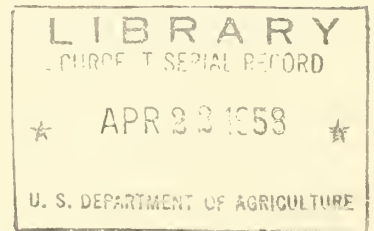


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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service



BIBLIOGRAPHY
OF ORGANIC ACIDS
IN HIGHER PLANTS

October 1957



BIBLIOGRAPHY OF ORGANIC ACIDS IN HIGHER PLANTS

by
M. L. Buch

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

Non-volatile, non-nitrogen-containing, carboxylic acids whose structure is generally accepted (144) (272) are included. Fatty acids and long chain polymers such as pectins are excluded, as are compounds which contain a sugar group as part of the molecule. Thus carboxylic saponinins are included but saponins are not. The acids reported are those which are found in the free state or as salts, not as esters.

Plants are listed by family, genus and species. The family name follows the system given by Willis (799), as do genus and species when possible. Only spermatophyta are included.

Journal abbreviations and listings are, so far as possible, those used by Chemical Abstracts. All titles are in English.

This review covers all available publications through 1954. Only a limited number of references have been included from more recent literature.

Table I.

Naturally Occurring Organic Acids Listed in Alphabetical Order

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| Aconitic | 6 |
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| Ascorbic | 8 |
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| Benzoic | 9 |
| Betulinic | See Betulinic |

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| Caffeic | 10 |
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| Caffeic acid-4-methyl ether - See Isoferulic. | |
| Chelidonic | 11 |
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| Cinnamic | 25 |
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| Digallic | 27 |
| 3,4-Dihydroxy benzoic - See Protocatechuic | |
| 5,6-Dihydroxy-3-carboxy phenyl ester of gallic - See Digallic. | |
| 3,4-Dihydroxy cinnamic - See Caffeic | |
| 3,4-Dihydroxy hydrocinnamic - See Hydrocaffeic | |
| Dihydroxy maleic | 27 |
| Dihydroxy malonic - See Mesoxalic | |
| α,β -Dihydroxy tricarballylic - See Hydroxycitric | |
| 3,4-Dimethoxybenzoic - See Veratric | |
| 3,4-Dimethoxycinnamic | 27 |
| 3,4-Dimethoxyphthalic - See Hemipinic | |
| Ethyl malic | 27 |
| Ferulic | 27 |
| Fluoracetic | 28 |
| Fumaric | 28 |
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| Glucosaccharic - See Saccharic | |
| Glucuronic | 31 |
| Glutaric | 32 |
| Glyceric | 32 |
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| Glycuronic - See Glucuronic | |
| Glyoxalic | 34 |
| Glyoxylic - See Glyoxalic | |
| Hemipic - See Hemipinic | |
| Hemipinic | 35 |
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| Hydroxycitric | 36 |
| 4-Hydroxy-3,5-dimethoxybenzoic - See Syringic | |
| 1-Hydroxy-1-ethyl succinic - See Ethyl malic | |
| Hydroxyglutaric | 36 |
| Hydroxy hydrocinnamic - See Melilotic | |
| Hydroxymalonic - See Tartronic | |
| 2-Hydroxy-6-methoxy benzoic | 36 |
| 3-Hydroxy-4-methoxycinnamic - See Isoferulic | |
| 4-Hydroxy-3-methoxycinnamic - See Ferulic | |

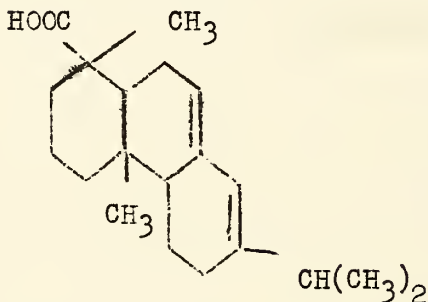
| | Page |
|--|------|
| l-Hydroxy-l-methylsuccinic - See Methylmalic | |
| p-Hydroxyphenylacetic | 36 |
| 4-Hydroxy- α -toluic - See Phenylacetic | |
| Isochlorogenic | 36 |
| Isocitric | 37 |
| Isoferulic | 28 |
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| Ketoglutaric | 38 |
| Ketomalonic - See Mesoxalic | |
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| Pimaric | 57 |
| Piperonic | 58 |
| Podocarpic | 58 |
| Protocatechuic | 58 |
| Protocatechuic dimethyl ether - See Veratric | |
| Pyruvic | 59 |
| Quinic | 59 |
| Quinovic | 61 |
| Saccharic | 61 |
| Saccharinic | 61 |
| Salicylic | 61 |
| Shikimic | 63 |
| Succinic | 64 |
| Syringic | 69 |
| Tartaric | 69 |
| Tartronic | 75 |
| Tricarballic | 76 |
| Ursolic | 76 |
| Veratric | 77a |

TABLE II.

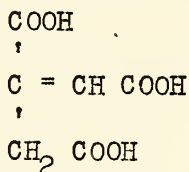
Occurrence of Organic Acids in Higher Plants

Abietic Acid



| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|-------------------|
| Pinaceae | | Colophony | 37, 117, 166, 173 |
| | <i>Pinus abies</i> | Resin | 48, 422 |
| | <i>P. larix</i> | | 422 |
| | <i>P. palustris</i> | Resin | 35a, 265a, 344a |

Aconitic Acid

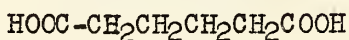


| | | | |
|----------------|------------------------------|-----------------|---|
| Chenopodiaceae | <i>Beta vulgaris</i> | Juice | 396, 399 |
| | " " | Unripe beet | 713 |
| Compositae | <i>Achillea millefolium</i> | | 291 |
| | <i>Helianthus annuus</i> | | 58 |
| Gramineae | <i>Avena sativa</i> | | 483 |
| | <i>Hordeum vulgare</i> | Etiolated shoot | 172 |
| | " " | Seedling | 320, 483 |
| | <i>Saccharum officinarum</i> | Juice | 10, 36, 50, 415, 609, 610, 611, 702, 707, 711, 794, 821, 827. |
| | <i>Secale cereale</i> | | 483 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------------------|------------------|
| | Secale cereale | Seedling | 676 |
| | Sorghum vulgare | | 419, 754 |
| | " " | Scale from evap. pans | 513 |
| | " " | Juice | 755, 796, 797 |
| | Triticum sp. | | 481 |
| | " " | Temporary in sprout | 675 |
| | T. sativum | Seedling | 676 |
| | Zea mays | Sprouting seed | 676 |
| Leguminosae | Phaseolus coccineus | | 58 |
| Ranunculaceae | Aconitum spp. | | 58, 112, 504 |
| | A. columbianum | | 49 |
| | A. heterophyllum | | 328 |
| | " " | Root | 779 |
| | A. napellus | | 50 |
| | A. septentrionale | Tuber & root | 321 |
| | A. vernalis | | 504 |
| | " " | Leaf | 392 |
| | Delphinium barbeyi | | 49 |
| | D. bicolor | | 49 |
| | D. consolida | Leaf sap | 791 |
| | D. culculatum | | 49 |
| | D. geyeri | | 49 |
| | D. glaucescens | | 49 |
| | D. nelsonii | | 49 |
| Solanaceae | Solanum lycopersicum | Fruit | 113 |
| | " " | Root, leaf, ripe fruit | 120 |

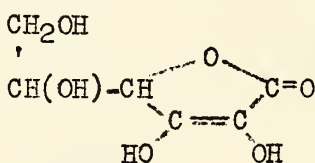
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|------------------|
| Umbelliferae | Angelica archangelica | Root | 698 |

Adipic Acid



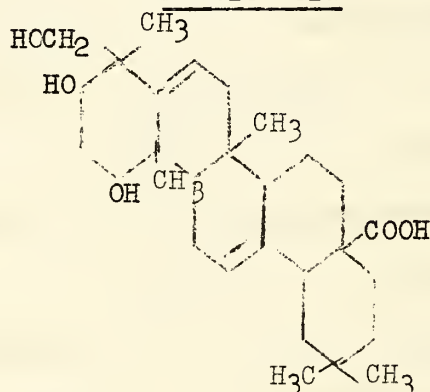
| | | | |
|----------------|---------------|--|----------|
| Chenopodiaceae | Beta vulgaris | | 400, 752 |
|----------------|---------------|--|----------|

Ascorbic Acid

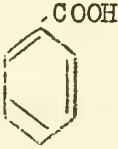


Since its structure was elucidated by Svirbely and Szent-Györgyi in 1932 (699) (700), ascorbic acid has been reported in almost every plant in which its presence has been investigated.

Bassic Acid

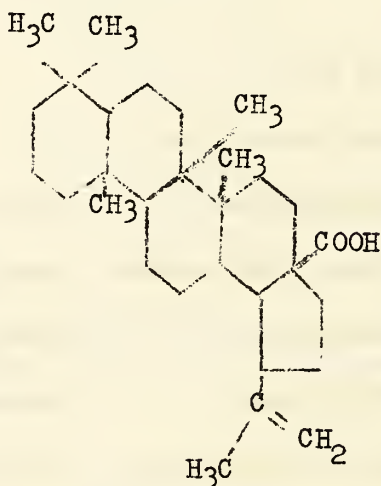


| | | | |
|------------|------------------|------|----------|
| Sapotaceae | Achras sapota | Seed | 282 |
| | Bassia butyracea | Seed | 282, 283 |
| | B. latifolia | Seed | 282, 283 |
| | B. longifolia | Seed | 282 |
| | B. parkii | Seed | 282, 283 |
| | Dumoria heckelii | Seed | 282 |
| | Mimusops djave | Seed | 282 |
| | M. elengi | Seed | 282 |
| | M. hexandra | Seed | 282 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|---|---------------|-----------------------------|
| | Payena lucida | Seed | |
| | <u>Benzoic Acid</u> | | |
| |  | | |
| Compositae | Dahlia sp. | | 517 |
| Droseraceae | Drosera rotundifolia | | 806 |
| Empetraceae | Empetrum nigrum | Leaf | 312 |
| Ericaceae | Vaccinium macrocarpum | Berry | 247, 436, 475 |
| | V. oxycoccus | Berry | 247, 418, 485, 605 |
| | V. vitis-idaea | Berry | 51, 247, 334, 385, 407, 485 |
| Gramineae | Bambusa arundinaceae | Young shoot | 226 |
| Leguminosae | Daviesia latifolia | Leaf & stem | 562 |
| | Myroxylon pereirae | Balsam | 364 |
| | M. toluiferum | Balsam | 114, 150 |
| Lentibulariaceae | Pinguicula vulgaris | Leaf | 409 |
| Liliaceae | Dracena draco | Resin | 725 |
| | Gloriosa superba | Tuber | 127 |
| Magnoliaceae | Illicium anisatum | Fruit & Seed | 505 |
| Myrtaceae | Psidium spp. | | 521 |
| Papaveraceae | Papaver somniferum | | 641 |
| Pinaceae | Agathis australis | | 464 |
| Rosaceae | Prunus serotina | Bark | 557 |
| | " " | Leaf | 558 |
| Rubiaceae | Coffea sp. | | 414, 522 |
| Rutaceae | Casimiroa edulis | Seed | 556 |

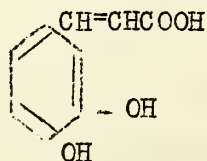
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|---------------------------|---------------|------------------|
| Scrophulariaceae | <i>Digitalis purpurea</i> | | 337 |
| Styracaceae | <i>Styrax</i> sp. | | 375, 535 |
| | <i>Styrax benzoin</i> | Resin | 725 |

Betulinic Acid



| | | | |
|--------------|------------------------------|------------------------|-----|
| Apocynaceae | <i>Alyxia buxifolia</i> | Bark | 22 |
| Cornaceae | <i>Cornus florida</i> | | 612 |
| Gentianaceae | <i>Menyanthes trifoliata</i> | Rhizome | 679 |
| Loranthaceae | <i>Nuytsia floribunda</i> | Leaves, stems, bark | 22 |
| Myrtaceae | <i>Melaleuca-6</i> species | Bark | 22 |
| | <i>Syncarpia laurifolia</i> | Bark | 586 |
| Platanaceae | <i>Platanus acerifolia</i> | Bark | 104 |
| Punicaceae | <i>Punica granatum</i> | Leaves and bark | 102 |
| Rhamnaceae | <i>Ziziphus vulgaris</i> | Seeds & bark | 339 |

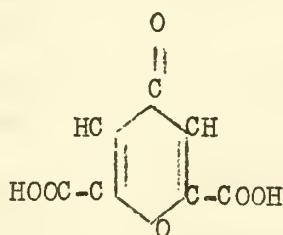
Caffeic Acid



| | | | |
|---------------|------------------------|------|-----|
| Aquifoliaceae | <i>Ilex aquifolium</i> | Leaf | 686 |
|---------------|------------------------|------|-----|

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------------|------------------------|------------------|
| | <i>I. paraguayensis</i> | Leaf | 686 |
| Compositae | <i>Anthemis nobilis</i> | Flower | 554 |
| | <i>Taraxacum officinale</i> | Root | 553 |
| Labiatae | <i>Melissa</i> sp. | Leaf | 279 |
| Pinaceae | <i>Larix europaea</i> | Resin | 37 |
| Ranunculaceae | <i>Aconitum septentrionale</i> | | 321 |
| | <i>Clematis vitalba</i> | Flowering branch | 740 |
| Rosaceae | <i>Crataegus oxyacantha</i> | Leaf, fruit, flower | 194 |
| Rubiaceae | <i>Cinchona cuprea</i> | Bark | 352 |
| | <i>Coffea</i> sp. | Bean | 194 |
| | <i>Coffea</i> sp. | Leaf | 686 |
| Scrophulariaceae | <i>Digitalis purpurea</i> | | 89, 337 |
| | <i>Scrophularia nodosa</i> | Root | 323 |
| Solanaceae | <i>Solanum tuberosum</i> | | 329 |
| Umbelliferae | <i>Angelica archangelica</i> | | 698 |
| | <i>Conium maculatum</i> | | 294 |

Chelidonic Acid



| | | | |
|---------------|----------------------------|---------------------------|-----|
| Amarylidaceae | | | 692 |
| | <i>Agave</i> sp. | Leaf | 588 |
| | <i>Agave falcata</i> | Anther, perigone | 589 |
| | <i>Amaryllis crispa</i> | Leaf, perigone, anther | 589 |
| | <i>Androstemma junceum</i> | Leaf, perigone, anther | 589 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------------|-------------------------------------|------------------|
| | <i>Anigozanthos humilis</i> | Leaf | 589 |
| | <i>A. preissii</i> | Anther | 589 |
| | <i>Anoiganthus breviflorus</i> | Pericarp | 589 |
| | <i>Blancoa canescens</i> | Leaf, perigone | 589 |
| | <i>Brunsvigia angustifolia</i> | Leaf, Flower | 589 |
| | <i>B. josephinae</i> | Pericarp, leaf, perigone, anther | 589 |
| | <i>B. uitenhagensis</i> | Flower | 589 |
| | <i>Buphane ciliaris</i> | Leaf, perigone, anther | 589 |
| | <i>Carpolyza spiralis</i> | Leaf, perigone, bulb | 582 |
| | <i>Conostylis</i> 12 spp | | 589 |
| | <i>Crinum capese</i> | Leaf, perigone, pedicel | 589 |
| | <i>C. kirkii</i> | Leaf, perigone, pedicel | 589 |
| | <i>C. purpurascens</i> | Leaf, perigone, anther | 589 |
| | <i>Cummingia tenella</i> | Perigone | 589 |
| | <i>Galanthus nivalis</i> | Leaf, pedicel, anther, perigone | 589 |
| | <i>G. plicatus</i> | Leaf, perigone, pedicel, bulb | 589 |
| | <i>Hessea maximiliani</i> | Flower | 589 |
| | <i>Hippeastrum mandoni</i> | Leaf, perigone anther, pedicel | 589 |
| | <i>Hypoxis juncea</i> | Flower | 589 |
| | <i>H. minuta</i> | Flower, leaf | 589 |
| | <i>H. probata</i> | Perigone | 589 |
| | <i>H. serrata</i> | Perigone, leaf, anther | 589 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--|--|------------------|
| | <i>H. villosa</i> | Leaf, perigone | 589 |
| | <i>Ixiolirion montanum</i> | Perigone, leaf, flower | 589 |
| | <i>Lanaria plumosa</i> | Leaf, perigone | 589 |
| | <i>Leucojum</i> 5 spp. | | 589 |
| | <i>Lophiola americana</i> | Leaf, flower | 589 |
| | <i>Lycoris aurea</i> | Perigone, anther, pedicel, pericarp | 589 |
| | <i>Narcissus</i> 14 spp. | | 589 |
| | <i>Pancratium canariense</i> | Leaf, anther | 589 |
| | <i>Sternbergia colchici</i> flora | Leaf, perigone, anther, seed | 589 |
| | <i>S. lutea</i> | Leaf, perigone, anther | 589 |
| | <i>Tribonantes uniflora</i> | Perigone | 589 |
| | <i>Zephyranthes rosea</i> | Perigone, leaf, anther | 589 |
| Berberidaceae | <i>Berberis vulgaris</i> | | 373 |
| Campanulaceae | <i>Centropogon</i> 6 spp. | | 589 |
| | <i>Downingia pulchella</i> | | 589 |
| | <i>Isotoma</i> 5 spp. | | 589 |
| | <i>Laurentia</i> 4 spp. | | 589 |
| | <i>Lobelia</i> 25 spp. | | 589 |
| | <i>Lobelia cardinalis</i> | | 373 |
| | <i>L. inflata</i> | | 373 |
| | <i>L. inflata</i> | Fruit | 588 |
| | <i>L. syphilitica</i> | | 373 |
| | <i>Siphocampylus</i> 9 spp. | | 589 |
| Cannaceae | <i>Canna</i> spp. | Root | 588 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------|------------------------------|------------------|
| Dioscoreaceae | Discorea balcanica | Leaves, flower, pericarp | 589 |
| | D. deltoidea | Leaves, flower | 589 |
| | D. humifusa | Seed, pericarp | 589 |
| Haemodoraceae | Dilatris corymbosa | Flowers, leaves | 589 |
| | Lachenalia tinctoria | Flowers, leaves | 589 |
| | Wachendorfia paniculata | Flowers, leaves, pericarp | 589 |
| | W. thyrsoiflora | Anther | 589 |
| Hippocastanaceae | Aesculus flava | Perigone, leaf | 589 |
| | A. hippocastanum | | 588 |
| Liliaceae | Acanthocarpus Preissii | Pericarp, leaf | 589 |
| | Allium cirrhosum | Leaf | 589 |
| | A. flavescens | Leaf | 589 |
| | A. obliquum | Leaf | 589 |
| | A. tenuissimum | Leaf, flower | 589 |
| | Aloe minima | Leaf | 589 |
| | Androcymbium 3 spp. | | 589 |
| | Anguillaria dioica | Leaf | 589 |
| | A. tenella | Leaf | 589 |
| | Anticlea sibirica | Leaf, bulb, filament | 589 |
| | Asparagus 11 spp. | | 589 |
| | Asparagus officinalis | | 587 |
| | Asphodelus clavatus | | 589 |
| | A. damascena | | 589 |
| | Bellevalia dubia | Flower | 589 |
| | Boemetra columellaris | Filament, leaf, perigone | 589 |

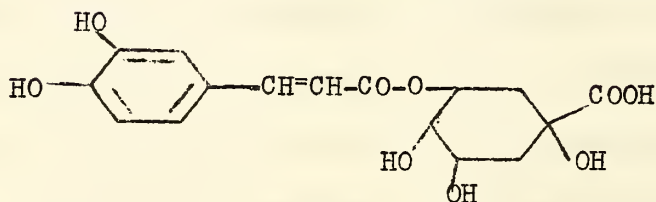
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|----------------------------------|---------------------------|------------------|
| | <i>Borya septentrionalis</i> | Leaf | 589 |
| | <i>Brodiaea</i> 3 spp. | | 589 |
| | <i>Bulbine alooides</i> | Flower | 589 |
| | <i>Bulbocodium ruthenicum</i> | Leaf | 589 |
| | <i>B. versicolor</i> | Leaf | 589 |
| | <i>Chlorophytum Bowkeri</i> | Flower | 589 |
| | <i>C. parviflorum</i> | Pedicel | 589 |
| | <i>Colchicum</i> 12 spp. | | 589 |
| | <i>C. autumnale</i> | | 373 |
| | <i>Convallaria majalis</i> | | 373 |
| | " " | Leaf, anther, perigone | 589 |
| | <i>Cordyline Banksii</i> | Flower | 589 |
| | <i>C. Pumilio</i> | Leaf | 589 |
| | <i>Dasyilirion graminifolium</i> | Flower | 589 |
| | <i>Dasypogon bromeliifolius</i> | Flower | 589 |
| | <i>Dichopogon humilis</i> | Flower | 589 |
| | <i>Dracena angustifolia</i> | Leaf | 589 |
| | <i>D. elliptica</i> | Flower | 589 |
| | <i>Eremurus himalaicus</i> | Leaf | 589 |
| | <i>Gloriosa superba</i> | | 373 |
| | <i>Hookera hyacintha</i> | Flower | 589 |
| | <i>H. minor</i> | Flower | 589 |
| | <i>Hyacinthys leucophaeus</i> | Flower | 589 |
| | <i>Iphigenia diuterik</i> | Leaf | 589 |
| | <i>I. indica</i> | Leaf | 589 |
| | <i>Johnsonia lupulina</i> | Leaf | 589 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|-------------------------|------------------|
| | Kniphofia 4 spp. | | 589 |
| | Lachenalia montigena | Leaf | 589 |
| | L. picta | Leaf, flower | 589 |
| | Liriope graminifolia | Leaf | 589 |
| | Melanthium tenue | Leaf, perigone, seed | 589 |
| | M. virginicum | Leaf, flower | 589 |
| | Merendera 5 spp. | | 589 |
| | Muscari botryoides | Flower | 589 |
| | M. calandrinianum | Flower, leaf | 589 |
| | Nartheccium scardicum | Flower | 589 |
| | Ophiopogon bockianus | Leaf | 589 |
| | O. japonicus | Leaf | 589 |
| | Ornithogalum arabicum | Anther | 589 |
| | O. fimbriatum | Leaf, perigone | 589 |
| | O. narbonense | Flower | 589 |
| | O. oligophyllum | Pedicel | 589 |
| | Ornithoglossum glaucum | Leaf, flower | 589 |
| | Paradisea liliastrum | Leaf | 589 |
| | Paris bockiana | Leaf, perigone | 589 |
| | Polygonatum 4 spp. | Leaf, perigone | 589 |
| | Reineckea carnea | Leaf, pedicel | 589 |
| | Rhipogonum album | Pedicel | 589 |
| | R. scandens | Leaf, pedicel | 589 |
| | Ruscus hypoglossum | Flower | 589 |
| | Sabadilla officinarum | | 692 |
| | Sandersonia aurantiaca | Leaf, perigone | 589 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|----------------------------|---|
| | Schoenocaulon officinale | | 373 |
| | Scilla obtusifolia | Leaf, flower | 589 |
| | S. pratensis | Flower | 589 |
| | S. verna | Leaf | 589 |
| | Smilax 6 spp. | | 589 |
| | Sugerokia orientalis | Leaf, flower, anther | 589 |
| | Tofieldia 4 spp. | | 589 |
| | Trichopetalum stellatum | Flower | 589 |
| | Trillium 9 spp. | | 589 |
| | Tupistra viridiflora | Leaf | 589 |
| | Urginea maritima | | 373 |
| | Uvularia sessilifolia | Leaf, flower | 589 |
| | Veratrum 7 spp. | | 589 |
| | V. album | | 373, 642, 692 |
| | V. viride | | 373 |
| | Wurmbea 4 spp. | | 589 |
| | Xerotes elongata | Flower | 589 |
| | X. pauciflora | Flower | 589 |
| | X. suaveolens | Flower | 589 |
| | Yucca brevifolia | Perigone, pedicel | 589 |
| | Zygadenus 5 spp. | | 589 |
| Papaveraceae | Chelidonium majus | | 262, 306, 373, 386, 391, 643, 692, 830 |
| | " " | Leaf | 567 |
| | " " | Leaf, perigone, pedicel | 589 |
| | Stylophrum diphyllum | Leaf, perigone, anther | 589, 638 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|-------------------------------|---------------|------------------|
| Rhamnaceae | <i>Paliurus aculeatus</i> | Pedicel | 589 |
| | <i>Rhamnella franguloides</i> | Leaf | 589 |
| | <i>Rhamnus</i> 21 spp. | | 589 |
| | <i>Rhamnus cathartica</i> | Fruit | 588 |
| | <i>Sageretia minutifolia</i> | Leaf | 589 |
| | <i>Zizyphus lotus</i> | Leaf | 589 |
| Rubiaceae | <i>Uragoga ipecacuanha</i> | | 373 |
| Thymelaeaceae | <i>Daphne</i> 9 spp. | | 589 |
| | <i>D. gnidium</i> | Fruit | 588 |
| | <i>Cnidia</i> 9 spp. | | 589 |
| | <i>Passerina</i> 5 spp. | | 589 |
| | <i>Pimelea flava</i> | Leaf | 589 |
| | <i>Stellera chamaejasme</i> | Leaf, flower | 589 |
| | <i>Thymelaea</i> 4 spp. | | 589 |
| | <i>Wikstroemia</i> 3 spp. | | 589 |

Chlorogenic Acid



| | | | |
|-------------|---------------------------------|--|-----|
| Acanthaceae | <i>Barleria cristata</i> | | 236 |
| | <i>Eranthemum macrophyllum</i> | | 236 |
| | <i>Graptobilanthes hortense</i> | | 236 |
| | <i>Strobilanthes lupinus</i> | | 236 |
| | <i>Thunbergia laurifolia</i> | | 236 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|--------------------------|------------------|------------------|
| Apocynaceae | Allamanda Hendersonii | | 236 |
| | Alstonia scholaris | | 236 |
| | Kopsia flavida | | 236, 238 |
| Aquifoliaceae | Ilex aquifolium | Leaf, stem, root | 122 |
| | I. salicifolia | | 236 |
| Araliaceae | Aralia maculata | | 236 |
| | Hedera helix | | 257 |
| | Heptapleurum sp. | | 236 |
| | Paratropia sp. | | 236 |
| | Trevesia sundaica | | 236 |
| Asclepiadaceae | Hoya bandanensis | | 236 |
| Bignoniaceae | Crescentia cuneifloia | | 236 |
| | Kigelia pinnata | | 236 |
| | Spathodea campanulata | | 236 |
| Boraginaceae | Cordia suaveolens | | 236 |
| | Ehretia buxifolia | | 236 |
| Canaceae | Canna indica | | 236 |
| Caprifoliaceae | Lonicera sp. | | 236 |
| | Sambucus javanica | | 236 |
| | S. nigra | Flower | 122 |
| Chenopodiaceae | Suaeda dodeneifloia | | 236 |
| Compositae | 95 genera | | 547 |
| | Achillea millefolium | Flower | 122 |
| | Anacyclus pyrethrum | Flower | 122 |
| | Arnica montana | Flower | 122 |
| | Centaurea jacea | Leaf | 122 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|-----------------------|------------------------------|---------------|-----------------------|
| | <i>Cichorium intybus</i> | Leaf | 122 |
| | <i>Clibadium asperum</i> | | 236 |
| | <i>C. surinamense</i> | | 236 |
| | <i>Dahlia variabilis</i> | | 544 |
| | <i>Eupatorium javanicum</i> | | 236 |
| | <i>E. pallescens</i> | | 236 |
| | <i>Gymnanthemum grande</i> | | 236 |
| | <i>Helianthus sp.</i> | Seed | 240 |
| | <i>H. annuus</i> | Seed | 232, 237, 367, 502 |
| | <i>H. doronicoides</i> | Leaf | 122 |
| | <i>H. tuberosus</i> | | 543, 544, 545 |
| | <i>Lactuca sativa</i> | | 545 |
| | <i>Lappa major</i> | Leaf | 122 |
| | <i>Pluchea indica</i> | | 236 |
| | <i>P. odorata</i> | | 236 |
| | <i>Silybum marianum</i> | | 543 |
| | <i>Stiffitia chrysantha</i> | | 236 |
| | <i>Tagetes erecta</i> | | 236 |
| | <i>Taraxacum gymnanthum</i> | | 544 |
| | <i>Tithonia diversifolia</i> | | 236 |
| | <i>Vernonia sp.</i> | | 236 |
| <u>Convolvulaceae</u> | <i>Argyrea kurzei</i> | | 236 |
| | <i>Erycibe tomentosa</i> | | 236 |
| | <i>Ipomoea batatas</i> | | 236, 545 |
| | " " | Root | 616 |
| | <i>Lepistemon flavescens</i> | | 236 |
| | <i>Merremia dissecta</i> | | 236 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|-----------------|---------------------------------|---------------|------------------|
| | <i>Porana paniculata</i> | | 236 |
| Cornaceae | <i>Mastixia cuspidata</i> | | 236 |
| Cucurbitaceae | <i>Coccinia cordifolia</i> | | 236 |
| | <i>Trichosanthes</i> sp. | | 236 |
| Dipsacaceae | <i>Dipsacus silvestris</i> | | 122 |
| Ericaceae | <i>Vaccinium lucidum</i> | | 236 |
| Erythroxylaceae | <i>Erythroxylum coca</i> | | 236 |
| | <i>E. novogranatense</i> | | 236 |
| Eucommiaceae | <i>Eucommia</i> sp. | Leaf | 255 |
| Gesneriaceae | <i>Aeschynanthus longiflora</i> | | 236 |
| | <i>Agalmyla staminea</i> | | 236 |
| | <i>Cyrtandra bicolor</i> | | 236 |
| | <i>Episcia pulchella</i> | | 236 |
| | <i>Gloxinia caulescens</i> | | 236 |
| | <i>Sinningia</i> sp. | | 236 |
| Gnetaceae | <i>Gnetum ovalifolium</i> | | 236 |
| Goodeniaceae | <i>Scaevola sericea</i> | | 236 |
| Gramineae | | Mixed herbage | 305 |
| | <i>Bambusa</i> sp. | | 236 |
| | <i>Oryza sativa</i> | | 236 |
| | <i>Paspalum vaginatum</i> | | 236 |
| | <i>Phragmites</i> sp. | | 236 |
| | <i>Saccharum officinarum</i> | | 236 |
| Labiatae | <i>Ballota foetida</i> | Leaf | 122 |
| | <i>Calamintha officinalis</i> | | 122 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------------|------------------------------------|------------------|
| | <i>Mentha javanica</i> | | 236 |
| | <i>M. rotundifolia</i> | | 122 |
| | <i>Salvia coccinea</i> | | 236 |
| | <i>S. pratensis</i> | | 122 |
| | <i>Stachys lanata</i> | | 122 |
| Liliaceae | <i>Convallaria maialis</i> | Leaf | 122 |
| Loganiaceae | <i>Crateriphytum molucanum</i> | | 236 |
| | <i>Strychnos</i> sp. | Seed | 240 |
| | <i>S. nux vomica</i> | | 236 |
| | " " " | Seed | 735 |
| Magnoliaceae | <i>Michelia fuscata</i> | | 236 |
| Malvaceae | <i>Gossypium</i> sp. | | 502a |
| Martyniaceae | <i>Martynia diandra</i> | | 236 |
| Moraceae | <i>Castilloa elastica</i> | Latex | 239 |
| | <i>Ficus elastica</i> | Latex | 239 |
| Oleaceae | <i>Jasminum nudiflorum</i> | Leaf, flower | 122 |
| Orbanchaceae | <i>Orobanche epithymum</i> | Stem | 122 |
| | <i>O. rapum</i> | Stem, flower, underground parts | 122 |
| | <i>Phelipaea lutea</i> | | 122 |
| Pandanaceae | <i>Freycinetia strobilacea</i> | | 236 |
| Pedaliaceae | <i>Sesamum orientale</i> | | 236 |
| Ranunculaceae | <i>Aconitum septentrionale</i> | | 321 |
| | <i>Clematis paniculata</i> | | 236 |
| | <i>C. vitalba</i> | Leaf | 122 |
| | <i>Ranunculus bulbosus</i> | Leaf | 122 |
| Rosaceae | <i>Crataegus oxyacantha</i> | Fruit, leaf, flower | 194 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------------|------------------|-----------------------|
| | <i>Prunus domestica</i> | Fruit | 151 |
| | <i>Pyrus communis</i> | Fruit | 95, 789 |
| | " " | Leaf | 798 |
| | <i>P. Malus</i> | Fruit | 95, 302, 467, 789 |
| | " " | Juice | 537, 538 |
| | " " | Leaf | 798 |
| Rubiaceae | <i>Adina cordifolia</i> | | 236 |
| | <i>Coelospermum corymbosum</i> | | 236 |
| | <i>Coffea</i> sp. | Bean | 194, 240, 248, 292 |
| | <i>C. arabica</i> | | 236, 599 |
| | <i>C. bengalensis</i> | | 236 |
| | <i>C. liberica</i> | | 235, 236, 238 |
| | <i>Exostemma longiflorum</i> | | 236 |
| | <i>Hymenodictyon</i> sp. | | 236 |
| | <i>Mussaenda officinalis</i> | | 236 |
| | <i>Nauclea fagifolia</i> | | 236 |
| | <i>Oxyanthus hirsutus</i> | | 236 |
| | <i>Palicourea gardenioides</i> | | 236 |
| | <i>Timonius compressicaule</i> | | 236 |
| Saxifragaceae | <i>Hydrangea mutabilis</i> | | 236 |
| Scrophulariaceae | <i>Capraria biflora</i> | | 236 |
| | <i>Torenia</i> sp. | | 236 |
| | <i>Veronica alpina</i> | Whole plant | 122 |
| | <i>V. chamaedrys</i> | " " | 122 |
| | <i>V. officinalis</i> | " " | 122 |
| | <i>V. traversii</i> | Root, stem, leaf | 122 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------------|---------------|------------------|
| Solanaceae | <i>Atropa belladonna</i> | Leaf | 546 |
| | <i>Brunfelsia americana</i> | Leaf | 546 |
| | <i>Capsicum annuum</i> | Leaf | 546 |
| | <i>C. grossum</i> | Leaf | 546 |
| | <i>C. violaceum</i> | Leaf | 546 |
| | <i>Cestrum aurantiacum</i> | Leaf | 546 |
| | <i>C. elegans</i> | Leaf | 546 |
| | <i>Datura arborea</i> | Leaf | 546 |
| | <i>D. stramonium</i> | Leaf | 546 |
| | <i>Hyoscyamus albus</i> | Leaf | 546 |
| | <i>H. aureus</i> | Leaf | 546 |
| | <i>H. pusillus</i> | Leaf | 546 |
| | <i>H. reticulatus</i> | Leaf | 546 |
| | <i>Mandragora officinarum</i> | Leaf | 546 |
| | <i>Nicotiana sp.</i> | | 351 |
| | <i>Petunia nyctaginiflora</i> | Leaf | 546 |
| | <i>Physalis alkekengi</i> | Leaf | 122 |
| | <i>P. angulata</i> | Leaf | 546 |
| | <i>P. peruviana</i> | Leaf | 546 |
| | <i>Physochlaena orientalis</i> | Leaf | 546 |
| | <i>Scopolia carnifolica</i> | Leaf | 546 |
| | <i>Solanum</i> 16 spp. | Leaf | 546 |
| | <i>S. lycopersicum</i> | | 122 |
| | <i>S. tuberosum</i> | | 327, 329, 544 |
| | <i>Vithania frutescens</i> | | 546 |
| | <i>V. somnifera</i> | | 546 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|------------------|
| Theaceae | Thea sinensis | Leaf | 608 |
| Tiliaceae | Corchorus olitorius | | 236 |
| Umbelliferae | Angelica archangelica | Root | 698 |
| | Apium graveolens | | 544 |
| | Eryngium pandanifolium | | 236 |
| | Hydrocotyle sp. | | 236 |
| | Thapsia garganica | | 544 |
| Urticaceae | Boehmeria nivea | | 236 |
| Verbenaceae | Verbena officinalis | Leaf | 122 |

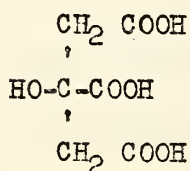
Cinnamic Acid



| | | | |
|------------------|-----------------------|--|--------------------|
| Compositae | Parthenium argentatum | Aq. extract of root, rubber, resin, leaf | 79, 776 |
| Ericaceae | Enkianthus japonicus | Leaf | 169 |
| Globulariaceae | Globularia spp. | | 268 |
| | G. alypum | Stalk, leaf | 269 |
| | G. vulgaris | Stalk, leaf | 269, 753 |
| Hamamelidaceae | Liquidambar sp. | Resin | 299, 310 |
| | L. orientalis | Resin | 727 |
| | L. styraciflua | Resin | 311, 728 |
| Lauraceae | Cinnamonum sp. | Leaf | 368 |
| Leguminosae | Myroxylon perobae | Balsam | 219, 273, 359, 364 |
| | M. toluiferum | Balsam | 114, 121, 150, 219 |
| Myrtaceae | Eugenia jambolana | Seed | 552 |
| Scrophulariaceae | Scrophularianodosa | Root | 323 |
| Styracaceae | Styrax liquidus | Resin | 666 |

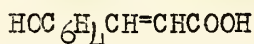
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|--|--------------------------|---------------|------------------|
| <u>Citramalic Acid</u> | | | |
| $\begin{array}{c} \text{COOH} \\ \\ \text{H}_3\text{C}-\text{C}-\text{OH} \\ \\ \text{CH}_2 \\ \\ \text{COOH} \end{array}$ | | | |
| Rosaceae | <i>Pyrus malus</i> | Peel | 303, 304 |

Citric Acid



Citric acid was first found by Scheele (631) (632) in lemons and appears to be ubiquitous in higher plants. Franzen & Helwert (207) have made a critical review of the literature on occurrence of citric acid.

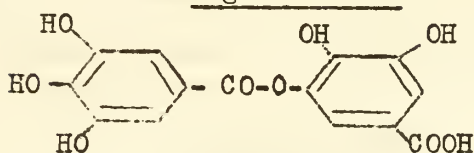
Coumaric Acid



| | | | |
|--------------|-----------------------------|-----------------|-----|
| Bignoniaceae | <i>Catalpa bignonioides</i> | Leaf | 469 |
| | <i>C. ovata</i> | Leaf, bark | 288 |
| Leguminosae | <i>Daviesia latifolia</i> | Leaf, stem | 562 |
| | <i>Melilotus alba</i> | Vegetative part | 103 |
| | " " | Root | 622 |
| | <i>M. officinalis</i> | Vegetative part | 103 |
| | <i>Trifolium pratense</i> | Flower | 560 |
| Papaveraceae | <i>Papaver somniferum</i> | | 641 |
| Pinaceae | <i>Pinus sp.</i> | Resin | 37 |
| Rosaceae | <i>Prunus serotina</i> | Bark | 557 |

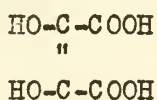
Family Genus and Species Source Reference

Digallic Acid



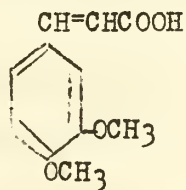
Theaceae *Thea sinensis* Leaf 607, 608

Dihydroxymaleic Acid



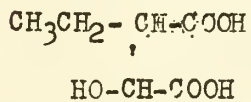
Papaveraceae *Glaucium luteum* Pressed juice 640

3,4-Dimethoxycinnamic Acid



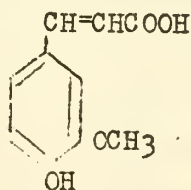
Scrophylariaceae *Veronica virginica* Rhizome, root (leptandra) 559

Ethylmalic Acid



Euphorbiaceae *Euphorbia biglandulosa* Latex 347

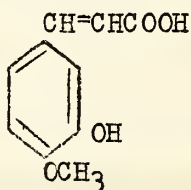
Ferulic Acid



Bignoniaceae *Catalpa ovata* Bark 288

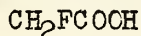
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|---------------------------|--------------------------------|------------------|
| Pinaceae | <i>Larix europaea</i> | Resin | 37 |
| Umbelliferae | <i>Ferula assafoetida</i> | Resin of roots and rhizomes | 644 |

Isoferulic Acid



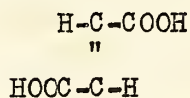
| | | | |
|---------------|----------------------------|-----------|-----|
| Bignoniaceae | <i>Catalpa ovata</i> | Root bark | 288 |
| Ranunculaceae | <i>Cimicifuga racemosa</i> | Rhizome | 195 |

Fluoracetic Acid



| | | | |
|-----------------|-----------------------------|--|-----|
| Dichapetalaceae | <i>Dichapetalum cymosum</i> | | 428 |
|-----------------|-----------------------------|--|-----|

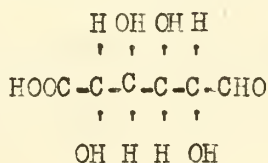
Fumaric Acid



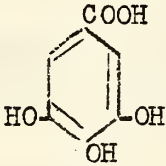
| | | | |
|----------------|--------------------------|------------------------------|----------|
| Aceraceae | <i>Acer saccharum</i> | Sirup | 476 |
| | " " | "sugar sand" | 477 |
| | " " | Sap, sirup | 549 |
| Asclepiadaceae | <i>Asclepias syriaca</i> | Root | 430 |
| Chenopodiaceae | <i>Beta vulgaris</i> | Beet diffusion juice | 508, 681 |
| Compositae | <i>Helianthus annuus</i> | | 58 |
| Cruciferae | <i>Bunias orientalis</i> | Stem, leaf, flowering top | 322 |
| Eucommiaceae | <i>Eucommia ulmoides</i> | Leaf | 254 |
| Euphorbiaceae | <i>Cluytia similis</i> | Leaf, stem | 739 |
| | <i>Ricinus communis</i> | Germinating bean | 149 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|-----------------|--------------------|
| Gramineae | Hordeum vulgare | Leaf | 118 |
| | " " | Etiolated shoot | 172 |
| | " " | Seedling | 320 |
| | Oryza sativa | Grain | 264 |
| | " " | Leaf | 819 |
| | Saccharum officinarum | Juice | 609, 610, 611 |
| | Sorghum sp. | Sirup | 419 |
| Labiatae | Salvia officinalis | Leaf | 100 |
| Leguminosae | Daviesia latifolia | Leaf, stem | 562 |
| | Phaseolus coccineus | | 58 |
| | P. mungo | | 133 |
| Papaveraceae | Corydalis bulbosa | | 790 |
| | Fumaria officinalis | Sap | 142, 144, 722, 800 |
| | Glaucium flavum | Leaf | 494 |
| | G. luteum | | 567, 568, 640 |
| | Papaver somniferum | | 641 |
| Solanaceae | Nicotiana sp. | | 661, 758, 759 |
| Umbelliferae | Daucus carota | Root tissue | 109, 110, 413 |
| | Myrrhis odorata | Leaf | 494, 314 |

Gelacturonic Acid

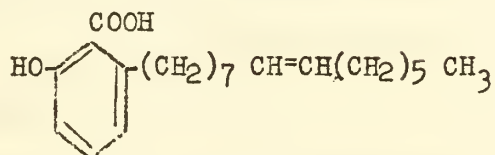


| | | | |
|----------|----------------|-------|---------------|
| Rosaceae | Fragaria vesca | Juice | 450, 451, 452 |
| | Prunus persica | Juice | 19 |
| | " " | Fruit | 20 |
| | Pyrus comunis | Fruit | 20 |
| | P. malus | Juice | 537 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|---|--------------------|------------------|
| | <u>Gallic Acid</u> | | |
| |  | | |
| Anacardiaceae | <i>Rhus coriaria</i> | Stalks | 389, 685 |
| | <i>R. glabra</i> | Fruit | 624 |
| | <i>R. semialata</i> | Fruit | 744 |
| Celastraceae | <i>Celastrus scandens</i> | Fruit | 786 |
| Commelinaceae | <i>Commelina agraria</i> | | 600 |
| Cornaceae | <i>Cornus sericea</i> | Fruit pulp | 687 |
| | <i>C. florida</i> | Flowers and bracts | 624a |
| Ericaceae | <i>Arctostaphylos uva ursi</i> | | 613 |
| | <i>Epigaea repens</i> | | 509 |
| Euphorbiaceae | <i>Phyllanthus distichus</i> | Root bark | 140 |
| Fagaceae | <i>Quercus aegilops</i> | Acorn | 685 |
| | <i>Q. pedunculata</i> | Wood | 445 |
| Geraniaceae | <i>Geranium onoli</i> | | 307 |
| | <i>G. pratense</i> | | 92 |
| | <i>G. zonale</i> | | 94 |
| Lauraceae | <i>Persea gratissima</i> | Fruit kernel | 520, 521 |
| Leguminosae | <i>Pithecolobium saman</i> | Bark | 313 |
| Loganiaceae | <i>Gelsemium sempervirens</i> | Root | 295 |
| Musaceae | <i>Musa paradisiaca</i> | Sap | 267 |
| Myrtaceae | <i>Psidium spp.</i> | | 521 |
| Nymphaeaceae | <i>Brasenia schreberi</i> | | 468 |
| Oleaceae | <i>Olea europea</i> | Leaves | 119 |
| Polygonaceae | <i>Rheum austriacum</i> | Root | 280 |
| | <i>R. rhaponticum</i> | Root | 280 |

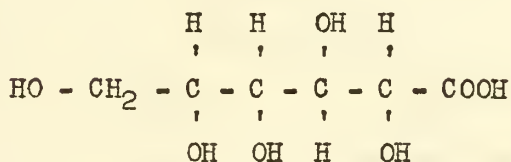
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------|---------------|------------------|
| Punicaceae | Punica granatum | Root bark | 454 |
| Rubiaceae | Coffea sp. | | 536 |
| Sapotaceae | Mimusops sp. | | 521 |
| Scrophulariaceae | Digitalis sp. | | 470 |
| | D. purpurea | | 274 |
| Simarubaceae | Quassia simaruba | Root bark | 457 |
| Solanaceae | Nicotiana tabacum | Leaf | 360 |
| Theaceae | Thea sinensis | | 372, 607, 608 |

Ginkgolic Acid



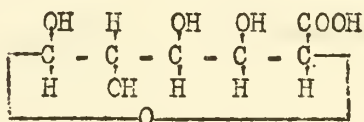
| | | | |
|-------------|---------------|-------|-----|
| Ginkgoaceae | Ginkgo biloba | Fruit | 340 |
|-------------|---------------|-------|-----|

Gluconic Acid



| | | | |
|----------------|---------------|--------------------------|-----|
| Chenopodiaceae | Beta vulgaris | Crust on juice preheater | 406 |
|----------------|---------------|--------------------------|-----|

Glucuronic Acid



| | | | |
|---------------|----------------------|------------------|-----|
| Compositae | Taraxacum officinale | Young leaf | 510 |
| Cucurbitaceae | Cucurbita pepo | Seed | 510 |
| Gramineae | Hordeum vulgare | Germinating Seed | 510 |
| | Musa sp. | Shoot | 626 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---|--------------------------|-------------------------------------|--------------------|
| Leguminosae | Phaseolus or vicia | Germinating seed, etiolated leaf | 510 |
| <u>Glutaric Acid</u> | | | |
| $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$ | | | |
| Chenopodiaceae | Beta vulgaris | Beet | 398, 400, 752 |
| <u>Glyceric Acid</u> | | | |
| $\text{CH}_2\text{OH}-\text{CH}(\text{OH})-\text{COOH}$ | | | |
| Chenopodiaceae | Beta vulgaris | Diffusion juice | 681 |
| Gramineae | Hordeum vulgare | | 56 |
| | " " | Leaf | 57, 118 |
| Leguminosae | Glycine sp. | Leaf | 25 |
| Solanaceae | Nicotiana tabacum | | 695 |
| <u>Glycolic Acid</u> | | | |
| $\text{HO}-\text{CH}_2-\text{COOH}$ | | | |
| Caprifoliaceae | Sambucus niger | Leaf | 35 |
| Caryophyllaceae | Herniaria glabra | Leaf | 35 |
| Chenopodiaceae | Beta vulgaris | Beet juice | 400, 508, 680, 681 |
| Combretaceae | Combretum micranthum | Leaf | 35 |
| Compositae | Cynara scolymus | Leaf | 35 |
| | Solidago virgaurea | Flowering twig | 35 |
| Dichapetalaceae | Dichapetalum cymosum | | 428 |
| Ericaceae | Arbutus unedo | Leaf | 35 |
| | Erica multiflora | Flowering twig | 35 |
| Euphorbiaceae | Ricinus communis | | 65, 149 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------------|------------------------------|
| Gramineae | Agropyron repens | Root and/or rhizome | 35 |
| | Avena sativa | Seedling | 297 |
| | Hordeum vulgare | | 56, 57 |
| | " " | Leaf | 118, 695 |
| | " " | Etiolated shoot | 172 |
| | " " | Seedling | 297 |
| | Saccharum officinarum | Juice | 566, 609, 610, 611, 662, 794 |
| | Zea mays | Stigmata | 35 |
| Labiatae | Lavandula vera | Flowering twig | 35 |
| | Orthosiphon stamineus | Leaf | 35 |
| | Rosmarinus spp. | Flowering twig | 35 |
| Leguminosae | Lupinus albus | Seedling | 297 |
| | Medicago sativa | Sap | 191 |
| | Pisum sativum | Seedling | 297 |
| Liliaceae | Asparagus spp. | Root and/or rhizome | 35 |
| | Ruscus aculeatus | Root and/or rhizome | 35 |
| Pinaceae | Juniperus communis | Berry | 35 |
| Rosaceae | Frunus cerasus | Peduncle | 35 |
| | Pyrus communis | Juice | 598 |
| | P. malus | Juice | 708 |
| Solanaceae | Nicotiana tabacum | | 694 |
| | " " | Leaf | 695 |
| | Physalis akekengi | Berry | 35 |
| | Solanum lycopersicum | Leaf | 694, 695 |
| Umbelliferae | Apium graveolens | Root and/or rhizome | 35 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------------|------------------|
| | Eryngium campestre | Root and/or rhizome | 35 |
| | Foeniculum vulgare | Root and/or rhizome | 35 |
| | Petroselinum sativum | Root and/or rhizome | 35 |
| Urticaceae | Parietaria spp. | Leaf | 35 |
| Vitaceae | Ampelopsis nederacea | Leaf | 243 |
| | Vitis vinifera | Unripe fruit | 105, 187, 188 |
| | " " | Fruit | 286 |

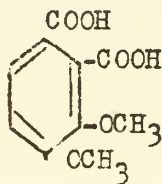
Glyoxalic Acid



| | | | |
|----------------|-----------------------|--------------|----------|
| Chenopodiaceae | Beta vulgaris | | 400 |
| Cornaceae | Cornus mas | Fruit | 637 |
| Ericaceae | Vaccinium oxycoccus | | 690 |
| Gramineae | Saccharum officinarum | Juice | 794 |
| Labiatae | Mentha piperita | Leaf | 717, 719 |
| Leguminosae | Arachis hypogaea | Seedling | 202, 203 |
| Liliaceae | Tulipa gesneriana | | 717, 718 |
| Polygonaceae | Rheum officinale | | 106 |
| Rosaceae | Prunus domestica | Unripe fruit | 106 |
| | Pyrus malus | Unripe fruit | 106 |
| | " " | Fruit | 303 |
| Saxifragaceae | Ribes sp. | Unripe fruit | 106 |
| | R. grossularia | Unripe fruit | 106 |
| Solanaceae | Solanum tuberosum | Tuber | 719 |
| Umbelliferae | Daucus carota | Leaf, root | 717 |
| | " " | Root | 719 |

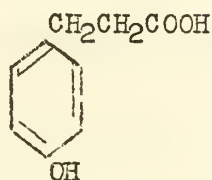
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|--------------------|
| Vitaceae | Vitis vinifera | | 106, 107, 256, 286 |
| | " " | Juice | 653 |

Hemipinic Acid



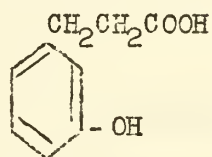
| | | | |
|--------------|--------------------|--|-----|
| Papaveraceae | Papaver somniferum | | 641 |
|--------------|--------------------|--|-----|

Hydrocaffeic Acid



| | | | |
|----------------|----------------------|-------|-----|
| Chenopodiaceae | Beta vulgaris | Leaf | 401 |
| Solanaceae | Solanum tuberosum | Tuber | 593 |
| Vitaceae | Ampelopsis hederacea | | 593 |

Hydrocumaric Acid



| | | | |
|-------------|-----------------------|--|-----|
| Leguminosae | Melilotus officinalis | | 832 |
|-------------|-----------------------|--|-----|

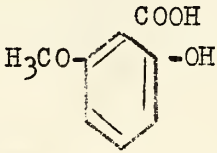
p-Hydroxybenzoic Acid




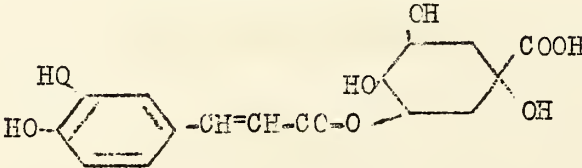
| | | | |
|--------------|--------------------|--------------|-----|
| Bignoniaceae | Bignonia catalpa | Unripe fruit | 541 |
| | Catalpa ovata | Leaf | 469 |
| Papaveraceae | Papaver somniferum | | 641 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---|--------------------------|---------------|------------------|
| <u>Hydroxycitric Acid</u> | | | |
| $\begin{array}{c} \text{CH}_2\text{-COOH} \\ \\ \text{HO-C-COOH} \\ \\ \text{HO-C-COOH} \\ \\ \text{H} \end{array}$ | | | |
| Chenopodiaceae | Beta vulgaris | Juice | 399 |

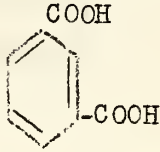
| | | | |
|---|---------------|-----|-----|
| <u>α-Hydroxyglutaric Acid</u> | | | |
| $\text{HOCC-CH}_2\text{CH}_2\text{CHOH-COOH}$ | | | |
| Chenopodiaceae | Beta vulgaris | Sap | 398 |

| | | | |
|---|------------------|--------|-----|
| <u>2-Hydroxy-6-Methoxy Benzoic Acid</u> | | | |
|  | | | |
| Liliaceae | Gloriosa superba | Tubers | 127 |

| | | | |
|---|----------------------|------|-----|
| <u>p-Hydroxyphenylacetic Acid</u> | | | |
|  | | | |
| Compositae | Taraxacum officinale | Root | 553 |

| | | | |
|--|----------------|----------------|-----|
| <u>Isochlorogenic Acid</u> | | | |
|  | | | |
| Rosaceae | Pyrus communis | Leaf and shoot | 95 |
| | " " | Leaf | 798 |
| Rubiaceae | Coffea sp. | | 41 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------|-----------------------|---|
| | <u>Isocitric Acid</u> | | |
| | | CH(OH)-COOH | |
| | | CH-COOH | |
| | | CH ₂ -COOH | |
| Anonaceae | Anona muricata | | 479 |
| Crassulaceae | Bryophyllum sp. | Leaf | 511, 579, 81 |
| | B. calycinum | Leaf | 113, 365, 570, 571, 574, 575, 694, 695 |
| | " " | Leaf and stem | 748, 757 573 |
| | Escheveria sp. | Leaf | 365 |
| | E. secunda | | 492, 493 |
| | Sedum acre | | 493 |
| | S. maximum | | 493 |
| | S. praealtum | | 813 |
| | Sempervivum tectorum | | 493 |
| Gramineae | Hordeum vulgare | | 56 |
| | " " | Leaf | 57, 695 |
| Lecythidaceae | Couroupita guianensis | Fruit | 484 |
| Leguminosae | Pisum sativum | Ungerminated seeds | 427 |
| Rosaceae | Pyrus malus | Fruit | 109, 110 |
| | Rubus fruticosus | Fruit | 131, 473, 478 |
| Scrophulariaceae | Digitalis purpurea | | 337 |
| | " " | Leaf | 365 |
| Solanaceae | Nicotiana tabacum | | 694 |
| | " " | Leaf | 695 |
| | Solanum lycopersicum | Leaf | 694, 695 |
| | S. tuberosum | Juice of tuber | 130 |

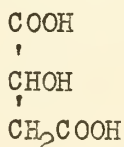
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---|--------------------------|------------------|------------------|
| Umbelliferae | Daucus carota | | 109, 110 |
| <u>Isophthalic Acid</u> | | | |
|  | | | |
| Iridaceae | Iris versicolor | Rhizome | 561 |
| <u>α-Ketocadipic Acid</u> | | | |
| $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CO}-\text{COOH}$ | | | |
| Leguminosae | Pisum sativum | Germinating seed | 763 |
| <u>Ketoglutaric Acid</u> | | | |
| $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CO}-\text{COOH}$ | | | |
| Euphorbiaceae | Ricinis communis | Germinating seed | 149 |
| Gramineae | Hordeum vulgare | Etiolated Shoot | 172 |
| Labiatae | Mentha piperita | Leaf | 717, 719 |
| Leguminosae | Arachis hypogaea | Seedling | 202, 203 |
| | Pisum sativum | Young plant | 767, 769 |
| | Trifolium pratense | | 766, 767 |
| Liliaceae | Tulipa gesneriana | | 717, 718 |
| Rosaceae | Pyrus malus | Fruit | 303 |
| Solanaceae | Solanum tuberosum | Tuber | 38, 719 |
| Umbelliferae | Daucus carota | Root and leaf | 717 |
| | " " | Root | 719 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|--------------------------------|--------------------------|---------------------|------------------|
| <u>Lactic Acid</u> | | | |
| $\text{CH}_3\text{-CHOH-COOH}$ | | | |
| Amaryllidaceae | Agave sisalana | Leaf | 417, 646, 647 |
| Bromeliaceae | Ananas sativas | | 521 |
| Chenopodiaceae | Beta vulgaris | | 440 |
| | " " | Juice | 630, 631 |
| | " " | Beet | 633, 639 |
| | " " | Beet and leaf | 752 |
| Compositae | Helianthus annuus | | 58 |
| | Lactuca sp. | | 521 |
| | " " | Leaf | 646 |
| | L. sativa | Leaf | 647 |
| Crassulaceae | Bryophyllum calycinum | | 311 |
| Cruciferae | Brassica oleracea | Kale | 42 |
| | " " | Cabbage | 647 |
| Cucurbitaceae | Cucumis sativus | | 633 |
| Ericaceae | Vaccinium myrtillus | | 331 |
| Euphorbiaceae | Ricinis communis | | 141 |
| | " " | Germinating Seed | 149, 300 |
| | " " | Seedling | 646 |
| | " " | Seedling, leaf | 647 |
| Fagaceae | Castanea vesca | Fruit | 152 |
| | Fagus sylvatica | Nut | 333 |
| Gentianaceae | Erythraea centaurium | | 261 |
| Gramineae | Bambusa sp. | Shoot | 626 |
| | Hordeum distichum | Germinating Seed | 639 |
| | H. sativum | | 803 |
| | H. vulgare | Etiolated shoot | 172 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|----------------------------|---------------------|------------------|
| | <i>Oryza</i> spp. | Leaf | 819 |
| | <i>Secale cereale</i> | Leaf | 676 |
| | <i>Triticum sativum</i> | Leaf | 676 |
| | <i>T. Vulgare</i> | Germinating seed | 689 |
| | <i>Zea mays</i> | Germinating seed | 646, 647, 803 |
| Leguminosae | <i>Glycine</i> sp. | | 333 |
| | <i>Lupinus</i> sp. | Seed | 463 |
| | <i>L. luteus</i> | Germinating seed | 689 |
| | <i>Phaseolus coccineus</i> | | 58 |
| | <i>P. vulgaris</i> | Seedling | 647 |
| | <i>Pisum sativum</i> | Germinating seed | 646, 647, 689 |
| | <i>Tamarindus indica</i> | | 3, 331 |
| | <i>Vicia faba</i> | Leaf, sprout | 646, 647 |
| | " " | Germinating seed | 689 |
| Malvaceae | <i>Gossypium</i> sp. | Seed | 333 |
| Myricaceae | <i>Myrica rubra</i> | Fruit | 357 |
| Myrsinaceae | <i>Maesa picta</i> | Seed | 23 |
| Papaveraceae | <i>Glaucium luteum</i> | Pressed juice | 640 |
| | <i>Papaver somniferum</i> | "Poppy straw" | 641 |
| Polygonaceae | <i>Rheum</i> sp. | Leaf | 646 |
| | <i>R. hybridum</i> | Tuber | 647 |
| Rosaceae | <i>Eriobotrya japonica</i> | Milky juice | 192 |
| | <i>Fragaria</i> sp. | Juice of Fruit | 287 |
| | <i>Prunus avium</i> | | 204 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|------------------------------|----------------|---|
| | <i>Prunus cerasus</i> | Juice of fruit | 439 |
| | <i>Pyrus communis</i> | Juice of fruit | 439 |
| | " " | Juice, fruit | 598 |
| | <i>P. . . malus</i> | Fruit | 206, 287 |
| | " " | Juice of fruit | 438, 439, 710 |
| | <i>Rubus sp.</i> | Leaf | 646 |
| | <i>R. fruticosus</i> | Leaf | 210, 211, 647 |
| | <i>R. idaeus</i> | Leaf | 217, 218, 648 |
| Rutaceae | <i>Citrus decumana</i> | Juice of fruit | 287 |
| Salicaceae | <i>Salix sp.</i> | Bark | 155 |
| Scrophulariaceae | <i>Digitalis purpurea</i> | | 337 |
| | <i>Euphrasia officinalis</i> | | 176 |
| | <i>Veronica officinalis</i> | | 175 |
| Solanaceae | <i>Solanum dulcamara</i> | Peduncle | 809 |
| | <i>S. lycopersicum</i> | Fruit | 113, 120, 747 |
| | " " | Fruit juice | 601 |
| | <i>S. tuberosum</i> | Tuber | 39, 40, 646, 647, 688, 689, 788, 803 |
| Sterculiaceae | <i>Theobroma cacao</i> | Seed | 459, 460 |
| Umbelliferae | <i>Daucus carota</i> | | 646 |
| | " " | Root | 647, 689 |
| Vitaceae | <i>Vitis vinifera</i> | Juice | 439 |
| | " " | Sap | 810 |

Malic Acid

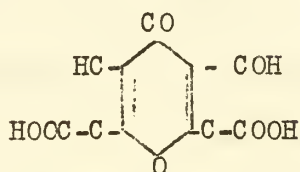


Malic acid was discovered by Scheele (633), who reported its presence in a number of plants. Franzen & Keyssner (212) have made a critical review of the literature on its occurrence but it appears to be ubiquitous in higher plants.

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|---|----------------------------|------------------|
| | <u>Malonic Acid</u> | | |
| | $\begin{array}{c} \text{COOH} \\ \\ \text{CH}_2\text{COOH} \end{array}$ | | |
| Chenopodiaceae | Beta vulgaris | Incrustation on evaporator | 397 |
| | " " | Beet juice | 399 |
| | " " | Beet and leaf | 752 |
| Compositae | Helianthus annuus | | 58 |
| | H. tuberosus | | 234 |
| Cruciferae | Bunias orientalis | Stem, leaf, flowering top | 322 |
| Gramineae | | Mixed herbage | 305 |
| | Avena sativa | | 297, 483 |
| | Dactylis glomerata | | 138 |
| | Hordeum vulgare | | 297, 483 |
| | Triticum sp. | | 481 |
| Leguminosae | Anthyllis sp. | | 58 |
| | Astragalus sp. | | 58 |
| | A. sinicus | | 822 |
| | Colutea sp. | | 58 |
| | Lotus sp. | | 58 |
| | Lupinus sp. | | 58, 297 |
| | Medicago sp. | | 58 |
| | M. sativa | | 737 |
| | Melilotus sp. | | 58 |
| | Ononis sp. | | 58 |
| | Phaseolus coccineus | | 58 |
| | Sophora sp. | | 58 |

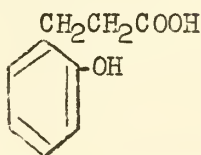
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|------------------|
| | Thermopsis sp. | | 58 |
| | Trifolium sp. | | 58 |
| | Trigonella sp. | | 58 |
| | Vicia sp. | | 58 |
| Rosaceae | Fragaria sp. | Fruit | 691 |
| Umbelliferae | Anthriscus sp. | | 58 |
| | Apium sp. | | 58 |

Meconic Acid



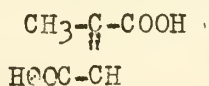
| | | | |
|--------------|----------------|----------------|----------|
| Papaveraceae | Papaver Rhoeas | | 516 |
| | P. somniferum | | 66 |
| | " " | Dried capsules | 145 |
| | " " | Milky sap | 654, 655 |

Melilotic Acid



| | | | |
|-------------|-------------------|-----------------|----------|
| Leguminosae | Melilotus alba | Vegetative part | 103 |
| | M. officinalis | Vegetative part | 103, 832 |
| Solanaceae | Nicotiana tabacum | Leaf | 360 |

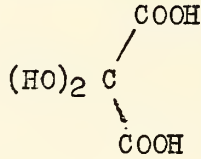
Mesaconic Acid



| | | | |
|--------------|-----------------------|--------|---------------|
| Bignoniaceae | Crescentia sp. | Curare | 336 |
| Cruciferae | Brassica oleracea | Leaf | 115, 116 |
| Gramineae | Saccharum officinarum | Juice | 609, 610, 611 |

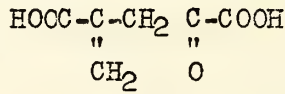
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
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Mesoxalic Acid



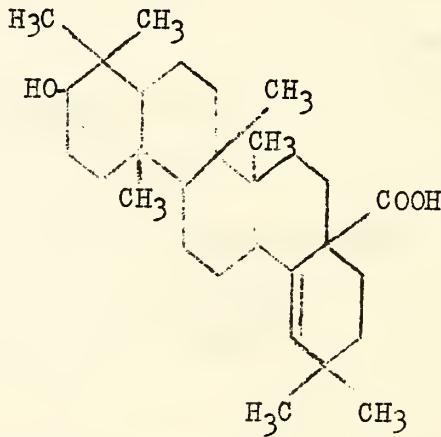
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|-------------|------------------------|--|-----|
| Leguminosae | <i>Medicago sativa</i> | | 191 |
|-------------|------------------------|--|-----|

γ -Methylene- α -ketoglutaric Acid



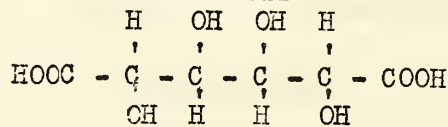
| | | | |
|-------------|--------------------------|----------|----------|
| Leguminosae | <i>Arachis hypogaea</i> | Seedling | 202, 203 |
| Liliaceae | <i>Tulipa gesneriana</i> | | 717, 718 |

Morolic Acid



| | | | |
|-----------|----------------------------|--|-----|
| Ericaceae | <i>Agauria salicifolia</i> | | 162 |
|-----------|----------------------------|--|-----|

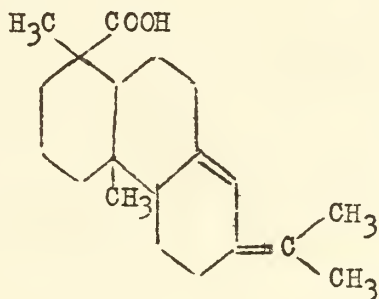
Mucic Acid



| | | | |
|----------------|-----------------------------|-----------------|-----|
| Chenopodiaceae | <i>Beta vulgaris</i> | Diffusion juice | 680 |
| Elaeocarpaceae | <i>Elaeocarpus serratus</i> | Fruit pulp | 817 |
| Rosaceae | <i>Prunus persica</i> | Ripe fruit | 20 |
| | <i>Pyrus communis</i> | Ripe fruit | 20 |

Family Genus and Species Source Reference

Neobietic Acid



Pinaceae

Pinus palustris

oleoresin

265a

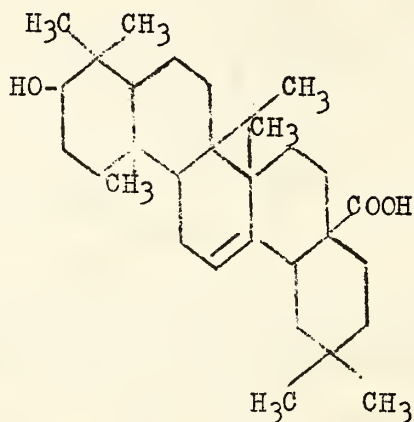
P. silvestris

oleoresin,
wood rosin

265b

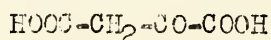
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|------------------|
|---------------|--------------------------|---------------|------------------|

Oleanolic Acid



| | | | |
|---------------|------------------------------|--------|-----|
| Apocynaceae | <i>Alyxia buxifolia</i> | Bark | 22 |
| Ericaceae | <i>Vaccinium myrtillus</i> | | 590 |
| Euphorbiaceae | <i>Petalogstigma sericea</i> | | 22 |
| Labiatae | <i>Thymus vulgaris</i> | | 615 |
| | <i>Salvia officinalis</i> | | 101 |
| Loranthaceae | <i>Viscum album</i> | Leaf | 805 |
| Myrtaceae | <i>Psidium guajava</i> | Leaf | 26 |
| Oleaceae | <i>Olea europea</i> | Leaf | 259 |
| Rosaceae | <i>Crataegus oxycantha</i> | Leaf | 60 |
| | <i>Eriobotrya japonica</i> | Leaf | 27 |
| Solanaceae | <i>Anthocercis intricata</i> | Bark | 22 |
| | <i>A. littorea</i> | Bark | 22 |
| | <i>A. odgersii</i> | Bark | 22 |
| Vitaceae | <i>Vitis labrusca</i> | Pomace | 434 |

Oxalacetic Acid



| | | | |
|-----------|-------------------------|--|----------|
| Gramineae | <i>Hordeum vulgare</i> | | 766 |
| | <i>Phleoma pratense</i> | | 766 |
| Labiatae | <i>Mentha piperita</i> | | 717, 719 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|---------------|--------------------------|---------------|----------------------------|
| Leguminosae | Convalia ensiformis | | 766 |
| | Pisum sativum | | 765, 766, 767, 768; 769 |
| | Trifolium pratense | Young leaves | 764, 765, 766, 767 |
| Liliaceae | Tulipa gesneriana | | 717, 718 |
| Rosaceae | Pyrus malus | Fruit | 303 |
| Solanaceae | Solanum tuberosum | Tuber | 719 |
| Umbelliferae | Daucus carota | Root, leaf | 717 |
| | " " | Root | 719 |

Oxalic Acid



Reviews and surveys of the occurrence of oxalic acid include Andrews and Višer Esbach (189) (18), Kohman (354), Meyen (446), Miller, Ross and Lewis (449), Molisch (455), Patschovsky (514), Schimper (636), and Treviranus (721).

| | | | |
|--------------|------------------------|-----------------|--------|
| Aceraceae | Acer platanoides | Root | 362 |
| | A. saccharum | Sap, sugar sand | 778 |
| Aizoaceae | Mesembryanthemum sp. | | 515 |
| | M. acinaciforme | | 2 |
| | M. crystallinum | | 17, 63 |
| | " " | Leaf, flower | 62 |
| Amarantaceae | | | 515 |
| | Alternanthera sessilis | | 298 |
| | Amarantus sp. | | 244 |
| | A. aquatica | | 627 |
| | A. caudatus | Leaf, flower | 63 |
| | " " | | 62 |
| | A. gangeticus | | 298 |
| | A. polygonoides | | 298 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------|---------------|------------------|
| Amaryllidaceae | Agave americana | Leaf | 825 |
| Anacardiaceae | Mangifera indica | | 87 |
| Araceae | Acorus calamus | | 820 |
| | Arum italicum | Berry | 348 |
| Aristolochiaceae | Asarum sp. | | 515 |
| Balsaminaceae | Impatiens parviflora | | 462 |
| | I. sultani | | 462 |
| Begoniaceae | Begonia sp. | | 228 |
| | B. evansiana | | 658, 659, 660 |
| | B. rex | | 770 |
| | B. semperflorens | | 129, 617, 742 |
| Berberidaceae | Berberis vulgaris | Fruit | 348 |
| Betulaceae | Alnus sp. | Leaf | 781 |
| | Betula sp. | | 362 |
| | Ostrya vulgaris | | 362 |
| Bombacaceae | Adansonia digitata | Fruit | 5 |
| Bromeliaceae | Bromelia pinguin | Fruit | 29 |
| Cactaceae | | | 515 |
| | Cereus peruvianus | | 738 |
| | Opuntia sp. | | 486 |
| | O. vulgaris | Stem | 348 |
| Caprifoliaceae | Sambucus nigra | Young leaf | 47 |
| | Symphoricarpus sp. | Leaf | 781 |
| Caryophyllaceae | Dianthus barbatus | | 500 |
| | D. carthusianorum | Leaf, stem | 13 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|-----------------------------|---------------------------------------|--|
| | <i>Lychnis coronaria</i> | | 75 |
| | <i>L. dioica</i> | | 13, 75, 92 |
| | <i>L. flos-jovis</i> | | 75 |
| | <i>L. githago</i> | | 13 |
| | <i>Saponaria sp.</i> | | 486 |
| | <i>S. officinalis</i> | | 13 |
| | <i>Spergula arvensis</i> | | 75 |
| | <i>Stellaria media</i> | | 462, 500 |
| | <i>Tunica saxifraga</i> | | 13 |
| Celastraceae | <i>Celastrus obscurus</i> | Leaf | 158 |
| | <i>Euonymus japonicus</i> | | 2 |
| Chenopodiaceae | | | 449 |
| | <i>Atriplex sp.</i> | | 515 |
| | <i>Beta vulgaris</i> | | 500, 515, 540, 627 |
| | " " | Juice | 400, 447, 508, 680, 681 |
| | " " | Root, leaf | 421, 752 |
| | " " | Leaf | 34, 461, 621, 629 |
| | " " | Swiss chard, mangold, beet leaf | 630 |
| | " " | Seed | 153, 693 |
| | " " | Root | 24, 190, 234, 244, 783 |
| | <i>Chenopodium</i> | | 515 |
| | <i>C. quinoa</i> | Leaf, flower | 62, 63 |
| | <i>Halogeton glomeratus</i> | | 198, 296 |
| | <i>Spinacia oleracea</i> | | 24, 91, 189, 190, 384, 482, 515, 540. |
| | " " | Leaf | 46, 70, 154, 244, 500, 621, 792, 820. |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|------------------------------|------------------------------|--------------------------------------|
| Commelinaceae | <i>Callisia repens</i> | | 462 |
| | <i>Tradescantia</i> | | 515 |
| | <i>T. fluminensis</i> | | 53, 787 |
| | <i>T. sellei</i> | Leaf | 636 |
| | <i>T. virginica</i> | Leaf | 348 |
| Compositae | <i>Cichorium endivia</i> | | 24, 190 |
| | <i>Helianthus tuberosus</i> | | 234 |
| | <i>Kleinia articulata</i> | | 318 |
| | <i>Lactuca</i> spp. | | 521 |
| | <i>L. setiva</i> | | 482, 540, 792 |
| Convolvulaceae | <i>Ipomoea aquatica</i> | | 298 |
| Cornaceae | <i>Cornus sericea</i> | Fruit pulp | 687 |
| Crassulaceae | <i>Bryophyllum calycinum</i> | Leaf | 113, 570, 574, 580, 694, 695, 748 |
| | " " | Leaf, stem | 573 |
| | <i>B. crenatum</i> | Leaf | 81, 348 |
| | <i>Echeveria glauca</i> | Leaf | 348 |
| | <i>Sedum azureum</i> | | 17 |
| | <i>S. faberia</i> | Leaf | 348 |
| | <i>Sempervivum glaucum</i> | Leaf | 52 |
| | <i>S. tectorum</i> | Leaf | 348 |
| Cruciferae | | | 515 |
| | <i>Brassica oleracea</i> | | 24, 190, 482 |
| | <i>B. pekinensis</i> | | 820 |
| | <i>Bunias orientalis</i> | Stem, leaf, flowering top | 322 |
| Cucurbitaceae | <i>Cucumis melo</i> | | 24, 190, 540 |
| | <i>Cucurbita pepo</i> | | 792 |
| Dipsacaceae | <i>Succisa pratensis</i> | | 500 |
| Ericaceae | <i>Vaccinium myrtillus</i> | | 24, 190, 331 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|--------------------------|---------------|---|
| Euphorbiaceae | Aleurites cordata | Leaf | 22) |
| | Euphorbia sp. | | 515 |
| | Mercurialis annuelle | | 134 |
| | M. perennis | | 500 |
| | Phyllanthus emblica | | 332 |
| | Ricinus communis | | 65 |
| Fagaceae | Fagus sylvatica | | 98, 500, 652 |
| | Quercus pedunculata | | 445 |
| Gesneraceae | Aeschynanthus sp. | | 515 |
| Globulariaceae | Globularia spp. | | 268 |
| Gramineae | | | 515 |
| | Avena sativa | Seedling | 297, 483, 530 |
| | Bambusa sp. | Shoot | 626 |
| | Hordeum vulgare | Leaf | 47, 695 |
| | " " | Seedling | 297, 320, 483, 694 |
| | Lolium perenne | | 423 |
| | Oplismenus imbecillis | | 53 |
| | Oryza spp. | Leaf | 819 |
| | Phyllostachys mitis | Sprout | 703 |
| | Poa pratensis | | 540 |
| | Saccharum officinarum | Juice | 10, 86, 518, 609, 610, 611, 707, 821 |
| | Secale cereale | | 483 |
| | Sorghum sp. | Juice | 419 |
| | S. vulgare | | 796, 797 |
| | S. vulgare | Leaf | 812 |
| | Triticum sp. | | 481 |
| | T. aestivum | | 540 |
| | Zea mays | | 53, 771 |

| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|------------------|--------------------------|----------------------|------------------|
| Hippocastanaceae | Aesculus hippocastanum | Young leaf | 47 |
| Hydrocharitaceae | Elodea densa | | 466 |
| | E. canadensis | | 466 |
| Juglandaceae | Juglans regia | Bark | 356 |
| Labiatae | | | 515 |
| Leguminosae | Acacia spp. | Bark | 683 |
| | Acacia cambagei | Bark and wood | 682, 683 |
| | Arachis hypogaea | Kernal | 591 |
| | Cassia sp. | Leaf | 773 |
| | Cicer arietinum | Secretion from hairs | 453 |
| | " " | Fruit | 828 |
| | Glycine soja | | 540 |
| | Lupinus albus | Seedling | 297 |
| | L. luteus | Seed | 606 |
| | Medicago sativa | | 540 |
| | Mimosa spegazzinii | | 462 |
| | Phaseolus limensis | | 540 |
| | Pisum sativum | Seedling | 297, 540, 792 |
| | Tamarindus indica | | 209, 331, 332 |
| " " | Mature leaf | 245 | |
| Vicia sp. | | 324 | |
| Vicia faba | | 24, 190 | |
| Liliaceae | | | 515 |
| | Agapanthus umbellatus | Leaf | 343 |
| | Allium cepa | | 8, 221, 363, 792 |
| | Asparagus officinalis | | 24, 190 |
| | Erythronium dens canis | Bulb | 157 |

| Family | Genus and Species | Source | Reference |
|----------------|-------------------------------|--------------------|---------------------|
| | <i>Hyacintha orientalis</i> | Bulb | 76 |
| | <i>Smilacina bifolia</i> | Fruit | 167 |
| Loranthaceae | <i>S. racemosa</i> | Fruit | 167 |
| | <i>Viscum sp.</i> | | 515 |
| Malvaceae | <i>Gossypium sp.</i> | | 184, 185, 186, 415a |
| Melastomaceae | <i>Memecylon tinctorum</i> | | 159 |
| Menispermaceae | <i>Jateorhiza columba</i> | | 734 |
| Moraceae | <i>Cannabis sp.</i> | | 134 |
| | <i>Ficus carica</i> | | 244 |
| Musaceae | <i>Musa sapientum</i> | Over-ripe fruit | 490 |
| Myricaceae | <i>Myrica rubra</i> | Fruit | 357 |
| Myristicaceae | <i>Myristica surinamensis</i> | Seed | 724 |
| Myrtaceae | <i>Eucalyptus</i> 12 spp. | Bark | 673 |
| | <i>Psidium guajava</i> | Leaf | 11 |
| Nyctaginaceae | <i>Mirabilis sp.</i> | Flower, fruit | 542 |
| Nymphaeaceae | <i>Nymphaea alba</i> | Rhizome | 252 |
| | <i>N. lutea</i> | Rhizome | 252 |
| Orchidaceae | | | 515 |
| | <i>Vanilla planifolia</i> | | 777 |
| Oxalidaceae | <i>Averrhoa carambola</i> | | 124 |
| | " " | Fruit | 388 |
| | " " | Juice | 480 |
| | <i>Oxalis sp.</i> | | 228, 244, 515 |
| | <i>O. acetosella</i> | Leaf | 348, 500 |
| | <i>O. corniculata</i> | | 245 |
| | <i>O. stricta</i> | | 63 |

| Family | Genus and Species | Source | Reference |
|----------------|-----------------------------|----------------------|--|
| Oxalidaceae | <i>Oxalis violacea</i> | | 521 |
| Papaveraceae | | | 515 |
| | <i>Fumaria officinalis</i> | Seed coat | 246 |
| Pedaliaceae | <i>Essenium indicum</i> | Seed | 266a |
| Phytolaccaceae | <i>Phytolacca</i> sp. | | 515 |
| | <i>P. dioica</i> | Shoot, bark, pith | 2 |
| Pinaceae | | | 614 |
| | <i>Pinus abies</i> | Sap | 330, 652 |
| | <i>P. cembra</i> | Seedling | 650 |
| | <i>P. excelsa</i> | Needle | 500, 823 |
| Piperaceae | <i>Peperomia</i> sp. | | 515 |
| Polygonaceae | <i>Emex</i> sp. | | 515 |
| | <i>Fagopyrum esculentum</i> | | 53, 540 |
| | " " | Leaf, stem | 534 |
| | <i>Oxyria</i> sp. | | 515 |
| | <i>Polygonum</i> sp. | | 515 |
| | <i>Rheum</i> sp. | | 24, 108, 190, 244, 384, 515, 760, 792 |
| | " " | Leaf | 684 |
| | <i>R. crispum</i> | Stem | 506 |
| | <i>R. hybridum</i> | Leaf, rhizome | 9 |
| | " " | Leaf | 572, 583, 695, 770 |
| | " " | Stem, rhizome | 618, 619 |
| | <i>R. leucorhizum</i> | Stem | 506 |
| | <i>R. nepalense</i> | Stem | 506 |
| | <i>R. nutans</i> | Stem | 506 |
| | <i>R. officinale</i> | Leaf | 106, 770 |
| | <i>R. palmatum</i> | Stem | 506 |
| | <i>R. paragon</i> | Stem | 506 |

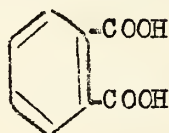
| Family | Genus and Species | Source | Reference |
|-------------------|---------------------------|-----------------|---------------|
| Polygonaceae | <i>R. rhaponticum</i> | Stem | 373 |
| | <i>R. undulatum</i> | Petiole | 348 |
| | <i>Rumex</i> sp. | | 228, 244, 515 |
| | <i>R. acetosa</i> | Leaf | 45 |
| | " " | Seed, root | 63 |
| | " " | | 61, 190, 521 |
| | <i>R. obtusifolius</i> | Root | 362 |
| Polypodiaceae | <i>Lonchitis</i> sp. | | 515 |
| Portulacaceae | <i>Portulaca</i> sp. | | 244, 515 |
| | <i>Talinum speciosa</i> | | 278 |
| Primulaceae | | | 515 |
| | <i>Primula elatior</i> | | 500 |
| Punicaceae | <i>Punica granatum</i> | | 332 |
| | " " | Bark | 486 |
| Pyrolaceae | <i>Monotropa</i> sp. | | 515 |
| Ranunculaceae | <i>Anemone</i> sp. | | 515 |
| | <i>A. nemorosa</i> | | 742 |
| Rhamnaceae | <i>Rhamnus lycioides</i> | Leaf | 221 |
| | <i>Zizyphus jujuba</i> | | 332 |
| Rosaceae | <i>Crataegus</i> sp. | Leaf | 781 |
| | <i>C. oxyacantha</i> | Leaf | 47 |
| | <i>Fragaria</i> sp. | Fruit | 24, 190, 792 |
| | " " | | 6 |
| | <i>Mespilus germanica</i> | Over-ripe fruit | 490 |
| | <i>Prunus armenica</i> | Dried fruit | 472 |
| | <i>P. avium</i> | Fruit | 204 |
| <i>P. cerasus</i> | Fruit | 24, 343 | |

| Family | Genus and Species | Source | Reference |
|--------------------|--------------------------|-------------------------|-------------------|
| Rosaceae | <i>Prunus domestica</i> | Fruit | 24, 108 |
| | <i>P. persica</i> | Fruit | 24, 190 |
| | <i>Pyrus communis</i> | Fruit | 24 |
| | " " | Over-ripe fruit | 490 |
| | <i>P. malus</i> | Fruit | 24, 206, 303, 736 |
| | <i>Quillaja</i> | | 486 |
| | <i>Rubus</i> sp. | Fruit | 24, 792 |
| | <i>R. fruticosus</i> | Leaf | 211 |
| | " " | Fruit | 473 |
| | <i>R. idaeus</i> | | 742 |
| Rubiaceae | <i>Cinchona</i> spp. | Bark | 592 |
| | <i>Coffea</i> sp. | Seed | 46 |
| | <i>C. arabica</i> | Fruit capsule | 277 |
| | <i>Dentella asiatica</i> | | 298 |
| | <i>Galium lucidum</i> | Leaf | 348 |
| | Rutaceae | <i>Citrus aurantium</i> | Fruit |
| " " | | Leaf | 668 |
| " " | | Peel | 667 |
| <i>C. decumana</i> | | Fruit | 332, 441 |
| " " | | Peel | 667 |
| <i>C. limonum</i> | | Fruit | 24, 332, 490, 792 |
| " " | | Peel | 667 |
| <i>C. medica</i> | | Petiole | 221 |
| " " | | Fruit | 332 |
| <i>C. nobilis</i> | | Fruit | 490 |
| Santalaceae | <i>Santalum album</i> | | 315 |

| Family | Genus and Species | Source | Reference |
|-------------------------|--------------------------------|--|--------------------------------|
| Saxifragaceae | <i>Ribes grossularia</i> | | 24, 108, 792 |
| | <i>R. rubrum</i> | | 205 |
| Simarubaceae | <i>R. sanguineum</i> | | 361 |
| | <i>Quassia amara</i> | Root bark | 457 |
| Solanaceae | | | 134 |
| | <i>Capsicum annuum</i> | | 24, 63, 190, 244 |
| | <i>Datura sp.</i> | | 515 |
| | <i>D. stramonium</i> | | 462 |
| | <i>Nicotiana sp.</i> | Leaf | 31, 501, 511, 576, 581 |
| | " " | | 582, 670, 758, 759, 81 |
| | " " | | 33, 694, 715, 716, 761 |
| | <i>Nicotiana tabacum</i> | Leaf | 360, 462, 695 |
| | <i>Solanum sp.</i> | | 515 |
| | <i>S. lycopersicum</i> | | 4, 63, 126, 540, 694, 820 |
| | " " | Fruit | 7, 24, 108, 190, 354, 384, 792 |
| | " " | Unripe fruit | 84, 85 |
| <i>S. tuberosum</i> | Tuber | 130, 190, 309, 429, 462, 569, 664, 792 | |
| Sterculiaceae | <i>Sterculia plantanifolia</i> | | 8 |
| | <i>Theobroma cacao</i> | | 24, 244, 458, 459, 460, 792 |
| Theaceae | | | 244, 298, 795 |
| Umbelliferae | | | 515 |
| | <i>Angelica archangelica</i> | Root | 698 |
| | <i>Anothum graveolens</i> | Leaf | 792 |
| | <i>Apium graveolens</i> | | 24, 190 |
| | <i>Pastinaca sativa</i> | | 792 |
| | <i>Petroselinum sativum</i> | | 792 |
| | Valerianaceae | <i>Valeriana officinalis</i> | |
| <i>Valerianella sp.</i> | | | 515 |

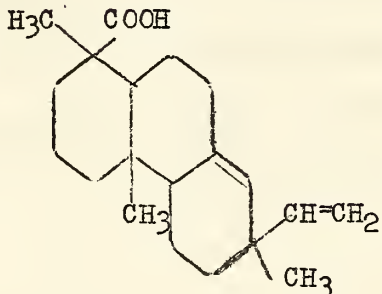
| <u>Family</u> | <u>Genus and Species</u> | <u>Source</u> | <u>Reference</u> |
|----------------|--------------------------|---------------|---------------------------|
| Vitaceae | Ampelopsis sp. | | 515 |
| | A. quinquefolia | Fruit | 564 |
| | Vitis vinifera | Fruit | 24, 188, 190, 193, 284 |
| | " " | | 285, 286 |
| | " " | Vines | 489 |
| | " " | Leaf, fruit | 348 |
| | " " | Leaf, shoot | 487 |
| | " " | Sap | 488, 814 |
| Zingiberaceae | Hedychium sp. | Leaf | 221 |
| Zygophyllaceae | Guaiacum sp. | Phloem | 221 |

Phthalic Acid

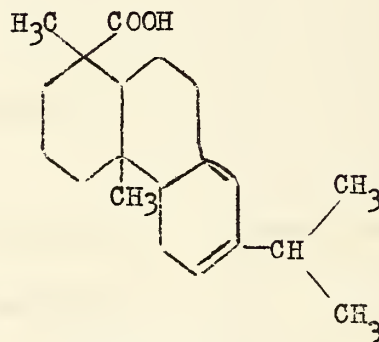


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|--------------|--------------------|--|-----|
| Papaveraceae | Papavor somniferum | | 641 |
|--------------|--------------------|--|-----|

Pimaric Acid



d-pimaric

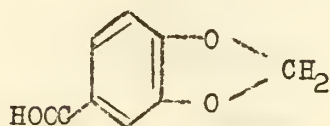


levopimaric

| | | | |
|----------|----------------|----------------|------------------|
| Pinaceae | Picea vulgaris | Resin | 67 |
| | P. excelsa | Resin | 265c, 349a, 349b |
| | Pinus 5 spp. | Oleoresin | 265c |
| | P. maritima | Resin | 161, 381 |
| | P. palustris | Oleoresin | 35a, 265a |
| | " " | Resin | 360a |
| | " " | Turpentine gum | 509a |
| | P. pinaster | | 163 |
| | P. silvestris | | 265b, 280a |

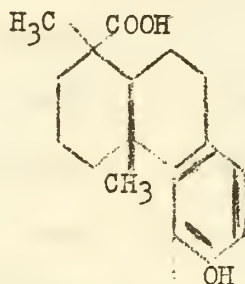
| Family | Genus and Species | Source | Reference |
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Piperonilic Acid



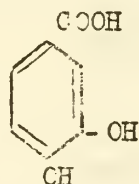
| | | | |
|-----------|------------------------------|------|-----|
| Rubiaceae | <i>Palicourea densiflora</i> | bark | 324 |
|-----------|------------------------------|------|-----|

Podocarpic Acid



| | | | |
|----------|------------------------------|--|----------|
| Pinaceae | <i>Dacrydium cupressinum</i> | | 165, 657 |
| | <i>Podocarpus cupressina</i> | | 507, 657 |
| | <i>P. dacrydioides</i> | | 165, 657 |

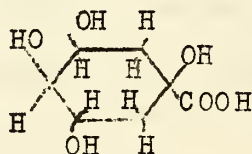
Protocatechuic Acid



| | | | |
|----------------|-----------------------------|--------------|-------------------|
| Bignoniaceae | <i>Crescentia</i> sp. | Crude curare | 336, 793 |
| Globulariaceae | <i>Globularia alypum</i> | | 753 |
| Liliaceae | <i>Allium cepa</i> | Skin | 21, 393, 394, 772 |
| Magnoliaceae | <i>Illicium anisatum</i> | Fruit, seed | 505 |
| | <i>I. religiosum</i> | Fruit | 125, 168, 170 |
| | <i>I. verum</i> | Capsule | 77 |
| Saxifragaceae | <i>Hydrangea Thunbergii</i> | Leaf | 706 |
| Vitaceae | <i>Vitis vinifera</i> | Leaf | 74 |

| Family | Genus and Species | Source | Reference |
|--|--------------------|------------------|-----------|
| <u>Pyruvic Acid</u> | | | |
| $ \begin{array}{c} \text{CH}_3 \\ \\ \text{C}=\text{O} \\ \\ \text{COOH} \end{array} $ | | | |
| Chenopodiaceae | Spinacia oleracea | Leaf | 32 |
| Euphorbiaceae | Ricinus communis | Germinating seed | 149 |
| Gramineae | Hordeum vulgare | | 57 |
| | " " | Seedling | 320 |
| Labiatae | Mentha piperita | Leaf | 717, 719 |
| Leguminosae | Arachis hypogaea | Seedling | 202, 203 |
| | Pisum sativum | Leaf | 32 |
| | " " | Seedling | 769 |
| | " " | | 767 |
| | Trifolium pratense | | 767 |
| Liliaceae | Allium cepa | | 55 |
| | " " | Juice | 456 |
| | Tulipa gesneriana | | 717, 719 |
| Rosaceae | Pyrus malus | Fruit | 303 |
| Solanaceae | Solanum tuberosum | Tuber | 38, 719 |
| Umbelliferae | Daucus carota | Leaf, root | 717 |
| | " " | Root | 719 |

Quinic Acid

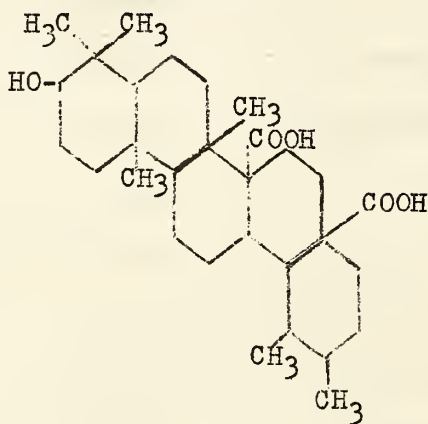


| | | | |
|------------|----------------------|--|-----|
| Compositae | Taraxacum officinale | | 408 |
|------------|----------------------|--|-----|

| Family | Genus and Species | Source | Reference |
|---------------|---------------------------------|---------------|----------------------------|
| Ericaceae | <i>Vaccinium arctostaphylos</i> | Leaf | 678 |
| | <i>V. myrtillus</i> | | 331 |
| | " " | Young leaf | 346 |
| | " " | Foliage | 831 |
| | <i>V. oxycoccus</i> | Fruit | 355, 382 |
| | <i>V. vitis idaea</i> | Leaf | 334 |
| Gramineae | | Hay | 407, 408 |
| | | Mixed herbage | 305 |
| Leguminosae | <i>Tamarindus indica</i> | Fruit | 331 |
| Magnoliaceae | <i>Illicium verum</i> | Capsule | 77 |
| Pinaceae | <i>Cedrus Libani</i> | Needle | 709 |
| | <i>Larix europaea</i> | Needle | 709 |
| | <i>Picea excelsa</i> | Young shoot | 345 |
| | " " | | 346 |
| Ranunculaceae | <i>Aconitum septentrionale</i> | | 321 |
| Rosaceae | <i>Prunus domestica</i> | Ripe fruit | 151 |
| | " " | Fruit | 355 |
| | <i>P. persica</i> | Fruit | 19, 137 |
| | <i>Pyrus communis</i> | Juice | 598 |
| | " " | Fruit | 743 |
| | <i>P. malus</i> | Fruit | 301, 303 |
| | " " | Juice | 537, 538, 708 |
| Rubiaceae | <i>Cinchona</i> sp. | | 293, 527, 528, 592, 751 |
| | <i>C. Cordifolia</i> | | 528 |
| | <i>Coffea</i> sp. | Fruit | 833 |
| | <i>Gallium mollugo</i> | | 498 |
| Solanaceae | <i>Nicotiana tabacum</i> | Leaf | 360 |

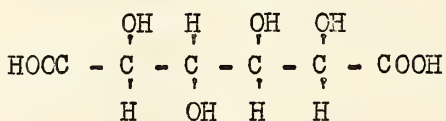
| Family | Genus and Species | Source | Reference |
|--------------|-----------------------|--------|-----------|
| Umbelliferae | Angelica archangelica | Root | 698 |
| Vitaceae | Vitis vinifera | Fruit | 355 |

Quinovic Acid



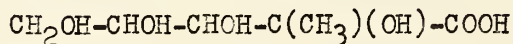
| | | | |
|----------------|-----------------------|------|-----|
| Rosaceae | Potentilla | Root | 595 |
| Rubiaceae | Cinchona spp. | | 592 |
| | C. sp. | | 620 |
| Zygophyllaceae | Zygophyllum coccineum | | 677 |

Saccharic Acid



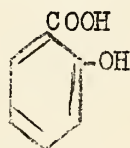
| | | | |
|----------|----------------|-------|-----|
| Moraceae | Ficus elastica | Latex | 239 |
|----------|----------------|-------|-----|

Saccharinic Acid



| | | | |
|--------------|----------------|-------|----|
| Bromeliaceae | Ananas sativas | Fruit | 80 |
|--------------|----------------|-------|----|

Salicylic Acid

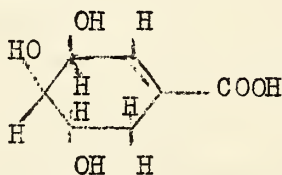


| | | | |
|------------|-----------------------|--|-----|
| Compositae | Calendula officinalis | | 147 |
|------------|-----------------------|--|-----|

| Family | Genus and Species | Source | Reference |
|----------------|------------------------------|-------------------------|--------------------|
| Compositae | <i>Matricaria chamomilla</i> | Flower head | 555 |
| Euphorbiaceae | <i>Cluytia similis</i> | Stem, leaf | 739 |
| Iridaceae | <i>Iris versicolor</i> | Rhizome | 561 |
| Leguminosae | <i>Daviesia latifolia</i> | Leaf, stem | 562 |
| | <i>Glycyrrhiza glabra</i> | Root | 146 |
| | <i>Trifolium pratense</i> | Flower | 560 |
| Liliaceae | <i>Alce</i> sp. | | 741 |
| | <i>Gloriosa superba</i> | Tuber | 127 |
| | <i>Hyacinthus</i> sp. | | 249 |
| | <i>Tulipa</i> sp. | | 249 |
| | <i>Yucca</i> sp. | | 249 |
| Moraceae | <i>Morus</i> sp. | Fruit | 146 |
| Pittosporaceae | <i>Pittosporum undulatum</i> | Fruit | 563 |
| Polygalaceae | <i>Polygala</i> sp. | Root | 645 |
| Ranunculaceae | <i>Cimicifuga racemosa</i> | Rhizome | 195 |
| Resedaceae | <i>Reseda odorata</i> | | 424 |
| Rosaceae | <i>Fragaria</i> sp. | Calyx, pedicel | 437 |
| | " " | Fruit | 550, 551, 720, 745 |
| | " " | Fruit pulp and juice | 697 |
| | " " | Juice | 801 |
| | <i>Prunus armenica</i> | Fruit | 720 |
| | <i>P. avium</i> | Fruit | 147 |
| | <i>P. cerasus</i> | Fruit | 147, 251, 720 |
| | " " | Juice | 317 |
| | <i>P. domestica</i> | Fruit | 720 |
| | <i>P. persica</i> | Fruit | 720 |
| | <i>Rubus fruticosus</i> | Fruit | 720 |

| Family | Genus and Species | Source | Reference |
|---------------|----------------------|-----------------------------|--------------------|
| Rosaceae | Rubus idaeus | Fruit | 116, 251, 720, 745 |
| | " " | Juice | 271, 801 |
| | R. occidentalis | Fruit | 720 |
| | Spiraea ulmaria | Flower | 424, 425 |
| Rubiaceae | Uragoga ipecacuanha | Root | 424 |
| Rutaceae | Barosma sp. | | 780 |
| | Casimiroa edulis | Seed | 556 |
| Saxifragaceae | Ribes sp. | Fruit | 720 |
| Solanaceae | Solanum lycopersicum | | 201, 525 |
| Violaceae | Viola 6 spp. | | 147 |
| | V. sylvatica | Leaf, stem, rhizome | 426 |
| | V. tricolor | Flower, leaf, stem, root | 250 |
| | " " | Leaf, stem, rhizome | 426 |
| Vitaceae | Vitis labrusca | Fruit | 251 |
| | V. vinifera | Fruit | 437 |

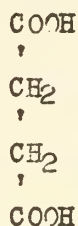
Shikimic Acid



| | | | |
|--------------|-------------------|--------|----------|
| Ginkgoaceae | Ginkgo biloba | Leaf | 266, 818 |
| Gramineae | Loium perenne | | 602 |
| Magnoliaceae | Illicium anisatum | | 505 |
| | I. religiosum | Fruit | 125, 168 |
| | " " | | 170 |
| | " " | Carpel | 663 |
| | I. Verum | | 77, 220 |

| Family | Genus and Species - 64 - | Source | Reference |
|--------------|--------------------------|--------|-----------|
| Magnoliaceae | <i>Illicium verum</i> | Carpel | 663 |
| Pinaceae | 25 spp. | | 266 |
| Taxaceae | 4 spp. | | 266 |

Succinic Acid



Critical review of literature - Franzen & Ostertag (215)

| | | | |
|----------------|------------------------------|--------------|--------------------|
| Aceraceae | <i>Acer saccharum</i> | Sirup | 476, 549 |
| | " " | "Sugar sand" | 477 |
| Amaryllidaceae | <i>Narcissus poeticus</i> | Leaf, root | 762 |
| Begoniaceae | <i>Begonia semperflorens</i> | | 617, 742 |
| Betulaceae | <i>Corylus sp.</i> | Nut | 148 |
| Bignoniaceae | <i>Crescentia sp.</i> | | 72 |
| | " " | Crude curare | 336 |
| Bombacaceae | <i>Adansonia digitata</i> | Fruit | 5 |
| Celastraceae | <i>Goupia tomentosa</i> | Wood | 160 |
| Compositae | <i>Artemisia absinthium</i> | | 714 |
| | " " | Leaf | 829 |
| | <i>Helianthus annuus</i> | | 58 |
| | <i>Lactuca sativa</i> | | 350, 742 |
| | <i>L. virosa</i> | | 350 |
| | <i>Taraxacum officinale</i> | | 408 |
| Chenopodiaceae | <i>Beta vulgaris</i> | Juice | 400, 508, 680, 681 |
| | " " | Top, root | 578 |
| | " " | Leaf, root | 752 |
| | <i>Spinacia oleraceae</i> | Leaf | 381 |

| Family | Genus and Species | Source | Reference |
|---------------|----------------------------|------------------------------|---------------|
| Compositae | <i>Lactuca</i> spp. | | 521 |
| Crassulaceae | <i>Bryophyllum</i> sp. | Leaf | 577, 578 |
| | <i>B. calycinum</i> | Leaf | 113, 570, 695 |
| | " " | Detached leaf | 748 |
| | " " | | 694 |
| | <i>Echeveria secunda</i> | | 214 |
| | " " | Leaf | 492 |
| | <i>Sedum acre</i> | Leaf | 492 |
| | <i>Sempervivum glaucum</i> | Leaf | 52 |
| Cruciferae | <i>Brassica oleraceae</i> | Leaf, bud | 482 |
| | <i>Bunias orientalis</i> | Stem, leaf, flowering top | 322 |
| Ericaceae | <i>Vaccinium myrtillus</i> | Fruit | 331 |
| | " " | Whole plant | 590 |
| Euphorbiaceae | <i>Ricinus communis</i> | | 65, 149 |
| Fagaceae | <i>Fagus sylvatica</i> | Sap | 652 |
| | <i>Quercus</i> sp. | Nut | 148 |
| Gramineae | | | 305 |
| | <i>Avena sativa</i> | | 297 |
| | <i>Bambusa</i> sp. | | 71 |
| | <i>Dactylis glomerata</i> | | 138 |
| | <i>Hordeum vulgare</i> | Leaf | 118, 695 |
| | " " | Etiolated shoot | 172 |
| | " " | Seedling | 297, 694 |
| | " " | | 320, 749 |
| | <i>Lolium perenne</i> | | 138 |
| | <i>Oryza</i> spp. | | 819 |
| | <i>O. sativa</i> | | 264 |

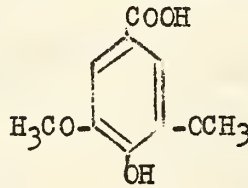
| Family | Genus and Species | Source | Reference |
|--------------|------------------------------|--------------|------------------------------|
| Gramineae | <i>Phleum pratense</i> | | 138 |
| | <i>Saccharum officinarum</i> | Juice | 10,99,609,610,611 804,821 |
| | <i>Triticum sp.</i> | | 749 |
| | <i>Zea mays</i> | Leaf | 43, 578 |
| Juglandaceae | <i>Juglans regia</i> | Nut | 148 |
| Lauraceae | <i>Persea gratissima</i> | Kernel | 520 |
| Leguminosae | <i>Lupinus albus</i> | Seedling | 297 |
| | <i>Phaseolus coccineus</i> | | 58 |
| | <i>Pisum sativum</i> | Seedling | 297 |
| | <i>Tamarindus indica</i> | | 209, 331 |
| Loganiaceae | <i>Strychnos toxifera</i> | | 71, 73 |
| Malvaceae | <i>Gossypium sp.</i> | | 185 |
| Moraceae | <i>Morus sp.</i> | | 816 |
| | <i>M. alba</i> | Bark exudate | 233 |
| | <i>M. indica</i> | Leaf | 332 |
| Musaceae | <i>Musa basjoo</i> | Juice | 628 |
| | <i>M. sapientum</i> | Fruit | 200 |
| Papaveraceae | <i>Chelidonium majus</i> | | 643 |
| | <i>Eschscholtzia sp.</i> | | 776 |
| | <i>Glaucium luteum</i> | Juice | 640 |
| | <i>Papaver somniferum</i> | | 776 |
| Pinaceae | | Turpentine | 383 |
| | <i>Abies pectinata</i> | Turpentine | 117 |
| | " " | Resin | 733 |
| | <i>Agathis australis</i> | Resin | 464 |
| | <i>A. dammara</i> | Resin | 729 |

| Family | Genus and Species | Source | Reference |
|---------------|-----------------------------|---------------|--------------|
| Pinaceae | <i>Larix decidua</i> | Rosin | 732 |
| | <i>Picea vulgaris</i> | Resin | 730 |
| | <i>Pinus</i> sp. | Sap | 652 |
| | <i>P. silvestris</i> | Resin | 731 |
| Polygonaceae | <i>Fagopyrum esculentum</i> | | 148 |
| | " " | Leaf and stem | 578 |
| | <i>Rheum hydridum</i> | Rhizome, stem | 618 |
| | " " | Leaf | 695 |
| | <i>R. officinale</i> | Petiole | 106 |
| | <i>R. rhaponticum</i> | Leaf, petiole | 578 |
| | <i>R. Undulatum</i> | Petiole | 348 |
| Proteaceae | <i>Orites excelsa</i> | Wood | 672 |
| Ranunculaceae | <i>Anemone nemorosa</i> | Leaf | 404 |
| | " " | | 742 |
| Rosaceae | <i>Fragaria</i> sp. | Fruit | 6 |
| | <i>Prunus avium</i> | Fruit | 204 |
| | <i>P. cerasus</i> | Juice | 325 |
| | " " | Fruit | 343 |
| | <i>P. communis</i> | Fruit pulp | 326 |
| | <i>P. persica</i> | Fruit | 19 |
| | <i>Pyrus aucuparia</i> | Fruit | 213 |
| | " " | | 405 |
| | <i>P. communis</i> | Juice | 598 |
| | " " | Fruit | 743 |
| | <i>P. malus</i> | Fruit | 43, 109, 110 |
| | " " | | 206 |
| " " | Juice | 537, 710 | |

| Family | Genus and Species | Source | Reference |
|------------------|------------------------------|---------------------|-------------------|
| Rosaceae | <i>Rubus fruticosus</i> | Leaf | 211 |
| | " " | Fruit | 473 |
| | <i>R. idaeus</i> | Leaf | 218, 325, 742 |
| Rutaceae | <i>Citrus limonum</i> | Fruit | 332 |
| Santalaceae | <i>Santalum album</i> | | 315 |
| Sapotaceae | <i>Mimusops</i> sp. | | 521 |
| Saxifragaceae | <i>Ribes rubrum</i> | | 205 |
| Scrophulariaceae | <i>Digitalis purpurea</i> | | 88, 337 |
| Solanaceae | <i>Atropa belladonna</i> | | 369 |
| | <i>Nicotiana</i> sp. | | 43, 578, 661, 694 |
| | " " | Leaf | 577, 758, 759 |
| | <i>N. tabacum</i> | Leaf | 695, 761 |
| | <i>Solanum lycopersicum</i> | Fruit | 7, 746, 747 |
| | " " | Over-ripe fruit | 83, 84, 85 |
| | " " | Leaf, stalk | 578 |
| | " " | Leaf | 694, 695 |
| | " " | <i>S. tuberosum</i> | Tuber |
| Umbelliferae | <i>Angelica archangelica</i> | Root | 698 |
| | <i>Daucus carota</i> | Root | 109, 110, 413 |
| Vitaceae | <i>Vitis vinifera</i> | Leaf | 74 |
| | " " | Unripe fruit | 105 |
| | " " | Fruit | 106, 348 |

| Family | Genus and Species | Source | Reference |
|----------|-----------------------|------------|-----------|
| Vitaceae | <i>Vitis vinifera</i> | Sap, fruit | 286 |
| | " " | Sap | 489, 814 |

Syringic Acid



| | | | |
|-----------|------------------------------|----------------|-----|
| Gramineae | <i>Saccharum officinarum</i> | Juice | 611 |
| | " " | Crude molasses | 704 |

Tartaric Acid

| | |
|--|--|
| Critical review of literature Franzen & Helwert (208) | $ \begin{array}{c} \text{COOH} \\ \\ \text{CHOH} \\ \\ \text{CHOH} \\ \\ \text{COOH} \end{array} $ |
|--|--|

| | | | |
|----------------|-----------------------------------|--------------|----------|
| Aceraceae | <i>Acer saccharum</i> | "Sugar sand" | 402, 674 |
| | " " | Sirup | 477 |
| Amaryllidaceae | <i>Agave americana</i> | Leaf sap | 111 |
| Anacardiaceae | <i>Mangifera indica</i> | | 87 |
| | <i>Rhus coriaria</i> | | 156 |
| | <i>R. semialata</i> | | 744 |
| | <i>Spondias purpurea</i> | | 565 |
| Araliaceae | <i>Aralia hispida</i> | Fruit | 230 |
| Asclepiadaceae | <i>Asclepias syriaca</i> | Milky sap | 649 |
| Berberidaceae | <i>Berberis integerrima</i> | Fruit | 348 |
| | <i>Caulophyllum thalictroides</i> | Fruit pulp | 687 |
| Betulaceae | <i>Betula alba</i> | Sap | 225 |
| Bombacaceae | <i>Adansonia</i> sp. | Fruit pulp | 270 |

| Family | Genus and Species | Source | Reference |
|----------------|---------------------------------|-------------|-----------|
| Bombacaceae | <i>Adansonia</i> sp. | Fruit | 440 |
| | <i>A. digitata</i> | Fruit | 5 |
| Bromeliaceae | <i>Ananas sativas</i> | Fruit | 80, 521 |
| Caprifoliaceae | <i>Diervilla florida</i> | Fruit | 139 |
| | <i>Lonicera xylosteum</i> | Fruit | 174 |
| | <i>Sambucus calicarpa</i> | Fruit | 128 |
| | <i>S. ebulus</i> | Fruit | 178 |
| | " " | Root | 179 |
| | <i>S. nigra</i> | Fruit | 177 |
| | <i>Symphoricarpus racemosus</i> | Fruit | 671 |
| | <i>Viburnum lantana</i> | | 182 |
| | <i>V. nudum</i> | | 410 |
| Caricaceae | <i>Carica papaya</i> | Fruit | 519 |
| Celastraceae | <i>Celastrus obscurus</i> | Leaf | 158 |
| | <i>C. scandens</i> | Fruit | 786 |
| | <i>Euonymus atropurpureus</i> | Root bark | 471 |
| | <i>E. europaeus</i> | Seed kernel | 253 |
| Chenopodiaceae | <i>Beta vulgaris</i> | Root | 234, 400 |
| | " " | Root, leaf | 752 |
| | <i>Chenopodium ambrosioides</i> | | 69 |
| Commelinaceae | <i>Tradescantia purpurea</i> | Stem sap | 227 |
| | <i>T. zebrina</i> | Stem sap | 227 |
| Compositae | <i>Bellis perennis</i> | | 183 |
| | <i>Helianthus tuberosus</i> | Tuber | 93, 234 |
| | <i>Matricaria chamomilla</i> | Flower | 276 |

| Family | Genus and Species | Source | Reference |
|----------------|--------------------------------|------------|---------------|
| Cornaceae | <i>Cornus paniculatum</i> | Fruit | 656 |
| | <i>C. sericea</i> | Fruit | 687 |
| Cruciferae | <i>Capella bursa pastoris</i> | | 135 |
| Elaeagnaceae | <i>Hippophaë rhamnoides</i> | Fruit | 807 |
| Elaeocarpaceae | <i>Elaeocarpus serratus</i> | Fruit | 817 |
| Ericaceae | <i>Vaccinium</i> sp. | Leaf | 334 |
| | <i>V. corymbosum</i> | Fruit | 265 |
| | <i>V. vitis idaea</i> | Leaf | 499 |
| | " " " | Fruit | 802 |
| Eucommiaceae | <i>Eucommia ulmoides</i> | Leaf | 254 |
| Euphorbiaceae | <i>Euphorbia cyparissias</i> | Milky sap | 784 |
| | <i>E. platyphylla</i> | Milky sap | 785 |
| | <i>Phyllanthus emblica</i> | | 332 |
| | <i>Ricinus communis</i> | | 65 |
| Fagaceae | <i>Quercus pedunculata</i> | Wood | 445 |
| Geraniaceae | <i>Geranium zonale</i> | | 94 |
| Gramineae | <i>Bambusa</i> sp. | Shoot | 626 |
| | <i>Saccharum officinarum</i> | Juice | 821 |
| | <i>Sorghum vulgare</i> | | 419, 796, 797 |
| Guttiferae | <i>Garcinia gambogia</i> | Fruit rind | 370 |
| Hydrocaraceae | <i>Prosopanche burmeisteri</i> | | 826 |
| Labiatae | <i>Glechoma hederaceae</i> | | 180 |
| | <i>Orthoclydon obtusius</i> | | 344 |
| Lauraceae | <i>Persea gratissima</i> | Fruit pulp | 520, 521 |

| Family | Genus and Species | Source | Reference |
|--------------|-------------------------------|----------------------|------------------------------|
| Leguminosae | <i>Astragalus</i> sp. | Twig | 412 |
| | <i>Bauhinia reticulata</i> | Fruit, leaf | 585 |
| | <i>Cassia</i> sp. | Leaf | 726, 773 |
| | <i>C. acutifolia</i> | Leaf | 379 |
| | <i>Tamarindus indica</i> | Fruit pulp | 82, 596, 756 |
| | " " | " " | 3, 199, 209, 241 634, 750 |
| | " " | Leaf | 245 |
| | " " | Mesocarp | 278 |
| | " " | Green and ripe fruit | 316, 565 |
| Liliaceae | <i>Clintonia borealis</i> | Fruit | 669 |
| | <i>Erythronium dens canis</i> | Bulb | 157 |
| | <i>Smilacina bifolia</i> | Fruit | 167 |
| | <i>S. racemosa</i> | Fruit | 167 |
| Magnoliaceae | <i>Schizandra chinensis</i> | Fruit | 531 |
| Moraceae | <i>Morus indica</i> | Leaf | 332 |
| Myrtaceae | <i>Eugenia australis</i> | | 411 |
| | <i>Psidium guajava</i> | | 625 |
| Musaceae | <i>Musa sapientum</i> | Fruit | 200 |
| Orchidaceae | <i>Vanilla planifolia</i> | Fruit | 387 |
| Oxalidaceae | <i>Oxalis corniculata</i> | Leaf | 245 |
| Pinaceae | <i>Pinus sylvestris</i> | Pollen | 366 |
| Piperaceae | <i>Piper nigrum</i> | | 526 |
| Papaveraceae | <i>Adlumina cirrosa</i> | Root | 639 |
| | <i>Chelidonium majus</i> | Leaf | 567 |

| Family | Genus and Species | Source | Reference |
|---------------|-----------------------------|----------|---------------------------------|
| Papaveraceae | <i>Fumaria officinalis</i> | Sap | 444 |
| | <i>Papaver somniferum</i> | Capsule | 145 |
| Polygonaceae | <i>Polygonum reynoutria</i> | Stem | 705 |
| Ranunculaceae | <i>Aconitum napellus</i> | | 594 |
| Rosaceae | <i>Crataegus</i> sp. | Fruit | 435 |
| | <i>Cydonia vulgaris</i> | Fruit | 123, 701, 723 |
| | <i>Eriobotrya japonica</i> | Fruit | 371 |
| | <i>Fragaria</i> sp. | | 123, 465, 723 |
| | <i>Prunus armeniaca</i> | Fruit | 123, 495, 497, 701 |
| | " " | | 723 |
| | <i>P. avium</i> | | 123 |
| | <i>P. cerasus</i> | Fruit | 123, 465, 495, 496, 497, 723 |
| | <i>P. domestica</i> | Fruit | 495, 496, 497, 723 |
| | <i>P. persica</i> | Fruit | 496, 635 |
| | <i>P. spinosa</i> | | 648 |
| | <i>Pyrus arbutifolia</i> | Fruit | 591 |
| | <i>P. aucuparia</i> | | 390, 405 |
| | <i>P. malus</i> | Fruit | 495, 497 |
| | " " | Juice | 701 |
| | <i>Rubus</i> sp. | | 136 |
| | <i>R. idaeus</i> | Fruit | 465 |
| " " | Fruit juice | 123, 341 | |
| " " | Sap | 338 | |
| Rubiaceae | <i>Coffea</i> sp. | | 522 |
| Rutaceae | <i>Citrus decumana</i> | Fruit | 441 |
| | <i>Cusparia trifoliata</i> | | 97 |

| Family | Genus and Species | Source | Reference |
|------------------|--------------------------------|--------|------------------|
| Santalaceae | Leptomeria acida | Fruit | 597 |
| Sapindaceae | Sapindus saponaria | | 241 |
| Sapotaceae | Achras sapota | | 523 |
| | Bassia latifolia | | 349 |
| | Sideroxylon crassipedicellatum | Fruit | 523 |
| Saxifragaceae | Ribes sp. | | 465 |
| | R. grossularia | | 802 |
| | R. nigrum | | 123 |
| | R. rubrum | | 216, 802 |
| Scrophulariaceae | Antirrhinum majus | | 775 |
| | Digitalis grandiflora | | 775 |
| | Euphrasia officinalis | | 176 |
| | Linaria cymbalaria | | 775 |
| | Scrophularia nodosa | | 775 |
| | Veronica officinalis | | 175 |
| | | | |
| Solanaceae | Cyphomandra calycina | | 524 |
| | Physalis peruviana | Fruit | 376 |
| | Solanum dulcamara | Fruit | 16, 736 |
| | S. lycopersicum | | 4 |
| | " " | Fruit | 7, 181, 348, 701 |
| | S. Tuberosum | Tuber | 171 |
| Sterculiaceae | Theobroma cacao | Berry | 90 |

| Family | Genus and Species | Source | Reference |
|------------|--|----------------------|--------------------------------------|
| Tiliaceae | <i>Tilia vulgaris</i> | | 275 |
| Urticaceae | <i>Parietaria officinalis</i> | | 289 |
| Vitaceae | | | 193 |
| | <i>Ampelopsis hederacea</i> | | 242 |
| | A: " | Leaf | 243 |
| | <i>Parthenocissus quinque-</i> <i>folia</i> | Leaf | 539 |
| | <i>Vitis</i> sp. | | 12 |
| | " " | Leaf | 511 |
| | <i>V. hederaceae</i> | | 808 |
| | <i>V. labrusca</i> | Juice | 416, 635 |
| | <i>V.</i> " | Fruit | 474 |
| | <i>V. sylvestris</i> | Fruit | 604 |
| | <i>V. vinifera</i> | | 14, 64, 224, 286, 308, 488 |
| | " " | Fruit | 15, 197, 284, 332, 495, 548, 701 |
| | " " | Leaf | 74, 348, 533, 651 |
| | " " | Juice | 143, 222, 231, 263, 358, 534, 653 |
| | " " | Sap | 377, 810, 814 |
| | " " | Vine | 285 |
| | " " | Unripe fruit | 420, 503, 532 |
| | " " | Young shoot, leaf | 487 |

Tartronic Acid

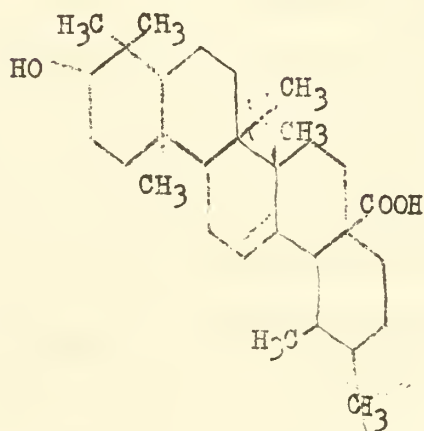


Gramineae

603

| Family | Genus and Species | Source | Reference |
|---|------------------------|------------------|-----------|
| <u>Tricarballic Acid</u> | | | |
| $\begin{array}{c} \text{CH}_2\text{COOH} \\ \\ \text{CH COOH} \\ \\ \text{CH}_2\text{COOH} \end{array}$ | | | |
| Aceraceae | <i>Acer saccharum</i> | "Sugar sand" | 402, 477 |
| Chenopodiaceae | <i>Beta vulgaris</i> | Evaporated juice | 395, 406 |
| | " " | Root | 396, 713 |
| | " " | Juice | 399 |
| | " " | Root, leaf | 752 |
| Gramineae | <i>Hordeum vulgare</i> | Whole plant | 483 |

Ursolic Acid

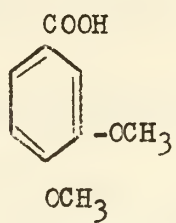


| | | | |
|---------------|---------------------------------|----------------|------|
| Apocynaceae | <i>Allamanda cathartica</i> | Leaf | 27 |
| Aquifoliaceae | <i>Ilex aquifolium</i> | | 196 |
| | <i>I. latifolia</i> | Cruticle | 335 |
| | <i>I. paraguariensis</i> | Leaf | 442 |
| Cornaceae | <i>Cornus florida</i> | Flower, bract. | 624a |
| Ericaceae | <i>Arcostaphylos uva-ursi</i> | Leaf | 623 |
| | <i>Enkianthus quinqueflorus</i> | | 28 |
| | <i>Erica arborea</i> | | 196 |
| | <i>E. carnea</i> | | 196 |
| | <i>E. mediterranea</i> | | 196 |

| Family | Genus and Species | Source | Reference |
|-------------|------------------------------|---------------|-----------|
| Ericaceae | <i>Kalmia angustifolia</i> | | 319 |
| | <i>Leucothoe keiskei</i> | Leaf | 665 |
| | <i>Rhododendron</i> 6 sp. | | 28 |
| | <i>R. pulchrum</i> | Leaf | 27 |
| | <i>R. simsii</i> | Leaf | 27 |
| | <i>Vaccinium macrocarpon</i> | Pomace | 433 |
| | <i>V. myrtillus</i> | | 196, 590 |
| | <i>V. oxycoccus</i> | Fruit pulp | 374 |
| | <i>V. vitis-idaea</i> | | 196 |
| Labiatae | <i>Thymus vulgaris</i> | | 615 |
| | <i>Salvia officinalis</i> | | 101 |
| Myrtaceae | <i>Psidium guajava</i> | Leaf | 26 |
| Punicaceae | <i>Punica granatum</i> | Peel, leaf | 102 |
| | | | |
| Pyrolaceae | <i>Pyrola minor</i> | | 196 |
| | <i>P. umbellata</i> | | 196 |
| Rosaceae | <i>Crataegus oxyacantha</i> | | 59 |
| | <i>Eriobotrya japonica</i> | | 27 |
| | <i>Prunus avium</i> | Cuticle | 433a |
| | <i>P. serotina</i> | | 258 |
| | " " | Leaf | 623 |
| | <i>Pyrus communis</i> | Fruit skin | 431 |
| | <i>P. malus</i> | Fruit | 260 |
| | " " | Fruit skin | 281, 623 |
| | " " | Fruit cuticle | 432 |
| Solanaceae | <i>Anthocercis intricata</i> | | 22 |
| | <i>A. littorea</i> | | 22 |
| | <i>A. odgersii</i> | | 22 |
| Verbenaceae | <i>Verbena stricta</i> | | 512 |

| Family | Genus and Species | Source | Reference |
|--------|-------------------|--------|-----------|
|--------|-------------------|--------|-----------|

Veratric Acid



Liliaceae

Sabadilla officinalis

Seed.

443

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