

Berberis integerrima Bunge, *Berberis oblonga* (Regel) C.K. Schneid., *Berberis vulgaris* L. - BERBERIDACEAE



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Berberis integerrima Bunge

Synonyms: *Berberis densiflora* Boiss. & Buhse; *Berberis iliensis* Popov; *Berberis turcomanica* subsp. *eriwanensis* (C.K. Schneid.) Takht.

Berberis oblonga (Regel) C.K. Schneid.

Synonyms: *Berberis heterobotrys* E.L. Wolf; *Berberis heterobotrys* f. *brachypoda* Zaprjagaeva; *Berberis heterobotrys* f. *coerulescens* Zaprjagaeva; *Berberis heterobotrys* f. *nitens* Zaprjagaeva; *Berberis heteropoda* var. *oblonga* Regel

Berberis vulgaris L.

Synonyms: *Berberis baluchistanica* Ahrendt

Local Names

Berberis integerrima **Russian:** Барбарис цельнокрайний (Barbaris tsel' nokrayniy); **Uzbek:** Qizil zirk; **Tadjik:** Зулиел (Zuliel); Зирк (Zirk); **Kyrgyz:** Бёркукарат (Byoru karagat); **English:** Barbery (Fedorov 1984).

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Berberis oblonga **Russian:** Барбарис продолговатый (*Barbaris prodolgovatyi*); **Uzbek:** Zirk; **Tadjik:** Зелол (*Zelol*); Зирк (*Zirk*); **Kyrgyz:** Бёрукарагат (*Byoru karagat*); **English:** Barbery (Fedorov 1984).

Berberis vulgaris: **Russian:** Барбарис цельнокрайний (*Barbaris tsel'nokrayniy*); **Uzbek:** Kizil zirk; **Kyrgyz:** Бёрукарагат (*Byoru karagat*); **English:** Barbery (Fedorov 1984).

Botany and Ecology

Berberis integerrima: Shrub, 4 m tall; strongly branching, spiny, with brownish or purple angular branches; on lower sterile branches, spines tripartite or with at least one lateral tooth on each side; on other branches spines simple, large; leaves coriaceous, obovate or oblong, not more than 4–5 cm long, 13–18 mm broad subapically, entire or subentire often with large, acute teeth on young shoots; leaves cuneately tapering into a petiole; inflorescence a long axillary raceme, 5 cm long or more, with 12–20 flowers; sepals and petals obovate; style very short, stigma large, retained at maturity when fruits usually pendulous; ovules 384; berries obovate or oblong, purple-red, with bloom, 7–8 mm long. Flowering May – June. Stony mountain slopes. Dzhungarian Ala-Tau, Tien Shan, Pamir – Alai (Shishkin and Bobrov 1937) (Figs. 1, 2, and 3).

Berberis oblonga: Shrub, 2.5 m tall, branching; young branches brown, turning gray when old; spines simple or tripartite, 15 mm long; leaves obovate, oblong or elliptic, 6 cm long, membranous, grayish green above, glaucescent beneath, tapering into a petiole, with entire or slightly dentate margin; flowers 1 cm in diameter, usually 10–20, rarely more in branching paniculate racemes; pedicels 8 mm long; ovary oblong, with 1–3 ovules, short-pedicelled; berries black with glaucous bloom, oblong-elliptic, 1 cm long, not more than 6 mm broad; usually with single seed. May.

Fig. 1 *Berberis integerrima* (Berberidaceae), Chatkal Range, Chimgan, Tashkent region, Uzbekistan. (Photo A. Gaziev)



Fig. 2 *Berberis integerrima* (Berberidaceae), Chatkal Range, Chimgan, Tashkent region, Uzbekistan. (Photo A. Gaziev)



Fig. 3 *Berberis integerrima* (Berberidaceae), Chatkal Range, Chimgan, Tashkent region, Uzbekistan. (Photo A. Gaziev)



Stony mountain slopes. – Central Asia: Tien Shan, Pamir – Alai. Endemic (Shishkin and Bobrov 1937) (Figs. 4, 5, 6, and 7).

***Berberis vulgaris*:** Deciduous shrubs up to 3 m tall. Stems long, with short branches bearing spines. Bark of second year stems smooth and gray in color. Bud scales fall off early. Leaves simple, usually obovate with one midvein and with short petioles, margins flat with shallow teeth tipped with small spines. Flowers in a raceme disposed from short shoots with 10–20 flowers each; anther filaments lack curved teeth. Berries are red to purple, round, juicy and solid. Mainly under cultivation. Found throughout the Caucasus, Central Europe, Mediterranean, the Balkans, Russia and Central Asia. Introduced to North America. Flowers and fruits from May to June. *Berberis vulgaris* is an important food for many small birds, which disperse the seeds in their droppings. The species is the alternate host species of the wheat rust fungus (*Puccinia graminis*), a grass-infecting rust fungus that is a serious

Fig. 4 *Berberis oblonga* (Berberidaceae), Chatkal Range, Chimgan, Tashkent region, Uzbekistan. (Photo O.K.Khojimatov)



Fig. 5 *Berberis oblonga* (Berberidaceae), Chatkal Range, Chimgan, Tashkent region, Uzbekistan. (Photo O.K.Khojimatov)



Fig. 6 *Berberis oblonga* (Berberidaceae), Turkestan Range, Zaamin National Park, Jizzakh region, Uzbekistan. (Photo N. Yu.Beshko)



Fig. 7 *Berberis oblonga* (Berberidaceae), Chatkal Range, Beldersoy, Tashkent region, Uzbekistan. (Photo N. Yu.Beshko)



Fig. 8 *Berberis vulgaris* (Berberidaceae), Tbilisi, Georgia. (Photo R.W. Bussmann & N.Y. Paniagua-Zambrana)



fungal disease of wheat and related grains. Ural, Caucasus, on forest edges, in bush thickets, in mixed and deciduous forests, on stony slopes of mountains, from the lowland to the mid-mountain belt (Shishkin and Bobrov 1937) (Figs. 8 and 9).

Phytochemistry

Alkaloids (berberine, jatrorricin, palmatine, hydroxyacetine, magnoflorine, columbamine, isotetradrine, oblongine, methylberbamine, berberrubIn, oblongamine, berbaminine, hydroxyacanthine, talikmidine, isocoridine, glaucine, oxyacanthine, talimidine, isocoridine, isoboldine, reticuline), vitamins (C, carotene) (Fedorov 1984).

Fig. 9 *Berberis vulgaris* (Berberidaceae), Tbilisi, Georgia. (Photo R.W. Bussmann & N.Y. Paniagua-Zambrana)



Local Medicinal Uses

***Berberis integerrima* / *Berberis vulgaris*:** A decoction of the leaves is used to treat kidney stones, tuberculosis, chest pains, and headaches (Sakhobiddinov 1948). An infusion of the fruits is used to treat constipation and wounds (Fedorov 1984). Decoction of plant roots, used in the treatment of diabetes (Khojimatov 2021). In Tajikistan a root infusion is used to treat cardiovascular diseases, gastric diseases, neurasthenia, rheumatism, fevers, and a poultice is used for inflammatory processes of fractures and bruises. In northern Tajikistan the roots are used to treat wounds, bone fractures, rheumatism, radiculitis, heart pain, and stomach aches. In Kazakhstan, the extract of young branches is used for headache. The fruit infusion acts as anticoagulant. In Uzbekistan the leaves are used as cardiogenic and antipyretic. All over the region the fruits are used as antipyretic, to relieve thirst. A decoction of the leaves is used to treat kidney stones, tuberculosis, chest pains, and headaches. An infusion of the fruits is used to treat constipation and wounds (Dadabaeva 1996; Fedorov 1984). An infusion of the fruits is used to treat constipation and wounds (Bussmann et al. 2020). Also used to treat high blood pressure and skin problems (Sher et al. 2016; Ur-Rahman et al. 2019).

***Berberis vulgaris*:** to treat jaundice, bone fractures, as anthelmintic and laxative (Ghorbani 2005). In Jammu, Kashmir and Ladakh used intestinal ulcers, ling disease, diarrhea and vomiting blood (Gairola et al. 2014). In Matalaya as anthelmintic and as liver protectant (Tetik et al. 2013), in Pakistan for gastrointestinal problems and sore-throat (Kayani et al. 2015).

Medicinal Uses of Other Species

Berberis aristata is popularly known as Daruharidra in Ayurveda, has been used since ancient times to treat liver and heart problems. Its root and stem are used to prepare the Ayurvedic preparation called Rasaut. The Rasaut is mainly used for eye

problems and also for piles and glandular swellings. It is also taken as blood purifier and tonic (Watanabe et al. 2005). Bark, wood, and roots are used to treat Jaundice, malarial fever, fever, diabetes, diarrhoea and skin diseases (Rajbhandari 2001; Manandhar 2002; Watanabe et al. 2005; Chapagain et al. 2018). In Jammu, Kashmir and Ladakh used as laxative, for backache, fractures, jaundice, rheumatism, as rejuvenating tonic, for eye ailments, fever and weakness (Gairola et al. 2014). To treat fever, jaundice, malaria, diarrhea, swellings, eye problems and rabies in Sikkim (Tamang et al. 2017). Used by the Lepcha for skin disorders, jaundice and gastric problems (Palit and Banerjee 2016).

Berberis asiatica fruits are used as mild laxative for children, the roots and bark as astringent, stomatic, diaphoretic and to remedy piles (Bhat et al. 2015; Joshi et al. 2010). Used for eye problems (Kunwar et al. 2008), and serves for gastric problems, as anthelmintic, for diabetes and eye infections (Bhat et al. 2015; Joshi et al. 2010; Kunwar et al. 2009), and also as mild laxative, especially for children. In Jammu, Kashmir and Ladakh used for backache and joint pain (Gairola et al. 2014). In Gharwal to remedy diabetes, eye infections, and kidney stones (Singh et al. 2019), in Ladakh for gastric problems, diabetes and eye infections (Malik et al. 2015). Applied to snakebites (Houghton and Osibogun 1993) and as ophthalmic (Kumar et al. 2011a, b). The wood, root bark and the plant extract are alterative, deobstruent, astringent, antiperiodic, and diaphoretic. Decoction of root bark is used in eye disease (Watanabe et al. 2005). It is used as blood purifier and to treat rheumatism, jaundice, fever, diarrhoea and dysentery, and in eye problems (Rajbhandari 2001; Kunwar and Bussmann 2009a, b, c). It is also used with butter for the treatment of bleeding piles (Bhattacharjee et al. 1980). Studies suggested that several species of *Berberis* are traded under the same vernacular name (Srivastava and Rawat 2013; Kreuzer et al. 2019).

Berberis lycium: A brown extract from its roots and lower parts of stem is called 'Rasaunt' and is mixed with water for use as cooling agent or tonic. It is also used as an eye lotion (Ali & Qaiser 1995–2020). Root is used in jaundice and diarrhea. The bark of the root is used in diabetes, also used as tonic (Gilani et al. 2006). Root and leaves are used for Jaundice and diarrhea (Ahmad et al. 2017). The paste of bark and roots is used to treat fracture and headache. Locally the dried root is used for the treatment of fractured bones and wounds healing and as general body tonic (Ahmad and Habib 2014). Dried root bark given orally as body tonic (Akhtar et al. 2013). Root of the plant is used for hepatitis, menorrhagia, chronic fever, jaundice (Ahmad et al. 2014). Leaves and fruit decoction is used for dyspepsia (Wali et al. 2019a, b). Root is febrifuge, used in piles. Leaves are used in jaundice (Hussain et al. 2008). The plant is locally used as carminative, febrifuge, treating eye complaints, chronic diarrhea, piles, toothache and septic gums, jaundice, fencing and hedges, diabetics and as tonic (Jan et al. 2017). The paste of root bark is externally applied on wounds. Powdered bark is mixed in water and the paste is applied on bone fracture. Crushed bark is soaked in water and the resultant extract is taken early morning to treat diabetes, scabies, boils and pimples. The extract possesses cooling effect and seldom used in winter season (Ahmed et al. 2013). Root and stem barks are tonic. Decoction

of root and stem barks are used against splenic trouble, as intestinal astringent, good for cough, chest and throat trouble and a good application to boils. The paste of root bark is externally applied on wounds and on bone fracture. Crushed bark is soaked in water and the resultant extract is taken early morning to treat diabetes, scabies, boils and pimples. The extract possesses cooling effect and seldom used in winter season. Used to heal wounds (Ur-Rahman et al. 2018), conjunctivitis and diabetes, eye infections, jaundice, fever and urinary infections (Sher et al. 2016), for bone fractures, pneumonia, headache, stomachic, arthritis, wound healing, to speed delivery (Wali et al. 2019a, b), and blood purification (Muhammad et al. 2019). Used for eye problems and piles (Joshi et al. 2010). In Jammu, Kashmir and Ladakh used as cooling agent, to reduce stomach acidity, as coagulant, for constipation, diarrhea, intestinal problems, jaundice, liver ailments, piles, stomach-ache, wounds, antiseptic, for blemishes, throat pain, colds, cough, diabetes, dropsy, eczema, eye ailments, fever, as gastric tonic, for indigestion, irregular bowel moments, as laxative, for toothache, urinary problems wounds, as astringent, for boils, chest problems, and spleen trouble (Gairola et al. 2014).

Berberis brandisiana: In Jammu, Kashmir and Ladakh used for as tonic and for eye problems (Gairola et al. 2014).

Berberis pachyacantha: In Jammu, Kashmir and Ladakh to treat fever (Gairola et al. 2014).

Berberis pseudumbellata: In Jammu, Kashmir and Ladakh used for throat-ache and intestinal disorders (Gairola et al. 2014).

Berberis ulicina: In Jammu, Kashmir and Ladakh to remedy ringworm, as tonic, for throat problems, diarrhea, intestinal ulcers, lung diseases, eye problems, piles, as tonic, for bloody vomit and lung diseases (Gairola et al. 2014).

Berberis orthobotrys: Used as sedative, bronchitis, for fever and as analgesic (Majid et al. 2019).

Berberis parkeriana: For bone fractures, jaundice, back-ache, as tonic and high blood pressure (Majid et al. 2019).

Berberis pseudumbellata: Used to remedy indigestion, typhoid, muscular pain, jaundice and urinary problems (Kayani et al. 2015).

Berberis rigidifolia: The roots are used to treat fevers, as a purgative, as a tonic, against excessive sweating and especially the root is used to stop bleeding (Paniagua Zambrana et al. 2020).

Other species like ***Berberis glauca*** and ***Berberis goudotii*** are used for constipation, fevers, hemorrhages, as sudorific, to treat malaria, and as skin tonic. The fruit is used in refrigerating syrups (Paniagua Zambrana et al. 2020).

Berberis buceronis is used in for liver problems and hepatitis, respiratory and nervous system disorders and gynecological problems. The plants show antibacterial properties. and essentially no toxicity. Most material is used in mixtures with other

species. Packages labeled as “*Berberis vulgaris*” are distributed to patients in the Peruvian social security health system, and *Berberis* species are widely sold in markets (Paniagua Zambrana et al. 2020).

Berberis holstii: Root decoction as remedy for constipation, as laxative and for chest diseases (Kokwaro 2009).

Local Food Uses

Berberis jamesiana* / *Berberis vulgaris: The fruits are eaten fresh, and dried for use in sauces, for making jams and sweets, as well as spice (Batsatsashvili et al. 2017; Bussmann et al. 2014, 2016a, b, c, 2017, 2018; Bussmann 2017a, b; Fedorov 1984) (Figs. 10 and 11).

Fig. 10 *Berberis oblonga* (Berberidaceae), dried fruits sale on Parkent market, Tashkent, Uzbekistan. (Photo Z.B.Bagirova)



Fig. 11 *Berberis oblonga* (Berberidaceae), dried fruits sale on Parkent market, Tashkent, Uzbekistan. (Photo Z.B.Bagirova)



Food Uses of Other Species

***Berberis aristata* and *Berberis asiatica*:** fruits are eaten. Ripe fruits are eaten fresh and used to make alcoholic drinks. The inner bark of stem and roots are used to make yellow dye. The spiny branches are sometimes used to make fences around fields in villages (Manandhar 2002).

Berberis rigidifolia fruits can be eaten (Paniagua Zambrana et al. 2020).

***Berberis holstii*:** The fruits are eaten fresh, and dried for use in sauces, for making jams and sweets, as well as spice (Batsatsashvili et al. 2017; Bussmann et al. 2014, 2016a, b, c, 2017, 2018; Bussmann 2017a, b; Fedorov 1984).

The fruits of ***Berberis brandisiana*** are also eaten (Abbas et al. 2019).

Local Handicraft and Other Uses

***Berberis jamesiana* / *Berberis vulgaris*:** The bark yields yellow, golden, dark violet, dark blue and olive dyes for wool and silk (Batsatsashvili et al. 2017; Bussmann et al. 2014, 2016a, b, c, 2017, 2018; Bussmann 2017a, b; Fedorov 1984).

Handicraft and Other Uses of Other Species

***Berberis rigidifolia* Ecuador:** The root is used as a dye because it contains yellow berberine. The plant is used as a living fence (Paniagua Zambrana et al. 2020).

Berberis lycium is also used for forage, and widely sold (Ahmad Jan et al. 2017; Ullah et al. 2019; Wali et al. 2019a, b), and is given to livestock for internal wounds (Ali et al. 2019).

Berberis holstii has no use among the Samburu (Bussmann 2006). The bark of many species however yields yellow, golden, dark violet, dark blue and olive dyes for wool and silk (Batsatsashvili et al. 2017; Bussmann et al. 2014, 2016a, b, c, 2017, 2018; Bussmann 2017a, b; Fedorov 1984).

Berberis balochistanica (Umair et al. 2019). The leaf and bark powder of.

The spiny branches of ***Berberis brandisiana*** are used as fence around gardens, house and hut material. Whole plant is also used as fuel wood (Abbas et al. 2019).

References

- Abbas Z, Alam J, Muhammad S, Bussmann RW, Mulk Khan S, Hussain M (2019) Phyto-cultural diversity of the Shigar valley Central Karakorum Baltistan, Northern Pakistan. *Ethnobot Res Appl* 1832. <https://doi.org/10.32859/era.18.31.1-18>
- Ahmad KS, Habib S (2014) Indigenous knowledge of some medicinal plants of Himalaya Region, Dawarian village, Neelum valley, Azad Jammu and Kashmir, Pakistan. *Univ J Plant Sci* 2(2):40–47
- Ahmad Jan H, Wali S, Ahmad L, Jana S, Ahmad N, Ullah N (2017) Ethnomedicinal survey of medicinal plants of Chinglai valley, Buner district, Pakistan. *Eur J Integr Med* 13:64–74
- Ahmad M, Sultana S, Fazl-i-Hadi S, Ben Hadda T, Rashid S, Zafar M, Yaseen G (2014) An ethnobotanical study of medicinal plants in high mountainous region of Chail valley (District Swat-Pakistan). *J Ethnobiol Ethnomed* 10(1):36
- Ahmad KS, Hamid A, Nawaz F, Hameed M, Ahmad F, Deng J, Mahroof S (2017) Ethnopharmacological studies of indigenous plants in Kel village, Neelum Valley, Azad Kashmir, Pakistan. *J Ethnobiol Ethnomed* 13(1):68
- Ahmed E, Arshad M, Saboor A, Qureshi R, Mustafa G, Sadiq S, Chaudhari SK (2013) Ethnobotanical appraisal and medicinal use of plants in Patriata, New Murree, evidence from Pakistan. *J Ethnobiol Ethnomed* 9(1):13
- Akhtar N, Rashid A, Murad W, Bergmeier E (2013) Diversity and use of ethno-medicinal plants in the region of Swat, North Pakistan. *J Ethnobiol Ethnomed* 9(1):25
- Ali SI, Qaiser M (1995–2020) *Flora of Pakistan*. Department of Botany, University of Karachi, Pakistan and Missouri Botanical Garden, St. Louis
- Ali A, Aldosari A, Tng DYP, Ullah M, Hussain W, Ahmad M, Hussain J, Khan A, Hussain H, Sher H, Bussmann RW, Shao J-W (2019) Traditional uses of plants by indigenous communities for veterinary practices at Kurram District, Pakistan. *Ethnobot Res Appl* 1824. <https://doi.org/10.32859/era.18.24.1-19>
- Batsatsashvili K, Mehdiyeva N, Fayvush G, Kikvidze Z, Khutsishvili M, Maisaia I, Sikharulidze S, Tchelidze D, Aleksanyan A, Alizade V, Paniagua Zambrana NY, Bussmann RW (2017) *Berberis vulgaris* L. In: Bussmann RW (ed) *Ethnobotany of the Caucasus*. Springer International Publishing, Cham
- Bhat J, Malik ZA, Ballabha R, Bussmann RW, Bhatt AB (2015) Ethnomedicinal plants traditionally used in health care practices by inhabitants of Western Himalaya. *J Ethnopharmacol* 172:133–144
- Bhattacharjee S, Tiwari KC, Majumdar R, Misra AK (1980) Folklore medicine from district Kamrup (Assam). *Bull Med Ethno Bot Res* 1:447–460
- Bussmann RW (2006) Ethnobotany of the Samburu of Mt. Nyiru, South Turkana, Kenya. *J Ethnobiol Ethnomed* 2:35
- Bussmann RW (ed) (2017a) *Ethnobotany of the Caucasus*. Springer International Publishing XXVII, 746p. isbn:978-3-319-49411-1
- Bussmann RW (ed) (2017b) *Ethnobotany of the Caucasus*. Springer International Publishing International Publishing, Cham, p XXVII, 746 p. ISBN 978-3-319-49411-1
- Bussmann RW, Paniagua-Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Jinjikhadze T, Shanshiashvili T, Chelidze D, Batsatsashvili K, Bakanidze N (2014) Wine, beer, snuff, medicine and loss of diversity – ethnobotanical travels in the Georgian Caucasus. *Ethnobot Res Appl* 12:237–313
- Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Batsatsashvili K, Hart RE (2016a) Medicinal and food plants of Svaneti and Lechkhumi, Sakartvelo (Republic of Georgia), Caucasus. *J Medicinal Aromat Plants* 5:266. <https://doi.org/10.4172/2167-0412.1000266>
- Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Batsatsashvili K, Hart RE (2016b) Medicinal and food plants of Svaneti and Lechkhumi, Sakartvelo (Republic of Georgia), Caucasus. *J Medicinal Aromat Plants* 5:266. <https://doi.org/10.4172/2167-0412.1000266>

- Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Khutsishvili M, Batsatsashvili K, Hart RE (2016c) Plant and fungal use in Tusheti, Khevsureti and Pshavi, Sakartvelo (Republic of Georgia), Caucasus. *Acta Soc Bot Pol* 86(2):3517. <https://doi.org/10.5586/asbp.3517>
- Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Batsatsashvili K, Hart RE (2017) Ethnobotany of Samtskhe-Javakheti, Sakartvelo (republic of Georgia), Caucasus. *Indian J Tradit Knowl* 16(1):7–24
- Bussmann RW, Paniagua Zambrana NY, Sikharulidze S, Kikvidze Z, Kikodze D, Tchelidze D, Batsatsashvili K, Hart RE (2018) Unequal brothers – plant and fungal use in Guria and Racha, Sakartvelo (Republic of Georgia), Caucasus. *Indian J Tradit Knowl* 17(1):7–33
- Bussmann RW, Batsatsashvili K, Kikvidze Z (2020) *Berberis jamesiana* Forrest & W.W. Sm., *Berberis vulgaris* L. In: Batsatsashvili K, Kikvidze Z, Bussmann RW (eds) Ethnobotany of mountain regions Central Asia and Altai. Springer International Publishing International Publishing
- Chapagain NH, Tamang R, Thakur C (2018) Ethnobotany of Tamang Community of Nepal. Department of Plant Resources, District Plant Resources Office, Makwanpur
- Dadabaeva O (1996) Dikorastushie lekarstvennie rastenia flori Tadjikistana. Rakhim Djalil, Khujand. 585 p. (In Russian)
- Fedorov AA (ed) (1984) Plant resources of the USSR: flowering plants, their chemical composition, use, vol 1. Families Magnoliaceae - Limoniaceae. Akademia Nauk, Leningrad, 460 p. (in Russian)
- Gairola S, Sharma J, Singh BY (2014) A cross-cultural analysis of Jammu, Kashmir and Ladakh (India) medicinal plant use. *J Ethnopharmacol* 155:925–986
- Ghorbani A (2005) Studies on pharmaceutical ethnobotany in the region of Turkmen Sahra, north of Iran (part 1): general results. *J Ethnopharmacol* 102:58–68
- Gilani SA, Qureshi RA, Gilani SJ (2006) Indigenous uses of some important ethnomedicinal herbs of Ayubia National Park, Abbottabad, Pakistan. *Ethnobotanical Leaflets* 2006(1):32
- Houghton PJ, Osibogun IM (1993) Flowering plants used against snakebite. *J Ethnopharmacol* 39:1–29
- Hussain K, Shahazad A, Zia-ul-Hussain S (2008) An ethnobotanical survey of important wild medicinal plants of Hattar district Haripur, Pakistan. *Ethnobotanical Leaflets* 2008(1):5
- Jan HA, Wali S, Ahmad L, Jan S, Ahmad N, Ullah N (2017) Ethnomedicinal survey of medicinal plants of Chinglail valley, Buner district, Pakistan. *Eur J Integr Med* 13:64–74
- Joshi M, Kumar M, Bussmann RW (2010) Ethnomedicinal uses of plant resources of the Haigad watershed in Kumaun Himalaya. *Med Aromat Plant Sci Biotechnol* 4(special issue 1):43–46
- Kayani S, Ahmad M, Sultana S, Khan Shinwari ZM, Yaseen G, Hussain M, Bibi T (2015) Ethnobotany of medicinal plants among the communities of Alpine and Sub-alpine regions of Pakistan. *J Ethnopharmacol* 164:186–202
- Khojimatov OK (2021) Lekarstvennie rasteniya Uzbekistana (properties, use and sustainable using). Tashkent, “Ma’naviyat”, 328 p. (In Russian)
- Kokwaro JO (2009) Medicinal plants of East Africa. University of Nairobi Press, Nairobi
- Kreuzer M, Howard C, Adhikari B, Pendry CA, Hawkins JA (2019) Phylogenomic approaches to DNA barcoding of herbal medicines: developing clade-specific diagnostic characters for *Berberis*. *Front Plant Sci* 10:586. <https://doi.org/10.3389/fpls.2019.00586>
- Kumar M, Bussmann RW, Mukesh J, Kumar P (2011a) Ethnomedicinal uses of plants close to rural habitation in Garhwal Himalayan, India. *J Med Plant Res* 5(11):2252–2260
- Kumar M, Bussmann RW, Mukesh J, Kumar P (2011b) Ethnomedicinal uses of plants close to rural habitation in Garhwal Himalayan, India. *J Med Plant Res* 511:2252–2260
- Kunwar RM, Bussmann RW (2009a) Medicinal plants and quantitative ethno medicine: a case study from Baitadi and Darchula districts, far-west Nepal. *J Nat Hist* 24:72–81
- Kunwar RM, Bussmann RW (2009b) Medicinal plants and quantitative ethnomedicine: a case study from Batadi and Darchula districts, Far-West Nepal. *J Nat Hist Mus* 24(1):72–81

- Kunwar RM, Bussmann RW (2009c) Medicinal, aromatic and dye plants of Baitadi and Darchula districts, Nepal Himalaya: status, uses and management. In: Hartmann M, Weipert J (eds) Biodiversität, Naturlausstattung im Himalaya, Bd. III. Erfurt, pp 475–489
- Kunwar RM, Chowdhary CL, Bussmann RW (2008) Diversity, utilization and management of medicinal plants in Baitadi and Darchula districts, farwest Nepal. *Initiation* 21:157–164
- Kunwar RM, Upreti Y, Burlakoti C, Chowdhary CL, Bussmann RW (2009) Indigenous use and ethnopharmacology of medicinal plants in Far-west Nepal. *Ethnobot Res Appl* 7:5–28
- Majid A, Ahmad H, Saqib Z, Ur Rahman I, Khan U, Alam J, Hussain Shah A, Ahmad Jan S, Ali N (2019) Exploring threatened traditional knowledge; ethnomedicinal studies of rare endemic flora from Lesser Himalayan region of Pakistan. *Rev Bras* 29(6):785–792
- Malik ZA, Bhat J, Ballabha R, Bussmann RW, Bhat AB (2015) Ethnomedicinal plants traditionally used in health care practices by inhabitants of Western Himalaya. *J Ethnopharmacol* 172:133–144
- Manandhar (2002) *Plants and people of Nepal*. Timber Press Portland, Oregon
- Muhammad S, Hussain M, Abbas Z, Saquib Z, Bussmann RW, Shah GM (2019) An ethnomedicinal appraisal of Kurram Agency Tribal area Pakistan. *Indian J Tradit Knowl* 184:631–647
- Palit D, Banerjee A (2016) Traditional uses and conservative lifestyle of Lepcha tribe through sustainable bioresource utilization - case studies from Darjeeling and Norgh Sikkim, India. *Int J Conserv Sci* 7(3):735–752
- Paniagua Zambrana NY, Bussmann RW, Romero C (2020) *Berberis rigidifolia* Kunth ex DC. In: Paniagua Zambrana NY, Bussmann RW (eds) *Ethnobotany of mountain regions – ethnobotany of the Andes*. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-77093-2_37-1
- Rajbhandari KR (2001) *Ethnobotany of Nepal*. Ethnobotanical Society of Nepal (ESON)
- Sakhobiddinov SS (1948) *Dikorastushie lekarstvennie rasteniya Srednei Asii*. – Tashkent: Gosizdat UzSSR. – 216 p. (In Russian)
- Sher H, Bussmann RW, Hart R, de Boer HJ (2016) Traditional use of medicinal plants among the Kalasha, Ismaeli and Sunni ethnic groups in Khyber Pakhtunkhwa province, Pakistan. *J Ethnopharmacol* 188:57–69. <https://doi.org/10.1016/j.jep.2016.04.059>
- Shishkin BK, Bobrov EG (1937) (English 1970). *Flora of the USSR*, vol. 7: Ranales to Rhodales. Akademia Nauk, Leningrad, 615 p
- Singh AP, Kumar M, Nagar B, Pala NA, Bussmann RW (2019) Ethnomedicinal use of plant resources in Kirtinagar Block of Tehri Garhwal in Western Himalaya. *Ethnobot Res Appl* 1814. <https://doi.org/10.32859/era.18.14.1-11>
- Srivastava S, Rawat AKS (2013) Quality evaluation of ayurvedic crude
- Tamang M, Pal K, Kumar Rai S, Kalam A, Rehan Ahmad S (2017) Ethnobotanical survey of threatened medicinal plants of West Sikkim. *Int J Bot Stud* 2(6):116–125
- Tetik F, Civelek S, Cakilcioglu U (2013) Traditional uses of some medicinal plants in Malatya (Turkey). *J Ethnopharmacol* 146:331–346
- Ullah M, Mehmood S, Ali M, Bussmann RW, Aldosari A, Ali Khan R, Ullah R, Hussain W, Rahman Shah MA (2019) An ethnopharmacological study of plants used for treatment of diabetes in the Southern and Tribal regions of Khyber Pakhtunkhwa province, Pakistan. *Ethnobot Res Appl* 18(8). <https://doi.org/10.32859/era.18.8.1-20>
- Umair M, Altaf M, Bussmann RW, Abbasi AM (2019) Ethnomedicinal uses of the local flora in Chenab riverine area, Punjab province Pakistan. *J Ethnobiol Ethnomed* 15:7. <https://doi.org/10.1186/s13002-019-0285-4>
- Ur-Rahman I, Afsal A, Iqbal Z, Ijas F, Ali N, Asif M, Alam J, Majid A, Bussmann RW (2018) Traditional and ethnomedicinal dermatology practices in Pakistan. *Clin Dermatol* 363:310–319. <https://doi.org/10.1016/j.clindermatol.2018.03.018>
- Ur-Rahman I, Sher H, Bussmann RW (eds) (2019) *Reference guide on high value medicinal and Aromatic plants – sustainable management and cultivation practices*. University of Swat, Pakistan. isbn:978-969-23419-0-5

- Wali R, Rahman K, Raja NI, Qureshi R, Bussmann RW, Mashwani ZUR (2019a) A quantitative medico botanical expedition of Fairy Meadows National Park, Diamir, Gilgit Baltistan, Pakistan. *Ethnobot Res Appl* 1835. <https://doi.org/10.32859/era.18.35.1-30>
- Wali S, Ahmad Jan H, Bussmann RW (2019b) Quantitative ethnomedicinal study of indigenous medicinal plants used for digestive disorders of Laspur Valley, Chitral, Northern Pakistan. *Ethnobot Res Appl* 1832. <https://doi.org/10.32859/era.18.32.1-18>
- Watanabe T, Rajbhandari KR, Malla KJ, Yahara S (2005) A handbook of medicinal plants of Nepal. Kubfai Publishing Project, Foundation of Democracy and Development Studies, Bangkok