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A Bibliography of

ORGANIC ACIDS IN HIGHER PLANTS

Agricultural Handbook No. 164

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

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A BIBLIOGRAPHY OF ORGANIC ACIDS IN HIGHER PLANTS[1]

By M. L. Buch, *chemist, Eastern Utilization Research and Development Division, Agricultural Research Service*

Scientific interest in the organic acids of higher plants has prompted a search of the literature and tabulation of these acids and their occurrence.

Nonvolatile, non-nitrogen-containing, carboxylic acids whose structure is generally accepted (*44*, *267*, *483*)[2] are included. Fatty acids, long-chain polymers—such as pectins—and compounds which contain a sugar group as part of the molecule are excluded. Thus, carboxylic sapogenins are included but saponins are not. The acids reported are those that are found in the free state or as salts, not as esters.

Plants are listed by family and by genus and species. The family names are those given by Willis (*789*), and, when possible, the names of the genus and species follow this system. Where the name disagrees with that in established usage by the Department of Agriculture the latter name is given in parentheses following the original name. Where the name is apparently misspelled, doubtful, or not known by the Department a query(?) has been inserted following the original name. Only spermatophyta are included.

Titles of articles and books published in other languages have been translated into English. In those cases in which the report could not be verified by consulting the original paper or an abstract, a secondary reference is substituted.

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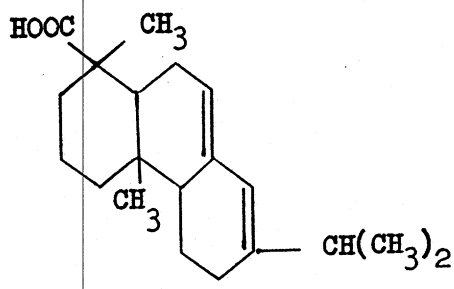
[1] This review covers all publications through 1954 and a limited number published in 1955 and 1956.
[2] Italic numbers in parentheses refer to Literature Cited, p. 51.

OCCURRENCE OF ORGANIC ACIDS IN HIGHER PLANTS

Family	Genus and species	Source	Reference
	Abietic Acid		
			
Pinaceae	----------	Colophony	(*37, 113, 162, 169*)
	Pinus abies (*Picea abies*)	Resin	(*48, 419*)
	P. larix (*Larix decidua*)	----------	(*419*)
	P. palustris	Resin	(*35, 258, 339*)
	Aconitic Acid		
	$\begin{array}{l} COOH \\ \vert \\ C{=}CH\ COOH \\ \vert \\ CH_2COOH \end{array}$		
Chenopodiaceae	*Beta vulgaris*	Juice	(*392, 395*)
		Unripe beet	(*705*)
Compositae	*Achillea millefolium*	----------	(*285*)
	Helianthus annuus	----------	(*58*)
Gramineae	*Avena sativa*	----------	(*474*)
	Hordeum vulgare	Etiolated shoot.	(*168*)
		Seedling	(*314, 474*)
	Saccharum officinarum	Juice	(*36; 50; 411; 603; 604; 605; 694; 699; 703; 704, ref. 162; 784; 811; 817*)
	Secale cereale	----------	(*474*)
		Seedling	(*668*)

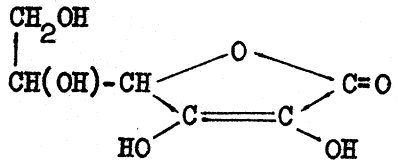
Family	Genus and species	Source	Reference
	Aconitic Acid—Continued		
Gramineae	*Sorghum vulgare*	----------	(414, 744)
		Scale from evaporation pans.	(507)
		Juice	(745, 786, 787)
	Triticum sp	----------	(473)
		Sprout	(667)
	T. sativum (*T. aestivum*)	Seedling	(668)
	Zea mays	Sprouting seed	(668)
Leguminosae	*Phaseolus coccineus*	----------	(58)
Ranunculaceae	*Aconitum* spp		(54;58;108;160, p.567,ref.3;497)
	A. columbianum		(49)
	A. heterophyllum	----------	(322)
		Root	(769)
	A. napellus		(50)
	A. septentrionale	Tuber and root	(315)
	A. vernalis (*Adonis vernalis*).	----------	(497)
		Leaf	(388)
	Delphinium barbeyi		(49)
	D. bicolor		(49)
	D. consolida	Leaf sap	(781)
	D. cucullatum		(49)
	D. geyeri		(49)
	D. glaucescens		(49)
	D. nelsonii		(49)
Solanaceae	*Solanum lycopersicum* (*Lycopersicon esculentum*).	Fruit	(109)
		Root, leaf, and ripe fruit.	(116)
Umbelliferae	*Angelica archangelica*	Root	(690)

Adipic Acid

$$HOOC—CH_2CH_2CH_2CH_2COOH$$

Chenopodiaceae	*Beta vulgaris*		(396, 742)

Ascorbic Acid

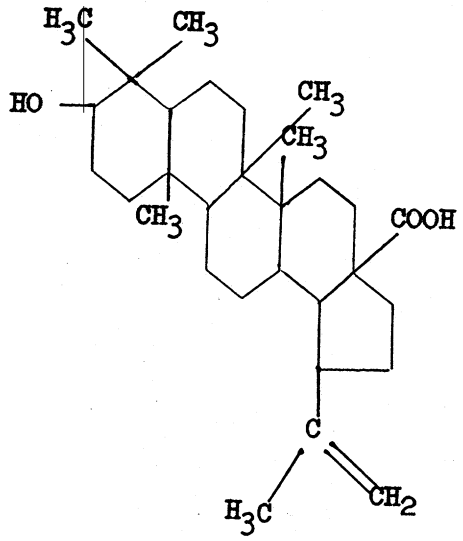


Since its structure was elucidated by Svirbely and Szent-Györgyi in 1932 (*691, 692*), ascorbic acid has been reported in almost every plant in which its presence has been investigated.

Family	Genus and species	Source	Reference
	Bassic Acid		
Sapotaceae	*Achras sapota*	Seed	(*276*)
	Bassia butyracea (*Madhuca butyracea*).	do	(*276, 277*)
	B. latifolia (*M. latifolia*)	do	(*276, 277*)
	B. longifolia (*M. longifolia*).	do	(*276*)
	B. parkii	do	(*276, 277*)
	Dumoria heckelii	do	(*276*)
	Mimusops djave (*Baillonella toxisperma*).	do	(*276*)
	M. elengi	do	(*276*)
	M. hexandra	do	(*276*)
	Payena lucida	do	(*276*)
	Benzoic Acid		
Compositae	*Dahlia* sp		(*511*)
Droseraceae	*Drosera rotundifolia*		(*796*)
Empetraceae	*Empetrum nigrum*	Leaf	(*306*)
Ericaceae	*Vaccinium macrocarpum*	Berry	(*239, 434, 467*)
	V. oxycoccos	do	(*239, 415, 477, 599*)
	V. vitis-idaea	do	(*51, 239, 328, 382, 403, 477*)
Gramineae	*Bambusa arundinacea*	Young shoot	(*218*)

Family	Genus and species	Source	Reference
	Benzoic Acid—Continued		
Leguminosae	*Daviesia latifolia*	Leaf and stem	(*555*)
	Myroxylon pereirae	Balsam	(*361*)
	M. toluiferum	do	(*110, 146*)
Lentibulariaceae	*Pinguicula vulgaris*	Leaf	(*405*)
Lilaceae	*Dracera draco*	Resin	(*715a*)
	Gloriosa superba	Tuber	(*123*)
Magnoliaceae	*Illicium anisatum*	Fruit and seed	(*498*)
Myrtaceae	*Psidium* spp		(*515*)
Papaveraceae	*Papaver somniferum*		(*635*)
Pinaceae	*Agathis australis*		(*457*)
Rosaceae	*Prunus serotina*	Bark	(*550*)
		Leaf	(*551*)
Rubiaceae	*Coffea* sp		(*410, 516*)
Rutaceae	*Casimiroa edulis*	Seed	(*549*)
Scrophulariaceae	*Digitalis purpurea*		(*331*)
Styracaceae	*Styrax* sp		(*372; 718, p. 507, ftn. 4.*)
	S. benzoin	Resin	(*715a*)

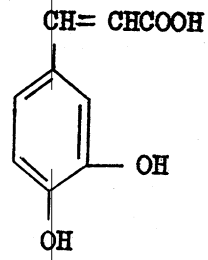
Betulinic Acid



Apocynaceae	*Alyxia buxifolia*	Bark	(*21*)
Cornaceae	*Cornus florida*		(*606*)
Gentianaceae	*Menyanthes trifoliata*	Rhizome	(*671*)
Loranthaceae	*Nuytsia floribunda*	Leaves, stems, and bark.	(*21*)
Myrtaceae	*Melaleuca* (6 spp.)	Bark	(*21*)
	Syncarpia laurifolia	do	(*579*)
Platanaceae	*Platanus acerifolia*	do	(*100*)
Punicaceae	*Punica granatum*	Leaves and bark	(*98*)
Rhamnaceae	*Ziziphus vulgaris*	Seeds and bark	(*333*)

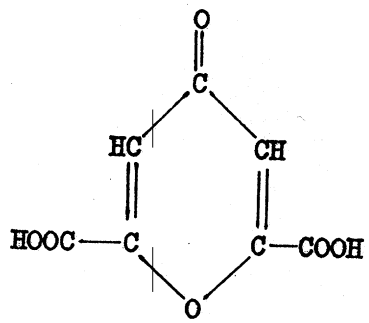
Family	Genus and species	Source	Reference

Caffeic Acid



Aquifoliaceae	*Ilex aquifolium*	Leaf	(*678*)
	I. paraguarensis	do	(*678*)
Compositae	*Anthemis nobilis*	Flower	(*547*)
	Taraxacum officinale	Root	(*546*)
Labiatae	*Melissa* sp	Leaf	(*272*)
Pinaceae	*Larix europaea* (*L. decidua.*	Resin	(*37*)
Ranunculaceae	*Aconitum septentrionale*		(*315*)
	Clematis vitalba	Flowering branch.	(*730*)
Rosaceae	*Crataegus oxyacantha*	Leaf, fruit, and flower.	(*187*)
Rubiaceae	*Cinchona cuprea*	Bark	(*349*)
	Coffea spp	Bean	(*187*)
		Leaf	(*678*)
Scrophulariaceae	*Digitalis purpurea*		(*88, 331*)
	Scrophularia nodosa	Root	(*317*)
Solanaceae	*Solanum tuberosum*		(*323*)
Umbelliferae	*Angelica archangelica*		(*690*)
	Conium maculatum		(*288*)

Chelidonic Acid



Amarylidaceae			(*684*)
	Agave sp	Leaf	(*581*)
	A. falcata	Anther and perianth.	(*582*)
	Amaryllis crispa (*Hessea crispa*).	Leaf, perianth, and anther.	(*582*)

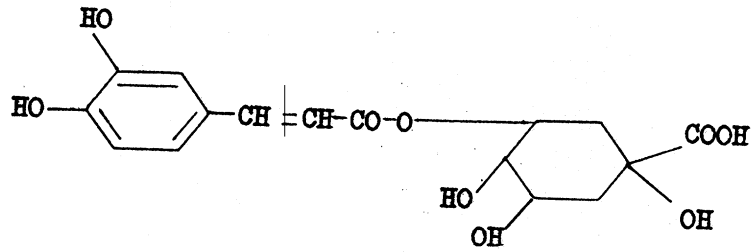
Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Amarylidaceae	*Androstemma junceum* (*Conostylis androstemma*).	Leaf, perianth, and anther.	(*582*)
	Anigozanthos humilis	Leaf	(*582*)
	A. preissii	Anther	(*582*)
	Anoiganthus breviflorus	Pericarp	(*582*)
	Blancoa canescens	Leaf and perianth.	(*582*)
	Brunsvigia angustifolia	Leaf and flower	(*582*)
	B. josephinea (*B. gigantea*).	Pericarp, leaf, perianth, and anther.	(*582*)
	B. uitenhagensis	Flower	(*582*)
	Buphane ciliaris	Leaf, perianth, and anther.	(*582*)
	Carpolyza spiralis	Leaf, perianth, and bulb.	(*575*)
	Conostylis (12 spp.)		(*582*)
	Crinum capense (*C. longifolium*).	Leaf, perianth, and pedicel.	(*582*)
	C. kirkii	do	(*582*)
	C. purpurascens	Leaf, perianth, and anther.	(*582*)
	Cummingia tenella (*Conanthera campanulata*).	Perianth	(*582*)
	Galanthus nivalis	Leaf, pedicel, anther, and perianth.	(*582*)
	G. plicatus	Leaf, perianth, pedicel, and bulb.	(*582*)
	Hessea maximiliani	Flower	(*582*)
	Hippeastrum mandoni	Leaf, perianth, anther, and pedicel.	(*582*)
	Hypoxis juncea	Flower	(*582*)
	H. minuta	Flower and leaf	(*582*)
	H. probata	Perianth	(*582*)
	H. serrata	Perianth, leaf, and anther.	(*582*)
	H. villosa	Leaf, and perianth.	(*582*)
	Ixiolirion montanum	Perianth, leaf, and flower.	(*582*)
	Lanaria plumosa	Leaf and perianth.	(*582*)
	Leucojum (5 spp.)		(*582*)
	Lophiola americana	Leaf and flower	(*582*)
	Lycoris aurea	Perianth, anther, pedicel, and pericarp.	(*582*)
	Narcissus (14 spp.)		(*582*)
	Panoratium canariense	Leaf and anther	(*582*)
	Sternbergia colchiciflora	Leaf, perianth, anther, and seed.	(*582*)
	S. lutea	Leaf, perianth, and anther.	(*582*)
	Tribonanthes uniflora	Perianth	(*582*)
	Zephyranthes rosea	Perianth, leaf, and anther.	(*582*)
Berberidaceae	*Berberis vulgaris*		(*370*)

Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Campanulaceae	*Centropogon* (6 spp.)		(582)
	Downingia pulchella		(582)
	Isotoma (5 spp.)		(582)
	Laurentia (4 spp.)		(582)
	Lobelia (25 spp.)		(582)
	L. cardinalis		(370)
	L. inflata		(370)
		Fruit	(581)
	L. syphilitica		(370)
	Siphocampylus (9 spp.)		(582)
Cannaceae	*Canna* spp	Root	(581)
Dioscoreaceae	*Discorea balcanica*	Leaf, flower, and pericarp.	(582)
	D. deltoidea	Leaf and flower.	(582)
	D. humifusa	Seed and pericarp.	(582)
Haemodoraceae	*Dilatris corymbosa*	Flower and leaf.	(582)
	Lachenalia tinctoria	do	(582)
	Wachendorfia paniculata	Flower, leaf, and pericarp.	(582)
	W. thyrsiflora	Anther	(582)
Hippocastanaceae	*Aesculus flava*	Perianth and leaf.	(582)
	A. hippocastanum		(581)
Liliaceae	*Acanthocarpus preissii*	Pericarp and leaf.	(582)
	Allium cirrhosum	Leaf	(582)
	A. flavescens	do	(582)
	A. obliquum	do	(582)
	A. tenuissimum	Leaf and flower.	(582)
	Aloe minima	Leaf	(582)
	Androcymbium (3 spp.)		(582)
	Anguillaria dioica	do	(582)
	A. tenella	do	(582)
	Anticlea sibiricus (*Zigadenus sibiricus*).	Leaf, bulb, and filament.	(582)
	Asparagus (11 spp.)		(582)
	A. officinalis		(580)
	Asphodelus clavatus		(582)
	A. damascena		(582)
	Bellevalia dubia (*Hyacinthus dubuis*).	Flower	(582)
	Boemetra columellaris(?)	Filament, leaf, and perianth.	(582)
	Borya septentrionalis	Leaf	(582)
	Brodiaea (3 spp.)		(582)
	Bulbine alooides	Flower	(582)
	Bulbocodium ruthenicum	Leaf	(582)
	B. versicolor	do	(582)
	Chlorophytum bowkeri	Flower	(582)
	C. parviflorum	Pedicel	(582)
	Colchicum (12 spp.)		(582)
	C. autumnale		(370)
	Convallaria majalis		(370)
		Leaf, anther, and perianth.	(582)
	Cordyline banksii	Flower	(582)
	C. pumilio	Leaf	(582)
	Dasylirion graminifolium.	Flower	(582)

Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Liliaceae	*Dasypogon bromeliifoius*	Flower	(582)
	Dichopogon humilis	do	(582)
	Dracaena angustifolia	Leaf	(582)
	D. elliptica	Flower	(582)
	Eremurus himalaicus	Leaf	(582)
	Gloriosa superba		(582)
	Hookera hyacintha	Flower	(370, 399)
	H. minor	do	(582)
	Hyacinthus leucophaeus	do	(582)
	Iphigenia diuterik(?)	Leaf	(582)
	I. indica	do	(582)
	Johnsonia lupulina	do	(582)
	Kniphofia (4 spp.)		(582)
	Lachenalia montigena	Leaf	(582)
	L. picta	Leaf and flower.	(582)
	Liriope graminifolia	Leaf	(582)
	Melonthium tenue	Leaf, perianth, and seed.	(582)
	M. virginicum (*M. comosum*).	Leaf and flower.	(582)
	Merendera (5 spp.)		(582)
	Muscari botryoides	Flower	(582)
	M. calandrinianum	Flower and leaf	(582)
	Narthecium scardicum	Flower	(582)
	Ophiopogon bockianus	Leaf	(582)
	O. japonicus	do	(582)
	Ornithogalum arabicum	Anther	(582)
	O. fimbriatum	Leaf and perianth.	(582)
	O. narbonense	Flower	(582)
	O. oligophyllum	Pedicel	(582)
	Ornithoglossum glaucum	Leaf and flower	(582)
	Paradisea liliastrum	Leaf	(582)
	Paris bockiana	Leaf and perianth.	(582)
	Polygonatum (4 spp.)	do	(582)
	Reineckea carnea	Leaf and pedicel.	(582)
	Rhipogonum album	Pedicel	(582)
	R. scandens	Leaf and pedicel.	(582)
	Ruscus hypoglossum	Flower	(582)
	Sabadilla officinarum (*Schoenocaulon officinale*).		(684)
	Sandersonia aurantiaca	Leaf and perianth.	(582)
	Schoenocaulon officinale		(370)
	Scilla obtusifolia	Leaf and flower	(582)
	S. pratensis	Flower	(582)
	S. verna	Leaf	(582)
	Smilax (6 spp.)		(582)
	Sugerokia orientalis (*Heloniopsis orientalis*).	Leaf, flower, and anther.	(582)
	Tofieldia (4 spp.)		(582)
	Trichopetalum stellatum (*Bottionea thysantoides*).	Flower	(582)
	Trillium (9 spp.)		(582)
	Tupistra viridiflora	Leaf	(582)
	Urginea maritima		(370)
	Uvularia sessilifolia	Leaf and flower	(582)

Family	Genus and species	Source	Reference
	Chelidonic Acid—Continued		
Liliaceae	*Veratrum* (7 spp.)		(582)
	V. album		(370, 637, 684)
	V. viride		(370)
	Wurmbea (4 spp.)		(582)
	Xerotes elongata	Flower	(582)
	X. pauciflora	do	(582)
	X. sauveolens	do	(582)
	Yucca brevifolia	Perianth and pedicel.	(582)
	Zygadenus (5 spp.)		(582)
Papaveraceae	*Chelidonium majus*		(254, 300, 370, 383, 387, 636, 684, 820)
		Leaf	(560)
		Leaf, perianth, and pedicel.	(582)
	Stylophorum diphyllum	Leaf, perianth, and anther.	(582, 632)
Rhamnaceae	*Paliurus aculeatus*	Pedicel	(582)
	Rhamnella franguloides	Leaf	(582)
	Rhamnus (21 spp.)		(582)
	R. cathartica	Fruit	(581)
	Sageretia minutifolia	Leaf	(582)
	Zizyphus lotus	do	(582)
Rubiaceae	*Uragoga ipecacuanha* (*Cephaelis ipecacuanha*).		(370)
Thymelaeaceae	*Daphne* (9 spp.)		(582)
	D. gnidium	Fruit	(581)
	Gnidia (9 spp.)		(582)
	Passerina (5 spp.)		(582)
	Pimelea flava	Leaf	(582)
	Stellera chamaejasme	Leaf and flower	(582)
	Thymelaea (4 spp.)		(582)
	Wikstroemia (3 spp.)		(582)

Chlorogenic Acid



Acanthaceae	*Barleria cristata*		(228)
	Eranthemum macrophyllum.		(228)
	Graptobilanthes hortense (*Graptophyllum hortense*).		(228)
	Strobilanthes lupinus		(228)
	Thunbergia laurifolia		(228)

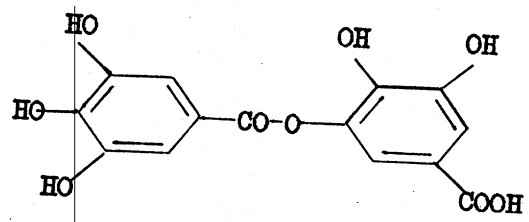
Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Apocynaceae	*Allamanda hendersonii*	----------	(228)
	Alstonia scholaris	----------	(228)
	Kopsia flavida	----------	(228, 231)
Aquifoliaceae	*Ilex aquifolium*	Leaf, stem, and root.	(118)
	I. salicifolia	----------	(228)
Araliaceae	*Aralia maculata*	----------	(228)
	Hedera helix	----------	(249)
	Heptapleurum sp	----------	(228)
	Paratropia sp	----------	(228)
	Trevesia sundaica	----------	(228)
Asclepiadaceae	*Hoya bandanensis*	----------	(228)
Bignoniaceae	*Crescentia cuneifloia* (*C. cujete*).	----------	(228)
	Kigelia pinnata	----------	(228)
	Spathodea campanulata	----------	(228)
Boraginaceae	*Cordia suaveolens*	----------	(228)
	Ehretia buxifolia	----------	(228)
Cannaceae	*Canna indica*	----------	(228)
Caprifoliaceae	*Lonicera* sp	----------	(228)
	Sambucus javanica	----------	(228)
	S. nigra	----------	(228)
Chenopodiaceae	*Suaeda dodoneifolia*(?)	Flower	(118)
Compositae	95 genera	----------	(228)
	Achillea millefolium	Flower	(540)
	Anacyclus pyrethrum	----do	(118)
	Arnica montana	----do	(118)
	Centaurea jacea	Leaf	(118)
	Cichorium intybus	----do	(118)
	Clibadium asperum	----------	(228)
	C. surinamense	----------	(228)
	Dahlia variabilis (*D. pinnata*).	----------	(539)
	Eupatorium javanicum	----------	(228)
	E. pallescens	----------	(228)
	Gymnanthemum grande	----------	(228)
	Helianthus sp	Seed	(230)
	H. annuus	----do	(224, 229, 364, 494)
	H. doronicoides	Leaf	(118)
	H. tuberosus	----------	(536, 538, 539)
	Lactuca sativa	----------	(538)
	Lappa major (*Arctium majus*).	Leaf	(118)
	Pluchea indica	----------	(228)
	P. odorata	----------	(228)
	Silybum marianum	----------	(536)
	Stifftia chrysantha	----------	(228)
	Tagetes erecta	----------	(228)
	Taraxacum gymnanthum	----------	(539)
	Tithonia diversifolia	----------	(228)
	Vernonia sp	----------	(228)
Convolvulaceae	*Argyreia kurzei*	----------	(228)
	Erycibe tomentosa	----------	(228)
	Ipomoea batatas	----------	(228, 538)
		Root	(610)
	Lepistemon flavescens	----------	(228)
	Merremia dissecta	----------	(228)
	Porana paniculata	----------	(228)

Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Cornaceae	*Mastixia cuspidata*		(228)
Cucurbitaceae	*Coccinia cordifolia*		(228)
	Trichosanthes sp		(228)
Dipsacaceae	*Dipsacus sylvestris*		(118)
Ericaceae	*Vaccinium lucidum*		(228)
Erythroxylaceae	*Erythroxylon coca*		(228)
	E. novogranatense		(228)
Eucommiaceae	*Eucommia* sp	Leaf	(247)
Gesneriaceae	*Aeschynanthus longiflora*		(228)
	Agalmyla staminea		(228)
	Cyrtandra bicolor		(228)
	Episcia pulchella		(228)
	Gloxinia caulescens		(228)
	Sinningia sp		(228)
Gnetaceae	*Gnetum ovalifolium*		(228)
Goodeniaceae	*Scaevola sericea*		(228)
Gramineae	Mixed herbage		(299)
	Bambusa sp		(228)
	Oryza sativa		(228)
	Paspalum vaginatum		(228)
	Phragmites sp		(228)
	Saccharum officinarum		(228)
Labiatae	*Ballota foetida*	Leaf	(118)
	Calamintha officinalis		(118)
	Mentha javanica		(228)
	M. rotundifolia		(118)
	Salvia coccinea		(228)
	S. pratensis		(118)
	Stachys lanata		(118)
Liliaceae	*Convallaria majalis*	Leaf	(118)
Loganiaceae	*Crateriphytum molucanum*		(228)
	Strychnos sp	Seed	(230)
	S. nux-vomica		(228)
		Seed	(725)
Magnoliaceae	*Michelia fuscata*		(228)
Malvaceae	*Gossypium* sp		(495)
Martyniaceae	*Martynia diandra*		(228)
Moraceae	*Castilla elastica*	Latex	(232)
	Ficus elastica	do	(232)
Oleaceae	*Jasminum nudiflorum*	Leaf and flower	(118)
Orbanchaceae	*Orobanche epithymum*	Stem	(118)
	O. rapum	Stem, flower, and underground parts.	(118)
	Phelipaea lutea		(118)
Pandanaceae	*Freycinetia strobilacea*		(228)
Pedaliaceae	*Sesamum orientale*		(228)
Ranunculaceae	*Aconitum septentrionale*		(315)
	Clematis paniculata		(228)
	C. vitalba	Leaf	(118)
	Ranunculus bulbosus	do	(118)
Rosaceae	*Crataegus oxyacantha*	Fruit, leaf, and flower.	(187)
	Prunus domestica	Fruit	(147)
	Pyrus communis	do	(94, 779)
		Leaf	(779)
	P. malus (*Malus sylvestris*)	Fruit	(94, 296, 460, 779)
		Juice	(530, 531)
		Leaf	(788)

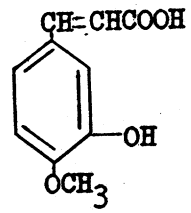
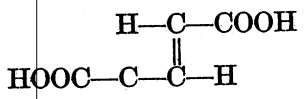
Family	Genus and species	Source	Reference
	Chlorogenic Acid—Continued		
Rubiaceae	*Adina cordifolia*		(228)
	Coelospermum corymbosum		(228)
	Coffea sp	Bean	(187, 230, 240, 286)
	C. arabica		(228, 593)
	C. bengalensis		(228)
	C. liberica		(227, 228, 231)
	Exostemma longiflorum		(228)
	Hymenodictyon sp		(228)
	Mussaenda officinalis		(228)
	Nauclea fagifolia		(228)
	Oxyanthus hirsutus		(228)
	Palicourea gardenioides		(228)
	Timonius compressicaulis		(228)
Saxifragaceae	*Hydrangea mutabilis*		(228)
Scrophulariacea	*Capraria biflora*		(228)
	Torenia sp		(228)
	Veronica alpina	Whole plant	(118)
	V. chamaedrys	do	(118)
	V. officinalis	do	(118)
	V. traversii	Root, stem, and leaf.	(118)
Solanaceae	*Atropa belladona*	Leaf	(537)
	Brunsfelsia americana	do	(537)
	Capsicum annuum (*C. frutescens*).	do	(537)
	C. grossum (*C. frutescens*).	do	(537)
	C. violaceum	do	(537)
	Cestrum aurantiacum	do	(537)
	C. elegans	do	(537)
	Datura arborea	do	(537)
	D. stramonium	do	(537)
	Hyoscyamus albus	do	(537)
	H. aureus	do	(537)
	H. pusillus	do	(537)
	H. reticulatus	do	(537)
	Mandragora officinarum	do	(537)
	Nicotiana sp		(348)
	Petunia nyctaginiflora	Leaf	(537)
	Physalis alkekengi	do	(118)
	P. angulata	do	(537)
	P. peruviana	do	(537)
	Physochlaina orientalis	do	(537)
	Scopolia carniolica	do	(537)
	Solanum (16 spp)	do	(537)
	S. lycopersicum (*Lycopersicon esculentum*).	do	(118)
	S. tuberosum		(321, 323, 539)
	Withania frutescens		(537)
	W. somnifera		(537)
Theaceae	*Thea sinensis*	Leaf	(602)
Tiliaceae	*Corchorus olitorius*		(228)
Umbelliferae	*Angelica archangelica*	Root	(690)
	Apium graveolens		(539)
	Eryngium pandanifolium.		(228)
	Hydrocotyle sp		(228)
	Thapsia garganica		(539)
Urticaceae	*Boehmeria nivea*		(228)
Verbenaceae	*Verbena officinalis*	Leaf	(118)

Family	Genus and species	Source	Reference
	Cinnamic Acid		
Compositae	*Parthenium argentatum*	Aqueous extract of root, rubber, resin, and leaf.	(*78, 764*)
Ericaceae	*Enkianthus japonicus*	Leaf	(*166*)
Globulariaceae	*Globularia* spp		(*264*)
	G. alypum	Stalk and leaf	(*265*)
	G. vulgaris	do	(*265, 743*)
Hamamelidaceae	*Liquidambar* sp	Resin	(*293, 305*)
	L. orientalis	do	(*718*)
	L. styraciflua	do	(*304, 717*)
Lauraceae	*Cinnamonum* sp	Leaf	(*365*)
Leguminosae	*Myroxylon pereirae*	Balsam	(*212, 268, 356, 361*)
	M. toluiferum (*M. balsamum*).	do	(*110, 117, 146, 212*)
Myrtaceae	*Eugenia jambolana*	Seed	(*545*)
Scrophulariaceae	*Scrophularia nodosa*	Root	(*317*)
Styracaceae	*Styrax liquidus* (?)	Resin	(*658*)
	Citramalic Acid		
Rosaceae	*Pyrus malus*	Peel	(*297, 298*)
	Citric Acid		

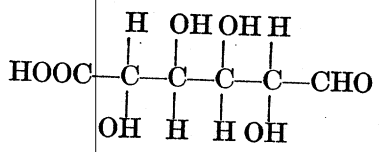
Citric acid was first found by Scheele (*626, 627*) in lemons. Franzen and Helwert (*199*) have made a critical review of the literature on occurrence of citric acid, and it appears to be ubiquitous in higher plants.

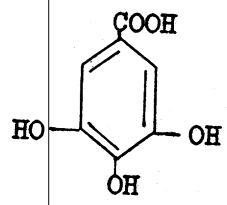
Family	Genus and species	Source	Reference
	Coumaric Acid		
	$HOC_6H_4CH{=}CHCOOH$		
Bignoniaceae	*Catalpa bignonioides*	Leaf	(*462*)
	C. ovata	Leaf and bark	(*282*)
Leguminosae	*Daviesia latifolia*	Leaf and stem	(*555*)
	Melilotus alba	Vegetative part.	(*99*)
		Root	(*616*)
	M. officinalis	Vegetative part.	(*99*)
	Trifolium pratense	Flower	(*553*)
Papaveraceae	*Papaver somniferum*		(*635*)
Pinaceae	*Pinus* sp	Resin	(*37*)
Rosaceae	*Prunus serotina*	Bark	(*550*)
	Digallic Acid		
			
Theaceae	*Thea sinensis*	Leaf	(*601, 602*)
	Dihydroxymaleic Acid		
	$HO{-}C(=C){-}COOH$ / $HO{-}C{-}COOH$		
Papaveraceae	*Glaucium luteum*	Pressed juice	(*634*)

Family	Genus and species	Source	Reference
	3,4-Dimethoxycinnamic Acid		
Scrophylariaceae	*Veronica virginica*	Rhizome and root.	(*552*)
	Ethylmalic Acid		
Euphorbiaceae	*Euphorbia biglandulosa*	Latex	(*342*)
	Ferulic Acid		
Bignoniaceae	*Catalpa ovata*	Bark	(*282*)
Pinaceae	*Larix europaea* (*L. decidua*).	Resin	(*37*)
Umbelliferae	*Ferula assafoetida*	Resin of roots and rhizomes.	(*638*)

Family	Genus and species	Source	Reference
	Isoferulic Acid		
			
Bignoniaceae	*Catalpa ovata*	Root bark	(*282*)
Ranunculaceae	*Cimicifuga racemosa*	Rhizome	(*188*)
	Fluoracetic Acid		
	CH_2FCOOH		
Dichapetalaceae	*Dichapetalum cymosum*		(*425*)
	Fumaric Acid		
			
Aceraceae	*Acer saccharum*	Sirup	(*468*)
		Sugar sand	(*469*)
		Sap and sirup	(*542*)
Asclepiadaceae	*Asclepias syriaca*	Root	(*427*)
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	(*501, 673*)
Compositae	*Helianthus annuus*		(*58*)
Cruciferae	*Bunias orientalis*	Stem, leaf, and flowering top.	(*316*)
Eucommiaceae	*Eucommia ulmoides*	Leaf	(*246*)
Euphorbiaceae	*Cluytia similis*	Leaf and stem	(*729*)
	Ricinus communis	Germinating bean.	(*145*)
Gramineae	*Hordeum vulgare*	Leaf	(*114*)
		Etiolated shoot	(*168*)
		Seedling	(*314*)
	Oryza sativa	Grain	(*256*)
		Leaf	(*809*)
	Saccharum officinarum	Juice	(*603, 604, 605*)
	Sorghum sp	Sirup	(*416*)

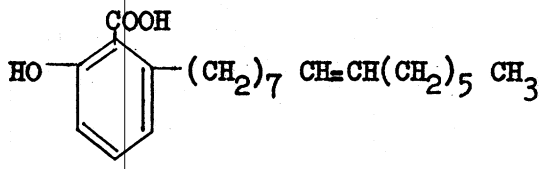
Family	Genus and species	Source	Reference
	Fumaric Acid—Continued		
Labiatae	*Salvia officinalis*	Leaf	(*96*)
Leguminosae	*Daviesia latifolia*	Leaf and stem	(*555*)
	Phaseolus coccineus		(*58*)
	P. mungo		(*129*)
Papaveraceae	*Corydalis bulbosa*		(*781*)
	Fumaria officinalis	Sap	(*138, 140, 713, 790*)
	Glaucium flavium	Leaf	(*486*)
	G. luteum		(*560, 561, 634*)
	Papaver somniferum		(*635*)
Solanaceae	*Nicotiana* sp		(*653, 748, 749*)
Umbelliferae	*Daucus carota*	Root tissue	(*105, 106, 409*)
	Myrrhis odorata	Leaf	(*308, 486*)
	Galacturonic Acid		
Rosaceae	*Fragaria vesca*	Juice	(*447, 448*)
	Prunus persica	do	(*18*)
		Fruit	(*19*)
	Pyrus communis	Fruit	(*19, 29*)
	P. malus (*Malus sylvestris*).	Juice	(*530*)
	Gallic Acid		
Anacardiaceae	*Rhus coriaria*	Stalk	(*386, 677*)
	R. glabra	Fruit	(*618*)
	R. semialata	do	(*734*)
Celastraceae	*Celastrus scandens*	do	(*776*)
Commelinaceae	*Commelina agraria*		(*594*)
Cornaceae	*Cornus florida*	Flower and bract.	(*619*)
	C. sericea	Fruit pulp	(*679*)



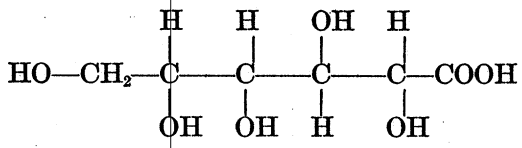
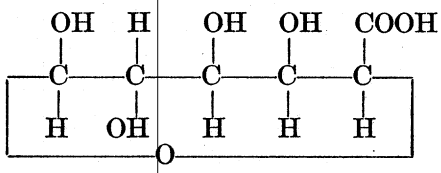


Family	Genus and species	Source	Reference
	Gallic Acid—Continued		
Ericaceae	*Arctostaphylos uvaursi*		(*607*)
	Epigaea repens		(*502*)
Euphorbiaceae	*Phyllanthus distichus*	Root bark	(*136*)
Fagaceae	*Quercus aegilops*	Acorn	(*677*)
	Q. pedunculata (*Q. robur*).	Wood	(*442*)
Geraniaceae	*Geranium onoei*		(*301*)
	G. pratense		(*91*)
	G. zonale		(*93*)
Lauraceae	*Persea gratissima* (*P. americana*).	Fruit kernel	(*514, 515*)
Leguminosae	*Pithocellobium saman* (*Samanea saman*).	Bark	(*307*)
Loganiaceae	*Gelsemium sempervirens*	Root	(*289*)
Musaceae	*Musa paradisiaca*	Sap	(*263*)
Myrtaceae	*Psidium* spp		(*515*)
Nymphaeaceae	*Brasenia schreberi*		(*461*)
Oleaceae	*Olea europea*	Leaf	(*115*)
Polygonaceae	*Rheum austriacum*	Root	(*273*)
	R. rhaponticum	do	(*273*)
Punicaceae	*Punica granatum*	Root bark	(*772, p. 641, note 1*)
Rubiaceae	*Coffea* sp		(*529*)
Sapotaceae	*Mimusops* sp		(*515*)
Scrophulariaceae	*Digatalis* sp		(*88, p. 776*)
	D. purpurea		(*88, p. 776*)
Simarubaceae	*Quassia simaruba*	Root bark	(*772, p. 641, note 1*)
Solanaceae	*Nicotiana tabacum*	Leaf	(*772, p. 1112, note 2*)
Theaceae	*Thea sinensis*		(*369, 601, 602*)

Ginkgolic Acid



Ginkgoaceae	*Ginkgo biloba*	Fruit	(*334*)

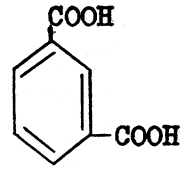
Family	Genus and species	Source	Reference
	Gluconic Acid		
			
Chenopodiaceae	*Beta vulgaris*	Crust on juice preheater.	(*402*)
	Glucuronic Acid		
			
Compositae	*Taraxacum officinale*	Young leaf	(*504*)
Cucurbitaceae	*Cucurbita pepo*	Seed	(*504*)
Gramineae	*Hordeum vulgare*	Germinating seed.	(*504*)
	Musa sp	Shoot	(*621*)
Leguminosae	*Phaseolus* or *Vicia*	Germinating seed and etiolated leaf.	(*504*)
	Glutaric Acid		
	$HOOC—CH_2—CH_2—CH_2—COOH$		
Chenopodiaceae	*Beta vulgaris*	Beet	(*395, 396, 742*)
	Glyceric Acid		
	$CH_2OH—CH(OH)—COOH$		
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	(*673*)
Gramineae	*Hordeum vulgare*	----------	(*56*)
		Leaf	(*57, 114*)
Leguminosae	*Glycine* sp	Leaf	(*24*)
Solanaceae	*Nicotiana tabacum*	----------	(*687*)

Family	Genus and species	Source	Reference
	Glycolic Acid		
	$HO—CH_2—COOH$		
Caprifoliaceae	*Sambucus nigra*	Leaf	(34)
Caryophyllaceae	*Herniaria glabra*	do	(34)
Chenopodiaceae	*Beta vulgaris*	Beet juice	(396, 501, 672, 673)
Combretaceae	*Combretum micranthum*	Leaf	(34)
Compositae	*Cynara scolymus*	do	(34)
	Solidago virga-aurea	Flowering twig	(34)
Dichapetalaceae	*Dichapetalum cymosum*		(34)
Ericaceae	*Arbutus unedo*	Leaf	(425)
	Erica multiflora	Flowering twig	(34)
Euphorbiaceae	*Ricinus communis*		(34)
Gramineae	*Agropyron repens*	Root and rhizome.	(65, 145)
	Avena sativa	Seedling	(291)
	Hordeum vulgare	Leaf	(56, 57)
		Etiolated shoot	(114, 687)
		Seedling	(168)
	Saccharum officinarum	Juice	(291)
	Zea mays	Stigmata	(559, 603, 604, 605, 654, 686)
Labiatae	*Lavandula vera*	Flowering twig	(34)
	Orthosiphon stamineus	Leaf	(34)
	Rosmarinus spp	Flowering twig	(34)
Leguminosae	*Lupinus albus*	Seedling	(34)
	Medicago sativa	Sap	(291)
	Pisum sativum	Seedling	(185)
Liliaceae	*Asparagus* spp	Root and rhizome.	(291)
	Ruscus aculeatus	do	(34)
Pinaceae	*Juniperus communis*	Berry	(34)
Rosaceae	*Prunus cerasus*	Peduncle	(34)
	Pyrus communis	Juice	(34)
	P. malus (Malus sylvestris).	do	(592)
Solanaceae	*Nicotiana tabacum*		(700)
	Physalis alkekengi	Leaf	(686)
	Solanum lycopersicum (Lycopersicon esculentum).	Berry	(687)
		Leaf	(34)
Umbelliferae	*Apium graveolons*	Root and rhizome.	(686, 687)
	Eryngium campestre	do	(34)
	Foeniculum vulgare	do	(34)
	Petroselinum sativum (P. crispum).	do	(34)
Urticaceae	*Parietaria* spp	Leaf	(34)
Vitaceae	*Ampelopsis hederacea (Parthenocissus quinquefolia.)*	do	(34)
	Vitis vinifera	Unripe fruit	(101, 183, 184)
		Fruit	(280)

Family	Genus and species	Source	Reference
	Glyoxalic Acid		
Chenopodiaceae	*Beta vulgaris*	----------	(*396*)
Cornaceae	*Cornus mas*	Fruit	(*631*)
Ericaceae	*Vaccinium oxycoccos*	----------	(*682*)
Gramineae	*Saccharum officinarum*	Juice	(*784*)
Labiatae	*Mentha piperita*	Leaf	(*709, 711*)
Leguminosae	*Arachis hypogaea*	Seedling	(*195, 196*)
Liliaceae	*Tulipa gesneriana*	----------	(*709, 710*)
Polygonaceae	*Rheum officinale*	----------	(*102*)
Rosaceae	*Prunus domestica*	Unripe fruit	(*102*)
	Pyrus malus (*Malus sylvestris*).	do	(*102*)
		Fruit	(*298*)
Saxifragaceae	*Ribes* sp	Unripe fruit	(*102*)
	R. grossularia	do	(*102*)
Solanaceae	*Solanum tuberosum*	Tuber	(*711*)
Umbelliferae	*Daucus carota*	Leaf and root	(*709*)
		Root	(*711*)
Vitaceae	*Vitis vinifera*	----------	(*102, 103, 248, 280*)
		Juice	(*647*)
	Hemipinic Acid		
Papaveraceae	*Papaver somniferum*	----------	(*635*)
	Hydrocaffeic Acid		
Chenopodiaceae	*Beta vulgaris*	Leaf	(*397*)
Solanaceae	*Solanum tuberosum*	Tuber	(*587*)
Vitaceae	*Ampelopsis hederacea* (*Parthenocissus quinquefolia*).	----------	(*587*)

Family	Genus and species	Source	Reference
	Hydrocoumaric Acid		
Leguminosae	*Melilotus officinalis*	----------	(*822*)
	p-Hydroxybenzoic Acid		
Bignoniaceae	*Bignonia catalpa*	Unripe fruit	(*534*)
	Catalpa ovata	Leaf	(*462*)
Papaveraceae	*Papaver somniferum*	----------	(*635*)
	Hydroxycitric Acid		
Chenopodiaceae	*Beta vulgaris*	Juice	(*395*)
	alpha-Hydroxyglutaric Acid		
Chenopodiaceae	*Beta vulgaris*	Sap	(*394*)

Family	Genus and species	Source	Reference
2-Hydroxy-6-Methoxybenzoic Acid			
Liliaceae	*Gloriosa superba*	Tuber	(*123*)
p-Hydroxyphenylacetic Acid			
Compositae	*Taraxacum officinale*	Root	(*546*)
Isochlorogenic Acid			
Rosaceae	*Pyrus communis*	Leaf and shoot	(*94*)
Rubiaceae	*Coffea* sp	Leaf	(*788*)
			(*41*)

Family	Genus and species	Source	Reference
	Isocitric Acid		
	$CH(OH)—COOH$ | $CH—COOH$ | $CH_2—COOH$		
Anonaceae	*Anona muricata*	----------	(*479*)
Crassulaceae	*Bryophyllum* sp	Leaf	(*80, 505, 572*)
	B. calycinum	----do	(*109, 362, 563, 564, 566, 568, 686, 687, 738, 747*).
		Leaf and stem	(*567*)
	Escheveria sp	Leaf	(*362*)
	E. secunda	----------	(*484, 485*)
	Sedum acre	----------	(*485*)
	S. maximum	----------	(*485*)
	S. praealtum	----------	(*803*)
	Sempervivum tectorum	----------	(*485*)
Gramineae	*Hordeum vulgare*	----------	(*56*)
		Leaf	(*57, 589*)
Lecythidaceae	*Couroupita guianensis*	Fruit	(*476*)
Leguminosae	*Pisum sativum*	Ungerminated seeds.	(*424*)
Rosaceae	*Pyrus malus* (*Molus sylvestris*).	Fruit	(*105, 106*)
	Rubus fruticosus	----do	(*127, 465, 470*)
Scrophulariaceae	*Digitalis purpurea*	----------	(*331*)
		Leaf	(*362*)
Solanaceae	*Nicotiana tabacum*	----------	(*686*)
		Leaf	(*687*)
	Solanum lycopersicum (*Lycopersicon esculentum*).	Leaf	(*686, 687*)
	S. tuberosum	Juice of tuber	(*126*)
Umbelliferae	*Daucus carota*	----------	(*105, 106*)
	Isophthalic Acid		
			
Iridaceae	*Iris versicolor*	Rhizome	(*554*)
	alpha-Ketoadipic Acid		
	$HOOC—CH_2—CH_2—CH_2—CO—COOH$		
Leguminosae	*Pisum sativum*	Germinating seed.	(*753*)

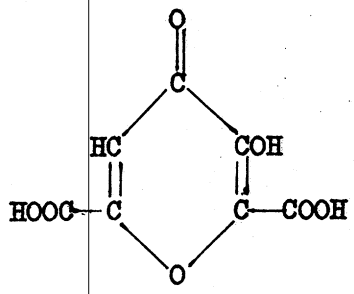
Family	Genus and species	Source	Reference
	alpha-Ketoglutaric Acid		
	$HOOC—CH_2—CH_2—CO—COOH$		
Euphorbiaceae	*Ricinis communis*	Germinating seed.	(*145*)
Gramineae	*Hordeum vulgare*	Etiolated shoot	(*168*)
Labiatae	*Mentha piperita*	Leaf	(*709, 711*)
Leguminosae	*Arachis hygogaea*	Seedling	(*195, 196*)
	Pisum sativum	Young plant	(*757, 759*)
	Trifolium pratense		(*756, 757*)
Liliaceae	*Tulipa gesneriana*		(*709, 710*)
Rosaceae	*Pyrus malus* (*Malus sylvestris*).	Fruit	(*298*)
Solanaceae	*Solanum tuberosum*	Tuber	(*38, 711*)
Umbelliferae	*Daucus carota*	Root and leaf	(*709*)
		Root	(*711*)
	Lactic Acid		
	$CH_3—CHOH—COOH$		
Amaryllidaceae	*Agave sisalana*	Leaf	(*414, 640, 641*)
Bromeliaceae	*Ananas sativas* (*A. comosus*).		(*515*)
Chenopodiaceae	*Beta vulgaris*		(*438*)
		Juice	(*672, 673*)
		Root	(*680, 681*)
		Root and leaf	(*742*)
Compositae	*Helianthus annuus*		(*58*)
	Lactuca sp		(*515*)
		Leaf	(*640*)
	L. sativa	Leaf	(*641*)
Crassulaceae	*Bryophyllum calycinum*		(*801*)
Cruciferae	*Brassica oleracea*	Fresh and fermented kale.	(*42*)
		Cabbage leaf	(*641*)
Cucurbitaceae	*Cucumis sativus*		(*680*)
Ericaceae	*Vaccinium myrtillus*		(*325*)
Euphorbiaceae	*Ricinis communis*		(*137*)
		Germinating seed.	(*145, 294*)
		Seedling	(*640*)
		Seedling and leaf.	(*641*)
Fagaceae	*Castanea vesca* (*C. sativa*)	Fruit	(*148*)
	Fagus sylvatica	Nut	(*327*)
Gentianaceae	*Erythraea centaurium*		(*253*)
Gramineae	*Bambusa* sp	Shoot	(*621*)
	Hordeum distichum	Germinating seed.	(*681*)
	H. sativum		(*793*)
	H. vulgare	Etiolated shoot	(*168*)
	Oryza spp	Leaf	(*809*)
	Secale cereale	do	(*668*)
	Triticum sativum (*T. aestivum*).	do	(*668*)
	T. vulgare	Germinating seed.	(*681*)
	Zea mays	do	(*640, 641, 793*)

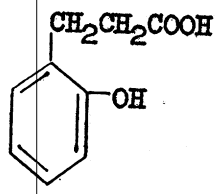
Family	Genus and species	Source	Reference
	Lactic Acid—Continued		
Leguminosae	*Glycine* sp		(327)
	Lupinus sp	Seed	(456)
	L. luteus	Germinating seed.	(681)
	Phaseolus coccineus		(58)
	P. vulgaris	Seedling	(641)
	Pisum sativum	Germinating seed.	(640, 641, 681)
	Tamarindus indica		(3, 325)
	Vicia faba	Leaf and sprout	(640, 641)
		Germinating seed.	(681)
Malvaceae	*Gossypium* sp	Seed	(327)
Myricaceae	*Myrica rubra*	Fruit	(354)
Myrsinaceae	*Maesa picta*	Seed	(22)
Papaveraceae	*Glaucium luteum*	Pressed juice	(634)
	Papaver somniferum	"Poppy straw"	(635)
Polygonaceae	*Rheum* sp	Leaf	(640)
	R. hybridum	Tuber	(641)
Rosaceae	*Eriobotrya japonica*	Milky juice	(128, p. 93, ftn. 12)
	Fragaria sp	Juice of fruit	(281)
	Prunus avium		(197)
	P. cerasus	Juice of fruit	(437)
	Pyrus communis	do	(437)
		Juice and fruit	(592)
	P. malus (*Malus sylvestris*).	Fruit	(200, 281)
		Juice of fruit	(436, 437, 702)
	Rubus sp	Leaf	(640)
	R. fruticosus	do	(203, 204, 641)
	R. idaeus	do	(210, 211, 642)
Rutaceae	*Citrus decumana* (*C. grandis*).	Juice of fruit	(281)
Salicaceae	*Salix* sp	Bark	(151)
Scrophulariaceae	*Digatalis purpurea*		(331)
	Euphrasia officinalis		(172)
	Veronica officinalis		(171)
Solanaceae	*Solanum dulcamara*	Peduncle	(800)
	S. lycopersicum (*Lycopersicon esculentum*).	Fruit	(109, 116, 737)
		Juice of fruit	(595)
	S. tuberosum	Tuber	(39, 40, 640, 641, 680, 681, 778, 793)
Sterculiaceae	*Theobroma cacao*	Seed	(453)
Umbelliferae	*Daucus carota*		(640)
		Root	(641, 681)
Vitaceae	*Vitis vinifera*	Juice	(437)
		Sap	(799)

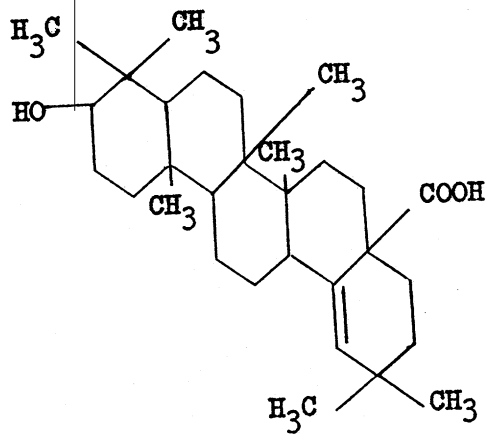
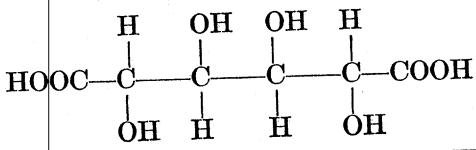
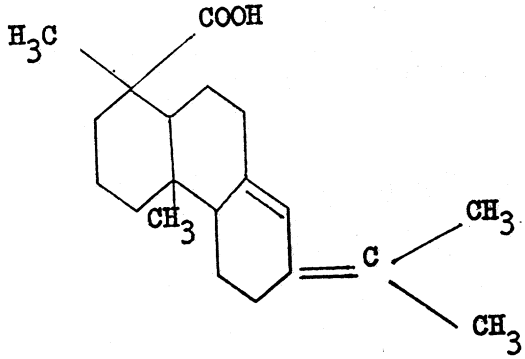
Malic Acid

$$\begin{array}{l} COOH \\ | \\ CHOH \\ | \\ CH_2COOH \end{array}$$

Malic acid was discovered by Scheele (*623*), who reported its presence in a number of plants. Franzen and Keyssner (*304*) have made a critical review of the literature on its occurrence, but it appears to be ubiquitous in higher plants.

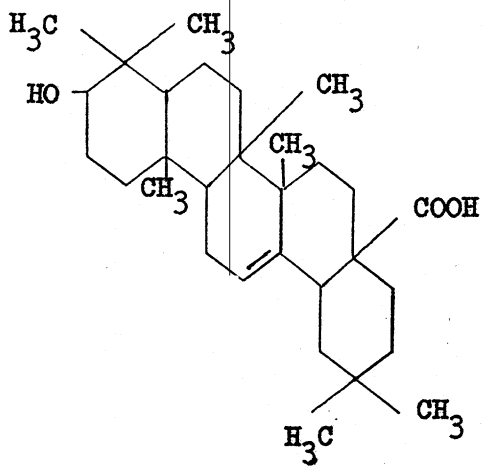
Family	Genus and species	Source	Reference
	Malonic Acid		
	$\begin{array}{l} COOH \\ \vert \\ CH_2COOH \end{array}$		
Chenopodiaceae	*Beta vulgaris*	Incrustation on evaporator.	(*393*)
		Juice	(*395*)
		Beet and leaf	(*742*)
Compositae	*Helianthus annuus*		(*58*)
	H. tuberosus		(*226*)
Cruciferae	*Bunias orientalis*	Stem, leaf, and flowering top.	(*316*)
Gramineae	Mixed herbage		(*299*)
	Avena sativa		(*291, 474*)
	Dactylis glomerata		(*134*)
	Hordeum vulgare		(*291, 474*)
	Triticum sp		(*473*)
Leguminosae	*Anthyllis* sp		(*58*)
	Astragalus sp		(*58*)
	A. sinicus		(*812*)
	Colutea sp		(*58*)
	Lotus sp		(*58*)
	Lupinus sp		(*58, 291*)
	Medicago sp		(*58*)
	M. sativa		(*727*)
	Melilotus sp		(*58*)
	Ononis sp		(*58*)
	Phaseolus coccineus		(*58*)
	Sophora sp		(*58*)
	Thermopsis sp		(*58*)
	Trifolium sp		(*58*)
	Trigonella sp		(*58*)
	Vicia sp		(*58*)
Rosaceae	*Fragaria* sp	Fruit	(*683*)
Umbelliferae	*Anthriscus* sp		(*58*)
	Apium sp		(*58*)
	Meconic Acid		
			
Papaveraceae	*Papaver rhoeas*		(*510*)
	P. somniferum		(*66*)
		Dried capsules	(*141*)
		Milky sap	(*1, p. 1337, ftn. 1*)

Family	Genus and species	Source	Reference
	Melilotic Acid		
			
Leguminosae	*Melilotus alba*	Vegetative part	(*99*)
	M. officinalis	do	(*99, 822*)
Solanaceae	*Nicotiana tabacum*	Leaf	(*772, p. 1112, note 2*)
	Mesaconic Acid		
	$CH_3—C(=CH)—COOH$ $HOOC—CH$		
Bignoniaceae	*Crescentia* sp	Curare	(*330*)
Cruciferae	*Brassica oleracea*	Leaf	(*111, 112*)
Gramineae	*Saccharum officinarum*	Juice	(*603, 604, 605*)
	Mesoxalic Acid		
	$(HO)_2C(COOH)_2$		
Leguminosae	*Medicago sativa*	----------	(*185*)
	gamma-Methylene-alpha-Ketoglutaric Acid		
	$HOOC—C(=CH_2)—CH_2C(=O)—COOH$		
Leguminosae	*Arachis hypogaea*	Seedling	(*195, 196*)
Liliaceae	*Tulipa gesneriana*	----------	(*709, 710*)

Family	Genus and species	Source	Reference
	Morolic Acid		
			
Ericaceae	*Agauria salicifolia*		(*158*)
	Mucic Acid		
			
Chenopodiaceae	*Beta vulgaris*	Diffusion juice	(*672*)
Elaeocarpaceae	*Elaeocarpus serratus*	Fruit pulp	(*870*)
Rosaceae	*Prunus persica*	Ripe fruit	(*19*)
	Pyrus communis	do	(*19*)
	Neoabietic Acid		
			
Pinaceae	*Pinus palustris*	Oleoresin	(*258*)
	P. sylvestris	Oleoresin and wood resin.	(*259*)

Family	Genus and species	Source	Reference

Oleanolic Acid



Apocynaceae	*Alyxia buxifolia*	Bark	(*21*)
Ericaceae	*Vaccinium myrtillus*	----------	(*583*)
Euphorbiaceae	*Petalostigma sericeum*	----------	(*21*)
Labiatae	*Salvia officinalis*	----------	(*97*)
	Thymus vulgaris	----------	(*609*)
Loranthaceae	*Viscum album*	Leaf	(*795*)
Myrtaceae	*Psidium guajava*	do	(*27*)
Oleaceae	*Olea europea*	do	(*252*)
Rosaceae	*Crataegus oxyacantha*	do	(*60*)
	Eriobotrya japonica	do	(*26*)
Solanaceae	*Anthocercis intricata*	Bark	(*21*)
	A. littorea	do	(*21*)
	A. odgersii	do	(*21*)
Vitaceae	*Vitis labrusca*	Pomace	(*432*)

Oxalacetic Acid

$$HOOC—CH_2—CO—COOH$$

Gramineae	*Hordeum vulgare*	----------	(*756*)
	Phleum pratense	----------	(*756*)
Labiatae	*Mentha piperita*	----------	(*709, 711*)
Leguminosae	*Canvalia ensiformis*	----------	(*756*)
	Pisum sativum	----------	(*755, 756, 757, 758, 759*)
	Trifolius pratense	Young leaf	(*754, 755, 756, 757*)
Liliaceae	*Tulipa gesneriana*	----------	(*709, 710*)
Rosaceae	*Pyrus malus* (*Malus sylvestris*).	Fruit	(*298*)
Solanaceae	*Solanum tuberosum*	Tuber	(*711*)
Umbelliferae	*Daucus carota*	Root and leaf	(*709*)
		Root	(*711*)

Family	Genus and species	Source	Reference

Oxalic Acid

$$\begin{array}{c} COOH \\ | \\ COOH \end{array}$$

[Reviews and surveys of the occurrence of oxalic acid include those of Andrews and Viser (*17*), Esbach (*475, p. 1909*), Kohman (*550, 551*), Meyen (*443, p. 122*), Miller, Ross, and Lewis (*446*), Molisch (*450*), Patschovsky (*508*), Schimper (*630*), and Treviranus (*128, p. 66, note 6*)]

Aceraceae	*Acer platanoides*	Root	(*359*)
	A. saccharum	Sap and sugar sand.	(*768*)
Aizoaceae	*Mesembryanthemum* sp		(*509*)
	M. acinaciforme		(*2*)
	M. crystallinum		(*16, 63*)
		Leaf and flower	(*62*)
Amarantaceae			(*509*)
	Alternanthera sessilis		(*292*)
	Amaranthus sp		(*236*)
	A. aquatica (?)		(*622*)
	A. caudatus		(*62*)
		Leaf and flower	(*63*)
	A. gangeticus		(*292*)
	A. polygonoides		(*292*)
Amaryllidaceae	*Agave americana*	Leaf	(*815*)
Anacardiaceae	*Mangifera indica*		(*86*)
Araceae	*Acorus calamus*		(*810*)
	Arum italicum	Berry	(*343*)
Aristolochiaceae	*Asarum* sp		(*509*)
Balsaminaceae	*Impatiens parviflora*		(*455*)
	I. sultani		(*455*)
Begoniaceae	*Begonia* sp		(*220*)
	B. evansiana		(*650, 651, 652*)
	B. rex		(*760*)
	B. semperflorens		(*125, 611, 732*)
Berberidaceae	*Berberis vulgaris*	Fruit	(*343*)
Betulaceae	*Alnus* sp	Leaf	(*771*)
	Betula sp		(*359*)
	Ostrya vulgaris		(*359*)
Bombacaceae	*Adansonia digitata*	Fruit	(*5*)
Bromelianceae	*Bromolia pinguin*	do	(*28*)
Cactaceae			(*509*)
	Cereus peruvianus		(*728*)
	Opuntia sp		(*478*)
	O. vulgaris	Stem	(*343*)
Caprifoliaceae	*Sambucus nigra*	Young leaf	(*47*)
	Symphoricarpos sp	Leaf	(*771*)
Caryophyllaceae	*Dianthus babatus*		(*492*)
	D. carthusianorum	Leaf and stem	(*12*)
	Lychnis coronaria		(*74*)
	L. dioica		(*12, 74, 91*)
	L. flos-jovis		(*74*)
	L. githago (*Agrostemma githago*).		(*12*)
	Saponaria sp		(*478*)
	S. officinalis		(*12*)
	Spergula arvensis		(*74*)
	Stellaria media		(*455, 492*)
	Tunica saxifraga		(*12*)
Celastraceae	*Celastrus obscurus*	Leaf	(*154*)
	Euonymus japonicus		(*2*)

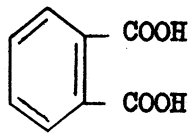
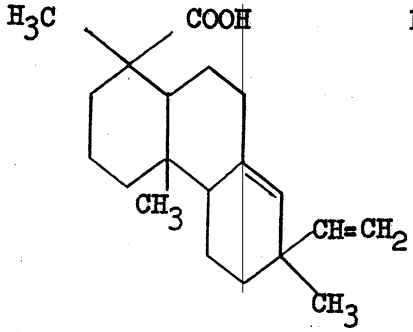
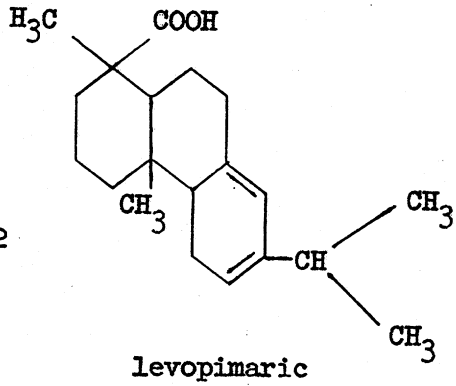
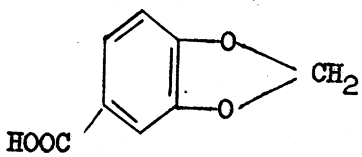
Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Chenopodiaceae	*Atriplex* sp		(446)
	Beta vulgaris		(509)
			(492, 509, 533, 622)
		Juice	(396, 444, 501, 672, 673)
		Root and leaf	(418, 742)
		Leaf	(33, 454, 615, 624)
		Swiss chard, mangold, and beet leaf.	(625)
		Seed	(149, 685)
		Root	(23, 226, 236, 773)
	Chenopodium sp		(509)
	C. quinoa	Leaf and flower	(62, 63)
	Halogeton glomeratus		(191, 290)
	Spinacia oleracea		(23, 90, 381, 475, 509, 533)
		Leaf	(46, 69, 150, 236, 492, 615, 782, 910)
Commelinaceae	*Callisia repens*		(455)
	Tradescantia sp		(509)
	T. fluminesis		(53, 777)
	T. selloi		(630)
	T. virginica	Leaf	(343)
Compositae	*Cichorium endivia*	do	(23)
	Helianthus tuberosus		(226)
	Kleinia articulata		(312)
	Lactuca spp		(515)
	L. sativa		(475, 633, 782)
Convolvulaceae	*Ipomoea aquatica*		(292)
Cornaceae	*Cornus sericea*	Fruit pulp	(679)
Crassulaceae	*Bryophyllum calycinum*	Leaf	(109, 563, 568, 573, 686, 687, 738)
		Leaf and stem	(567)
	B. crenatum	Leaf	(80, 343)
	Echeveria glauca	do	(343)
	Sedum azureum		(16)
	S. fabaria	Leaf	(343)
	Sempervivum glaucum	do	(52)
	S. tectorum	do	(343)
Cruciferae	*Brassica oleracea*		(509)
	B. pekinensis		(23, 475)
	Bunias orientalis		(810)
Cucurbitaceae	*Cucumis melo*	Stem, leaf, and flowering top.	(316)
	Cucurbita pepo		(23, 533)
Dipsacaceae	*Succisa pratensis*		(782)
Ericaceae	*Vaccinium myrtillus*		(492)
Euphorbiaceae	*Aleurites cordata*	Leaf	(23, 325)
	Euphorbia sp		(221)
	Mercurialis annuelle		(509)
	M. perennis		(130)
	Phyllanthus emblica		(492)
	Ricinus communis		(326)
Fagaceae	*Fagus sylvatica*		(65)
	Quercus pedunculata		(95, 492, 646)
			(442)

Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Gesneraceae	*Aeschynanthus* sp		(509)
Globulariaceae	*Globularia* spp		(264)
Gramineae			(509)
	Avena sativa	Seedling	(291, 474, 524)
	Bambusa sp	Shoot	(621)
	Hordeum vulgare	Leaf	(47, 687)
		Seedling	(291, 314, 474, 686)
	Lolium perenne		(420)
	Oplismenus imbecillis (*O. undulatifolius*).		(53)
	Oryza spp	Leaf	(809)
	Phyllostachys mitis	Sprout	(695)
	Poa pratensis		(533)
	Saccharum officinarum	Juice	(85; 512; 603; 604; 605; 699; 704, ref. 162; 811)
	Secale cereale		(474)
	Sorghum sp	Juice	(416)
	S. vulgare		(786, 787)
		Leaf	(802)
	Triticum sp		(473)
	T. aestivum		(533)
	Zea mays		(53, 761)
Hippocastanaceae	*Aesculus hippocastanum*	Young leaf	(47)
Hydrocharitaceae	*Elodea canadensis*		(459)
	E. densa		(459)
Juglandaceae	*Juglans rexia*	Bark	(353)
Labiatae			(509)
Leguminosae	*Acacia* spp	Bark	(675)
	Acacia cambagei	Bark and wood	(674, 675)
	Arachis hypogaea	Kernel	(585)
	Cassia sp	Leaf	(763)
	Cicer arietinum	Secretion from hairs.	(449)
		Fruit	(818)
	Glycine soja (*G. max*)		(533)
	Lupinus albus	Seedling	(291)
	L. luteus	Seed	(600)
	Medicago sativa		(533)
	Mimosa speggazzinii		(455)
	Phaseolus limensis (*P. lunatus*).		(533)
	Pisum sativum	Seedling	(291, 533, 782)
	Tamarindus indica		(202, 325, 326)
		Mature leaf	(237)
	Vicia sp		(318, 336)
	Vicia faba		(23)
Liliaceae			(509)
	Agapanthus umbellatus	Leaf	(343)
	Allium cepa		(8; 77, p. 165, ref. 4; 360, 782)
	Asparagus officinalis		(23)
	Erythronium denscanis	Bulb	(153)
	Hyacinthus orientalis	do	(75)
	Smilacina bifolia(?)	Fruit	(163)
	S. racemosa	do	(163)
Loranthaceae	*Viscum* sp		(509)
Malvaceae	*Gossypium* sp		(180, 181, 182, 412)

Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Melastomaceae	*Memecylon tinctorium*		(155)
Menispermaceae	*Jateorhiza columba*		(724)
Moraceae	*Cannabis* sp		(130)
	Ficus carica		(236)
Musaceae	*Musa sapientum* (*M. paradisiaca sapientum*).	Overripe fruit	(482)
Myricaceae	*Myrica rubra*	Fruit	(354)
Myristicaceae	*Myristica surinamensis*	Seed	(715)
Myrtaceae	*Eucalyptus* (12 spp.)	Bark	(665)
	Psidium guajava	Leaf	(10)
Nyctaginaceae	*Mirabilis* sp	Flower and fruit	(535)
Nymphaeaceae	*Nymphaea alba*	Rhizome	(244)
	N. lutea	do	(244)
Orchidaceae			(509)
	Vanilla planifolia		(767)
Oxalidaceae	*Averrhoa carambola*		(120)
		Fruit	(385)
		Juice	(472)
	Oxalis sp		(220, 236, 509)
	O. acetosella	Leaf	(343, 429)
	O. corniculata		(237)
	O. stricta		(63)
	O. violacea		(515)
Papaveraceae			(509)
	Fumaria officinalis	Seedcoat	(238)
Pedaliaceae	*Sesamum indicum*	Seed	(262)
Phytolaccaceae	*Phytolacca* sp		(509)
	P. dioica	Shoot, bark, and pith.	(2)
Pinaceae			(608)
	Pinus abies (*Picea abies*)	Sap	(324, 646)
	P. cembra	Seedling	(644)
	P. excelsa (*Picea abies*)	Needle	(492, 813)
Piperaceae	*Peperomia* sp		(509)
Polygonaceae	*Emex* sp		(509)
	Fagopyrum esculentum		(53, 533)
		Leaf and stem	(577)
	Oxyria sp		(509)
	Polygonum sp		(509)
	Rheum sp		(23, 104, 236, 381, 509, 750, 782)
		Leaf	(676)
	R. crispum(?)	Stem	(499)
	R. hybridum	Leaf and rhizome	(9)
		Leaf	(565, 576, 687, 760)
		Stem and rhizome.	(612, 613)
	R. leucorrhizum	Stem	(499)
	R. mepalense	do	(499)
	R. nutans	do	(499)
	R. officinale	Leaf	(102, 760)
	R. palmatum	Stem	(499)
	R. "Paragon"	do	(499)
	R. rhaponticum	do	(375)
	R. undulatum	Petiole	(343)
	Rumex sp		(220, 236, 509)
	R. acetosa	Leaf	(45)
		Seed and root	(63)
			(23, p. 99, ftn. 2; 61; 515)
	R. obtusifolius	Root	(359)

Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Polypodiaceae	*Lonchitis* sp		(509)
Portulacaceae	*Portulaca* sp		(236, 509)
	Talinum speciosum		(292)
Primulaceae			(509)
	Primula elatior		(492)
Punicaceae	*Punica granatum*		(326)
		Bark	(478)
Pyrolaceae	*Monotropa* sp		(509)
Ranunculaceae	*Anemone* sp		(509)
	A. nemorosa		(732)
Rhamnaceae	*Rhamnus lycioides*	Leaf	(77, p. 165, ref. 4)
	Zizyphus jujuba		(326)
Rosaceae	*Crataegus* sp	Leaf	(771)
	C. oxyacantha	do	(47)
	Fragaria sp		(6)
		Fruit	(23, 782)
	Mespilus germanica	Overripe fruit	(482)
	Prunus armeniaca	Dried fruit	(464)
	P. avium	Fruit	(197)
	P. cerasus	do	(23, 337)
	P. domestica	do	(23, 104)
	P. persica	do	(23)
	Pyrus communis	do	(23)
		Overripe fruit	(482)
	P. malus (*Malus sylvestris*).	Fruit	(23, 200, 298, 726)
	Quillaja sp		(478)
	Rubus sp	Fruit	(23, 782)
	R. fruticosus	Leaf	(205)
		Fruit	(465)
	R. idaeus		(732)
Rubiaceae	*Cinchona* spp	Bark	(284, 586)
	Coffea sp	Seed	(46)
	C. arabica	Fruit capsule	(270)
	Dentella asiatica		(292)
	Galium lucidum	Leaf	(343)
Rutaceae	*Citrus aurantium*	Fruit	(23, 482, 782)
		Leaf	(660)
		Peel	(659)
	C. decumana (*C. grandis*)	Fruit	(326, 439)
		Peel	(659)
	C. limon	Fruit	(23, 326, 482, 782)
		Peel	(659)
	C. medica	Petiole	(77, p. 165, ref. 4)
		Fruit	(326)
	C. nobilis (*C. reticulata*)	Fruit	(482)
Santalaceae	*Santalum album*		(309)
Saxifragaceae	*Ribes grossularia*		(23, 104, 782)
	R. rubrum		(198)
	R. sanguineum		(358)
Simarubaceae	*Quassia amara*	Root bark	(772, p. 641 note 1)

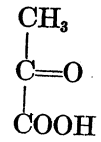
Family	Genus and species	Source	Reference
	Oxalic Acid—Continued		
Solanaceae	----------	----------	(130)
	Capsicum annuum (*C. frutescens*).	----------	(23, 63, 236)
	Datura sp	----------	(509)
	D. stramonium	----------	(455)
	Nicotiana sp	Leaf	(30, 493, 505, 569, 574, 575, 662, 748, 749, 805)
		----------	(32, 686, 707, 708, 751)
	N. tabacum	Leaf	(455; 687; 772, p. 1112, note 2)
	Solanum sp	----------	(509)
	S. lycopersicum (*Lycopersicon esculentum*).	----------	(4, 63, 122, 533, 686, 810)
		Fruit	(7, 23, 104, 351, 381, 782)
		Unripe fruit	(83, 84)
	S. tuberosum	Tuber	(23, p. 99, ftn. 2; 126; 303; 426; 455; 562; 656; 782)
Sterculiaceae	*Sterculia plantanifolia* (*Firmiana simplex*).	----------	(8)
	Theobroma cacao	----------	(23, 236, 452, 453, 782)
Theaceae	----------	----------	(236, 292, 785)
Umbelliferae	----------	----------	(509)
	Angelica archangelica	Root	(690)
	Anethum graveolens	Leaf	(782)
	Apium graveolens	----------	(23)
	Pastinaca sativa	----------	(782)
	Petroselinum sativum (*P. crispum*).	----------	(782)
Valerianaceae	*Valeriana officinalis*	----------	(91)
	Valerianella sp	----------	(509)
Vitaceae	*Ampelopsis* sp	----------	(509)
	A. quinquefolia (*Parthenocissus quinquefolia*).	Fruit	(557)
	Vitis vinifera	do	(23, 184, 186, 276)
		----------	(278, 280)
		Leaf and fruit	(343)
		Leaf and shoot	(479)
		Sap	(480, 804)
		Vines	(481)
Zingiberaceae	*Hedychium* sp	Leaf	(77, p. 165, ref. 4)
Zygophyllaceae	*Guaiacum* sp	Phloem	(77, p. 165, ref. 4)

Family	Genus and species	Source	Reference
	Phthalic Acid		
			
Papaveraceae	*Papaver somniferum*	----------	(*635*)
	Pimaric Acid		
			
	d-pimaric	levopimaric	
Pinaceae	*Picea vulgaris* (*P. abies*)	Resin	(*67*)
	P. excelsa (*P. abies*)	do	(*260, 345, 346*)
	Pinus (5 spp.)	Oleoresin	(*260*)
	P. maritima	Resin	(*157, 378*)
	P. palustris	Oleoresin	(*35, 257*)
		Resin	(*357*)
		Turpentine gum.	(*503*)
	P. pinaster	----------	(*159*)
	P. sylvestris	----------	(*259, 274*)
	Piperonilic Acid		
			
Rubiaceae	*Palicourea densiflora*	Bark	(*318*)

Family	Genus and species	Source	Reference
	Podocarpic Acid		
Pinaceae	*Dacrydium cupressinum*	----------	(*161, 649*)
	Podocarpus cupressina	----------	(*500, 649*)
	P. dacrydioides	----------	(*161, 649*)
	Protocatechuic Acid		
Bignoniaceae	*Crescentia* sp	Crude curare	(*330, 783*)
Globulariaceae	*Globularia alypum*	----------	(*743*)
Liliaceae	*Allium cepa*	Skin	(*20, 389, 390, 762*)
Magnoliaceae	*Illicium anisatum*	Fruit and seed	(*498*)
	I. religiosum	Fruit	(*121, 164, 165*)
	I. verum	Capsule	(*76*)
Saxifragaceae	*Hydrangea thunbergii* (*H. serrata*).	Leaf	(*698*)
Vitaceae	*Vitis vinifera*	do	(*73*)

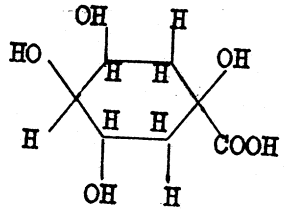
Family	Genus and species	Source	Reference

Pyruvic Acid



Chenopodiaceae	*Spinacia oleracea*	Leaf	(31)
Euphorbiaceae	*Ricinus communis*	Germinating seed.	(145)
Gramineae	*Hordeum vulgare*	----------	(57)
Labiatae	*Mentha piperita*	Seedling	(314)
Leguminosae	*Arachis hypogaea*	Leaf	(709, 711)
		Seedling	(195, 196)
	Pisum sativum	Leaf	(31)
		Seedling	(759)
	Trifolium pratense	----------	(757)
Liliaceae	*Allium cepa*	----------	(757)
		----------	(55)
	Tulipa gesneriana	Juice	(451)
Rosaceae	*Pyrus malus* (*Malus sylvestris*).	----------	(709, 710)
Solanaceae	*Solanum tuberosum*	Fruit	(298)
Umbelliferae	*Daucus carota*	Tuber	(38, 711)
		Leaf and root	(709)
		Root	(711)

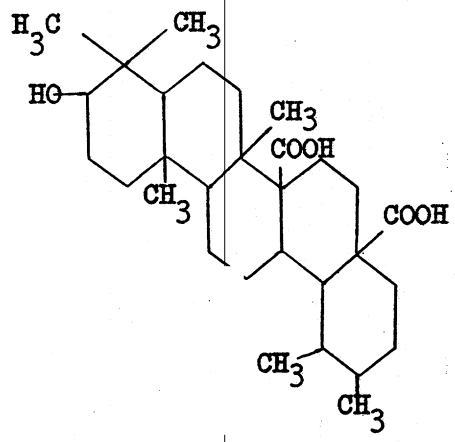
Quinic Acid



Compositae	*Taraxacum officinale*	----------	(404)
Ericaceae	*Vaccinium arctostaphylos*	Leaf	(670)
	V. myrtillus	----------	(325)
		Young leaf	(341)
		Foliage	(321)
	V. oxycoccos	Fruit	(352, 379)
	V. vitis-idaea	Leaf	(328)
Gramineae	----------	Hay	(403, 404)
	Mixed herbage	----------	(299)
Leguminosae	*Tamarindus indica*	Fruit	(325)
Magnoliaceae	*Illicium verum*	Capsule	(76)
Pinaceae	*Cedrus libani*	Needle	(701)
	Larix europaea (*L. decidua*).	----do	(701)
	Picea excelsa (*P. abies*)	Young shoot	(340)
Ranunculaceae	*Aconitum septentrionale*	----------	(341)
		----------	(315)

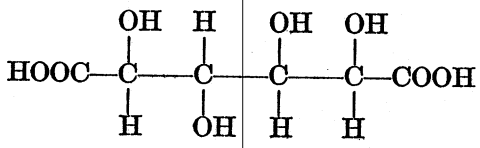
Family	Genus and species	Source	Reference
	Quinic Acid—Continued		
Rosaceae	*Prunus domestica*	Ripe fruit	(*147*)
		Fruit	(*352*)
	P. persica	Fruit	(*18, 133*)
	Pyrus communis	Juice	(*592*)
		Fruit	(*733*)
	P. malus (*Malus sylvestris*).	Fruit	(*295, 298*)
		Juice	(*530, 531, 700*)
Rubiaceae	*Cinchona* sp		(*284, 287, 521, 522, 586, 741*)
	C. cordifolia		(*522*)
	Coffea sp	Fruit	(*823*)
	Gallium mollugo		(*490*)
Solanaceae	*Nicotiana tabacum*	Leaf	(*772, p. 1112, note 2*)
Umbelliferae	*Angelica archangelica*	Root	(*690*)
Vitaceae	*Vitis vinifera*	Fruit	(*352*)

Quinovic Acid

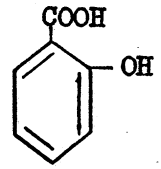


Rosaceae	*Potentilla*	Root	(*589*)
Rubiaceae	*Cinchona* spp		(*284, 586, 614*)
Zygophyllaceae	*Zygophyllum coccineum*		(*669*)

Saccharic Acid

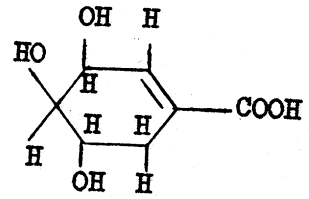


Moraceae	*Ficus elastica*	Latex	(*232*)

Family	Genus and species	Source	Reference
	Saccharinic Acid		
	$CH_2OH—CHOH—CHOH—C(CH_3)(OH)—COOH$		
Bromeliaceae	*Ananas sativas (A. comosus).*	Fruit	(79)
	Salicylic Acid		
			
Compositae	*Calendula officinalis*		(143)
	Matricaria chamomilla	Flower head	(548)
Euphorbiaceae	*Cluytia similis*	Stem and leaf	(729)
Iridaceae	*Iris versicolor*	Rhizome	(554)
Leguminosae	*Daviesia latifolia*	Leaf and stem	(555)
	Glycyrrhiza glabra	Root	(142)
	Trifolium pratense	Flower	(535)
Liliaceae	*Aloe* sp		(731)
	Gloriosa superba	Tuber	(123)
	Hyacinthus sp		(241)
	Tulipa sp		(241)
	Yucca sp		(241)
Moraceae	*Morus* sp	Fruit	(142)
Pittosporaceae	*Pittosporum undulatum*	do	(556)
Polygalaceae	*Polygala* sp	Root	(639)
Ranunculaceae	*Cimicifuga racemosa*	Rhizome	(188)
Resedaceae	*Reseda odorata*		(421)
Rosaceae	*Fragaria* sp	Calyx and pedicel.	(435)
		Fruit	(543, 544, 712, 735)
		Fruit pulp and juice.	(689)
		Juice	(791)
	Prunus armenica	Fruit	(712)
	P. avium	do	(143)
	P. cerasus	do	(142, 143, 243, 712)
		Juice	(311)
	P. domestica	Fruit	(712)
	P. persica	do	(712)
	Rubus fruticosus	do	(712)
	R. idaeus	do	(243, 712, 735)
		Juice	(266, 791)
	R. occidentalis	Fruit	(712)
	Spiraea ulmaria (Filipendula ulmaria).	Flower	(421, 422)
Rubiaceae	*Uragoga ipecacuanha (Cephaelis ipecacuanha).*	Root	(421)
Rutaceae	*Barosma* sp		(770)
	Casimiroa edulis	Seed	(549)
Saxfragaceae	*Ribes* sp	Fruit	(712)

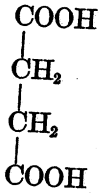
Family	Genus and species	Source	Reference
	Salicylic Acid—Continued		
Solaneaceae	*Solanum lycopersicum* (*Lycopersicon esculentum*.		(*194, 519*)
Violaceae	*Viola* (6 spp.)		
	V. syrtica	Leaf, stem, and rhizome.	(*143*) (*423*)
	V. tricolor	Flower, leaf, stem, and root.	(*242*)
		Leaf, stem, and rhizome.	(*423*)
Vitaceae	*Vitis labrusca*	Fruit	(*243*)
	V. vinifera	do	(*435*)

Shikimic Acid



Ginkgoaceae	*Ginkgo biloba*	Leaf	(*261, 808*)
Gramineae	*Lolium perenne*		(*596*)
Magnoliaceae	*Illicium anisatum*		(*498*)
	I. religiosum	Fruit	(*121, 164*)
		Carpel	(*165*)
	I. verum		(*655*)
		Carpel	(*76, 213*)
Pinaceae	25 spp		(*655*)
Taxaceae	4 spp		(*261*)
			(*261*)

Succinic Acid



Franzen and Ostertag (*208*) have made a critical review of the literature on the occurrence of succinic acid.]

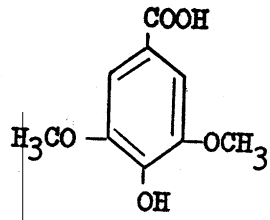
Aceraceae	*Acer saccharum*	Sirup	(*468, 542*)
		Sugar sand	(*469*)
Amaryllidaceae	*Narcissus poeticus*	Leaf and root	(*752*)
Begoniaceae	*Begonia semperflorens*		(*611, 732*)
Betulaceae	*Corylus* sp	Nut	(*144*)
Bigononiaceae	*Crescentia* sp		(*72*)
		Crude curare	(*330*)

Family	Genus and species	Source	Reference
	Succinic Acid—Continued		
Bombacaceae	*Adansonia digitata*	Fruit	(*5*)
Celastraceae	*Goupia tomentosa*	Wood	(*156*)
Chenopodiaceae	*Beta vulgaris*	Juice	(*396, 501, 672, 673*)
		Top and root	(*571*)
		Leaf and root	(*742*)
	Spinacia oleracea	Leaf	(*377*)
Compositae	*Artemisia absinthium*	----------	(*706*)
		Leaf	(*819*)
	Helianthus annuus	----------	(*58*)
	Lactuca spp	----------	(*515*)
	L. sativa	----------	(*347, 732*)
	L. virosa	----------	(*347*)
	Taraxacum officinale	----------	(*404*)
Crassulaceae	*Bryophyllum* sp	Leaf	(*570, 571*)
	B. calycinum	do	(*109, 563, 687*)
		Detached leaf	(*738*)
		----------	(*686*)
	Echeveria secunda	----------	(*207*)
		Leaf	(*484*)
	Sedum acre	Leaf	(*484*)
	Sempervivum glaucum	do	(*52*)
Cruciferae	*Brassica oleracea*	Leaf and bud	(*475*)
	Bunias orientalis	Stem, leaf, and flowering top.	(*316*)
Ericaceae	*Vaccinium myrtillus*	Fruit	(*325*)
		Whole plant	(*583*)
Euphorbiaceae	*Ricinus communis*	----------	(*65, 145*)
Fagaceae	*Fagus sylvatica*	Sap	(*646*)
	Quercus sp	Nut	(*144*)
Gramineae	----------	----------	(*299*)
	Avena sativa	----------	(*291*)
	Bambusa sp	----------	(*70*)
	Dactylis glomerata	----------	(*134*)
	Hordeum vulgare	Leaf	(*114, 687*)
		Etiolated shoot	(*168*)
		Seedling	(*291, 686*)
		----------	(*314, 739*)
	Lolium perenne	----------	(*134*)
	Oryza spp	----------	(*809*)
	O. sativa	----------	(*256*)
	Phleum pratense	----------	(*134*)
	Saccharum officinarum	Juice	(*68, ref. 57; 603; 604; 605; 704, ref. 162; 794; 811*)
	Triticum sp	----------	(*739*)
	Zea mays	Leaf	(*43, 571*)
Juglandaceae	*Juglans regia*	Nut	(*144*)
Lauraceae	*Persea gratissima* (*P. americana*).	Kernel	(*514*)
Leguminosae	*Lupinus albus*	Seedling	(*291*)
	Phaseolus coccineus	----------	(*58*)
	Pisum sativum	Seedling	(*291*)
	Tamarindus indica	----------	(*202, 325*)
Loganiaceae	*Strychnos toxifera*	----------	(*70, 71*)
Malvaceae	*Gossypium* sp	----------	(*181*)
Moraceae	*Morus* sp	----------	(*806*)
	M. alba	Bark exudate	(*225*)
	M. indica	Leaf	(*326*)
Musaceae	*Musa basjoo*	Juice	(*623*)
	M. sapientum	Fruit	(*193*)

Family	Genus and species	Source	Reference
	Succinic Acid—Continued		
Papaveraceae	*Chelidonium majus*		(636)
	Eschscholtzia sp		(766)
	Glaucium luteum	Juice	(634)
	Papaver somniferum		(766)
Pinaceae	*Abies pectinata (A. alba).*	Turpentine	(380)
	Agathis australis	do	(113)
	A. dammara	Resin	(722)
	Larix decidua	Resin	(457)
	Picea vulgaris (P. abies)	do	(719)
	Pinus sp	do	(723)
	P. sylvestris	do	(720)
Polygonaceae	*Fagopyrum esculentum*	Sap	(646)
	Rheum hybridum	Resin	(721)
		Leaf and stem	(144)
		Rhizome and stem.	(571)
	R. officinale	Leaf	(612)
	R. rhaponticum	Petiole	(687)
	R. undulatum	Leaf and petiole	(102)
Proteaceae	*Orites excelsa*	Petiole	(571)
Ranunculaceae	*Anemone nemorosa*	Wood	(343)
Rosaceae	*Fragaria* sp	Leaf	(664)
	Prunus avium		(400)
	P. cerasus	Fruit	(732)
		do	(6)
	P. communis	Juice	(197)
	P. persica	Fruit	(319)
	Pyrus aucuparia (Sorbus aucuparia).	Fruit pulp	(337)
	P. communis	Fruit	(320)
	P. malus (Malus sylvestris).	do	(18)
	Rubus fruticosus		(206)
	R. idaeus	Juice	(401)
Rutaceae	*Citrus limon*	Fruit	(592)
Santalaceae	*Santalum album*	Fruit	(733)
Sapotaceae	*Mimusops* sp	Juice	(43,105,106)
Saxifragaceae	*Ribes rubrum*		(200)
Scrophulariaceae	*Digitalis purpurea*	Leaf	(530, 702)
	Atropa belladonna	Fruit	(205)
Solanaceae	*Nicotiana* sp	Leaf	(465)
	N. tabacum	Fruit	(211, 319, 732)
	Solanum lycopersicum (Lycopersicon esculentum).		(326)
	S. tuberosum		(309)
Umbelliferae	*Angelica archangelica*		(515)
	Daucus carota		(198)
Vitaceae	*Vitis vinifera*		(87, 331)
			(366)
		Leaf	(43, 571, 653, 686)
		Leaf	(570, 748, 749)
		Fruit	(687, 751)
		Overripe fruit	(7, 736, 737)
		Leaf and stalk	(82, 83, 84)
		Leaf	(571)
		Tuber	(686, 687)
		Root	(814)
		do	(690)
		Leaf	(105, 106, 409)
		Unripe fruit	(73)
		Fruit	(101)
		Sap and fruit	(102, 343)
		Sap	(280)
			(481, 804)

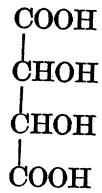
Family	Genus and species	Source	Reference

Syringic Acid



Gramineae	*Saccharum officinarum*	Juice	(605)
		Crude molasses	(696)

Tartaric Acid



[Franzen and Helwert (201) have made a critical review of literature on the occurrence of tartaric acid]

Aceraceae	*Acer saccharum*	Sugar sand	(398, 666)
		Sirup	(469)
Amaryllidaceae	*Agave americana*	Leaf sap	(107)
Anacardiaceae	*Mangifera indica*	----------	(86)
	Rhus coriaria	----------	(152)
	R. semialata	----------	(734)
	Spondias purpurea	----------	(558)
Araliaceae	*Aralia hispida*	Fruit	(222)
Ascelpiadaceae	*Asclepias syriaca*	Milky sap	(643)
Berberidaceae	*Berberis integerrima*	Fruit	(343)
	Caulophyllum thalictroides.	Fruit pulp	(679)
Betulaceae	*Betula alba*	Sap	(217)
Bombacaceae	*Adansonia* sp	Fruit	(445)
		Fruit pulp	(523, p. 779)
	A. digitata	Fruit	(5)
Bromeliaceae	*Ananas sativas (A. comosus).*	----do	(79, 515)
Caprifoliaceae	*Diervilla florida*	Fruit	(135)
	Lonicera xylosteum	----do	(170)
	Sambucus callicarpa	----do	(124)
	S. ebulus	----do	(174)
		Root	(175)
	S. nigra	Fruit	(173)
	Symphoricarpos racemosus (S. albus).	----do	(663)
	Viburnum lantana	----------	(178)
	V. nudum	----------	(406)
Caricaceae	*Carica papaya*	Fruit	(513)
Celastraceae	*Celastrus obscurus*	Leaf	(154)
	C. scandens	Fruit	(776)
	Euonymus atropurpureus	Root bark	(463)
	E. europaeus	Seed kernel	(245)

Family	Genus and species	Source	Reference
	Tartaric Acid—Continued		
Chenopodiaceae	*Beta vulgaris*	Root	(*226, 396*)
		Root and leaf	(*742*)
	Chenopodium ambrosioides		(*201, p. 297*)
Commelinaceae	*Tradescantia purpurea*	Stem sap	(*219*)
	T. zebrina (*Zebrina pendula*).	do	(*219*)
Compositae	*Bellis perennis*		(*179*)
	Helianthus tuberosus	Tuber	(*92, 226*)
	Matricaria chamomilla	Flower	(*269*)
Cornaceae	*Cornus paniculatum* (*C. racemosus*).	Fruit	(*648*)
	C. sericea	do	(*679*)
Cruciferae	*Capella bursapastoris*		(*131*)
Elaegnaceae	*Hippophae rhamnoides*	Fruit	(*797*)
Elaeocarpaceae	*Elaeocarpus serratus*	do	(*807*)
Ericaceae	*Vaccinium* sp	Leaf	(*328*)
	V. corymbosum	Fruit	(*257*)
	V. vitisidaea	Leaf	(*491*)
		Fruit	(*792*)
Eucommiaceae	*Eucommia ulmoides*	Leaf	(*246*)
Euphorbiaceae	*Euphorbia cyparissias*	Milky sap	(*774*)
	E. platyphylla	do	(*775*)
	Phyllanthus emblica		(*326*)
	Ricinus communis		(*65*)
Fagaceae	*Quercus pedunculata* (*Q. robur*).	Wood	(*442*)
Geraniaceae	*Geranium zonale*		(*93*)
Gramineae	*Bambusa* sp	Shoot	(*621*)
	Saccharum officinarum	Juice	(*811*)
	Sorghum vulgare		(*416, 786, 787*)
Guttiferae	*Garcinia gambogia*	Fruit rind	(*367*)
Hydnoraceae	*Prosopanche burmeisteri*		(*816*)
Labiatae	*Glechoma hederacea*		(*176*)
	Orthosiphon stamineus		(*338*)
Lauraceae	*Persea gratissima* (*P. americana*).	Fruit pulp	(*514, 515*)
Leguminosae	*Astragalus* sp	Twig	(*408*)
	Bauhinia reticulata	Fruit and leaf	(*578*)
	Cassia sp	Leaf	(*716, 763*)
	C. acutifolia	do	(*376*)
	Tamarindus indica	Fruit pulp	(*81, 590, 688, 746*)
			(*3; 192; 201, ref. 28; 202; 233; 740*)
		Leaf	(*237*)
		Mesocarp	(*271*)
		Green and ripe fruit.	(*310, 558*)
		Fruit	(*326, 693*)
Liliaceae	*Clintonia borealis*	Fruit	(*661*)
	Erythronium denscanis	Bulb	(*153*)
	Smilacina bifolia(?)	Fruit	(*163*)
	S. racemosa	do	(*163*)
Magnoliaceae	*Schizandra chinensis*	do	(*525*)
Moraceae	*Morus indica*	Leaf	(*326*)
Myrtaceae	*Eugenia australis*		(*407*)
	Psidium guajava		(*620*)
Musaceae	*Musa sapientum*	Fruit	(*193*)
Orchidaceae	*Vanilla planifolia*	do	(*384*)
Oxalidaceae	*Oxalis corniculata*	Leaf	(*237*)

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Family	Genus and species	Source	Reference
	Tartaric Acid—Continued		
Papaveraceae	*Adlumia cirrhosa* (*A. fungosa*).	Root	(*633*)
	Chelidonium majus	Leaf	(*560*)
	Fumaria officinalis	Sap	(*201, p 295*)
	Papaver somniferum	Capsule	(*141*)
Pinaceae	*Pinus sylvestris*	Pollen	(*363*)
Piperaceae	*Piper nigrum*		(*520*)
Polygonaceae	*Polygonum reynoutria*	Stem	(*697*)
Ranunculaceae	*Aconitum napellus*		(*588*)
Rosaceae	*Crataegus* sp	Fruit	(*433*)
	Cydonia vulgaris	do	(*119, 693, 714*)
	Eriobotrya japonica	do	(*368*)
	Fragaria sp		(*119, 458, 714*)
	Prunus armeniaca	Fruit	(*119, 487, 489, 693*)
			(*714*)
	P. avium		(*119*)
	P. cerasus	Fruit	(*119, 458, 487, 488, 489, 714*)
	P. domestica	do	(*487, 488, 489, 714*)
	P. persica	do	(*488, 629*)
	P. spinosa		(*642*)
	Pyrus arbutifolia	Fruit	(*584*)
	P. aucuparia (*Sorbus aucuparia*).		(*386a, 401*)
	P. malus (*Malus sylvestris*).	Fruit	(*487, 489*)
		Juice	(*693*)
	Rubus sp		(*132*)
	R. idaeus	Fruit	(*458*)
		Juice	(*119, 335*)
		Sap	(*332*)
Rubiaceae	*Coffea* sp		(*516*)
Rutaceae	*Citrus decumana* (*C. reticulata*).	Fruit	(*439*)
	Cusparia trifoliata		(*201, ref. 1*)
Santalaceae	*Leptomeria acida*	Fruit	(*591*)
Sapindaceae	*Sapindus saponaria*		(*233*)
Sapotaceae	*Achras sapota*		(*517*)
	Bassia latifolia		(*344*)
	Sideroxylon crassipedicellatum.	Fruit	(*517*)
Saxifragaceae	*Ribes* sp		(*458*)
	R. grossularia		(*792*)
	R. nigrum		(*119*)
	R. rubrum		(*209, 792*)
Scrophulariaceae	*Antirrhinum majus*		(*765*)
	Digitalis grandiflora		(*765*)
	Euphrasia officinalis		(*172*)
	Linaria cymbalaria		(*765*)
	Scrophularia nodosa		(*765*)
	Veronica officinalis		(*171*)
Solanaceae	*Cyphomandra calycina*		(*518*)
	Physalis peruviana	Fruit	(*373*)
	Solanum dulcamara	do	(*15, 776*)
	S. lycopersicum (*Lycopersicon esculentum*).		(*4*)
		Fruit	(*7, 177, 343, 693*)
	S. tuberosum	Tuber	(*167*)
Sterculiaceae	*Theobroma cacao*	Berry	(*89*)
Tiliaceae	*Tilia vulgaris*		(*201, ref. 29*)
Urticaceae	*Parietaria officinalis*		(*283*)

Family	Genus and species	Source	Reference
	Tartaric Acid—Continued		
Vitaceae	----------	----------	(186)
	Ampelopsis hederacea (Parthenocissus quinquefolia).	----------	(234)
		Leaf	(235)
	Parthenocissus quinquefolia.	Leaf	(532)
	Vitis sp	----------	(11)
		Leaf	(505)
	V. hederaceae (Parthenocissis quinquefolia).	----------	(798)
	V. labrusca	Juice	(413, 629)
		Fruit	(466)
	V. sylvestris	Fruit	(598)
	V. vinifera	----------	(13, 64, 216, 280, 302, 480)
		Fruit	(14, 190, 297, 326, 487, 541, 693)
		Leaf	(73, 343, 527, 645)
		Juice	(139, 214, 223, 255, 355, 528, 647)
		Sap	(374, 799, 804)
		Vine	(215, 278)
		Unripe fruit	(417, 496, 526)
		Young shoot and leaf.	(479)
	Tartronic Acid		
	COOH | CHOH | COOH		
Gramineae	----------	----------	(597)
	Tricarballylic Acid		
	CH_2COOH | CH COOH | CH_2COOH		
Aceraceae	*Acer saccharum*	Sugar sand	(398, 469)
Chenopodiaceae	*Beta vulgaris*	Evaporated juice.	(391, 402)
		Root	(392, 705)
		Juice	(395)
		Root and leaf	(742)
Gramineae	*Hordeum vulgare*	Whole plant	(474)

Family	Genus and species	Source	Reference
	Ursolic Acid		
Apocynaceae	*Allamanda cathartica*	Leaf	(*26*)
Aquifoliaceae	*Ilex aquifolium*		(*189*)
	I. latifolia	Cuticle	(*329*)
	I. paraguariensis	Leaf	(*440*)
Cornaceae	*Cornus florida*	Flower and bract	(*619*)
Ericaceae	*Arctostaphylos uva-ursi*	Leaf	(*617*)
	Enkianthus quinqueflorus		(*25*)
	Erica arborea		(*189*)
	E. carnea		(*189*)
	E. mediterranea		(*189*)
	Kalmia angustifolia		(*313*)
	Leucothoe keiskei	Leaf	(*657*)
	Rhododendron (6 spp.)		(*25*)
	R. pulchrum	Leaf	(*26*)
	R. simsii	do	(*26*)
	Vaccinium macrocarpon	Pomace	(*430*)
	V. myrtillus		(*189, 583*)
	V. oxycoccos	Fruit pulp	(*371*)
	V. vitis-idaea		(*189*)
Labiatae	*Salvia officinalis*		(*97*)
	Thymus vulgaris		(*609*)
Myrtaceae	*Psidium guajava*	Leaf	(*27*)
Punicaceae	*Punica granatum*	Peel and leaf	(*98*)
Pyrolaceae	*Pyrola minor*		(*189*)
	P. umbellata		(*189*)
Rosaceae	*Crataegus oxyacantha*		(*59*)
	Eriobotrya japonica		(*26*)
	Prunus avium	Cuticle	(*431*)
	P. serotina		(*251*)
		Leaf	(*617*)
	Pyrus communis	Fruit skin	(*428*)
	P. malus (*Malus sylvestris*).	Fruit	(*250*)
		Fruit skin	(*275, 617*)
		Fruit cuticle	(*429*)
Solanaceae	*Anthocercis intricata*		(*21*)
	A. littorea		(*21*)
	A. odgersii		(*21*)
Verbenaceae	*Verbena stricta*		(*506*)

Family	Genus and species	Source	Reference
	Veratric Acid		
Liliaceae	*Sabadilla officinalis*	Seed	(*441*)

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