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ОБЗОР

THE GENUS *IRIS* (IRIDACEAE) IN RUSSIA: PHYTOCHEMISTRY, BIOLOGICAL ACTIVITY AND APPLICATION IN TRADITIONAL MEDICINE

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The genus *Iris* in Russia is represented by 41 species, of which 4 species are endemic, 11 are included in the Red Book of the Russian Federation and 30 have various regional conservation status. The review provides information on the phytochemical compounds, biological activity and medicinal properties of 16 species growing in Russia, and on their use in traditional medicine of different peoples. The analysis of available data shows that studying the component composition, biological activity levels, and medicinal use of *Iris* L. species requires their correct identification and the knowledge concerning their geographical distribution, ecology, and morphological characteristics. The use of *Iris* species in traditional medicine is described. The extracts and compounds isolated from the most of the studied species exhibit analgesic, antioxidative, antipyretic, anti-inflammatory, antibacterial and antimicrobial activity. Some species also have cytotoxic, antitumor, antidiabetic, anti-influenza, neuroprotective, antihyperglycemic, antiallergic, antifeedant and other properties. Most of the isolated metabolites were flavonoids, isoflavonoids, anthocyanes, terpenoids, xantgones, quinones, phenolic and fatty acids. In official and traditional medicine in Asia and Europe, the underground and aboveground parts of *Iris aphylla*, *I. lactea*, *I. pseudacorus*, *I. ruthenica*, *I. sanguinea* and other species of the genus are used. The article results from the long-term studies of irises *in situ* and in the collections of two botanical gardens, as well as extensive examination of literature on the component composition and medicinal properties of the studied species.

Keywords: Iris, component composition, biological activity, pharmacological properties, traditional medicine

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Depending on the generic and/or specific concepts of different authors, the genus *Iris* L. (Iridaceae) comprises about 260 species [1], considering both bulbiferous and bulbotuberous palnts, or about 180 species [2], if only plants with rhizomes and ensiform leaves are considered. Most species of *Iris* s.l. are distributed in Southwest and Central Asia and the Mediterranean region. According to our data [3], there are 41 species of the genus *Iris* in Russia.

Irises are widely used in the traditional medicine of the peoples of Europe and Asia. Many *Iris* species containing such groups as xanthones are a promising source of natural compounds with antiviral activity, and, thus, the development of therapeutic agents based on them is an urgent issue.

Studying the component composition, biologically active substances, and pharmacological properties of *Iris* L. species, the researcher should be familiar with their geographical distribution, ecology, morphological characteristics, and indicate the origin of plant material and who identified it [4–6].

The analysis of 16 species (Table 1), which component composition and medicinal properties were studied, showed that the works of the following authors reflected the taxonomic discrepancy for species from the subgenus *Apogon:* in section *Limniris* – *I. ensata* Thunb., and in section *Haloiris* – *I. biglumis* Vahl., *I. lactea* Pall., *I. oxypetala* Bunge, *I. pallasii* Fisch.

I. ensata Thunb. was described in 1794 by Thunberg [7] from Japan and corresponds to *I. kaempheri* Sieb., and Thunberg's binomial *I. ensata* is a priority and bears no relationship to the continental saline irises [8].

In the Schroeter's summary [9], the description of *I. ensata* (*I. pallasii* Fisch. var. *chinensis* Fisch.) contains information on two different species, namely, *I. ensata* and also *I. oxypetala*, since it is known that the variety *I. pallasii* var. *chinensis* is a synonym of *I. oxypetala* and belongs to the group of halophytic species, as well as *I. lactea*. *I. oxypetala* Bunge was described from the northeast of China [10].

Table 1. The most important species from the genus *Iris* (Russia), their origin, and environmental demands

Section	Species	Origin	Environment
		Subgenus *Iris* (= Pogon)	
Iris	*I. aphylla*	Russia: south of the European part. Other regions: Central and Eastern Europe	Dryland
	I. pumila	Russia: south of the European part. Other regions: the east of Central and Southern Europe, Moldova, Ukraine, Transcaucasia and Kazakhstan	Dryland
Oncocyclus	*I. acutiloba*	Russia: Dagestan. Other regions: Azerbaijan, Northern Iran	Dryland
Psammiris	*I. humilis*	Russia: south of the European part, Eastern and Western Siberia. Other regions: Kazakhstan, Mongolia and China	Dryland
	I. potaninii	Russia: South of Central and Eastern Siberia. Other regions: Mongolia and China	Dryland
		Subgenus *Apogon*	
Haloiris	*I. oxypetala*	Russia: Khasansky district of the Primorye Territory. Other regions: China, the Korean peninsula and Afghanistan	Dense saline soils
	I. lactea	Russia: Eastern Siberia (Trans-Baikal Territory). Other regions: North-East Kazakhstan, Mongolia and China	Dense saline soils
	*I. biglumis**	Russia: Eastern Siberia, west of the Trans-Baikal Territory. Other regions: Northern Mongolia	Dense saline soils
	*I. pallasii**	Russia: Western Siberia. Other regions: North-East Kazakhstan and Mongolia	Dense saline soils
Tenuifolia	*I. tenuifolia*	Russia: south-east of the European part of Russia, south-western Siberia, the Trans-Baikal Territory. Other regions: Kazakhstan, north-western China and northern and north-eastern Mongolia	Very dry, neutral
Xyridion	*I. halophila*	Russia: South of the European part of Russia, Krasnodar and Stavropol Territories, Chechnya, Ingushetia, Dagestan and south of Western Siberia. Other regions: Central Europe, Kazakhstan, Mongolia and Afghanistan	Dryland
Limniris	*I. ensata*	Russia: Yakutia, the Amur Region, South-West of the Khabarovsk Territory, Primorye Territory and the Kuril Islands. Other regions: north-eastern China, the Korean peninsula and Japan	Wetland
	I. laevigata	Russia: Eastern Siberia, Primorye Territory and the Kuril Islands. Other regions: Eastern Mongolia, Northeast China and Japan	Wetland
	I. pseudacorus	Russia: The European part of Russia, Caucasus, Western Siberia. Other regions: Europe, Northern Africa and Asia Minor	Wetland
	I. sanguinea	Russia: Eastern Siberia and the Primorye Territory. Other regions: Mongolia, north-eastern China, the Korean Peninsula and Japan	Wet, moist, or normal
	I. sibirica	Russia: Eastern Europe, the Caucasus, Western and Central Siberia. Other regions: Armenia, Kazakhstan	Wet, moist, or normal
Tripetalae	*I. setosa*	Russia: Central and Eastern Siberia, the Far East. Other regions: Japan, north-eastern China, the Korean Peninsula, the Pacific coast of North America	From moist to wet
Ioniris	*I. ruthenica*	Russia: south of Siberia. Other regions: in Asia – Kazakhstan, north-western Mongolia and China; in Europe – the Romanian Carpathians	Slightly dry

* No data on the component composition and biological activity.

Phytochemical studies of the aboveground part of *I. ensata* auc. non. Thunb. [11–16] at Leningrad Chemical and Pharmaceutical Institute (now St. Petersburg State University of Chemical Pharmacy) should be attributed to *I. lactea*. Pall. [17].

In "Plant Resources..." reference book [18, 19], description of *I. ensata* provides information on two different species: *I. ensata* and *I. lactea*, as the distribution of *I. ensata* is indicated in the meadows of the Kuril Islands (Kunashir Island) on saline soils, and in steppes, though there are no steppes on Kunashir Island. Other species from the group of halophytic irises are listed under *I. biglumis* s.l. The taxonomic divergence in also found in the works of modern authors [20].

To avoid errors, in our review 4 saline species of the sect. *Haloiris*, are jointly referred to as *I. lactea* s.l. All works referring to the sect. *Haloiris* are grouped as follows:

I. oxypetala Bunge is mentioned in publications under the following names: *I. lactea* var. *chinensis* (Fisch.) Koidz., *I. pallasii* Fisch. var. *chinensis* Fisch., and *I. lactea pallasii* Fischer var. *chinensis* [21];

I. lactea Pall. is mentioned in publications as *I. lactea* Pall. var. *lactea*, *I. oxypetala* C.A. Mey, and *I. ensata* Thunb.) [22].

Representatives of the sect. *Haloiris* are widely used in traditional medicine in Russia, China, Mongolia, India and in Tibetan medicine. In traditional medical practice, all parts of *I. lactea* s.l. are utilized. Rhizomes and seeds are used for the treatment of gastroenteritis, hepatitis, fever, kidney disease, and as anti-inflammatory and antiexudative agents. Flowers are used for the treatment of gastrointestinal and gallstone diseases, fruits – for wounds, ulcers and burns. All parts of plants are anthelmintic, and produce immunostimulant, anti-inflammatory, cardiotonic and nephroprotective effects [23–27]. Seeds contain compounds that, among others, exhibit anti-inflammatory, antioxidant, antitumor, and antiradiation effects and are used in the treatment of lung cancer, esophageal cancer, head and neck cancer as an antineoplastic agent and radiosensitizer [28–32].

Also, all parts of *I. lactea* s.l. are used in traditional medicine for pneumonia, bronchitis, chronic gastritis and jaundice [24]. Pills or powder, or 3~9 g of decoction of *I. pallasii* var. *chinensis* are used for jaundice, nosebleeds, hematemesis, ulcers and boils, diarrhea, leucorrhoea, pharyngitis, metrorrhagia [33].

Resulting from extensive pharmacological studies carried out at St. Petersburg Chemical and Pharmaceutical Academy, Laktir, a drug in the form of tablets was developed. It has a pronounced anti-inflammatory effect at different stages of inflammation [34].

All species in the sect. *Limniris* have pronounced pharmacological properties. *I. pseudacorus* L. is commonly used in traditional medicine of Europe and Asia, due to its wide distribution in Russia and other countries. Its distribution range covers vast areas from the middle of taiga to the subtropical zone in Europe, the Caucasus, Western Siberia, North Africa and Asia Minor, as mentioned in numerous publications [5, 9, 18–20, 27, 34, 35].

Rhizomes of *I. pseudacorus* are used in the Tibetan and Chinese medicine as an antipyretic agent. Rhizomes, seeds and flowers are used in the treatment of pneumonia, bronchitis, chronic gastritis, jaundice and other liver diseases. All plant parts, especially the fruit, are considered laxative, anthelminthic, hypnotic, and astringent. Seeds are used as hemostatic agent in gynaecology, for the treatment of wounds, injuries, burns, malignant tumors, carbuncles. In traditional medicine a decoction of a fresh rhizome of *I. pseudacorus* is used as an astringent, tonic, laxative, antipneumonia, and anti-stomach ulcer agents, a treatment for urinary deseases, ascites, metrorrhagia, headache and toothache, and as hair growth stimulant. Furthermore, the essence is used for epilepsy, and as topical medication for diathesis, stomatitis, and toothache. It is one of the ingredients of M.N. Zdrenko polyherbal tea, used in anticancer therapy [9, 18, 19, 36–39].

All parts of *I. sanguinea* Donn. and *I. sibirica* L. are used in traditional medicine of Russia and China. A decoction of *I. sanguinea* rhizomes is used for gynecological diseases, has an emetic, laxative, anthelminthic, and antiedemic action, and as topical medication it exhibits hemostatic effect, and is used in wounds, burns and snake bites healing [24, 40–43]. *I. sibirica* is used as an emetic, laxative, pain reliever, and in the treatment of syphilis, gonorrhea and gynecological diseases [24, 40, 41, 44].

In different countries *I. setosa* Pall. is a popular medicinal plant. In Japanese medicine rhizomes of *I. setosa* are used for scabies, a decoction is used for pneumonia, ascites, tonsillitis; and externally – for wounds, ulcers, fistulas, and as antifreckle treatment; in Yakutia, rhizomes are used as an analgesic (for toothache) and emetic, and flowers – to treat skin abscesses [45, 46]. Rhizomes, flowers and seeds of *I. ruthenica* Ker-Gawl. are used as anthelmintic in Tibetan medicine [47].

In the literature the use of the species in the subgenera *Iris* (= *Pogoniris*) sect. *Iris* and *Psammiris* in traditional medicine is documented. An extract of *I. aphylla* L. exhibit antibacterial, antioxidant, anti-inflammatory and antiallergic activity [48–50]. Rhizomes and leaves of *I. pumila* L. exert antifungal and detoxifying activity [51, 52]. Rhizomes, seeds and flowers of *I. humilis* Georgii are used in Tibetan medicine: the rhizomes reduce intoxication, sepsis, various infectious diseases, and are used as an external hemostatic agent [53, 54]. In Mongolian traditional medicine *I. potaninii* Maxim. is used for the treatment of various diseases, such as bacterial infections, cancer, and inflammation [4].

Table 2. Component composition and biological activity of species *Iris* L.

Species	Plant part	Compounds	Biological activity and use	Ref.
		Haloiris Doronkin		
I. lactea Pall. (= *I. lactea* Pall. var. *lactea*, *I. oxypetala* C.A. Mey, *I. ensata* auc. non. Thunb.)	Rhizomes Roots	***Xanthones***: iriflophenon, iriflophenone 2-*O*-hexoside, iriflophenone 4-*O*-hexoside, isomangiferin, mangiferin, nigricansiden, 4-*O*-methyliriflophenon, 7-*O*-methylisomangiferin, 7-*O*-methylmangiferin, bellidifolin [73]. ***Phenolic acids***: vanillic, *trans*-cinnamic, salicylic, *p*-hydroxybenzoic, protocatechuic, ferulic, caffeic [73]. ***Phenols***: 3-hydroxy-5-methoxyacetonphenoone, apocynin [73]. ***Flavonoids and isoflavonoid***: apigenin 8-*C*-(2"-pentosyl)-hexoside, apigenin-6,8-di-*C*-arabinoside, luteolin 7-*O*-(2"-*p*-coumaroyl)-rhamnoside, iriflophenone 4-*O*-(6"-acetyl)-hexoside, 4'-methyltectorigenin-7-glucoside, 6,4'-dimethoxy-5-hydroxyflavone-7-glucoside, iridin, irilin A, irilin B, irilin D, iristectorigenin A, iristectorigenin A 7-*O*-hexuronide, iristectorigenin B, irigenin, irigenin S, iristectorin A, iristectorin B, iristectoridin B, irisdichotin A, irisdichotin C, irilone A, irilone B, irilone 4'-*O*-hexoside, irilone 4'-*O*-β-d-glucopyranoside, irilone 4'-*O*-(6"-hexosyl)-hexoside, irilone 4'-*O*-β-d-glucopyranoside-(2→1)-l-rhamnoside, irilone 4'-*O*-[6"-(3-hydroxy-3-methylglutaryl)]-hexoside, irisolidone, irisolidone 7-*O*-hexoside, irisolidone-7-*O*-α-*D*-glucoside, irisflorentin a, irisflorentin b, irifloside, irisflogenin-4'-*O*-[ß-*D*-glucopyranosyl(1→6)ß-*D*-glucopyranoside], iriskumaonin methyl ether, 6,3',4'-trimethoxy-7,8,5'-trihydroxyisoflavone, 5-methoxy-4'-hydroxy-6,7-methylenedioxyisoflavone, 4',7-di-*O*-methyldihydroquercetin-5,3,3'-trihydroxy-7,4'-dimethoxyflavanone, 7,4'-dimethoxy-8,3',5'-trihydroxy-6-*O*-β-*D*-glucopyranosylisoflavon, dichotomin, genistein, germanaism B, isoschaftoside, nigricin, schaftoside, swertiajaponin, tectoridin, tectorigenin [73]. ***Terpenoids***: α-dehydroirigermanal, 22,23-epoxy-10-deoxy-21-hydroxyiridal, 22,23-epoxy-iridal, isoiridogermanal, belamcandal, iridotectoral A, iridotectoral B, iridal, α-irigermanal, amorphen, α-muurolene, β-gurjuenene, γ-elemene, iriversical [73]. ***Fatty acids***: myristic, lauric, palmitic, stearic [73]. ***Steroids***: stigmasterol, stigmasterol-3-*O*-b-*D*-glucopyranoside, 7-β-hydroxystigmast-4-en-3-one [73]. ***Quinones***: irisoquin B [73].	***In Mongolian medicine***, the plant was used as an anthelmintic agent; in ***Transbaikalia*** – for infectious and viral diseases [25]. ***In Tibetan medicine*** – for kidney diseases (rhizomes), gastrointestinal diseases (flowers), and wounds (topical ointment from fruits) [27]. ***In China*** – for cough and cold, liver disorders, seeds and flowers – as antipyretic and detoxifier [77], as a hemostatic and anticolic agent [78]. ***In India*** *I. lactea* is known as "Teshrnamentok" and whole plant is used as green fodder supplement increasing milk production in cattle [79]. ***In Trans-Himalayan Region*** *I. lactea* is known as "Dres-ma", whole plant is dried and powdered, ***decoction*** is taken orally to improve appetite, as stomach and small and large intestinal cramps reliever, and as food-poisoning remedy [80]. The ***dry extract*** of *I. lactea* ***herb*** is nontoxic and produces immunostimulating, anti-inflammatory, cardiotonic and nephroprotective effects. Extract has an antioxidant effect in toxic hepatitis [26, 34, 81–87]. ***Dry extract of the rhizomes and roots*** has anti-inflammatory and antiexudative properties in pulmonary edema [88]. ***Methanol extracts from leaves and rhizomes*** inhibits the adhesion of gram-positive (*Staphylococcus aureus*) and gram-negative (*Pseudomonas aeruginosa*) bacteria as well as the dental plaque multispecies biofilm [73]. ***Embinin*** from the ***aqueous extract*** of *I. lactea* aerial parts has an inhibitory effect on the proliferative activity of lymphocytes [89]. ***Embinin*** exhibits high anti-influenza activity [25]. A technology for obtaining tincture and syrup with *I. lactea* extract was developed [90, 91].	11, 12, 13, 14, 15, 16, 17, 25, 26, 27, 34, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91
	Aerial parts	***Xanthones***: mangiferin, isomangiferin [13, 14, 25, 26]. ***Phenolic acids***: ferulic, *n*-coumaric, vanillic, *n*-hydroxybenzoic [15], caffeic, chlorogenic, neochlorogenic [25], protocatechuic, syringic, gallic, *trans*-cinnamic [74]. ***Flavonoids***: 6-C-β-*D*-glucopyranosyl-O-*L*-rhamnoside, apigenin 7,4'-dimethyl ether [14], orientin, homoorientin (luteolin-6-*C*-glucoside, isoorientin) [16], luteolin, apigenin, embinin, 4'''-acetylembinin, 2''',4'''-diacetylembinin [25], swertiajaponin [26, 75]. ***C-glycosylflavones***: diacetylembinin, acetylembinin, embigenin [17], 4'''-*O*-acetyl-embinin, 2''',4'''-*O*-diacetyl-embinin, 6'',4'''-*O*-diacetyl-embinin [76].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
	Leaves	***Xanthones***: iriflophenon, iriflophenone 2-*O*-hexoside, iriflophenone 4-*O*-hexoside, isomangiferin, mangiferin, nigricansiden, bellidifolin, 4-*O*-methyliriflophenon [73]. ***Phenolic acids***: vanillic, *trans*-cinnamic, salicylic, *p*-hydroxybenzoic, protocatechuic, ferulic, caffeic [73]. ***Flavonoids and isoflavonoid***: luteolin 7-*O*-(2"-*p*-coumaroyl)-rhamnoside, luteolin 6-*C*-glucoside, luteolin 8-*C*-hexoside, apigenin 8-*C*-(2"-hexosyl)-hexoside, apigenin 6-*C*-hexoside, apigenin 8-*C*-glucoside, kaempferol 7-*O*-(6"-rhamnosyl)-hexoside, kaempferol 3-*O*-galactoside, kaempferol 3-*O*-glucoside, isoorientin, irilone A, irilin A, irilin B, irilin D, irisolidone, iristectorigenin A, iristectorigenin B, isovitexin, tectorigenin [73]. ***Terpenoids***: α-dehydroirigermanal, 22,23-epoxy-10-deoxy-21-hydroxyiridal, 22,23-epoxyiridal, isoiridogermanal, belamcandal, iridotectoral A, iridotectoral B, spirobicyclic triterpenoid, amorphen, α-muurolene, β-gurjuenene, γ-elemene, iridal, α-irigermanal, irisgermanic C [73]. ***Fatty acids***: myristic, lauric, stearic, palmitic [73]. ***Steroids***: stigmasterol-3-*O*-b-*D*-glucopyranoside, 7-β-hydroxystigmast-4-en-3-one [73]. ***Quinones***: irisquinone A, irisoquin B, pallasone B, dihydroirisquinone [73]. Contain some traces of alkaloids, show unclear result for saponins and coumarins [11, 12].		
I. oxypetala Bunge (= *I. lactea* var. *chinensis* (Fisch.) Koidz., *I. lactea pallasii* Fischer var. *chinensis, I. pallasii* Fisch. var. *chinensis* Fisch.)	Seeds	***Phenol derivative***: 3-[(*Z*)-10-heptadecenyll-4,5-dimethoxyphenol (irisphenol), 3-[(*Z*)]-10-heptadecenyl]-5-methoxyphenol [92]. ***Benzene derivatives***: 3,5-dimethoxy-[(*Z*)-10-heptadecenyl]benzene, 2-[(Z)-10-heptadecenyl]-4,6-dimethoxyphenol (belamcandaphenol P), 1,2,3,4-tetramethylbenzene, pentamethylbenzene, 1-ethyl-2,4,5-trimethylbenzene [92]. ***Benzofuran derivatives***: 9,9b-di[(Z)-10-heptadecenyl]-4a,8-dihydroxy-2,7-dimethoxy-1,4-dioxo-1,4,4a,9b-tetrahydrodibenzofuran (belamcandone P) [93]. ***Quinones***: pallasone B (dihydroirisquinone), pallasone C [94, 95], irisquinone [29, 31, 94, 96], 3-hydroxyirisquinone [92]. ***Fatty oils*** content 12%. ***Higher fatty acids*** (%): decanoic (0.02–0.69), lauric (0.02–0.37), tetradecanoic (myristic) (0.08–1.12), stearic (0.89–36), palmitic (5–8.56), oleic (28.51–37.53), linoleic (41.31–65.35) [33], palmitoleic (0.13), arachidonic (1.72), linolenic (0.26), 11-eicosenoic (0.72), docosanoic (0.40), tricosanoic (0.11), lignoceric (0.24), docosahexaenoic (3.18) [92]. ***Flavan and proanthocyanidin***: epicatechin-(4α→8)-catechin (procyanidin B1), catechin-(4α→8)-catechin (procyanidin B3), gallocatechin-(4α→8)-catechin (prodelphinidin B3) [97], catechin, epicatechin-(4β→6)-catechin (procyanidin B7) [98, 99], 3,4-dihydroxybenzoic acid, 3'-*O*-(1-hydroxy-6-oxo-2-cyclohexene-1-carboxylic acid ester) of procyanidin B1, 6-[(1S)-3-methoxy-3-oxo-1-(2,4,5-trihydroxyphenyl)propyl]catechin, fisetinidol (4α,8)-catechin, epiafzelechin-(4β→8)-epicatechin, epicatechin, procyanidin A1, norathyriol, proanthocyanidin A1, procyanidin B6, (2'S,3'R)-9-(5',6'-dihydroxy-2'-hydroxymethyl-2',3'-dihydrobenzo[b]furan-3-yloxy)-6H-dibenzo[b,d]pyran-6-oe, hopeaphenol, isohopeaphenol, n-butyl pro-lithospermate [100]. ***Oligostilbenes***: vitisin A, viniferin, ε-viniferin, vitisin B, vitisin C [100–104], vitisin D, ampelopsin B, *cis*-vitisin A [105], *trans*-ε-viniferin, vatalbinoside C, *cis*-ε-viniferin-11a,13b-*O*-β-d-diglucopyranoside, *trans*-ε-viniferin-13b-*O*-β-d-glucopyranose, *cis*-vitisin B-13b-*O*-β-d-glucopyranoside, *cis*-vitisin B, *cis*-vitisin C [99], vitisin A-13-*O*-β-d-glucoside, hopeaphenol [106].	***In Chinese medicine the seeds*** are known as Ma Lin Zi and used for cold, phlegm, intestinal wind [92], jaundice, strangury, urine cloudiness, inhibited urination (dysuria), intestinal abscess, intestinal worms accumulation, malaria, pharyngitis, toothache, bloody spotting, spontaneous external bleeding, hematochezia, metrorrhagia and metrostaxis, swelling of sores, scrofula, hernia, hemorrhoids, scalds, snake bites [95] Also, ***seeds*** are used as treatment for malignancies, exhibit blood activating and detoxifying effect, and can be used for the treatment of metrorrhagia and vaginal discharge [28–30]. ***In Chinese traditional medicine, the dried seeds*** of *I. lactea* var. *chinensis* are used as treatment for jaundice, diarrhoea, leucorrhoea, pharyngitis, inflammation and carbuncles [108]. In traditional medicine ***seeds*** are used as a laxative [24, 44], anthelmintic [24, 47], hypnotic [111], astringent [45], tonic and blood purifier agents, and in therapy of syphilis [44]. Also, ***seeds*** are used for gynecological diseases [24], as a hemostatic agent [44, 45, 112], for the treatment of wounds [113], injuries [112], burns [23], malignant tumors [113], carbuncles, as a diuretic [44, 113], for dropsy [44, 114], stranguria, jaundice, and as an antidote to poisonous insect and snake bites [112]. ***Seeds*** contain compounds, which exhibit various biological effects, including anti-inflammatory, antioxidant, antitumor, and antiradiation ones [32]. ***Irisquinone*** capsules ***extracted from the seed coat*** have been registered in the Chinese New Drug Conversion Standard and are used as radiosensitizer. ***Irisquinone*** isolated from ***seeds***, has been successfully used in lung, esophageal, head and neck cancer therapy as an antineoplastic agent and radiosensitizer [31]. It is effective against transplantable tumors, such as	11, 12, 23, 24, 28, 29, 30, 31, 32, 33, 42, 44, 45, 47, 62, 71, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115,

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
		Carboxylic acids: acetic acid, hexanoic acid, nonanoic acid. ***Aldehydes***: hexanal, furfural, 2-heptenal, octanal, 5-methylfurfural, 2-octenal, 4-decenal, 1-nonanal, trans-2-nonenal, 5-hydroxymethylfurfural, vanillin. ***Aromatic alcohol***: benzyl alcohol. ***Fatty alcohols***: 1-hexanol, 1-octen-3-ol, 1-octanol, 1-nonen-4-ol, 1-nonanol, 4-phenyl-2-butanol. ***Heterocyclic compounds***: 3-ethyl-2,5-dimethylpyrazine, 4-methylpyridine, 2-furanmethanol, 2-pentylfuran. ***Terpenes***: limonene, *trans*-geranylgeraniol, squalene, *trans*-squalene, cycloartan-24-ene-1α,2α,3β-triol, lupeol, 2,6-dimethylocta-2,6-diene, (3β,24E)-3-hydroxy-9,19-cyclolanost-24-methylene. ***Cyclic ether***: 2,2-dimethyl-3-(3,7,12,16,20-pentamethyl-3,7,11,15,19-twenty-monopentenyl)-ethylene oxide. ***Alkanes***: dodecane, pentadecane, tridecane, tetradecane, hexadecane, 2,6,10,14-tetramethylpentadecane, *n*-eicosane, *n*-tricosane, 3-methyleicosane, *n*-tetracosane, *n*-pentacosane, 3-methylpentacosane, *n*-hexacosane, *n*-heptocasane, *n*-octacosane, *n*-nonacosane. ***Anhydrides***: 3-dodecyl-2,5-furandione. ***Phosphoric esters***: tri-*n*-butyl phosphate. ***Carboxylic ester***: octyl octanoate. ***Fatty acid derivative***: erucamide. ***Alkenes***: 3-heptylacrolein. ***Aromatic hydrocarbons***: naphthalene, benzothiazole, 2-methylnaphthalene, 1-methylnaphthalene, 1,7-dimethylnaphthalene, 1,5-dimethylnaphthalene, 1,2-dimethylnaphthalene, 1-ethylnaphthalene, γ-nonalactone, 1,2-dimethylindan. ***Aliphatic hydrocarbons***: 1-hexacosene. ***Ketones***: 4,7-dimethoxy-1-indanone, benzylacetone. ***Sterols***: campesterol, stigmasterol, β-sitosterol, delta5-avenasterol, betulinicaldehyde, γ-sitostenone [92].	cervical carcinoma U_{14}, lymphosarcoma, hepatoma and Ehrlich ascites carcinoma in mice by peritoneal injection and oral administration. It is also a sensitizer in radiation therapy of cancer [28–30]. The radiosensitizing effect of ***irisquinon A*** was detected *in vitro* against the tumor cell lines U_{14}, S-180V, HeLa, on the mice breast cancer cell lines Ma 7373, and against human intestinal mucoadenocarcinoma in hairless mice [28, 115, 116]. The mechanism of this effect was determined to an inhibition of oxygen consumption and depletion of glutathione in tumor cells [116]. In a clinical trial of 558 patients with lung cancer and nasopharyngeal cancer or superficial metastatic cancer during radiotherapy, oral *irisquinone A* significantly reduced tumor size and prolonged patients' survival [28, 95, 117]. ***Flavan3-ol compounds*** from the ***seed coat*** have potential therapeutic benefits in the treatment of human osteoarthritis and for enhancing prostate cancer cell antagonists [101, 118]. ***Oligostilbenes extracts*** from the ***seeds*** showed potent anti-inflammation activities, exhibited antidiabetic and antilipogenic effects, attenuated heperglycemia, hyperlipidemia, ameliorated lipid metabolism and attenuated hepatic steatosis in mice [100, 104, 106]. In addition, ***oligostilbenes*** isolated from ***seeds*** exhibited different bioactivities on adipocytes differentiation and can be useful for the treatment of obesity and obesity–related metabolic diseases. [103]. ***Vitisin B*** was a fatty acid synthase inhibitor and exhibited apoptotic effect on human breast cancer cells [102]. In traditional medicine ***rhizomes, seeds and flowers*** are used for pneumonia, bronchitis, chronic gastritis [24] and liver diseases [44, 114]. In ***Tibetan medicine, rhizomes*** are used as an antipyretic remedy [42, 113]. In ***Chinese traditional medicine, flowers and roots*** are used for the treatment of hemorrhoids, ulcer, blood vomiting and stranguria with cloudy discharge, and as an antipyretic agent, ***the leaves*** are used as a treatment for pharyngitis and pain in joints of the lower back and legs [119]. ***Embinin A*** and ***irislactin C*** isolated from the ***leaves*** showed weak cytotoxicity against A549 (human lung cancer) cells [109].	116, 117, 118, 119
	Rhizomes Roots	***Flavonoids***: 5-hydroxy-7-methoxyflavone (tectochrysin), 5,2'-dihydroxy-6,7-methylenedioxyflavanone, irisoid A, irisoid D [62, 107]. ***Isoflavones***: 5,7-dihydroxy-6,2'-dimethoxyisoflavone, 4',5-dihydroxy-6,7-dimethoxyisoflavone, 4',5,7-trihydroxy-6-methoxyisoflavone (tectorigenin), 5,3'-dihydroxy-2'-methoxy-6,7-methylenedioxyisoflavone, 5,2'-dihydroxy-6,7-methylenedioxyisoflavone (irisone B) [62, 107]. ***Fatty acids***: heptadecanoic acid [107]. Contain any traces of alkaloids, shown positive result for flavonoids and coumarins [11, 12].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
	Leaves	***Flavonoids and isoflavonoid***: apigenin 7-*O*-glucoside-6-*C*-glucoside, luteolin 6-*C*-β-*D*-glucoside, saponaretin, scoparin [32]. ***C-glycosylflavones***: 7-*O*-(2,4-di-*O*-acetyl-*β*-*D*-Rha*p*)-6-C-(6-*O*-acetyl-α-L-Glc*p*)-(1→2)-*β*-D-Glc*p* (irislactin A), 6-C-(2,3-di-*O*-acetyl-α-L-Rha*p*)-(1→2)-*β*-*D*-Glcp (irislactin B) [108], 5-hydroxy-7,4'-dimethoxyflavone-6-C-[*O*-(α-L-4'''-acetylrhamnopyranosyl)-(1→2)-*β*-*D*-glucopyranoside] (embinin A), 5-hydroxy-7,4'-dimethoxyflavone-6-C-[*O*-(α-L-2''',4'''-diacetylrhamnopyranosyl)-(1→2)-*β*-*D*-glucopyranoside] (embinin B), 5-hydroxy-7,4'-dimethoxyflavone-6-C-[*O*-(α-L-3''',4'''-diacetylrhamnopyranosyl)-(1→2)-*β*-*D*-glucopyranoside] (embinin C), 5-hydroxy-4'-methoxyflavone-7-*O*-(*β*-*D*-4''''-acetylrhamnopyranosyl)-6-*C*-[*O*-(α-L-6'''-acetylglucopyranosyl)-(1→2)-*β*-*D*-glucopyranoside] (irislactin C) [109], swertiajaponin, swertisin 2''-*O*-rhamnoside-4'-*O*-glucoside, swertisin 2''-*O*-(4'''-acetylrhamnoside)-4'-*O*-glucoside, embinin, 2'''-acetyl-embinin, 3'''-acetyl-embinin, the isomer of irislactin A, the isomer of irislactin C [32]. ***Xanthones***: neomangiferin, mangiferin, isomangiferin [32, 71].		
	Flowers	***Flavonoids***: quercetin, kaempferol, isorhamntin [110].		
		Tenuifolia (Diels) Alexeeva		
I. tenuifolia Pall.	Whole plant	***Flavonoids***: tenuifone, izalpinin, alpinone, irilin B, irisone A, irisone B, betavulgarin, 5,7-dihydroxy-2',6-dimethoxyisoflavone, 2',5-dihydroxy-6,7-methylenedioxy flavanone. ***Benzene derivatives***: tenuifodione. ***Polynuclear aromatic compounds***: arborinone. ***Steroids***: *β*-sitosterol. ***Oxygen-containing heterocycles***: irisoid A. ***Alkyl glycosides***: ethyl-*β*-*D*-glucopyranoside [61].	*I. tenuifolia* is known as Gres-Ma in ***Tibetan and Mongolian medicine***. The ***underground parts*** and ***seeds*** are used to treat intoxication, gastric colic, as an anthelmintic agent [53, 54]. ***The roots and rhizomes*** are commonly used in ***traditional Mongolian medicine*** for the treatment of kidney disorders. A ***root decoction*** is used for urethral stones, hypertension caused by adrenal gland diseases, and to relief renal colic and chronic nephritis [122]. ***Tenuifone, izalpinin and 5,7-dihydroxy-2',6-dimethoxyisoflavone*** have shown a considerable antioxidant activity [61]. *Compounds* ***3'-hydroxy-5,7-dimethoxy-4-O-2'-cycloflavan*** *and* ***5,2',3'-trihydroxy-6,7-dimethoxyflavanone*** have shown a neuroprotective activity [120]. Pretreatment with *I. tenuifolia* flavonoids from ***underground parts*** significantly inhibited H_2O_2-induced cell death in cortical neurons *in vitro* [123]. Treatment with ***ethanol extract*** of *I. tenuifolia* either 1 hr prior or immediately after middle cerebral artery occlusion (MCAO) significantly reduced the infarct volume in mice [124]. ***Flavonoids from rhizomes and roots*** have shown an antimicrobial activity against fungi, gram-positive and gram-negative bacteria. ***5,7,2',3'-tetrahydroxyflavanone*** was found to possess the highest antibacterial activity against vancomycin resistant *Enterococcus faecalis* and *Mycobacterium vaccae*. Isolated compounds and plant crude extract *in vitro* showed potent inhibitory effect against leukemia cells. ***5,2',3'-dihydroxy-6,7-dimethoxyisoflavone*** was active against both of the leukemia cells K-562 and THP-1 [121].	53, 54, 60, 61, 74, 120, 121, 122, 123, 124
	Rhizomes Roots	***Flavonoids and isoflavonoid***: 5,2',3'-trihydroxy-6,7-methylenedioxyflavanone, 5,2'-dihydroxy-6,7-methylenedioxyflavanone, 5,2',3'-trihydroxy-7-methoxyflavanone, 5,3'-dihydroxy-7,2'-dimethoxyflavanone, 3,5,2',3'-tetrahydroxy-7-methoxyflavanone, 3,5,3'-trihydroxy-7,2'-dimethoxyflavanone [60], 3'-hydroxy-5,7-dimethoxy-4-*O*-2'-cycloflavan, 3'-hydroxy-5-methoxy-6,7-methylenedioxy-4-*O*-2'-cycloflavan, 5,2',3'-trihydroxy-6,7-dimethoxyflavanone [120], 5-hydroxy-6,7-dimethoxyisoflavone-2'-*O*-β-*D*-glucopyranoside, 5-methoxy-6,7-methylenedioxy-4-*O*-2'-cycloflavan, (2S)-5,7,2',3'-tetrahydroxyflavanone, 5,2',3'-trihydroxy-6,7-dimethoxyisoflavone, 5,7-dihydroxy-6,2'-dimethoxyisoflavone, 3,5,3'-trihydroxy-7,2'-dimethoxyflavonol [121]. ***Steroids***: *β*-sitosterol. ***Macrolides***: moniristenulide [121].		
	Aerial parts	***Phenolic acids***: vanillic, protocatechuic, *p*-coumaric, *m*-hydroxybenzoic, ferulic [74].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
		Xyridion Tausch		
I. halophila Pall.	Leaves	Ascorbic acid 250–950.6 mg% [125, 126].	***Halophilol A*** expressed moderate activity against two human cancer cell lines KB and HMEC (human microvascular endothelial cell) [127].	125, 126, 127
	Seeds	***Stilbenes***: halophilol A, halophilol B, resveratrol, ε-viniferin, γ-2-viniferin [127].		
		Limniris Tausch		
I. ensata Thunb. (= *I. ensata* var. *spontanea* (Makino) Nakai; *I. kaempferi* Sieb.; *I. ensata* Thunb. var. *hortensis* Makino et Nemoto; *I. ensata* Thunb. var. *ensata* (Makino) Nakai; *I. kaempferi* Sieb. var. *hortensis* Makino)	Rhizomes Roots	***Carbohydrate*** (%): sucrose (1), fructans (2.5), starch (5.3) [55]. ***Higher fatty acids***: lauric, capric [128]. ***Higher aliphatic alcohols***: ceryl alcohol [129].	***Roots, flowers and seeds*** are used in ***Tibetan medicine*** [146]. The fruits are used for gastrointestinal diseases and as an anthelmintic agent [147]. ***In Chinese and Korean*** traditional medicine, ***rhizomes*** are used to treat throat pain, dysentery, bloating, and swelling [148]. ***In Iranian*** traditional medicine ***rhizomes*** of *I. ensata* are used in powder form with vinegar, internally and externally, to treat liver and spleen diseases (hepatalgia, spleenalgia, ascites, bile expulsion) [149]. ***In India,*** *I. ensata* is known as " Irisaunarjal" and its root is used as blood purifier, to treat venereal infection [150]. ***Seeds powder*** is used orally to eliminate stomach worms, to treat gastric ulcers and stomach problems [151, 152]. It is also used for liver disorders. The ***laccases*** contained in plants are used in hair cosmetic preparations, as an oxidizing agent in oxidative hair dyes and permanent hair wave-setting compositions. The ***root extracts*** are used in cosmetic preparations for the prevention of skin roughness and ageing [129]. ***In Pakistan*** *I. ensata* is known as «Oogakai» and decoction or fresh root is used as blood purifier and also for making local green rice [153, 154]. ***Extract*** of *I. ensata* var. *spontanea* exhibited properties that decrease cow rumen fluid methanogenesis *in vitro* by inhibiting protozoa species and might be used as a feed supplement for ruminants [155]. ***Extract of the underground parts*** has anti-hyperglycemic activity [156]. ***Acetone extract of the underground parts*** and ***leaves*** has an antifeedant activity [157]. Studies have shown that floating treatment wetlands (FTWs) with *I. ensata* can effectively remove N and P from runoff, improve water quality, reduce shoreline erosion, and improve the nutrient removal capacity of the pond [158].	55, 56, 57, 58, 59, 68, 71, 125, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158
	Aerial parts	***Higher aliphatic alcohols***: ceryl alcohol [130]. Xanthone glycosides, C-glycoside of apigenin and phenolic acids [129].		
	Leaves	***Xanthone***: isomangiferin, mangiferin [71]. ***Phenolic acids from hydrolyzed***: *p*-coumaric, sinapic, ferulic [68]. Ascorbic acid 170 mg% [125].		
	Flowers	***Xanthone***: mangiferin, isomangiferin [131]. ***Anthocyanins***: ensatin (malvidin-3-(*p*-coumaroyl)-rutinoside-5-glucoside), petanin (petunidin-3-(*p*-coumaroyl)-rutinoside-5-glucoside), delphinidin-3-(*n*-coumaroyl)-rutinoside-5-glucoside, delphinidin-3-rutinoside-5-glucoside, malvidin 3-rutinoside-5-glucoside, petunidin 3-rutinoside-5-glucoside, cyanidin 3-(*n*-coumaroyl)-rutinoside 5-glucoside, peonidin-3-(*n*-coumaroyl)-rutinoside-5-glucoside [55–59, 132–142], malvidin 3-*O*-rutinoside-5-*O*-glucosides, petunidin 3-*O*-rutinoside-5-*O*-glucoside, malvidin 3-*O*-β-[(4'''-*E*-*p*-coumaroyl-α-rhamnopyranosyl)-(1→6)-β-glucopyranoside]-5-*O*-β-glucopyranoside (*E*-ensatin), malvidin 3-*O*-β-[(4'''-*Z*-*p*-coumaroyl-α-rhamnopyranosyl)-(1→6)-β-glucopyranoside]-5-*O*-β-glucopyranoside (*Z*-ensatin), petunidin 3-*O*-β-[(4'''-*E*-*p*-coumaroyl-α-rhamnopyranosyl)-(1→6)-β-glucopyranoside]-5-*O*-β-glucopyranoside (*E*-petanin), petunidin 3-*O*-β-[(4'''-*Z*-*p*-coumaroyl-α-rhamnopyranosyl)-(1→6)-β-glucopyranoside]-5-*O*-β-glucopyranoside (*Z*-petanin) [143]. ***C-Glycosylflavones***: swertisin 2''-*O*-glucoside, vitexin [131, 135] apigenin 6,8-di-C-hexoside, isovitexin, isovitexin 7-*O*-glucoside (saponarin), isovitexin 2''-*O*-rhamnoside, isovitexin 2''-*O*-xyloside, velutin 6-*C*-glycoside, vicenin-2 [131], orientin, isoorientin [131, 144].		
	Callus tissue	***Flavone***: 5-hydroxy-2'-methoxyflavone, 5-hydroxy-3'-methoxyflavone, 5-hydroxy-4'-methoxyflavone [145].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
I. laevigata Fisch. et C.A. Mey.	Rhizomes Roots	***Xanthones***: mangiferin [159].	***In Chinese*** traditional medicine ***rhizomes*** are used as expectorant [113]. ***In Transbaikalia,*** root decoction is used for venereal diseases, as a laxative and emetic. ***Flowers and fresh leaves*** are used for snake bites (*Coluber natrix*) [40].	40, 56, 68, 69, 113, 144, 138, 159, 160, 161
	Aerial parts	***Xanthones***: mangiferin (0.73%) [69].		
	Leaves	***Phenolic acids from hydrolyzed***: *p*-coumaric, sinapic, ferulic, caffeic. ***Anthocyanins***: delphinidin, cyanidin [68].		
	Flowers	***Anthocyanins***: malvidin-3-(*p*-coumaroyl)-rutinoside-5-glucoside (ensatin), petunidin-3-(*p*-coumaroyl)-rutinoside-5-glucoside (petanin), malvidin 3-rutinoside-5-glucoside, petunidin 3-rutinoside-5-glucoside, delphinidin-3-rutinoside-5-glucoside [56, 138]. ***C-Glycosylflavone***: isovitexin, isovitexin 2"-*O*-rhamnoside, isovitexin 4'-*O*-glucoside, isovitexin 4'-*O*-galactoside, isovitexin X"-*O*-galactoside, acylated isovitexin X"-*O*-glucoside, vitexin, isoorientin, swertisin, swertisin X"-*O*-rhamnoside, swertisin X"-*O*-galactoside, vicenin-2, isoscoparin, scoparin 7-*O*-glucoside, apigenin 6,8-di-*C*-glycoside [144, 160, 161].		
I. pseudacorus L.	Rhizomes Roots	***Carbohydrate*** (%): sucrose (0.3), fructans (4.7) [55]. ***Triterpenoids***: (6*R*,10*S*,11*S*,14*S*,26*R*-(+)-29-Acetoxy-14,15-dihydro-26-hydroxyspiroirida-15(28),16-dienal; (6*R*,10*S*,11*S*,14*S*,26*R*)-(+)-14,15-Dihydro-26,29-dihydroxyspiroirida-15(28),16-dienal; (6*R*,10*S*,11*R*)-26ξ-Hydroxy-13ξ-oxaspiroirid-16-enal; (6*R*,10*S*,11*S*)-13ξ-oxaspiroirid-16-enal [162]; 26-acetoxy-22-methylene-irid-16-enal [162, 163], squalene, α-curcumene, sclareol, eugenol, α-bergamotene, [120]-farnesene, manoyloxide, *epi*-manoyloxide [164], γ-curcumene, α-bisabolol, β-bisabolene [165]. ***Higher fatty acids***: palmitic, lauric, capric, caproic, myristic [165], ethyl linoleate, ethyl palmitate [164]. ***Alkanes***: heptadecane, hexadecane [164]. ***Organic acid***: shikimic, quinic, malic, succinic, citric, fumaric, lactic [55, 166, 167], gallic, 2,3,5-trihydroxybenzoic, gentisic, *p*-hydroxybenzoic [168], myristic [129, 169]. ***Flavonol***: 3,6-dimethoxy-5,7-dihydroxyflavone [168], kaempferol, quercetin [170], epigallocatechin, catechin, epicatechin, gallocatechin [171], hyperoside [169]. ***Flavones:*** apigenin, formononentin, hispidulin [169, 170]. ***Isoflavonoid***: ayamenin A, irilin B, iristectorigenin A, tectorigenin, 5,7-dihydroxy-2',6-dimethoxyisoflavone, 5,7-dihydroxy-2',6-dimethoxyisoflavone 7-*O*-β-*D*-glucopyranoside [168], 5,6-dihydroxy-7,8,3',5'-tetramethoxyisoflavone [63], irisolidone, irigenin, iridin [172], irilone, irisolone (nigricin) [173], iristectorigenin B (5,7,4'-trihydroxy-6,3′-dimethoxyisoflavone) [171], tectoridin, nigricin-4'-glucoside, 6,7-dihydroxyisoflavone, 5,7-dihydroxy-4'-methoxyisoflavone [169].	***The extracts of flowers, leaves, roots*** are active against *Bact. abortus* Bang [199, 200]. ***Essential oil*** from *I. pseudacorus* contains antibacterial agents active against both gram-positive and gram-negative bacteria [201]. ***Extracts of leaves and rhizomes*** have been reported to have antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis* [202]. ***Methanolic extracts from rhizomes*** possessed antibacterial activity against human gram-positive *Staphylococcus aureus* and *Enterococcus faecalis* and gram-negative *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* pathogens. ***Extract from rhizome*** effectively combats *Staphylococcus aureus* biofilm [171]. *I. pseudacorus* non-polar fractions showed potent biofilm inhibitory potential against biofilm formation of methicillin-resistant *Staphylococcus Aureus* and methicillin susceptible *Staphylococcus aureus* [203]. ***Methanol extract*** of *I. pseudacorus* stimulated alkaline phosphatase activity and collagen type I secretion with a substantial effect on osteoblast proliferation [35]. ***Rhizome extract*** exhibits acivity against human cancer cell lines, especially against estrogenpositive MCF-7 breast cancer cell line [171].	35, 36, 37, 38, 39, 41, 51, 55, 63, 67, 68, 71, 78, 114, 125, 126, 129, 137, 162, 163, 164, 165, 166, 167,

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
		Xanthones: mangiferin (2-(C-β-D-glucopyranosyl)-1,3,6,7-tetrahydroxyxanthone), isomangiferin (4-(C-β-D-glucopyranosyl)-1,3,6,7-tetrahydroxyxanthone), norathyriol (1,3,6,7-tetrahydroxyxanthone) [174], daidzein, genistein, genistein-7-glucoside [169–171]. ***Amino acid***: methyl-2-pyrrolidone-5-carboxylate, 2-pyrrolidone-5-carboxylic [175], 3-(3-carboxyphenyl)alanine [176, 177], aspartic, lysine, glutamic, arginine, glycine, leucine, threonine, valine, phenylalanine, serine, alanine, isoleucine, histidine, tyrosine, methionine, proline [178]. ***Hydroxybenzoic acid:*** gallic, 2,3,5-trihydroxybenzoic, gentisic, *p*-hydroxybenzoic, protocatechuic [168, 171, 179]. ***Phenolcarboxylic acids***: caffeic, ferulic, chlorogenic, neochlorogenic [170], *p*-coumaric, *trans*-cinnamic [169], ellagic [171]. ***Polysaccharides***: water-soluble polysaccharides, pectic substances, hemicellulose A, hemicellulose B. ***Monosaccharides***: glucose, xylose, galactose, mannose, rhamnose, arabinose [39]. ***Coumarins:*** coumarin, umbelliferone (7-hydroxycoumarin), herniarin (7-methoxycoumarin), daphnoretin, esculetin, scopoletin, isoscopoletin [180].	***In India,*** *I. pseudacorus* is used in dysmenorrhoea and leucorrhoea. Juice of the root is used for obstinate coughs and convulsions [129]. In traditional medicine of ***Belarus***, a ***decoction*** of the ***rhizomes*** is used for gastric ulcers, as a hair growth stimulant [204]. ***In Ukrainian*** traditional medicine, peeled and cut rhizomes are used as an emetic, laxative, diuretic, stimulant, expectorant and coating agents. Powder from dried rhizomes is used as a toothpaste ingredient, to relieve toothache in children [37, 41, 174]. ***In Bulgaria***, the rhizomes were used for diabetes [205]. ***In Russian*** traditional medicine, a ***decoction of the rhizomes*** was used for respiratory infections, pneumonia, diseases of the urinary organs, ascites, scurvy, scrofula, dropsy and epilepsy, as an analgesic for headache and toothache, obstetric, hemostatic for algomenorrhea and metrorrhagia; as a laxative and antidiarrhoeal agent [36, 38, 206, 207]. Rhizomes were used for snake bites [41]. ***The sap from the rhizomes*** was used (orally) for epilepsy; locally – for diathesis, toothache, stomatitis [51, 206]. ***Seeds*** were used as a coffee substitute [51]. Rhizomes is one of the ingredients of M.N. Zdrenko polyherbal tea used in anticancer therapy [208, 209]. ***Rhizomes*** were included in different pharmacopoeias and have been used as a strong purgative agent [210]. In homoeopathic medicine, extracts of rhizomes are used for different forms of psychic ailments, migraine, for neuralgia of the trigeminus, in hyperemesis and hyperacidity of the stomach [163, 211]. *I. pseudacorus* ***rhizome sap*** was used by English rural population and administered with buckthorn syrup every one-two hours to treat dropsy [212]. *I. pseudacorus* was used externally for toothache, scabs and scrofula, internally for hydrops [78]. ***Dry hydrophilic leaf extract*** showed pronounced diuretic activity [213]. ***Underground parts and flowers*** were used as a tanning agent and yellow dye for leather, wool, paper [126, 214–217]. The larvicidal activity of ***ethanol leaf extracts*** on the larvae of *Culex pipiens* and *Aedes caspius* mosquitoes were investigated. The miracidiacidal and cercaricidal properties were tested against *Schistosoma mansoni* miracidia [218]. Floating treatment wetlands (FTWs) planted with *I. pseudacorus* uptake nitrogen and phosphorous, and can be used in a temperate climate to overcome problems with excessive algae growth in surface waters in urban and agricultural settings [219].	168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212,
	Leaves	***Isoflavonoid***: ayamenin A, ayamenin B, iriline B, irilin C, biochanin A, tectorigenin, irilin A, iristectorigenins A, iristectorigenins B, 3'-*O*-methylorobol, pratensein, genistein [181], ayamenins C, ayamenins D, ayamenin E [182], 5,7,3'-trihydroxy-6-methoxycoumaronochromone, lupinalbin A [181]. ***Flavanol***: gallocatechin-4-β-ol [67, 71]. ***Flavanones***: 5,7,2′-trihydroxyflavanone [182]. ***Dihydroflavonol:*** alpinone [182], 7-*O*-methyldihydrokaempferol (aromadendrin 7-methyl ether). ***Flavones:*** apigenin, luteolin, hispidulin [182, 183]. ***Anthocyanins***: delphinidin, cyanidin [68]. ***Catechins***: (-)-epicatechin. ***C-glycosides***: isovitexin, vitexin, isoorientin, orientin, vicenin-II. ***Organic acid***: protocatechuic, gallic [183]. ***Xanthones***: mangiferin, isomangiferin, mangiferin *O*-glycoside [71, 183, 184]. ***Higher fatty acids***: myristic, stearic, palmitic, lignoceric, arachidic, behenic, myristoleic, oleic, linoleic, linolenic, erucic, palmitoleic [185]. ***Phenolic acids***: *p*-coumaric, sinapic, ferulic [68]. Ascorbic acid 80–140 mg% [125].		
	Aerial parts	***Isoflavonoid***: 5,7-dihydroxy-2',6-dimethoxyisoflavone, irilone [186]. ***Flavonol:*** 3,6-dimethoxy-5,7-dihydroxyflavone [186]. ***Dihydroflavonol:*** alpinone, *trans*-3-hydroxy-5,7-dimethoxyflavanone [186].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
	Flowers	***Flavonol:*** isorhamnetin, kaempferol [187]. ***Carotenoids***: β-carotene, lutein, zeaxanthin, violaxanthin [137, 188, 189]. ***Tannins:*** 2.82% pyrogallol derivatives [114, 190]. ***Higher fatty acids***: stearic, palmitic, oleic, linoleic, linolenic [191]. The content of lipids has been investigated [191].		213, 214, 215, 216, 217, 218, 219
	Seeds	***Quinones***: irisquinone; 2-methoxy-6-(pentadec-8-enyl)-1,4-benzoquinone; 2-methoxy-6-pentadecyl-l,4-benzoquinone; 2-methoxy-6-nonadecyl-l,4-benzoquinone; 6-(heptadec-10'-enyl)-5-hydroxy-2-methoxy-l,4-benzoquinone; 5-hydroxy-2-methoxy-6-(pentadecenyl)-l,4-benzoquinone; 5-hydroxy-2-methoxy-6-pentadecyl-l,4-benzoquinone; 3-methoxy-5-(heptadec-10'-enyl)phenol; 3-methoxy-5-(pentadecenyl)phenol; 3-methoxy-5-pentadecylphenol; 5-(heptadec-10'-enyl)-3,4-dimethoxyphenol; 3,4-dimethoxy-5-(pentadecenyl)phenol; 3,4-dimethoxy-5-pentadecylphenol; 3,4-dimethoxy-5-(nonadecenyl)phenol [192–195]. ***Carbohydrates***: glucose, fructose, sucrose, raffinose, stachyose [196]. The content of lipids has been investigated [197].		
	Callus culture	***Phenylpropanoids***: lavandoside. ***Neolignan***: dehydrodiconiferyl alcohol-4-*O*-β-*D*-glucopyranoside. ***Isoflavonoids***: tectoridin, tectorigenin, iristectorigenin A [198].		
I. sanguinea Donn. (= *I. orientalis* Thunb., *I. nertshinskia* Lodd. f. *albiflora* Honda.	Rhizomes Roots	***Carbohydrate*** (%): sucrose (1.6), fructans (7.0), starch (3.2) [55].	***In Chinese*** traditional medicine ***rhizomes and roots*** are used to treat furuncles, carbuncles, stomach ache, indigestion, bruises, hemorrhoids, scabies, edema, cirrhotic ascites, difficult urination, constipation [148]. ***Flowers, seeds and rhizomes*** have been used in ***Tibetan medicine*** [42]. The ***Nanais*** used decoction of rhizomes for gynecological diseases and as an emetic and laxative [43]. ***In Russian*** traditional medicine rhizomes were used for dropsy and as an anthelminthic agent, externally – as a remedy for burns [24].	24, 42, 43, 55, 56, 71, 95, 148, 220, 221, 222, 223
	Leaves	***Flavonols***: myricetin, quercetin [71], myricetin 3-*O*-rhamnoside, quercetin 3-*O*-rhamnoside [220]. ***C-Glycosylflavones***: swertiajaponin, swertisin 2"-*O*-glucoside (flavoayamenin), swertisin, isoorientin 2"-*O*-glucoside, acetylated swertisin 2"-*O*-glucosides, acetylated swertisin [220].		
	Flowers	***C-Glycosylflavones***: swertiajaponin, luteoayamenin, swertisin, swertisin 2"-*O*-glucoside (flavoayamenin) [95, 221, 222], embigenin 2"-*O*-rhamnoside [223], vicenin-2, swertiajaponin X"-*O*-hexoside, isoorientin, isovitexin 2"-*O*-glucoside, isovitexin [220]. ***Anthocyanins***: delphinidin-3-(*n*-coumaroyl)-rutinoside 5-glucoside, petunidin-3-(*p*-coumaroyl)-rutinoside-5-glucoside (petanin), delphinidin-3-rutinoside-5-glucoside, petunidin 3-rutinoside-5-glucoside, malvidin glycoside [56], delphinidin 3-*O*-[(4'''-*p*-coumaroylrhamnosyl)-(1→6)-glucoside]-5-*O*-glucoside, petunidin 3-*O*-[(4'''-*p*-coumaroylrhamnosyl)-(1→6)-glucoside]-5-*O*-glucoside [220].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
I. sibirica L.	Rhizomes Roots	***Carbohydrate*** (%): sucrose (2.3), fructans (2.7), starch (2.5) [55]. ***Xanthones***: mangiferin, daidzein, genistein-7-glucoside [50, 169], formononetin, isomangiferin [170]. ***Phenolcarboxylic acids***: caffeic, gallic, chlorogenic, *p*-coumaric, ferulic, *trans*-cinnamic [50, 170]. ***Flavonoids and isoflavonoid***: germanaism B, tectoridin, irisolidone-*D*-glucoside, nigricin, irigenin, nigricin-4'-glucoside, 6,7-dihydroxyisoflavone, iristectorigenin B, nigricin, 7-hydroxyisoflavone, 5,6-dihydroxy-7,8,3',5'-tetramethoxyisoflavone, 5,7-dihydroxy-4'-methoxyisoflavone [50, 169]. ***Flavonols***: hyperoside, isoquercitin, kaempferol [169], quercetin [170]. ***Flavones***: apigenin. ***C-Glycosylflavones***: apigenin-7-glucoside [169]. ***Triterpenoids***: (6*R*,10*S*,11*S*)-(+)-26-hydroxyiridal, (6*R*,10*S*,11*S*)-(+)-17ξ,26-dihydroxyiridal, (6*R*,10*S*,11*S*)-(+)-17ξ-hydroxyiridal, (6*R*,10*S*,11*S*)-(+)-10-deoxy-17ξ-hydroxyiridal [224], 10-deoxy-17-hydroxyiridal, (6*R*,10*S*, 11*S*)-17,29-didehydroiridal [225]. ***Higher fatty acids***: lauric, myristic, palmitic, palmitoleic, stearic, oleic, linoleic, 9-methyl tetradecenoic, isomyristic, pentadecanoic, 14-methyl palmitoleic, heptadecanoic, 10-octadecadienoic, linolenoic, arachic, behenic, tricosyl, lignoceric [6].	*I. sibirica* is considered as an antisyphilitic treatment [78]. ***In Tibetan*** medicine, ***underground parts, flowers and seeds*** were used for pneumonia, bronchitis, gastritis, gynecological diseases [20]. ***In Russian*** traditional medicine ***underground parts*** were used for ascites, syphilis, scurvy, as a hemostatic, laxative, anthelmintic [146, 230]. ***In Siberia***, a ***decoction of the herb*** was used for heart disease, during pregnancy, for gastrointestinal diseases, and for anthrax [231]. The fruits were used as decoction, and as a wound healing remedy [41]. ***In the Urals***, a whole plant with fruits as decoction or alcoholic infusion was used orally for gastrointestinal diseases and dysentery. The decoction was taken by women after childbirth, and externally as a wound healing agent [232]. ***In Transbaikalia*** root decoction was used to treat venereal diseases, as a laxative and emetic agent. Flowers and fresh leaves were used for snake bites (*Coluber natrix*) [40]. The flowers were used as a green dye [233]. Flower pigments were used as a natural textile dye [234]. ***In Brazil*** *I. sibirica* is known as “Palmeirinha” and its roots are used for diarrhea [235]. ***Dry and lipophilic extracts from the leaves and rhizomes*** exhibited an antibacterial activity against *Staphylococcus aureus*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*, *Basillus subtilis* and *Candida albicans* [236].	6, 20, 40, 41, 50, 55, 68, 71, 78, 125, 146, 169, 170, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236
	Flowers	***C-Glycosylflavones***: 6-*C*-glucosyl-7-*O*-methylapigenin (swertisin), 6-*C*-glucosyl-7-*O*-methylluteolin (swertiajaponin), 6-*C*-sophorosyl-7-*O*-methylapigenin (flavoayamenin, spinosin), 6-*C*-sophorosyl-7,4'-di-*O*-methylapigenin (embinoidin) [226].		
	Leaves	***Xanthones***: mangiferin [227]. ***Flavonols***: quercetin, myricetin [71, 228], epigallocatechin, catechin [227]. ***Anthocyanins***: delphinidin, cyanidin. ***Phenolic acids***: caffeic, *p*-coumaric, sinapic, ferulic [20, 68, 227]. ***Higher fatty acids***: lauric, palmitic, palmitoleic, stearic, oleic, linoleic, pentadecanoic, heptadecanoic, linolenoic, arachic, behenic, tricosyl, lignoceric, hexadecadienoic [6]. ***Isoflavones***: tectorigenin-7-*O*-hexosyl-4'-*O*-hexoside, tectorigenin-7-*O*-dihexoside, dichotomitin, genistein-*O*-hexoside (genistin), genistin *O*-hexoside isomer, genistein, tectorigenin, rhamnocitrin, isotectorigenin, tectorigenin-*O*-hexoside (tectoridin), iristectorigenin B-*O*-hexoside (iristectorin B), iristectorigenin A-*O*-hexoside (iristectorin A), iristectorigenin A, iristectorigenin B, irisolidone, irisolidone isomer, irisolidone *O*-hexoside, irisolidone *O*-hexoside isomer, irilone, iristectorin B-4'-*O*-glucoside), irigenin [227]. ***Flavones***: naringenin-7-O-dihexoside (naringin), naringenin, eupatilin, hispidulin, genkwanin (7-methoxyapigenin), dihydrokaempferol, 6,7,3',4'-tetrahydroxyflavone [227]. ***C-Glycosylflavones***: apigenin-*C*-hexoside (vitexin), 4'-*O*-methyl-apigenin 8-*C*-hexoside, apigenin 8-*C*-(2"-hexosyl)-hexoside [227]. ***O-glycosylflavones***: flavonoid *O*-dihexoside, chrysoeriol-7-*O*-hexoside [227]. Ascorbic acid 400 mg% [125].		
	Seeds	***Carbohydrates***: polysaccharides were composed of D-glucose, D-mannose, D-galactose [229]. ***Polysaccharide***: glucomannan (18%) [55].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
		Tripetalae Alexeeva		
I. setosa Pall.	Ariel parts	***Xanthones***: mangiferin (2.76%) [69].	***In Russian*** traditional medicine a ***decoction of the rhizomes*** was used for pneumonia, ascites, and sore throat; externally – for wounds, ulcers, fistulas, and to remove freckles [46]. ***In Yakutia***, the rhizomes were used as an analgesic (for toothaches) and emetic agents. Dried rhizomes were used as an insecticide. A ***decoction of the rhizomes*** was used for gastrointestinal diseases [240]. ***In Japanese*** medicine, the powdered rhizomes were used for scabies [45]. ***Seeds*** were used as a coffee substitute [46]. The ***rhizomes*** were used as a yellow dye [46].	45, 46, 56, 69, 71, 144, 161, 237, 238, 239, 240
	Leaves	***C-Glycosylflavones***: luteolin 6,8-di-*C*-glycoside, swertiajaponin, isoswertiajaponin, isoswertiajaponin X"-*O*-rhamnoside, isoswertisin, swertisin X"-*O*-rhamnoside, isoorientin, isovitexin, orientin, vitexin, vicenin-2, isovitexin 4'-*O*-glucoside, swertisin [237, 238]. ***Xanthones***: mangiferin, isomangiferin [71, 237].		
	Flowers	***Anthocyanin***: malvidin 3-*O*-[(4'''-*p*-coumaroylrhamnosyl)-(1→6)-glucoside]-5-*O*-glucoside, malvidin glycoside, petunidin 3-*O*-[(4'''-*p*-coumaroylrhamnosyl)-(1→6)-glucoside]-5-*O*-glucoside, delphinidin hexoside [237, 239], delphinidin 3-*O*-rutinoside-5-*O*-glucoside, delphinidin 3-*O*-(*p*-coumaroylrutinoside)-5-*O*-glucoside, petunidin 3-*O*-rutinoside-5-*O*-glucoside, malvidin 3-*O*-rutinoside-5-*O*-glucoside [56, 161]. ***C-Glycosylflavones***: isovitexin 4'-*O*-galactoside, vitexin 4'-*O*-galactoside, isovitexin X"-*O*-glucoside, swertisin 2"-*O*-glucoside, isoorientin, isovitexin, orientin, vitexin, vicenin-2, isovitexin 4'-*O*-glucoside, swertisin [144, 237].		
		Ioniris (Spach) Rodion		
I. ruthenica Ker-Gawl.	Rhizomes Roots	***Carbohydrate*** (%): sucrose (1.0), fructans (1.2), starch (3.3) [55]. Content of polysaccharides 1.33% and pectin 2.2% [241]. The presence of saponins [242] and flavonoids [243] has been investigated.	***Roots, flowers and seeds*** are used in ***Tibetan medicine*** [146]. The flowers are used as an anthelminthic agent [47]. ***A decoction of the roots***, pre-dried, are used for gynecological diseases [244].	47, 55, 68, 146, 241, 242, 243, 244
	Leaves	***Phenolic acids from hydrolyzed***: *p*-coumaric, sinapic, ferulic [68]. Content of polysaccharides 3.5% and pectin 3.1% [241].		
		Oncocyclus (Siemss.) Baker		
I. acutiloba C. A. Mey (*I. ewbankiana* Foster)	Rhizomes Roots	***Carbohydrate*** (%): sucrose (2.5), starch (11.8) [55]. ***Higher fatty acids***: capric, lauric, myristic, stearic, palmitic, oleic, linoleic, linolenic [245].	The ***essential extract*** exhibits antibacterial activity [246].	55, 125, 245, 246
	Leaves	Ascorbic acid 280–391 mg% [125].		
		Iris		
I. aphylla L. (= *I. hungarica* Waldst. et Kit.)	Rhizomes Roots	***Xanthones***: mangiferin, isomangiferin [50, 170, 247]. ***Phenolcarboxylic acids***: *n*-coumaric, chlorogenic, cinnamic, caffeic [50], *trans*-cinnamic [169], gallic [170]. ***Flavonoids and isoflavonoid***: 7,4'-dihydroxyisoflavone (daidzein), 7-hydroxy-4'-methoxyisoflavone (formononetin), 5,7,4'-trihydroxyisoflavone (genistein), 5,7,4'-trihydroxy-6-methoxyisoflavone (tectorigenin), 4',5-dihydro-6-methoxy-7-(*O*-β-*D*-glucoside)isoflavone (tectoridin), germanaism B, irisolidone-*D*-glucoside, irisolidone, nigricin, irigenin, 5,6-dihydroxy-7,8,3',5'-tetramethoxyisoflavone [50, 247], 5,7,4'-trihydroxy-6,3'-di-methoxyisoflavone (iristectorigenin B), iristectorigenin B-7-*O*-β-*D*-glucoside (iristectorin B) [170], nigricin-4'-glucoside [169, 170].	***The essential extract*** exhibits antibacterial activity [48, 49]. ***1% dry rhizome extract*** has shown the highest inhibitory activity for gram-positive bacteria and fungi [247]. ***The dry extract of the leaves*** at the concentration 1% has a more pronounced antibacterial activity than the extract of the rhizomes and is the most susceptible to gram-negative bacteria – *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas aeruginosa*. The ***lipophilic extracts of the leaves and rhizomes*** were more susceptibility to gram-positive bacteria [236].	48, 49, 50, 68, 125, 169, 170, 236, 247, 248, 249

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
	Leaves	***Xanthone***: mangiferin [68]. ***Phenolic acids***: *p*-coumaric, ferulic [68], syringic, *p*-hydroxybenzoic, vanillic [248]. ***Carboxylic acids***: oxalic, malonic, fumaric, methoxysuccinic, succinic, 3-oxo-2-methylglutaric, malic, suberinic, azelaic, citric [248]. Ascorbic acid 450 mg% [125].	***Aqueous and ethanol extract*** of rhizomes showed a potent antioxidant capacity, anti-inflammatory and antiallergic activity. ***Aqueous extract*** of rhizomes showed inhibitory effect on the lipid droplets in Huh7 liver cells. ***Ethanol extract*** of rhizomes was effective against both melanoma (IGR39) and triple-negative breast cancer (MDA-MB-231) cells [50]. ***Dry extracts of leaves and rhizomes*** showed an anabolic activity, reduced urea excretion, normalized metabolism, restored nitrogen balance, and inhibited protein catabolism in rats [249].	
I. pumila L.	Rhizomes Roots	***Carbohydrate*** (%): sucrose (2.0), starch (5.0) [55]. ***Xanthones***: iriflophenone 4-*O*-hexoside, 7-*O*-methyl-mangiferin, isomangiferin, 7-*O*-methyl-isomangiferin, iriflophenone, 4-*O*-methyl-iriflophenone, bellidifolin [250]. ***O-glycosylflavones***: luteolin 7-*O*-(2"-*p*-coumaroyl)-rhamnoside. ***Isoflavones and derivatives***: tectoridin, iristectorin B, iristectorin A, iridin, 7-*O*-methyl-tectorigenin 4'-*O*-(6"-hexosyl)-hexoside, irifloside, irilone 4'-*O*-hexoside, irisolidone 7-*O*-hexoside, tectorigenin, iristectorigenin A, irigenin, irilone, iriflogenin, irisolidone [250]. Content (mg/g of dry weight) of soluble sugars 15.5, starch 6.3 [250].	***In Russian*** traditional medicine the ***rhizomes*** were used as antifever, emetic [41], and antirabies agent [51]. ***Rhizomes and leaves*** show antifungal activity [52].	41, 51, 52, 55, 69, 71, 125, 250, 251
	Ariel parts	***Xanthones***: mangiferin (1.28%) [69, 71], isomangiferin, 7-*O*-methyl-isomangiferin, iriflophenone, 4-*O*-methyl-iriflophenone, bellidifolin [250]. ***C-Glycosylflavones***: luteolin 6-*C*-glucoside, apigenin 8-*C*-glucoside, apigenin 6-*C*-hexoside, 4'-*O*-methyl-apigenin 8-*C*-hexoside, 4'-*O*-methyl-apigenin 6-*C*-hexoside [250]. ***O-glycosylflavones***: luteolin 7-*O*-(2"-*p*-coumaroyl)-rhamnoside [250]. ***Isoflavones and derivatives***: iristectorin B, iristectorin A, tectorigenin, irilone 4'-*O*-[6"-(3-hydroxy-3-methylglutaryl)]-hexoside, iristectorigenin A, irigenin [250]. Content (mg/g of dry weight) of soluble sugars 18.9, starch 2.3 [250]. Ascorbic acid 411–808 mg% [125].		
	Flowers	***Xanthones***: mangiferin, isomangiferin, 7-*O*-methyl-isomangiferin, iriflophenone [250]. ***C-glycosylflavones*:** luteolin 8-*C*-hexoside, luteolin 6-*C*-glucoside, apigenin 8-*C*-(2"-hexosyl)-hexoside, apigenin 8-*C*-(2"-pentosyl)-hexoside, apigenin 8-*C*-glucoside, apigenin 6-*C*-hexoside [250]. ***O-glycosylflavones***: kaempferol 7-*O*-(6"-rhamnosyl)-hexoside [250]. ***Isoflavones and derivatives***: irisolidone 7-*O*-hexoside [250]. Content (mg/g of dry weight) of soluble sugars 22.6, starch 1.17 [250]. The composition and relative contents of floral scent components has been investigated [251].		

Table 2. (Contd.)

Species	Plant part	Compounds	Biological activity and use	Ref.
		Psammiris (Spach) Taylor		
I. potaninii Mazim.	Underground parts	***Isoflavone***: 7,8,5'-trihydroxy-6,3',4'-trimethoxyisoflavone; 7,4'-dimethoxy-8,3',5'-trihydroxy-6-*O*-β-*D*-glucopyranosylisoflavone; 3',4',5',5-tetramethoxy-6,7-methylenedioxyisoflavone (iristlorentin); 3'-methoxy-4',5-dihydroxy-6,7-methylenedioxyisoflavone (iriskumaonin); 3',4'-dimethoxy-5',5-dihydroxy-6,7-methylenedioxyisoflavone (dichotomitin); 4',5-dimethoxy-3-hydroxy-6,7-methylenedioxyisoflavone (iriflogenin); 5-methoxy-4'-hydroxy-6,7-methylenedioxyisoflavone irisolone (nigricin) [4, 5, 195, 252, 253]. ***Flavanol***: 5,3',3- trihydroxy-7,4'-dimethoxyflavanone (blumeatin B) [4]. ***Xanthones***: iriflophenone [4, 254].	***In Mongolian*** traditional medicine ***roots*** are used for worm and poisoning diseases, wound healing, eye yellowing, drying lymph leakage, and treats stomach and large intestine aches, bacterial infections, cancer, and inflammation. ***Extract of the underground parts*** exhibit nephroprotective activity [4, 254, 255].	4, 5, 195, 252, 253, 254, 255
I. humilis Georgii (= *I. flavissima* Pall.)	Rhizomes Roots	***Carbohydrate*** (%): sucrose (2.3), starch (4.1) [55]. ***Xanthones***: isomangiferin, iriflophenone 4-*O*-(6"-acetyl)-hexoside, polygalaxanthone III, 7-*O*-methyl-isomangiferin, iriflophenone, 4-*O*-methyl-iriflophenone [250]. ***O-glycosylflavones***: irisdichotin B [250]. ***Isoflavones and derivatives***: irilone 4'-*O*-(6"-hexosyl)-hexoside, iridin, dichotomitin 3'-*O*-(6"-hexosyl)-hexoside, 7-*O*-methyl-tectorigenin 4'-*O*-(6"-hexosyl)-hexoside, nigracin 4'-*O*-[6"-(3-hydroxy-3-methylglutaryl)]-hexoside, irifloside, irilone 4'-*O*-hexoside, irisolidone 7-*O*-hexoside, tectorigenin, dichotomitin 3'-*O*-hexoside, irigenin [250]. ***Phenolic acids***: protocatechuic, *p*-hydroxybenzoic, vanillic, syringic, *p*-coumaric, ferulic [74]. Content (mg/g of dry weight) of soluble sugars 9.9, starch 12.0 [250].	The infusion was used as lotion for breast tumors [256]. ***In Tibetan*** medicine, the ***underground parts and seeds*** are used for intoxication, gastric colic, as an anthelmintic and antibacterial agents [53, 54]. ***In Mongolian*** medicine, ***flowers and roots*** were used as a hemostatic agent (externally), for blood diseases, and osteoalgia [27, 257]. ***Rhizomes*** were used for sepsis, various infectious diseases and as an external hemostatic agent [9, 258].	9, 27, 53, 54, 55, 68, 71, 74, 250, 256, 257, 258
	Aeriel parts	***Xanthones***: isomangiferin [250]. ***O-glycosylflavones***: kaempferol 3-*O*-galactoside, kaempferol 3-*O*-glucoside [250]. ***Isoflavones and derivatives***: iristectorigenin A 7-*O*-hexuronide, tectorigenin, iristectorigenin A [250]. Content (mg/g of dry weight) of soluble sugars 29.7, starch 1.1 [250].		
	Leaves	***Flavonol***: quercetin [68]. ***Xanthone***: mangiferin [71]. ***Anthocyanins***: cyanidin [68]. ***Phenolic acids***: caffeic, *p*-coumaric, sinapic, ferulic [68].		
	Flowers	***Xanthones***: mangiferin, isomangiferin [250]. ***O-glycosylflavones***: quercetin 3-*O*-galactoside, isorhamnetin 3-*O*-(2"-rhamnosyl)-hexoside, quercetin 3-*O*-glucoside, isorhamnetin 3-*O*-(6"-rhamnosyl)-hexoside, kaempferol 3-*O*-galactoside, kaempferol 7-*O*-(6"-rhamnosyl)-hexoside, isorhamnetin 3-*O*-galactoside, kaempferol 3-*O*-glucoside, isorhamnetin 3-*O*-glucoside [250]. Content (mg/g of dry weight) of soluble sugars 23.0, starch 1.1 [250].		

In more detail, the pharmacological and useful properties of *Iris* species are presented in Table 2. Moreover, it contains data on the compound activity and occurrence in different plant part. A varied content of secondary metabolites in irises increases their medicinal importance.

Almost all flavonoid derivatives are present in all plant parts: in rhizomes, leaves, flowers and seeds of *I. lactea*, *I. oxipetala*, *I. tenuifolia*, *I. pseudacorus*, *I. sanguinea*, *I. sibirica*, *I. setosa*, *I. aphylla*, *I. pumila*, *I. potaninii*, *I. humilis* [15, 16, 35, 55–67].

It is worth to mention *I. aphylla*, *I. lactea* s.l., *I. pseudacorus*, *I. ruthenica*, *I. setosa*, *I. ensata*, *I. laevigata* from the aboveground parts of which mangiferin was isolated [13, 68–71].

Species of the genus *Iris* biosynthesize secondary metabolites of various classes, of which isoflavonoids and flavonoids are especially important. Such polyphenolic compounds most often act as phytoalexins, protecting plants from adverse effects of the environment [72].

Thus, this review shows that the genus *Iris* belongs to the number of genera are actively studied in the context of the chemical diversity and biological activity. It should be recognized that most of the information is related to *I. lactea* s.l., *I. oxypetala*, *I. ensata*, *I. pseudacorus* and *I. tenuifolia* and, to a lesser extent, to other species of the genus. Nevertheless, the wide spectrum of biological activity in some *Iris* species in presence of a very diverse set of biologically active compounds makes this genus promising for further research. It can be assumed that closely related species, which are poorly or not studied, have similar properties: *I. colchica* Kem.-Nat., *I. furcata* Bieb., *I. glaucescens* Bunge, *I. klattii* Kem.-Nat., *I. lokiae* Alexeeva, *I. loczyi* Kanitz, *I. uniflora* Pall.

Therefore, based on the analysis of the literature data, a wide range of pharmacological effects of the species of the genus *Iris* in Russia has been established. Species promising for further in-depth chemical and pharmacological study have been identified.

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РОД *IRIS* (IRIDACEAE) В РОССИИ: КОМПОНЕНТНЫЙ СОСТАВ, БИОЛОГИЧЕСКАЯ АКТИВНОСТЬ И ПРИМЕНЕНИЕ В ТРАДИЦИОННОЙ МЕДИЦИНЕ

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Род *Iris* в России представлен 41 видом, 4 вида являются эндемиками, 11 занесены в Красную книгу Российской Федерации и 30 имеют природоохранный статус в различных регионах. В обзоре представлена информация о компонентном составе, биологической активности и лечебных свойствах 16 видов рода *Iris*, произрастающих в России, и об их использовании в народной медицине. Анализ данных показал, что при изучении компонентного состава, биологической активности и медицинского применения, исследователь должен произвести правильную идентификацию видов рода *Iris* L., зная их географическое распространение, экологию, морфологические характеристики. Собраны данные об использовании видов *Iris* в традиционной медицине. Экстракты и выделенные соединения большинства видов ириса обладают болеутоляющими, антиоксидантными, жаропонижающими, противовоспалительными, антибактериальными, противомикробными свойствами. Некоторые виды обладают также цитотоксическим, противоопухолевым, противодиабетическим, противогриппозным, нейропротекторным, антигипергликемическим, противоаллергическим, антифедантным действием. Большинство выделенных метаболитов представляют собой флавоноиды, изофлавоноиды, антоцианы, терпеноиды, ксантоны, хиноны, фенольные и жирные кислоты. В официальной и традиционной медицине Азии и Европы используются подземные и надземные части растений *Iris aphylla*, *I. lactea*, *I. pseudacorus*, *I. ruthenica*, *I. sanguinea* и др. Статья является итогом многолетнего изучения ирисов в природе и в коллекциях двух ботанических садов, а также обширного изучения литературы, касающейся компонентного состава и лечебных свойств растений.

Ключевые слова: Iris, компонентный состав, биологическая активность, фармакологические свойства, народная медицина