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COUMARINS: PLANTS, STRUCTURE, PROPERTIES

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Among the most important classes of natural compounds, an important position is occupied by oxygen-containing heterocyclic compounds — coumarins (benzo-α-pyrones).

The first representative of this class — coumarin — was discovered in 1820. While from 1820 to 1988, throughout the world, 786 coumarins were found, in the period from 1989 to 1996 alone, 614 were isolated. These facts witness an ever-increasing interest of researchers in this class of natural compounds.

After the break-up of the former USSR into independent sovereign states, a regular supply of literature on branches of science became practically impossible. This circumstance induced the authors of the present review to collect in handbook form information on natural coumarins published in journals of the former USSR.

The aim of this review, prepared by workers of the laboratory of coumarin and terpenoid chemistry of the Institute, was to collect and generalize factual literature material scattered through numerous poorly accessible sources.

Thus, the information given may be considered reference material for specialists in the field of the chemistry of natural compounds with respect to the distribution of coumarins in natural sources and their physicochemical properties and biological activity. In addition to this, comparative investigations of the physicochemical characteristics of coumarins may subsequently lead to fundamental generalizations of chemical properties and spectral characteristics (UV, IR, mass, and ^{1}H and ^{13}C NMR) and to the finding of new laws and relationships between structure and biological activity in the class of natural compounds concerned.

The review has been compiled from the literature on the investigation of plant coumarins published in the journals of the former USSR up to 1995, together with unpublished results of the authors, and consists of two chapters.

The first chapter relates to 375 plant species belonging to 31 families, with information on the coumarins of established structure that they contain. Taxon names given in the original papers have been retained, while the authors of taxons and names in parentheses follow S. K. Cherepanov (Vascular Plants of the USSR, Leningrad, Nauka (1981)).

The second chapter describes 330 coumarins in alphabetical order with information on the producing plants, physicochemical characteristics, and structures, with reference to the original papers. About 20% of the total number of compounds given in this chapter were isolated by workers of the Institute.

UV spectra were taken in ethanol (λ_{max}, nm, log ε), and ^{1}H and ^{13}C NMR spectra in deuterochloroform (δ-scale, J, Hz), except where otherwise stated.

Generally adopted abbreviations have been used. We give the abbreviations of the literature sources found most frequently:

KPS — Khimiya Prirodnykh Soedinenii (Chemistry of Natural Compounds).

Kuznetsova — G. A. Kuznetsova, Natural Coumarins and Furocoumarins [in Russian], Leningrad, Nauka (1967).

Perel'son — M. E. Perel'son, A. A. Savina, and Yu. N. Sheinker, The Spectra of Coumarins, Chromones, and Xanthones [in Russian], Moscow, Meditsina (1975).

Murray — R. D. H. Murray, Naturally Occurring Plant Coumarins, in: Fortschr. Chem. Org. Naturst., **35**, 199 (1977).

Academician Kh. N. Aripov*

*Deceased.

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Chapter 1

DISTRIBUTION OF COUMARINS IN PLANTS

FAM. ARALIEACEAE

***Eleutheroccocus senticosus* Maxim.**
Isofraxidin [1, 2]
Scopoletin [2]
Eleutheroside B_1 [1, 2]

FAM. ASCLEPIADACEAE

***Periploca sepium* Bunge**
Scopoletin [3]

FAM. ASPIDISTREAE

***Rhodea japonica* Thumb**
Scopoletin [4]
Umbelliferone [4]

FAM. BERBERIDACEAE

***Berberis vulgare* L.**
Esculetin [5]

FAM. CAMPANULACEAE (LOBELIACEAE)

***Campanula alliariifolia* Willd.**
Isofraxoside [6]
Fraxetol [7]
Fraxoside [7]

***Campanula ochrolenca* Kem. Nath.**
Fraxetol [7]
Fraxoside [7]

FAM. CARYOPHYLLACEAE

***Dievilla japonica* D.C.**
Fraxin [8]

***Herniaria auxina* Klok**
Herniarin [8]
Scopoletin [8]
Umbelliferone [8]

Herniaria polygona **J. Way.**
Herniarin [8]
Scopoletin [8]
Umbelliferone [8]

FAM. CHENOPODIACEAE

Salsola laricifolia **Turcz. et Litv.**
Isofraxidin [48]
Calycanthoside [49]
Cleomiscosin B [50]
Cleomiscosin D [50]
Lariside [48, 49]
Scopolin [48]
Fraxetin [48]
Fraxidin [48]
Fraxin [50]

FAM. COMPOSITAE (ASTERACEAE)

Achillea biebershteina **Afon**
Isoscopoletin [9]
Scopoletin [9]
Umbelliferone [9]

Artemisia absinthium **L.**
Scopoletin [10, 11]
Umbelliferone [10, 11]
Esculin [10]
Esculetin [10]

A. adamsii **Bess.**
Scopoletin [12]

A. annua **L.**
Scopolin [13]
Scopoletin [13]

A. armenica **Lam.**
Armin [14]

A. dracunculus **L.**
Scopoletin [15]

A. diffusa **Krasch.**
Herniarin [16]

A. freyniana **Krasch.**
Herniarin [17]
Scopoletin [17]

A. chamaemelifolia **Vill.**
Scopolin [18]
Scopoletin [18]

A. glauca **Pall.**
Scopoletin [19]
Scoparone [19]
Umbelliferone [19]

A. gmelinii **Web. ex Stechm.**
Scopoletin [21]

A. gorjaevuii **Poljak**
Scopoletin [21]

A. jacuta **Prob.**
Scopoletin [10]
Umbelliferone [10]
Esculetin [10]
Esculin [10]

A. japonica **Thunb.**
Herniarin [17]
Scopoletin [17]

A. laciniata **Willd.**
5-Hydroxy-7,8-dimethoxycoumarin [22]
5,6-Dimethoxy-7-(2′,3′-dihydroxy-3′-methylbutoxy)coumarin [22]
Lacarol [22]

A. martjanovii **Krasch.**
Coumarin [23]

A. obtusifolia **Lbd.**
Coumarin [23]

A. palustris **L.**
Umbelliferone [20]

A. persica **Boiss.**
Scopolin [25]
Scopoletin [25]

A. porrecta **Krasch.**
Herniarin [24]

A. santolinofolia **Turcz.**
Scopoletin [26]

A. saissanica **Krasch. Filat.**
Scopoletin [21]

A. scoparia **W. et Kit.**
Scoparone [28]

A. scotina **Nevsky**
Isofraxidin [27]
Isofraxetin [27]
Scopoletin [27]
Umbelliferone [27]
Fraxidin [27]

A. sieversiana **Willd.**
Umbelliferone [10]
Scopoletin [10]
Esculin [10]
Esculetin [29]

A. vulgaris **L.**
Coumarin [30]
Scopoletin [30]
Umbelliferone [30]
Esculetin [30]
Esculin [30]

Bidens tripartita **L.**
Scopoletin [31]
Umbelliferone [31]
Esculetin [31]

Calendula officinalis **L.**
Scopoletin [32]
Umbelliferone [32]
Esculetin [32]

Centaurea cyanus **L.**
Scopoletin [33]
Umbelliferone [33]

Centaurea meyeriana **Tzvel**
Scopoletin [34]

Cichorium intubus **L.**
Scopoletin [36]
Umbelliferone [36]
Cichoriin [35, 36]
Esculetin [35, 36]
Esculin [35, 36]

Doronicum macrophyllum **Fisch. ex Horten.**
(+)-Skimmin [37]
Umbelliferone [37]

Eupatorium japonicum **Thunb.**
Umbelliferone [88]

Helichrysum arenarium **(L.) Moench**
Scopoletin [32]
Umbelliferone [32]

H. italicum **Juss.**
Isoscopoletin [38]
Scopoletin [38]
Esculetin [38]

H. maracandicum **M. Pop. ex Kirp.**
Isoscopoletin [39]
Scopoletin [39]
Umbelliferone [39]
Esculetin [39]

Koelpinia linearis **Pall.**
Esculetin [40]
Esculin [40]
Cichoriin [40]

Leucanthemum sibiricum **L.**
Scopoletin [41]
Esculetin [41]

Matricaria recutita **L.**
Herniarin [42]
Isoscopoletin [42]
Coumarin [42]
Scopoletin [42]
Umbelliferone [42]

Ptarmica bisserata Bieb. **D.C.**
Scopoletin [43]
Scopolin [43]
Scoparone [44]

Ptarmica impatiens **D.C.**
Scopoletin [45]
Scopolin [45]
Scoparone [45]

P. ptarmifolia **(Willd.) G**
Scopoletin [45]
Scoparone [45]

Stevia rebaudiana **Bertoni**
Scopoletin [46]
Umbelliferone [46]

Taraxacum officinale **Web.**
Scopoletin [47]
Esculetin [47]

FAM. **CRASSULACEAE**

Rhodiola quadrifida **(Poll.) Fisch. et Mey.**
Scopoletin [51]
Umbelliferone [51]

Sedum caucasicum **Grossh. A. Bor.**
Esculetin [52]

Sedum ewersii **Lbd.**
Umbelliferone [53]
Esculetin [53]

Sempervivum ruthenicum **(Koch) Schnittsp. et Lehm.**
Coumarin [54]

FAM. DIPSACACEAE

Scabiosa comosa **Fisch. ex Roem. ex Schult.**
Bergapten [55]
Coumarin [55]
Umbelliferone [55]

FAM. **ERICACEAE**

Ledum decumbens **Ait. Lodd. ex Stend.**
Scopoletin [56]
Umbelliferone [56]
Esculetin [56]

Ledum hypoleucum **Kom.**
Scopoletin [56]
Umbelliferone [56]
Esculetin [56]

Ledum macrophyllum **Tolm.**
Scopoletin [56]
Umbelliferone [56]
Esculetin [56]

Ledum palustre **L.**
Scopoletin [56]
Fraxetin [57]
Umbelliferone [56]
Esculetin [56]

Rhododendron dauricum **L.**
Scopoletin [58]
Umbelliferone [58]

Rhododendron luteum **Sweet.**
Scopoletin [59]

Rhododendron ungernii **Trautv.**
Scopoletin [60]
Umbelliferone [60]

FAM. **GENTIANACEAE**

Gentiana barbata **Frooel**
Scopoletin [60a]
Umbelliferone [60a]
Esculetin [60a]

FAM. **HIPPOCASTANACEAE**

Aesculus hippocastanum **L.**
Esculin [60b]

FAM. **LABIATAE (LAMIACEAE)**

Ajuga chia **Schreb.**
Esculetin [61]

Prunella vulgaris **L.**
Scopoletin [62]
Umbelliferone [62]
Esculetin [62]

FAM. **LEGUMINOSAE (FABACEAE)**

Astragalus falcatus **Lam.**
Skimmin [63]
Scopolin [63]

A. onobrychis **L.**
Scopoletin [64]
Scopolin [64]
Umbelliferone [64]

Caragana frutex **C. Koch**
Bergapten [65]
Xanthotoxin [65]
Scopoletin [65]
Umbelliferone [65]
Esculetin [65]

Cicer orientinum **L.**
Scopoletin [66]
Umbelliferone [66]

Coronilla balansae **Boiss.**
Daphnoretin [67]
Psoralen [67]
Scopoletin [67]
Umbelliferone [67]

C. cretica **L.**
Daphnoretin [67]
Scopoletin [67]
Umbelliferone [67]

C. elegans **Panc.**
Daphnoretin [69]
7-Methoxyesculetin [69]
Scopoletin [69]
Umbelliferone [69]

C. hyrcana **Prilipko**
Daphnoretin [70]
Psoralen [70]
Scopoletin [70]
Umbelliferone [70]

C. orientalis **Mill.**
Daphnoretin [67]
Psoralen [67]
Scopoletin [67]
Umbelliferone [67]

C. rependa **(Poir) Boiss.**
Daphnoretin [68]
Psoralen [68]
Scopoletin [68]
Umbelliferone [68]

C. scorpioides **L.**
Psoralen [71]
Scopoletin [71]
Umbelliferone [71]

C. varia **L.**
Daphnoretin [67, 72]
Psoralen [72]
Scopoletin [67, 72]
Umbelliferone [67, 72]

Melilotus albus **Desr.**
Coumarin [73]

Onobrychis kemularia **Chinth.**
Scopoletin [74]
Umbelliferone [74]

Phaseolus aurens **(Roxb.) Piper.**
Isoscopoletin [75]
Scopoletin [75]
Umbelliferone [75]

Phaseolus vulgaris **L.**
Isoscopoletin [76]
Scopoletin [76]
Umbelliferone [76]
Esculetin [76]
Esculin [76]

Psoralea acaulis **Stev.**
Psoralen [77]

P. bituminosa **L.**
Angelicin [77]
Psoralen [77]

P. drupaceae **Bge.**
Angelicin [78]
Psoralen [78]

Securigera securidaca **L.**
Scopoletin [79]
Umbelliferone [79]

Vicia sativa **L.**
Bergapten [80]
Xanthotoxin [80]
Scopoletin [80]
Umbelliferone [80]
Esculetin [80]

Vicia trunculata **Fisch.**
Scopoletin [81]

FAM. LINACEAE

***Linum usitatissimum* L.**
Esculetin [82]
Esculin [82]

FAM. MALVACEAE

***Althaea armenica* Ten.**
Herniarin [83]
Isoscopoletin [83]
Coumarin [83]
Scopoletin [83]
Scopolin [83]
Umbelliferone [83]
Esculetin [83]
Esculin [83]
Cichoriin [83]

***A. officinalis* L.**
Herniarin [83]
Isoscopoletin [83]
Coumarin [83]
Scopoletin [83]
Scopolin [83]
Umbelliferone [83]
Esculetin [83]
Esculin [83]
Cichoriin [83]

***Sida hermaphrodita* Roxb.**
Scopoletin [84]
Scopolin [84]

FAM. MORACEAE

***Ficus carica* L.**
Bergapten [85]
O-β-*D*-Glucofuranosylfurocoumarinic acid [85]
Psoralen [85]

***F. pumila* L.**
Bergapten [86]

***F. ramantaceae* Roxb.**
Coumarin [86]

FAM. OLEACEAE

***Fraxinus mandschurica* Rupr.**
Isofraxetin [87]
Fraxinol [87]
Esculetin [87]

***F. nigra* Marsh.**
Fraxin [88]
Fraxetin [88]
Esculetin [88]

***F. ornys* L.**
Fraxin [87]
Cichoriin [87]
Esculetin [87]
Esculin [87]

***F. oxycarpa* Willd.**
Fraxin [87]
Cichoriin [87]
Esculetin [87]
Esculin [87]

***F. sogdiana* Bunge (*F. potomophylla* Herd.)**
Isofraxidin [87, 90]
Fraxin [90]
Fraxinol [87, 90]
Fraxinoside [90]
Cichoriin [90]
Esculetin [87, 90]
Esculin [87, 90]

***F. syriaca* Boiss**
Fraxin [87]
Fraxinol [87]
Cichoriin [87]
Esculetin [87]
Esculin [87]

***F. verecunda* Koidz.**
Esculetin [88]

***Syringa vulgaris* L.**
Esculetin [91]

FAM. PASSIFLORACEAE

***Passiflora incarnata* L.**
Scopoletin [92]
Umbelliferone [92]

FAM. POLYGONACEAE

***Polygonum divaricatum* L.**
Herniarin [93]
Coumarin [93]

***Polygonum weyrichii* Schm.**
Herniarin [93]
Coumarin [93]

FAM. RANUNCULACEAE

***Adonis amurensis* Rgl. et Radde**
Scopoletin [94]
Umbelliferone [94]

***Adonis mongolica* Sim.**
Scopoletin [95]
Umbelliferone [95]

FAM. ROSACEAE

***Potentilla anserina* L.**
Scopoletin [96]
Umbelliferone [96]
Esculetin [96]

***Potentilla erecta* (L.) Hampe.**
Scopoletin [96]
Umbelliferone [96]
Esculetin [96]

FAM. *RUTACEAE*

***Citrus limon* (L.) Burm**
Imperatorin [133]

***Dictamnus angustifolia* G. Don**
Bergapten [97]
Isoimperatorin [97]
Xanthotoxin [97]
Psoralen [97]
Scopoletin [97]
Umbelliferone [97]
Esculetin [97]

***D. gumnostylis* Stev.**
Xanthotoxin [99]
Psoralen [99]

D. dasycarpus **Turcz.**
Xanthotoxin [98, 99]
Psoralen [98, 99]
Scopoletin [98, 99]

D. tadshikorum **Vved.**
Bergapten [100]
Xanthotoxin [100]
Umbelliferone [100]

Haplophyllum alberty **Regelli., Korov.**
Collinin [101]

H. bungei **Trautv.**
Bungeidiol [103]
Isoscopoletin [103]
Coumarin [103]
6-Methoxy-7-dimethylallyloxycoumarin [102]
5-Hydroxy-7-methoxycoumarin [102]
Osthol [102]
Scopoletin [103]
Scoparone [103]
Umbelliferone [103]
Esculetin [103]

H. davuricum **(L.) G. Don**
Dauroside A [104]
Dauroside B [104]
Dauroside C [105]
Dauroside D [106]
5,7-Dihydroxycoumarin [108]
Skimmin [107]
Scopoletin [105]
Umbelliferone [107]

H. dzhungaricum **N. Rubtz.**
Xanthyletin [109]
Seselin [109]

H. dubium **Korov.**
Seselin [101]

H. kowalenskyi **Stschyl.**
Lomatin isovalerate [110]
Scopoletin [110]

H. multicaule **Vved.**
Xanthyletin [109]
Seselin [109]

H. obtusifolium **Lebed.**
Capensin [111]
6-Methoxy-7-dimethylallyloxycoumarin [112]
Obtusidin [116]
Obtusin [114]
Obtusinin [115]
Obtusinol [112]
Obtusiprenin [116]
Obtusiprenol [119]
Obtusifol [117]
Obtusifolin [118]
Obtusicin [111]
Obtusoside [121]
Scopoletin [116]
Feruloylscopolin [120]
Fraxetin [111]
Fraxetin 7-*β*-*D*-Glc*p* [120]
Haptusinol [113]

H. pedicellatum **Juss.**
6-Methoxycoumarin acetonide [125]
6-Geranyloxy-7-methoxycoumarin [112]
6-Methoxymarmin [123]
Pedicellone [124]
Scopoletin [123]

H. perforatum **Kar. et Kir.**
Scopoletin [126]
Scopolin [126]
Haploperoside A [126]
Haploperoside B [127]
Haploperoside C [128]
Haploperoside D [128]
Haploperoside E [128]

H. ramosissimum **(Pauls.) Ved.**
7-Dimethylallyloxy-6-methoxycoumarin [129]
Obtusinin [130]
Ramosin [129]
Ramosinin [129]
Scopoletin [130]
Scoparone [130]

H. schelkovnikovii **Grossh.**
Bergaptol [130]
Isoimperatorin [131a]
3-Methoxydaphnetin [131]
Obtusifol [131]
Oxypeucedanin [131a]
Oxypeucedanin hydrate [131a]

H. tenue **Boiss.**
Villosin [110]
Lomatin isovalerate [110]
Scopoletin [110]
Tenudiol [110]
Tenudin [110]

H. versicolor **Fisch. et C. A. Mey.**
Versicolin [132]

H. villosum **(Bieb) G. Don fil.**
Villosin [110]
Scopoletin [110]
Tenuidin [110]

Poncirys trifoliata **L. (Raf.)**
Imperatorin [133]

Ruta graveolens **L.**
Bergapten [134]
Isoimperatorin [135]
Xanthotoxin [135]
Psoralen [135]
Rutamarin [135]
Umbelliferone [135]
Chalepin [134]
Chalepensin [134]

FAM. **RUBIACEAE**

Galium tauricum (Willd.) **Roem. et Schult.**
Scopoletin [136]
Umbelliferone [136]

Hymenodictyon obovatum **Wall.**
Scopoletin [88]
Scopolin [88]

FAM. **SCROPHYLLARIACEAE**

Verbascum thapsiforme **Schrad.**
Coumarin [89]

FAM. **SOLANACEAE**

Brunfelsia calycina **Benth.**
Scopoletin [88]

Brunfelsia ramosissima **Benth.**
Scopoletin [88]

Physochlaina physoloides (L.) Don
Scopoletin [137]
Scopolin [137]
Umbelliferone [137]
Fabiatrin [137]

FAM. THEACEAE

Thea sinensis (L.)
Skimmin [138]

FAM. THYMELACEAE

Daphne albowiana Woron.
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

D. cneorum L. (*D. julia* K.-Pol.)
Daphnin [139, 141]
Daphnetin [139, 141]
Daphnetin 8-Glc*p* [139, 141]

D. glomerata Lam.
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

D. mezereum L.
Daphnetin [140, 141]
Daphnetin 8-Glc*p* [140, 141]
Daphnin [140, 141]
Daphnoretin [140, 141]
Umbelliferone[140, 141]

D. odora Thunb.
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

D. pontica L.
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

D. pseudosericea Pobed.
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

D. sophia **Kolen.**
Daphnetin [141]
Daphnin [141]
Umbelliferone [141]

Stellera chamaejasme **L.**
Daphnetin [142]
Daphnin [142]
Daphnoretin [142]
Daphnorin [142]
Isobergapten [143]
Isopimpenillin [143]
Pimpinellin [143]
Sphondin [143]
Umbelliferone [143]
Chamaejasmoside [142]

FAM. VALERIANACEAE

Patrinia intermedia **Roem. et Schult.**
Interoside B [144]

FAM. UMBELLIFERAE (APIACEAE)

Agasyllis latifolia **(B. B.) Boiss**
Agasyllin [145, 146]
Deltoin [146]
7-Geranyloxycoumarin [146]
Latifol [146]
Oxypeucedanin [146]
Ostruthin [147]

Ammi majus **L.**
Bergapten [148]
Isopimpinellin [148]
Xanthotoxin [148]
Marmesin [148]

Anethum graveolens **L.**
Bergapten [149]
Coumarin [149]
Scopoletin [149]
Umbelliferone [149]
Esculetin [149]

Angelica adzharica **M. Pimen.**
Adzharin [150]
Anomalin [150]
Bergapten [150]

Bergaptol [150]
Isooxypeucedanin [150]
Osthenol [150]
Umbelliferone [150]

A. altissima **(Miller) Grande**
Bergaptol [151]
Bergapten [151]
Xanthotoxin [151]
Imperatorin [151]
Isopimpinellin [151]
Peucedanin [151]

A. anomala **Ave-Lall.**
Anomalin [153]

A. archangelica **L.**
Bergapten [154, 155]
Imperatorin [154, 155]
Xanthotoxin [154, 155]
Ostruthol [154, 155]
Umbelliferone [154, 155]
Umbelliprenin [154, 155]
Phellopterin [154, 155]

A. brevicaulis **B. Fedtsch.**
Bergapten [156]
Isobergapten [156]
Isopimpinellin [156]
Pimpinellin [156]
Sphondin [156]

A. cineta **Boiss. (*A. amurensis* Schischk.)**
Anomalin [157]
Xanthogallin [157]
Oroselol [157]
Oroselone [157]

A. czeznaevia **Kit.**
Isoimperatorin [155]

A. dahurica **Benth. et Hook**
Biacangelicin [158]
Isoimperatorin [158]
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A. gmelinii **(DC) M. Pimen.**
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A. palustris **(Bess.) Hotf.**
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A. purpurascens **(Lallem.) Gilli** (*Xanthogalum purpurascens*)
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A. sachiokiana **Karjag.** (*Xanthogalum sachokianum* **Karjag.**)
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Isopimpinellin [172]
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A. saxatilis **Turcz. et Lebed.**
Bergapten [155, 173]
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A. sylvestris **L.**
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A. tatianae **Bordz.** (*Xanthogalum tatianae* **Schischk.**)
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Bergapten [174]
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A. ternata **Rgl. et Schmalh.**
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A. tschimganica **V. Tichom. (*Archangelica tschimganica* Korov.)**
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Cnidium dubium **(Schkuhr) Thell**
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C. silaifolium **Fiori et Pool**
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Dorema hyrcanum **K.-Pol.**
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Ferula aitchisonii **K.-Pol.**
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F. badrakema **K.-Pol.**
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F. caucasica **Korov**
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F. conocaula **Korov**
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F. foetidissima **Regel et Schmalh.**
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F. ferganensis **Lipsky ex Korov**
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F. eremophila
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F. eugenii **R. Kam.**
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F. gummosa **Boiss.** (*F. galbanniflua* **et Buhse** [sic])
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Isosamarcandin [220]
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F. gigantea **B. Fedtsch.**
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F. iliensis **Krasch. ex Korov**
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F. inciso-serrata **M. Pimen.**
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F. karakalensis **Korov**
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F. kelifii **Korov**
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F. karatavica **Regel et Schmalh.**
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F. kirialovii **M. Pimen**
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F. kokanica **Regel et Schmalh.**
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F. korshinskyi **Korov**
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F. lehmanni **Boiss**
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F. linczewskyi **Korov**
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F. mogoltavica **Lipsky**
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F. penninervis **Regel et Schmalh.**
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F. polyantha **Korov**
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F. persica **Willd.**
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F. schtschurowskiana **Regel et Schmalh.**
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F. sumbul **(Kauffm.) Hook**
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F. syreitshikowii **K.-Pol.**
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F. szowitsiana **DC.** (*F. microloba*)
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F. tadshikorum **M. Pimen**
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F. teterrima **Kar. et Kir.**
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Badrakemin [294]
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F. tubifera **Korov**
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F. vicaria **Korov**
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Heracleum aconitifolium **G. Worn.**
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H. antasiaticum **Manden**
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Bergapten [302, 303]
Isobergapten [303]
Isopimpinellin [302]
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Pimpinellin [303]
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H. apiifolium **Boiss.**
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H. asperum **(Hoffm.) Bieb.**
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H. carpaticum **Porc.**
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H. chorodanum **D.C.**
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H. calcareum **Albov. (*H. colchicum* Lipsky)**
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H. cyclocarpum **C. Koch**
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Pimpinellin [310]
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***H. grandiflorum* Stiven.**
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Isobergapten [301, 313]
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Bergapten [311]

Biacangelicin [311]
Heraclesol [311]
Isopimpinellin [311]
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Isoimperatorin [311]
Marmesin [311]
6-Isopentenyloxy-5-methoxyangelicin [311]
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***H. lehmannianum* Bge.**
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Isopimpinellin [315]
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Bergapten [316]
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***H. ligusticifolium* M. B.**
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***H. mandenovae* Satzyperova**
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Heraclesol [311]
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***H. mantegazzianum* Somm. et Lev.**
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Isopimpinellin [304, 314]
Imperatorin [304]
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***H. moellendorfii* Hance.**
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Biacangelicin [306]
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***H. nanum* Satzyperova**
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H. olgae **Rgl. et Schmalh.**
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H. osseticum **Manden**
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H. palmatum **Baumg.**
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Bergapten [311]
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Isopimpinellin [311]
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H. pastinacifolium **K. Koch**
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H. ponticum **(Lipsky) Manden**
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H. pubescens **M.B.**
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H. roseum **Stev.**
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H. scabrum **Alb.**
Bergapten [304]
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H. sibiricum **L.**
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H. sommieri **Manden**
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H. sosnowskyi **Manden**
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***H. sphondylium* L.**
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Isobergapten [317]
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***H. stevenii* Manden**
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***H. trachyloma* Fisch. et Mey**
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***H. transcaucasicum* Manden**
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***H. villosum* Fisch.**
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Isobergapten [321]
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Pimpinellin [321]
Sphondin [321]

***H. wilhelmsii* Fisch. et Gallem.**
Angelicin [304]
Bergapten [304]
Isobergapten [307]
Isopimpinellin [304]
Imperatorin [304]
Osthol [307]
Pimpinellin [307]

Psoralen [304]
Sphondin [307]

***Hippomarathrum caspicum* DC. Grossh. (*Bilacunaria caspia* (DC) M. Pimen et V. Tichomirov)**
Bergapten [323]
(−)-Heraclenin [322]
Isoimperatorin [322, 324]
Isopimpinellin [324]
Imperatorin [324]
Xanthotoxin [323, 324]
Oxypeucedanin [322, 323]
Oxypeucedanin hydrate [322, 323]
Osthol [322, 323]
Prangelin [322]
Umbelliferone [322, 323]

***Hippomarathrum microcarpum* M. B. B. Fedtsch. (*Bilacunaria microcarpa* (Bieb.) M. Pimen et V. Tichomirov)**
Bergapten [325]
(±)-Heraclenin [326]
Isoimperatorin [325]
Isopimpinellin [325]
Imperatorin [325]
Xanthotoxin [325]
(±)-Prangenin [326]
Oxypeucedanin [325]
Oxypeucedanin hydrate [325]
Osthol [325, 326]
Umbelliferone [326]

***Komarovia anisosperma* Korov.**
Isoimperatorin [327]
8-Geranyloxy-5-methoxypsoralen [327]
Phellopterin [327]

***Laser trilobum* L. Borkh.**
Oxypeucedanin [328]
Prangenin [328]

***Libanotis buchtormensis* (Fisch.) DC.**
Bergapten [329]
Buchtarmin [329]
Isoimperatorin [329]
Xanthogalin [329]
Xanthogalol [329]

***L. condensata* (L.) Crantz**
Bergapten [330, 331]
Pteryxin [330, 331]
Ostruthin [147]

L. lehmanniana **Bunge.**
Anomalin [336]
Bergapten [336]
cis-Khellactone [336]
Capryloyloxyxanthogalol [336]
Columbianin [336]
3′-(S)-Angeloyloxy-4′-(S)-hydroxydihydroseselin [336]
4′-(S)-Angeloyloxy-3′-(S)-hydroxydihydroseselin [336]
Pteryxin [336]

L. montana **Crantz** (*L. intermedia* **Rupr.**, *L. transcaucasica* **Schischk.**)
Anomalin [332]
Aurapten [334]
Bergapten [332]
Khellactone disenecionate [332]
7-Isopentenyloxycoumarin [334]
Isopeucedanin [335]
Xanthotoxin [332]
Libanotin [339]
Osthol [339]
Psoralen [332]
Pteryxin [332]
Suksdorfin [332]
Secorin [339]
Edultin [335]

L. seseloides **(Fisch. et Mey.) Turcz.**
Libanotin [337]
Edultin [337]

L. schrenkiana **C. A. Mey.**
Libanorin [338]
Libanoridin [338]

Meum athamanticum **Jacq.**
Peucedanin [151]

Myrrhis odorata **(L.) Scop.**
Peucedanin [151]

Oenanthe aquatica **(L.) Poir**
Imperatorin [151]

Pastinaca clausii **(Lebed.) M. Pimen**
Bergapten [340]
Isobergapten [340]
Isopimpinellin [340]
Imperatorin [340]
Sphondin [340]
Umbelliferone [340]

Pastinaca sylvestris **Mill.**
Bergapten [151]
Isoimperatorin [151]
Imperatorin [151]
Peucedanin [151]
Xanthotoxin [151]
Sphondin [151]

Pastinaca umbrosa **Stev. ex DC (*Pastinaca sativa* L.)**
Bergapten [341, 342]
Isopimpinellin [341, 342]
Imperatorin [341, 342]
Xanthotoxin [341, 342]
Xanthotoxol [341]
Osthol [341]
Sphondin [342]

Peucedanum alsaticum **L. (*P. lubimenkoanum* Kotov.)**
Imperatorin [151]
Peucedanin [151]

Peucedanum arenarium **Waldst et Kit (*P. borysthenicum* Klok ex Schischk.)**
Umbelliprenin [151]
Peucedanin [151]

P. baicalense **Redon**
Bergapten [343]
Deltoin [343]
Isopimpinellin [151]
Isoimperatorin [343]
Imperatorin [151]
Peucedanin [151]
8-Hydroxy-5-methoxypsoralen [343]
Phellopterin [343]

P. borysthenicum **Kloc.**
Peucedanin [151]
Umbelliprenin [151]

P. deltoideum **(Makino) (*P. terebinthaceum* Fisch.)**
Deltoin [346]
Peucedanin [151]

P. elegans **Komm.**
Isoimperatorin [347]
Imperatorin [347]

P. falcaria **Turcz.**
Peucedanin [151, 344]

P. hystrix **Bge.**
Libanorin [348]
Oroselol [348]
Oroselone [348]

P. litorale **Worosch. et Gorovoi**
Suberosin [349]
Umbelliferone [349]

P. longifolium **Walds et Kit**
Bergapten [345]
Isoimperatorin [345]
Isopimpinellin [345]
Imperatorin [345]
Oxypeucedanin [345]
Oxypeucedanin hydrate [345]
Peucedanin [344]

P. lubimenkoanum **Korov.**
Imperatorin [151]
Peucedanin [151]

P. luxurians **Tamamsch.**
Peucedanin [185]

P. macrophyllum **Schischk.**
Imperatorin [151]
Xanthotoxin [151]
Peucedanin [151]

P. mogoltavicum **Korov.**
Mogoltavin [351]
Mogoltavinin [351]
Mogoltin [351]
Tavimolidin [352]
Tadzhiferin [352]
Farnesiferol B [354]
Foliferidin [353]

P. morrisonii **Bess (*P. songoricum* Schischk.)**
Bergaptol [355]
Isoimperatorin [355]
Imperatorin [355]
Peucedanin [355]
Peucenol [353, 356]

P. oreoselinum **(L.) Moench**
Angelicin [357]
Athamanthin [358]
Bergapten [151]
Isopimpinellin [151]

Imperatorin [151]
Xanthotoxin [151]
Osthol [151]
Peucedanin [151, 357]

***P. palustre* Moench**
Bergapten [151]
Imperatorin [151]
Peucedanin [151]

***P. ruthenicum* Bieb.**
Bergapten [151]
Isopimpinellin [151]
Imperatorin [151]
Peucedanin [151, 359]
Peucedanin hydrate [359]
(+)-Oxypeucedanin hydrate [151]

***P. salinum* Pall.**
Peucedanin [361]

***P. tauricum* Bieb.**
Peucedanin [344]

***P. transiliense* Herd.**
Peucedanin [151]

***P. turcomanicum* Schischk.**
Oxypeucedanin hydrate [360]

***P. vaginatum* Lebed.**
Peucedanin [361]

***Phlojodicarpus sibiricus* (Steph.)**
3′-O-Acetyl-4′-O-(2-methylbutanoyl)-*cis*-khellactone [365]
Visnadin [362, 370]
Dihydrosamidin [330, 362]
Isoimperatorin [366]
Isophlojodicarpin [363]
cis-Khellactone [365]
4′-O-Methyl-*cis*-khellactone [365]
4′-O-Methyl-*trans*-khellactone [365]
8-(2′,3′-dihydroxy-3′-methylbutyl)-7-(β-Glc*p*-oxy)coumarin [364]
Saxodorphin [365]
Scopoletin [362]
Umbelliferone [362]
Umbelliferone β-*D*-Api-(1→6)-*D*-Glc*p* [364]
Phlojodicarpin [363]

***Ph. turczaninovii* (Sipl.)**
Buchtarmin [367]

Libanorin [367]
Peucedanin [367]
Peucedanol 3'-β-*D*-Glc*p* [368]

***Ph. villosus* Turcz.**
Agasyllin [369]
Visnadin [370]
Decursin [369]
Decursinol [369]
Dihydrosamidin [330]
Umbelliferone [369]
Umbelliferone *D*-Api-(1→6)-*D*-Glc*p* [364]

***Pimpinella aromatica* Bieb.**
Osthol [151]

***P. saxifraga* L.**
Bergapten [151]
Isopimpinellin [151]
Imperatorin [151]
Xanthotoxin [151]
Peucedanin [151]

***Platitenia absinthifolia* Nevs.**
Suberosin [371]

***P. dasycarpa* Rgl. et Schmalh.**
Bergapten [151]
Zosimin [372]
Isobergapten [372]
Isopimpinellin [372]
Imperatorin [372]
Pimpinellin [372]
Scopoletin [372]
Suberosin [373]
Sphondin [372]
Umbelliferone [372]

***P. piminelloides* Nevs.**
Angelicin [374]
Bergapten [374]
Zosimin [374]
Isobergapten [374]
Isopimpinellin [374]
Imperatorin [374]
Pimpinellin [374]
Suberoside [374]
Sphondin [374]
Umbelliferone [374]

Pleurospermum austriacum **L. (Hoffm.)**
Imperatorin [151]
Isopimpinellin [151]
Peucedanin [151]

Prangos acaulis **(DC) Bornm.**
Bergapten [375]
Deltoin [375]
Xanthotoxin [375]
Isoimperatorin [375]
Isopranferol [375]
Imperatorin [375]
Marmesin [375]
Merancin [375]
Merancin hydrate [375]
Oxypeucedanin [375, 376]
Oxypeucedanin hydrate [375]
Osthol [375]
Prangenin [375, 376]
Pranferol [375]
Psoralen [375]
Suberosin [375]

P. bucharica **B. Fedtsch.**
Isoimperatorin [377]
Imperatorin [377]
Oxypeucedanin [377, 378]
Oxypeucedanin hydrate [377]
Osthol [378]
Prangenin [377, 378]
Pranchimgin [377, 378]
Scopoletin [378]

P. didyma **(Regel) M. Pimen. et V. Tichomirov (*Cryptodiscus didymus* Korov.)**
Bergapten [380]
Isoimperatorin [380]
Imperatorin [380]
Xanthotoxol [380]
Oxypeucedanin [380]
Osthol [380]
Prangenin [380]
Prangenin hydrate [380]
Pranchimgin [380]
Umbelliferone [380]

P. equisetoides **Kuzm.**
Alloimperatorin [379]
Bergapten [379]
Deltoin [379]
Isoimperatorin [379]
Imperatorin [379]

Xanthotoxin [379]
Marmesin [379]
Merancin [379]
Oxypeucedanin [379]
Oxypeucedanin hydrate [379]
Osthol [379]
Pranferol [379]
Prangenin [379]
Prangenin hydrate [379]
Psoralen [379]
Suberosin [379]

***P. herderi* (Rgl.) Herrnst. et Heyn (*Cachrys herderi* Rgl.)**
Oxypeucedanin [185]
Osthol [185]

***P. fedtschenkovii* (Regel et Schmalh.) Korov.**
Deltoin [382]
Isoimperatorin [379, 382]
Imperatorin [382]
Xanthotoxin [379]
Marmesin [379]
Oxypeucedanin [379, 382]
Oxypeucedanin hydrate [379, 382]
Prangenin [382]
Pranchimgin [382]

***P. ferulaceae* (L.) Lindl. (*P. alata* Bieb.)**
Alatol [383]
Gosferol [385]
Isoimperatorin [376, 383, 384]
Imperatorin [372]
Xanthotoxin [384]
Lindiol [384]
(±)-Marmesin [383, 384]
Merancin [384]
Merancin hydrate [384]
Merancin hydrate monoacetate [386]
Methoxyferudiol [384]
Merancin hydrate monoacetate [386]
Oxypeucedanin [376, 383, 384]
Oxypeucedanin hydrate [376, 384]
Osthol [376, 383-385]
Prangenin [376]
Prangone [384]
Pranferol [384]
Umbelliferone [384]
Ferudenol [384]
Ferudiol [384]
Feruliden [384]

P. lamellata **Korov.**
Bergapten [375]
Deltoin [375]
Isoimperatorin [375]
Imperatorin [375]
Marmesin [375]
Merancin [375]
Oxypeucedanin [375]
Oxypeucedanin hydrate [375]
Osthol [375]
Psoralen [375]
Prangenin [375]
Prangenin hydrate [375]

P. latiloba **Korov.**
Gosferol [387]
Isoimperatorin [387]
Isooxypeucedanin [387]
Isosamarcandin [387]
Imperatorin [376]
Latilobinol [387]
Marmesin [388]
Oxypeucedanin [387-389]
Oxypeucedanin hydrate [387]
Pranferol [387]
Pranchimgin [387-389]
Umbelliferone [387]

P. lipskyi **Korov. (*P. isphairamica* B. Fedtsch.**
Bergapten [390]
Deltoin [390]
Isoimperatorin [379, 382, 390]
Imperatorin [382, 389]
Xanthotoxin [390]
Marmesin [386, 390]
Oxypeucedanin [386, 390]
Oxypeucedanin hydrate [386, 390]
Osthol [379, 390]
Prangenin [390]
Prangenin hydrate [390]
Pranchimgin [379, 382, 390]
Psoralen [390]
Suberosin [390]

P. ledobourii **Herrnst et Heyn. (*Cachrys macrocarpa* Lbd.)**
Bergapten [376]
Isoimperatorin [376]
Osthol [376]

P. lophoptera **Boiss.**
Bergapten [376, 390]

Heraclenin [391]
Heraclenol [391]
Isogosferol [391]
Isoimperatorin [391]
Imperatorin [376, 391]
Lophopterol [391]
Oxypeucedanin [376, 391]
Oxypeucedanin hydrate [391]
Osthol [391]
Peucedanin [376, 391]
Pranchimgin [391]
Prangenin [376, 391]
Suberenol [391]
Suberoside [391]

***P. meliocarpoides* Boiss. (*P. arcis-romanae* Boiss. et Huet.)**
Bergapten [381]
Isoimperatorin [381]
Imperatorin [381]
Marmesin [381]
Merancin [381]
Merancin hydrate [381]
Oxypeucedanin [376, 381]
Oxypeucedanin hydrate [381]
Osthol [381]
Prangenin [376, 381]
Pranferol [381]
Psoralen [381]
Suberosin [381]

***P. odontalgica* Pall. (*Cachrys odontalgica* Pall.)**
Bergapten [376]
Isoimperatorin [376]
Imperatorin [376]
Oxypeucedanin [376]
Osthol [376]
Prangenin [376]
Pranchimgin [398]

***P. ornata* Kuzm. (*P. quasiperforata* Kuzm.) (*P. uloptera* DC.)**
Alloimperatorin [391]
Deltoin [391]
Bergapten [376, 402]
Isoimperatorin [376, 394, 401]
Imperatorin [376]
Xanthotoxin [402]
Marmesin [401]
Merancin hydrate [402]
Methoxyferudiol [385]
Oxypeucedanin [376, 397, 401]
Oxypeucedanin hydrate [378, 401]

Osthol [397, 401]
Peucedanin [376]
Prangenin [376]
Prangenin hydrate [394, 402]
Pranchimgin [401]
Pranferol [401]
Ulopterol [401]
Umbelliferone [390]
Ferudiol [390]

***P. pabularia* Lindl. (*P. sarawschanica* Rgl. et Schmalh.)**
Alloimperatorin [379]
Bergapten [376]
Deltoin [379]
Isoimperatorin [376, 379]
Imperatorin [379, 399]
Xanthotoxin [379]
Xanthotoxol [392, 394]
Marmesin [379]
Merancin [379]
Merancin hydrate [379]
Oxypeucedanin [399]
Oxypeucedanin hydrate [399]
Osthol [376, 399]
Peucedanin [376]
Prangenin [376, 392, 393]
Prangenin hydrate [379, 399]
Prangenone [399]
Prangosine [394]
Pranferol [379]
Prangolarin [394-396]
Psoralen [379]

***P. trifida* (Mill.) Hernst et Heyn. (*Cachrys alpina* Bieb.)**
Bergapten [376]
Isoimperatorin [376]
Imperatorin [376]
Oxypeucedanin [376]
Prangenin [376]

***P. tschimganica* B. Fedtsch.**
Bergapten [379, 382]
Gosferol [400]
Deltoin [400]
Diisopentenyloxypsoralen [400]
Isoimperatorin [376, 382]
Imperatorin [376]
Xanthotoxin [400]
Oxypeucedanin [376]
Oxypeucedanin hydrate [379]
Osthenol [400]

Osthol [376, 382]
Prangenin [376]
Pranchimgin [379, 382]
Pranchimganin [400]

***Seseli abolinii* (Korov.) Schischk.**
Bergapten [403]
Isoimperatorin [403]

***S. annuum* L.**
Isoimperatorin [404]
Imperatorin [440]
Umbelliprenin [404]

***S. asperulum* (Trautv.) Schischk.**
Anomalin [405]
Deltoin [405]
Isofloroselin [405]
Seseliflorin [405]
Secorin [405]
Psoralen [405]

***S. coronatum* Lebed.**
Anomalin [410]
Bergapten [410]
Isofloroselin [410]
Secorin [410]
Seselirin [410]
Seseliflorin [410]
Psoralen [410]

***S. dichotomum* Pall.**
Anomalin [411]
Bergapten [411]
Xanthotoxin [411]

***S. eriocephalum* (Pall. ex Spreng.) Schischk.**
Anomalin [429]
Isoimperatorin [429]
Pteryxin [429]
Suksdorfin [429]

***S. foliosum* Manden.**
Osthol [412]
Peucedanin [335]
Scopoletin [412]
Suberosin [412]
Umbelliferone [412]
Edultin [412]

S. giganteum **Lipsky.**
Bergapten

S. gracilla **Waldst et Kit.**
Angelicin [413]
Bergapten [413]
Deltoin [413]
Isoimperatorin [413]
Imperatorin [413]
Xanthotoxin [413]
Marmesin [413]
Oxypeucedanin [413]
Oxypeucedanin hydrate [413]
Osthol [413]
Pranferol [413]
Pranchimgin [413]
Psoralen [413]

S. grandivittatum **Schischk.**
Anomalin [416]
Grandivittin [414]
Grandivittinol [414]
(−)-3′(R)-Decursinol
Decursinol angelate [414]
Libanotin [416]
Osthol [416]
Rutarin [415]

S. iliense **Rgl. et Schmalh.**
Anomalin [335]
Iliensin [417]
Iselin [417]
Peucenol [417]
Phellopterin [335]

S. incanum **B. Fedtsch.**
Anomalin [418]
cis-Khellactone disenecionate [418]

S. jomuticum **Schischk.**
Anomalin [335]
Bergapten [335]
Isoimperatorin [335]
Peucedanin [335]
Pteryxin [335]
Suksdorfin [335]
Jumitinol [419]

S. korovinii **(Korov.) Schischk.**
Bergapten [403]

S. krylovii **M. Pimen et Sdobn.**
Isoimperatorin [420]
Iselin [420]
Oxypeucedanin [420]
Oxypeucedanin hydrate [420]
Ostruthin [420]

S. mucronatum **M. Pimen et Sdobn.**
Anomalin [421]
Zosimin [421]
Pteryxin [335]
Ostruthin [335]
Secrolin [421]

S. nemorosum **(Korov.) M. Pimen.**
Anomalin [335]
Pteryxin [335]
Ostruthin [335]

S. peucedanoides **(Bieb.) K.-Pol.**
Deltoin [423]
Decursinol [422]
Coumurrayin [422]
Nodakenetin [422]
Pranferol angelate [422]
Pranchimgin [423]
Seseloside [423]
Umbelliprenin [422]

S. petraeum **M.B.**
Anomalin [411]
Xanthogalin [411]

S. ponticum **Lipsky**
Xanthogalin [411]

S. rigidum **Waldst. et Kit.**
Angelicin [424]
Bergapten [424]
Isoimperatorin [424]
Xanthotoxin [424]
Oxypeucedanin [424]
Oxypeucedanin hydrate [424]

S. saravschanicum **M. Pimen et Sdobn.**
Anomalin [441]
Zeravshanin [441]
4′-Angeloyloxy-3′-hydroxy-3′,4′-dihydroseselin [441]

S. saxicolum **(Albov.) M. Pimen.**
Peucedanin [425]
Saxicolin [425]

S. seseliflorum **Schrenk.**
Anomalin [427]
Seseliflorin [426]
Sechulin [427]
Floroselin [426]
Chuin [427]

S. talassicum **(Korov.) M. Pimen. et Sdobn.**
Anomalin [428]
Khellactone disenecionate [428]
Imperatorin [428]

S. tenuisetum **Rgl. et Schmalh.**
Anomalin [430]
4′-Hydroxy-3′,4′dihydroseselin 3′-angelate [430]
3′-Hydroxy-3′,4′dihydroseselin 4′-angelate [430]
trans-Khellactone [431]
cis-Khellactone [431]

S. tortuosum **L. (*S. compestre* Bess.)**
Deltoin [406]
3′-Acetoxy-4′-senecioyloxy-3′,4′-dihydroseselin [407]
Isoimperatorin [406]
Isocalypteryxin [408]
Isocampeselol [408]
Campesenin [406, 407]
Campeselol [406-408]
Campestrinol [408, 409]
Campestrol [408]
Calypteryxin [407]
Campestrinoside [408]
(−)-*trans*-Khellactone [408]
(−)-*trans*-Khellactone 3′-methyl ether [408]
(−)-*trans*-Khellactone 3′-ethyl ether [408]
Marmesin [406]
Tortuosin [409]
Tortuosinin [409]
Tortuosinol [409]
Tortuosidin [409]

S. transcaucasicum **M. Pimen. et Sdobn.**
Isopeucedanin [396]
Edultin [396]

S. tchuense **E. Nik.** ***sp. novo***
Anomalin [432]
Seselirin [432]

Sechulin [432]
Chuin [432]

S. valentinae **P. Pop.**
Anomalin [335]
Pteryxin [335]

S. unicaula **(Korov.) M. Pimen.**
Suksdorfin [433]

Smyrniopsis armena **Schischk.**
Alloimperatorin [434]
Imperatorin [434]
Osthol [434]
Smyrnovidin [434]
Smyrnovidinin [434]
Umbelliferone [434]

S. auheri **Boiss.**
Nachsmyrin [436]
Smyrinol [437]
Smyrindiol [437]
Smyrindioloside [437]
Smyrniorin [435]
Smyrnioridin [435]

Symphyoloma graveolens **C.A.M.**
Bergapten [308]
Isobergapten [308]
Isopimpinellin [308]
Imperatorin [308]
Pimpinellin [308]
Psoralen [308]
Scopoletin [308]
Sphondin [308]
Umbelliferone [308]

Zosima korovinii **P. Pimen.**
Agasyllin [429]
Bergapten [442]
Zosimin [339]
Isobergapten [442]
Isopimpinellin [442]
Imperatorin [438]
Pimpinellin [442]
Sphondin [442]
Umbelliferone [442]

Zosima orientalis **Hoffm. (*Zosima absinthifolia*)**
Bergapten [442]
Deltoin [438]

Zosimin [438]
Isobergapten [442]
Isopimpinellin [442]
Imperatorin [438]
Pimpinellin [442]
Sphondin [442]
Umbelliferone [442]

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