB-Antiviral activity		
39	*Forsskaolea tenacissima* L.	Aerial parts	Total methanol extract, *n*-hexane, dichloromethane, ethyl acetate and methanol fractions	Total methanol extract and methanol fraction showed high antiviral activity against Herpes Simplex Virus Type-1 (HSV-1) by MTT cell viability test.	[18]
40	*Cecropia glaziovii* Sneth.	Leaves	Aqueous extract and the C-glycosyl flavonoid enriched fraction	They showed antiviral activity against human herpes virus types 1 and 2 (HHV-1 and HHV-2) by plaque reduction assay.	[12]
41	*Phenax angustifolius* Wedd. and *Phenax rugosus* Wedd.	Leaves	Phenaxolactones (1-5) and flavones (vitexin and isovitexin)	They showed antiviral activity against HIV-1 virus using virus infectivity assay method.	[38]
42	*Boehmeria cylindrica* L.	Whole plant	Cryptopleurine	It showed antiviral activity against herpesvirus hominis.	[44]
43	*Urera baccifera* L.	Roots and Leaves	Total hydro-ethanol extract and its fractions (chloroform, ethyl acetate and *n*-butanol)	They showed antiviral activity against Herpes virus type 1 by MTT cell viability test.	[61]
44	*Urtica dioica* L.	Whole plant	Ethanol extract	It showed antiviral activity against replication of *Autographa californica* nuclear polyhedrosis virus (AcNPV) grown in *Spodoptera frugiperda* cell culture.	[74]
			III-Anti-inflammatory activity		
45	*Musanga cecropioides* R. Br.	Leaves	Ethanol extract	It showed anti-inflammatory activity using carrageenan, histamine, serotonin and xylene-induced edema tests in rats.	[75]
46	*Dendrocnide sinuata* (Blume) Chew.	Roots	Aqueous extract	It exhibited anti-inflammatory activity with carrageenan-induced paw edema in rats.	[76]
47	*Urtica dioica* L.	Seeds	Ethanol extract	It showed anti-inflammatory activity with inflammation induced by the toxic effects of fluoride.	[77]
48	*Urtica dioica* L.	Whole plant	Methanol extract	It exhibited anti-inflammatory activity with carrageenan-induced paw edema in rats.	[26]
49	*Cecropia obtusifolia* Bertol.	Leaves	Vanillic acid, palmitic acid, stearic acid, rehin, physcion, emodin, chrysophanol, aloe-emodin, stigmast-4-en-3-one, stigmasterol and *β*-sitosterol	These compounds exhibited anti-inflammatory activity by inhibition of vascular adhesion molecule 1 and intracellular adhesion molecule 1 expression in tumor necrosis factor-*α* (TNF-*α*)-stimulated human aortic endothelial cells (HAECs) by adhesion assay with the tetrazolium dye MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide].	[7]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
50	*Cecropia pachystachya* Trecul.	Leaves	Vitexin, rutin *α*-amyrin, oleanolic acid, pomolic acid, ursolic acid and *E*-phytol	These compounds showed anti-inflammatory activity on lipopolysaccharide (LPS)-induced inflammatory responses with mouse peritoneal macrophages.	[7]
51	*Cecropia obtusifolia* Bertol.	Leaves	Aqueous extract	It exhibited anti-inflammatory activity with carrageenan-induced paw edema in rats.	[12]
52	*Phenax rugosus* Wedd.	Whole plant	Aqueous extract	It exhibited anti-inflammatory activity with TPA-induced mouse ear edema and carrageenan-induced paw edema in rats.	[78]
53	*Urera baccifera* L.	Roots and Leaves	Total hydro-ethanol extract and its fractions (chloroform, ethyl acetate and *n*-butanol)	They exhibited no anti-inflammatory activity with topical application of root and leaf of the plant induced ear edema in rats.	[61]
54	*Cecropia telenitida* Cuatrec.	Roots	Yarumic acid, serjanic acid, spergulagenic acid A, 20-hydroxy-ursolic acid and goreishic acid I	They inhibited the secretion of the proinflammatory cytokines mediators using dendritic cell (DC) based assay method.	[16]
55	*Boehmeria caudata* Sw.	Whole plant	Crude ethanol extract	It exhibited anti-inflammatory activity with croton oil-induced mouse ear edema model in rats.	[79]
56	*Urtica pilulifera* L.	Seeds	Petroleum ether extract	It exhibited anti-inflammatory activity with carrageenan-induced paw edema in rats.	[80]
57	*Urera baccifera* L.	Leaves	Aqueous fraction	They showed anti-inflammatory activity with carrageenan-induced paw edema in rats.	[81]
58	*Urtica leptuphylla* Kunth. and *Urera baccifera* L.	Whole plant	Aqueous extract	It exhibited anti-inflammatory activity with carrageenan-induced paw edema model in rats.	[81]
59	*Morus indica* L.	Leaves	Ethanol extract	It showed anti-inflammatory activity with carrageenan-induced paw edema in rats.	[82]
60	*Urtica dioica* L.	Leaves	Methanol extract	It exhibited anti-inflammatory activity with acetic acid-induced writhing formalin test and carrageenan-induced paw edema in rats.	[83]
61	*Sarcochlamys pulcherrima* G.	Leaves	Methanol extract	It showed anti-inflammatory activity by inhibiting heat-induced protein denaturation using in *vitro* anti-inflammatory test method.	[84]
			IV-Antidiabetic activity		
62	*Girardinia heterophylla* Decne.	Leaves	Petroleum ether, chloroform, ethanol, aqueous and extracts	Chloroform, ethanol, aqueous and extracts showed significant improvement in antidiabetic activity with alloxan induced diabetes in rats.	[85]
63	*Urtica dioica* L.	Leaves	Aqueous extract	It exhibited antidiabetic activity with alloxan-induced diabetes in rats.	[86]
64	*Urtica dioica* L.	Leaves	Hydro-methanol extract	It exhibited antidiabetic activity with streptozotocin-induced diabetes in rats.	[26]
65	*Urtica pilulifera* L.	Leaves	Methanol extract	It showed antidiabetic activity with alloxan-induced diabetes in rats.	[26]
66	*Urtica dioica* L.	Whole plant	Aqueous extract	It exhibited antidiabetic activity with streptozotocin-induced diabetes in rats.	[87]
67	*Cecropia obtusifolia* Bertol.	Leaves	Phenolic acids, chlorogenic acid and isoorientin	These compounds showed antidiabetic effects by stimulating glucose uptake in both insulin-sensitive and insulin-resistant adipocytes without appreciable pro-adipogenic effects, which assayed on the adipogenesis and glucose uptake in murine adipocytes.	[7]
68	*Laportea ovalifolia* Schum.	Aerial parts	Methanol and methylene chloride extracts	They exhibited antidiabetic activity with alloxan-induced diabetes in rats.	[88]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
69	*Boehmeria rugulosa* Wedd.	Leaves	Ethanol extract	It exhibited antidiabetic activity with alloxan-induced diabetes in mice.	[31]
70	*Urtica pilulifera* L.	Seeds	Total extract	It exhibited antidiabetic activity with streptozotocin induced diabetes in rats.	[89]
71	*Forsskaolea tenacissima* L.	Aerial parts	Total methanol extract and its different fractions	The ethyl acetate fraction showed a significant decrease in blood glucose level in comparison with glibenclamide as positive control with alloxan-induced diabetes in rats.	[90]
			V-Anti-benign prostatic hyperplasia activity		
72	*Urtica dioica* L.	Roots	*n*-Hexane, ether, ethyl acetate and *n*-butanol extracts	They inhibit the membrane Na^+, K^+ ATPase activity of the prostate which can finally suppress prostate-cell metabolism and growth.	[87]
			Aqueous extract, methanol extract, agglutinin and stigmasta-4-en-3-one	They examined for their ability to modulate binding of sex hormone-binding globulin to its receptor on human prostatic membranes, which can preventing the benign prostatic hyperplasia.	
73	*Urtica fissa* Pritz.	Stems and Roots	Aqueous extract	It inhibited benign prostatic hyperplasia in animal models using castrated rat prostate hyperplasia induced by testosterone propionate.	[91]
74	*Urtica fissa* Pritz.	Whole plant	Ethanol extract	It exhibited decrease in the density of lecithin corpuscle and increase the acid phosphatase level, the benign prostatic hyperplasia rats induced by testosterone propionate	[92]
75	*Urtica dioica* L.	Roots	Ethanol extract	It showed inhibition in benign prostatic hyperplasia using testosterone-induced prostatic hyperplasia in rats.	[93]
			VI-Hepatoprotective activity		
76	*Dendrocnide sinuata* (Blume) Chew.	Root-bark	Aqueous extract	It showed significant hepatic protection indicated by the serum enzymes levels, which was comparable to that of silymarin treated group which is also supported by histological findings using carbon tetrachloride (CCl_4) induced rats.	[94]
77	*Forsskaolea tenacissima* L.	Aerial parts	Total methanol extract and its fractions (*n*-hexane and methanol)	The total methanol extract exhibited hepatoprotective activity nearly the same as silymarin against (CCl_4) induced hepatic injury in albino rats followed by methanol fraction and finally *n*-hexane fraction.	[95]
78	*Urtica dioica* L.	Leaves	Methanol extract	It showed hepatoprotective activity with (CCl_4) induced rats method.	[26]
79	*Urtica dioica* L.	Seeds	Methanol extract	It exhibited hepatoprotective effect by increasing the activity of paraoxonase, arylesterase and liver tissue catalase activity using ischemia reperfusion induced hepatotoxicity method.	[26]
80	*Urtica dioica* L.	Whole plant	Hydro-methanol extract	It exhibited hepatoprotective activity with (CCl_4) induced rats method.	[26]
			VII-Antioxidant activity		
81	*Dendrocnide sinuata* (Blume) Chew.	Leaves	Aqueous extract	It exhibited antioxidant activity using scavenging activity of DPPH (1,1-diphenyl-2 picrylhydrozyl) radical method.	[65]
82	*Forsskaolea tenacissima* L.	Whole plant	Hexane, dichloromethane, ethyl acetate and methanol extracts	They showed antioxidant activity Dichloromethane, ethyl acetate and methanol extract with (DPPH) and N,N-dimethyl-*p*-phenylendiamine (DMPD), metal-chelation capacity, ferric-reducing (FRAP) and phospho-molibdenum-reducing antioxidant power (PRAP) methods using ELISA microtiter assays.	[57]

Table 2: Biological activities of family "Urticaceae"(cont.).

No.	Plant source	Organ	Extract/Fraction/ Compound	Activity/Result	Ref.
83	*Forsskaolea tenacissima* L.	Aerial parts	Total methanol extract and its fraction (*n*-hexane, dichloromethane, ethyl acetate and methanol)	The total methanol extract and methanol fraction have the highest antioxidant activity followed by ethyl acetate, dichloromethane and *n*-hexane fractions, respectively, using (DPPH) method.	[95]
84	*Cecropia palmata* Willd.	Leaves	Hydro-methanol extract	It showed antioxidant activity with oxygen radical antioxidant capacity (ORAC) and trolox equivalent antioxidant capacity (TEAC) assay.	[12]
85	*Urtica dioica* L.	Leaves	Methanol extract and phenolic fraction of plant extract	They showed antioxidant capacity with the Rancimat test using sunflower oil as substrate.	[73]
86	*Urtica dioica* L.	Whole plant	Methanol extract	It showed antioxidant activity using (DPPH) method.	[96]
87	*Pilea microphylla* L., *Elatostema umbellatum* Bl. and *Urtica dioica* L.	Leaves	Total methanol extracts and its fractions (chloroform, diethyl ether, ethyl acetate and *n*-butanol)	The highest DPPH radical scavenging percentages were showed by the *n*-butanol and ethyl acetate fractions.	[3]
88	*Forsskaolea tenacissima* L.	Whole plant	Aqueous and methanol extracts	They showed high percentage of antioxidant activity using (TEAC) assay.	[97]
89	*Urtica dioica* L.	Aerial Parts	Chloroform, methanol and aqueous extracts	They showed antioxidant activity using (DPPH) method soybean oil models.	[98]
90	*Fluerya aestuans* L.	Leaves	Methanol extract	It exhibited antioxidant activity using (DPPH) method.	[99]
91	*Myriocarpa stipitata* Benth.	Whole plant	*n*-Hexane, dichloromethane and aqueous methanol fractions	They showed antioxidant activity using (DPPH) method.	[100]
92	*Debregeasia salicifolia* Rendle.	Roots and Leaves	Methanol extract	It exhibited antioxidant activity using (DPPH) method.	[101]
93	*Laportea Aestuans* L.	Leaves	Ethanol extract	It exhibited high scavenging antioxidant activity using (DPPH) method.	[102]
94	*Phenax rugosus* Wedd.	Whole plant	Methanol and aqueous extract	They showed antioxidant activity using deoxyribose assay.	[78]
95	*Pouzolzia zeylanica* L.	Whole plant	Ethyl acetate extract	It exhibited significant antioxidant activity using DPPH, hydroxyl radical scavenging assays and a reducing power assay.	[103]
96	*Pipturus albidus* Hook. & Arn.	Leaves	Methanol extract	It exhibited antioxidant capacity using the photochemiluminescence method.	[52]
97	*Pilea microphylla* L.	Whole plant	Methanol extract	It showed antioxidant activity using DPPH free radical scavenging method.	[104]
98	*Urtica dioica* L.	Leaves	Ethanol extract	It exhibited antioxidant activity using (DPPH) method.	[105]
			VIII-Wound healing activity		
99	*Forsskaolea tenacissima* L.	Aerial Parts	Total methanol extract	It showed marked increase in wound healing activity in comparison with gentamycin as positive control group with excision wound model.	[90]

7- Genus Pouzolzia showed 5 published biological activities, classified as (2 cytotoxicity, 2 antimicrobial and one antioxidant).

8- Genus Dendrocnide showed 5 published biological activities, classified as (2 antimicrobial, one anti-inflammatory, one hepatoprotective and one antioxidant).

9- Genus Pilea showed 4 published biological activities, classified as (2 cytotoxicity and 2 antioxidant).

10- Other genera showed very few biological activities.

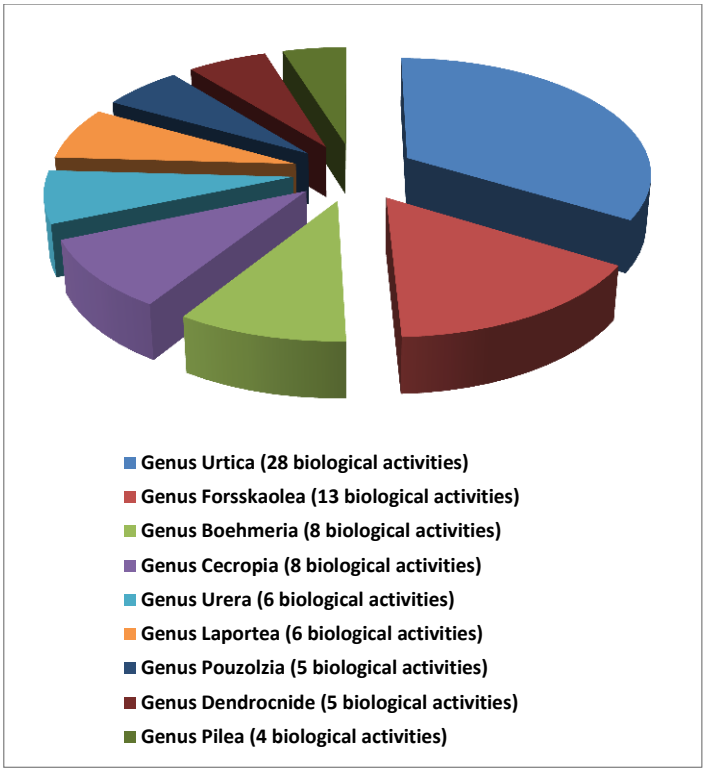

Figure 3: Biological activities in various genera of Family "Urticaceae".

3. Conclusion

This review provides valuable information about the various phytoconstituents and biological activities of family "Urticaceae" for the first time. It is reported that "Urticaceae" plants contain different classes of chemical constituents including triterpenes, sterols, flavonoids, lignans, sesquiterpenes, alkaloids, simple phenolic and miscellaneous compounds together with a several medicinal benefits such as cytotoxic, antimicrobial (antibacterial, antifungal and antiviral), anti-inflammatory, antidiabetic, anti-benign prostatic hyperplasia, hepatoprotective, antioxidant as well as wound healing. According to the present review, many genera of family "Urticaceae" are considered as good points of interest and further studies to explain the mechanisms of action of their biological actions that assists to develop and explore new drugs from natural source.

Declarations of interest

The authors declare that they have no conflict of interest.

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