

Review Article



Prunus cerasoides D. Don: A Review on Its Ethnomedicinal Uses, Phytochemistry and Pharmacology

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ABSTRACT

Prunus cerasoides D. Don (Rosaceae) is a medium sized deciduous tree found mainly in the temperate regions of the Northern hemisphere. Its distribution range is restricted to sub-montane and montane Himalaya extending from Himachal Pradesh in North-central India to Sikkim, Nepal, Bhutan, Myanmar, West China and Thailand. It is abundantly distributed in temperate zones of Garhwal Hills of Uttarakhand state. The plant is acclaimed for significant medicinal importance in the traditional system of medicines and used in several Ayurvedic formulations. Its efficacy has also been recognized by the modern system of medicine. The plant has been extensively investigated for its phytochemical constituents and a considerable number of chemical constituents of diverse classes including steroids, terpenoids, flavonoids, polyphenolics, glycosides, etc. have been reported from different parts of the plant. Pharmacological studies have revealed antimicrobial, diuretic, BPH protective, antioxidant and cytotoxic activities of the plant. However, despite wide-ranging chemical composition, and traditional medicinal significance, pharmacological investigation of the plant is limited. This review is an attempt to present a comprehensive summary of traditional uses, ethnomedicinal value, phytochemical, pharmacological, and toxicological aspects of the plant.

Keywords: *Prunus cerasoides*, Traditional uses, Ethnomedicinal value, Phytochemistry and Pharmacology.

INTRODUCTION

Wild edible fruits constitute an important food items in traditional diets of local population. They have great potential as high-value nutraceuticals, and source of bioactive compounds for dietary supplements or functional foods¹. These non-conventional wild fruits have been recognized to have a potential source of nutrients than conventionally eaten crops². *Prunus*, a large genus of trees and shrubs including almond, apricot, cherry, peaches, plum and nectarines under the family Rosaceae claims a leading status amongst all the temperate fruits. Many species have ornamental values as well. Members of the genus are deciduous or evergreen; however, a few species have spiny stems. The genus consists of about 430 species (distributed among five sub-genera, namely, *Padus*, *Amygdalis*, *Cerasus*, *Prunophora* and *Laurocerasus*) growing chiefly in the temperate regions of the Northern hemisphere^{3, 4}. Many members of the genus are valued as ornamentals on account of their showery flowers⁵. In India, about 36 *Prunus* species have so far been reported in the Indian Himalayan regions and 18 species are useful for cultivation for different purposes^{6, 7}. Morphologically, the genus is characterized by simple, alternate, usually lanceolate, unlobed leaves often with nectarines on the leaf stalk. The flowers are usually white to pink, sometimes red, with five petals and five sepals and numerous stamens. Flowers appear singly, or in umbels of two to six or sometimes more on racemes. Fruits are fleshy drupe with a single relatively large, hard-coated seed commonly called the stone fruit⁸. *Prunus cerasoides* is one among them which has been identified as an

excellent framework tree species for restoring evergreen forest in seasonally dry tropical forestlands⁹. It is a very common tree of the middle hill forests and is chief representative of the Himalayan Cherry tree¹⁰. *P. cerasoides*, commonly known as Padam or, Padmakashtha or Wild Himalayan Cherry is a sacred plant in Hindu mythology. The plant is very beneficial for the upliftment of local people. It is one of 31 multipurpose species which is used as a medicinal plant in Himalayan region¹¹. Relevant information and literature on *P. cerasoides* from electronic databases such as Academic Journals, Google, Google Scholar, Pub Med, Web of Science, and Science Direct were consulted and this review is an attempt to present a comprehensive summary of traditional uses, ethnomedicinal value, phytochemical, pharmacological, and toxicological aspects of the plant.

PRUNUS CERASOIDES D. DON – PLANT PROFILE

Taxonomic classification^{12, 13}

Kingdom	: Plantae
Subkingdom	: Tracheobionta (Vascular plants)
Infrakingdom	: Streptophyta (Land plants)
Superdivision	: Spermatophyta (Seed plants)
Division	: Magnoliophyta (Flowering plants)
Subdivision	: Spermatophytina (Spermatophytes)
Class	: Magnoliopsida (Dicotyledons)
Subclass	: Rosidae
Superorder	: Rosanae
Order	: Rosales
Family	: Rosaceae (Rose family)
Subfamily	: Amygdaloideae



Genus : *Prunus*
 Subgenus : *Cerasus*
 Species : *P. cerasoides* D. Don

Synonyms: *Cerasus cerasoides* Buch.-Ham. ex D. Don; *Prunus puddum* Roxb. ex Wall. Brandis; *Prunus majestica* Koehne¹⁴

Common Names: Padam, Wild Himalayan Cherry, Dwarf Cherry¹⁵

Vernacular Names^{14, 16}

Languages	Names
Hindi	: Padam, Padmakashtha
English	: Wild Himalayan Cherry
Assamese	: Dieng-soh-iong-kerm
Bengali	: <i>Padmak</i> , <i>Padmakashtha</i>
Gujrati	: <i>Padmaka thi</i> , <i>Padmaka nu lakadu</i> , <i>Padmakashtha</i> , <i>Padmak</i>
Kannada	: Padmaka
Khasi	: Dieng Kaditusoo
Malayalam	: Pathumukham
Marathi	: Padmaka, Padmakastha
Mizo	: Tlaizawng, Tlaizowng
Nepali	: Painyu
Punjabi	: Paja
Sanskrit	: Charu, Hima, Kaidara, Kedaraja, Malaya, Maleya, Padmagandhi, Padmaka
Telugu	: Padmakala

Botanical Description

Prunus cerasoides D. Don is a medium sized deciduous tree, up to 10 m high growing mainly in the temperate regions of the Northern hemisphere^{11, 17}. Sapwood is whitish and lustrous whereas heartwood is reddish brown, closely grained and moderately hard. It is resistant to fungus and insect attack and works to good finish. Bark of the tree is reddish brown, exfoliating in thin circular strips. Leaves conduplicate in bud, elliptic or ovate-lanceolate, 3.5-8.5 cm, apex acuminate, both surfaces glabrous, dark glossy, shining above, finely simple or double serrate, with gland tip teeth; petioles 1.2-2 cm long; stipules long, subulate. Flowers, pinkish white or crimson 1.2-2.5 cm in diameter, appearing before the leaves in umbellate fascicles and are the rich sources of nectar and pollen for bees; pedicels 0.5-2cm long. Calyx is bell shaped, 5-lobed, ovate-acute; petals 5, obovate. Fruits are red or yellow, ovoid, 1.2-1.5 cm long, about 15mm in diameter, glabrous, shining, supported by base of calyx tube and contain one large seed^{5, 18}. The plant blooms in October and lasts up to mid-December. Its pinkish- white flowers are the rich source of nectar and pollen for bees^{20, 21}. In this period the swarms of honey bees can be observed gathering nectar and pollen heavily from trees. The fruits ripen from April to May.

Distribution

P. cerasoides grows in the temperate forests and its distribution range extends in the Himalayas from

Himachal Pradesh in North-central India to Sikkim, Nepal, Bhutan, Myanmar, West China and Thailand. In India the plant is restricted to sub-montane and montane Himalaya ranging from 1500-2400 m (3, 900-7, 900 ft). It is abundantly distributed in temperate zones of Garhwal Hills of Uttarakhand state including Pauri, Tehri, Chamoli and Uttarkashi districts and also cultivated in Dhanolti region in Tehri Garhwal (Uttarakhand), India^{5, 22}. It is worshipped in all auspicious occasions by the inhabitants. People never cut the whole tree and use only its twigs in rituals as the wood are forbidden to be used as fuel. Thus, it is common to observe quite old trees of *P. cerasoides* in the area adequately²⁰. Because of its considerable value as both food and ornamental plants, many *Prunus* species have been introduced to the various parts of the world⁵.

Traditional Uses

P. cerasoides has a range of traditional uses including edible fruit, seed and gum, various medicinal applications, timber, dyestuff, tannins and beads¹⁸. Ripe fruits are edible, however occasionally eaten raw due to acidic and astringent taste, but are more often cooked and used to make sauces and cherry brandy¹⁹. Seed are also eaten raw or cooked. Gum exuding from trunk and branches are chewed and can be employed as a substitute for gum tragacanth. It is used by honeybees as honeydew⁵. Wood of the tree is moderately hard, strong, durable and aromatic, so used by locals in several rituals. The heartwood that seasons well is occasionally used for buildings and making ornamental furniture. The wood, branches and root suckers make excellent walking sticks and umbrella crooks. Leaves are used as fodder and young twigs are used as toothbrush²³. A green dye can be obtained from the leaves. A dark grey to green dye can be obtained from the fruit. The bark is a source of tannins²⁴. The seeds are used as beads in necklaces and rosaries²². Tree is mainly used as rootstock for cultivation of cherries. The plant is regarded as sacred and is conserved for religious purposes. It is used in rituals by the local inhabitants, especially in Gharwal Himalaya. The plant has immense apicultural importance. Flowers are useful source of bee-forage. Its pinkish-white flowers are the rich source of nectar and pollen for bees. All the four species of *Apis* present in India namely *Apis cerana indica*, *A. dorsata*, *A. florae* and *A. mellifera* visit the flowers of *P. cerasoides* for its rich nectar and pollen²⁵⁻²⁷. Seed kernels, leaves, twigs and bark are used medicinally²⁸⁻²⁹. The tree is used as a pioneer species in reforestation³⁰.

Therapeutic Actions

The plant is reputed to possess a high therapeutic value. The heartwood is bitter, acrid, anodyne, refrigerant, demulcent, antipyretic, vulnerary, constipating, and causes flatulence^{10, 14}. It is diuretic, emmenagogue, depurative, anti-abortifacient, analgesic, carminative, conceptive, expectorant, febrifuge and tonic. The stem and branches of the plant are pharmacologically regarded as antipyretic and refrigerant; tender branch as antilithic, spasmolytic; heartwood as astringent, refrigerant,



antipyretic and tonic; stem bark as anti-inflammatory, fruit as astringent^[31] and digestive and seed oil as emollient^{32, 33}.

Ethnomedicinal Claim

The bark paste is applied over the forehead for hemicranias⁵ and is also used as plaster for fractured bone^{34,35}, painful outgrowth below lounge, burn, indigestion, fever, foot and mouth diseases and dislocations³⁶. Paste of bark also used in wound healing. Amulet of bark tied in arm or waste of child for their well-being³⁷. Juice of bark is applied externally to treat backaches. The bark is used in the preparation of hair oil for massage. The paste of the bark is applied³⁸. It is beneficial in Neuralgia and is given to check over sweating in the body³⁹. The stems and branches are used for the treatment of gravel, kidney stones, asthma, thirst, leucoderma, leprosy and vomiting. The stem is reported to be useful in vomiting, thirst, asthma, leprosy and leucoderma. Decoction of stem bark is concentrated at low temperature and applied to cure joint pains (Sanjay *et al.*, 2006). Heartwood is moderately hard, strong, aromatic, astringent, bitter, acrid, refrigerant, antipyretic and tonic. It is useful in vitiated conditions of pitta, burning sensations, sprains, wounds, ulcers, leprosy, stomach troubles, seminal weakness and skin decolorations. It is beneficial in hallucinations, leucoderma, erysipelas, burnings, vomiting, asthma, hiccough thirst, diarrhoea and cardiac debility^{10, 14, 40}. The fruit is astringent, and digestive. Seed kernal is used in the treatment of stone and gravel in the kidney³². Seed are chewed in case of kidney stone⁴¹ and also useful in bleeding disorders, burning sensation and skin diseases²⁹. The smaller branches are crushed and soaked in water and taken internally to stop abortion¹⁰. It is also beneficial in scorpion stings³³. Powered shell charcoal is used as tooth powder. The plant is used in along with other fragrant drugs as a medicated smoking wick⁴². The honey is slightly bitter in taste but medicinal in properties and used to treat eye ailments⁴³. The native of the Punjab believes the fruits to be useful as an ascaricide. In Indo-china the bark is used in dropsy. The flowers are considered diuretic and laxative. The seeds are used as antihelmintic. In China and Malaya peach kernel are given for cough, blood disease and rheumatism. In *Ayurveda*, the plant is called as *Padmaka* prescribed for the treatment of skin diseases and said to enhance the complexion. The leaf extract of the plant is used in prostate and urinary disorder^{8,10}.

Important Ayurvedic Formulations

The plant and its various plants have traditionally used been as an important ingredient in several formulations used of therapeutic purpose in *Ayurveda*. These formulations include, *Asava and Arista* (Usirasava, Chandanasava, Dashmoolarista, Mritasanjivani sura, Sarivadyasava); *Arka* (Karpuradyarka); *Kvatha Churna* (Draksadi Kvatha churna, Guduchyadi ghana Kvatha churna); *Ghrita* (Kasisadi ghrita, Maha Kalyanaka ghrita,

Satavaryadi ghrita, Brhatcchagaladya ghrita); *Churna* (Sudarshana churna); *Taila* (Arimedadi taila, Kumkumadi taila, Chandanadi taila, Jatyadi taila, Triphaladi taila, Bala taila, Bhringaraja taila, Madhuyastyadi taila, Ashvagandha taila, Guduchyadi taila) and *Vati* and *Gutika* [Khadiradi Gutika (Mukharoga)]. Chandanadi taila is used to treat burning sensation, dizziness, nasal bleeding; Mahabringaraj oil to treat hair fall, headache, pain and stiffness of neck; Jatyadi oil beneficial in the treatment of wounds, ulcers; Triphaladi oil for external application to treat hair fall, sinusitis, neck pain; Bala oil to treat Vata diseases, vomiting, cough, cold, asthma, wound, emaciation etc.; Grahanimihira oil for diarrhea, fever, cough, etc.^{44, 45}. Stanyajanana rasayana, an ayurvedic formulation in the form of confectionery to benefit lactating mothers for increasing the breast milk, immunity and body strength. Kernel extract is used in sun creams and other formulations to make the skin-fair and beautification creams⁴⁶.

Toxicity and Hazards

Although no specific mention has been seen for this species, it belongs to a genus where most, if not all members of the genus contain amygdalin and prunasin, which break down in water to form hydrocyanic acid (cyanide or prussic acid), a poison found mainly in the leaves, seed and bark, and is readily detected by its bitter taste⁴⁷. The plant (especially the seed and young shoots) contains cyanogenic glycosides, especially amygdalin and prunasin. When ingested, these compounds break down in the digestive tract to release cyanide. Used in small quantities in both traditional and conventional medicine, this exceedingly poisonous compound has been shown to stimulate respiration, improve digestion, and promote a sense of well-being. In larger concentrations, however, cyanide can cause gasping, weakness, excitement, pupil dilation, spasms, convulsions, coma and respiratory failure leading to death⁴⁸.

Phytochemistry

P. cerasoides has been extensively investigated for its chemical constituents and a number of phtochemicals of different types have been isolated and characterized from various parts of the plant. Stem bark contains flavones and isoflavones. Stem sapwood gave flavone glucoside⁴⁹⁻⁵⁴. Compounds named dihydrotectochrysin, pinocembrin, dihydrowogonin, chrysin, naringenin, kaempferol⁴⁷, aromadendrin, quercetin, taxifolin, 7-hydroxy-5, 2', 4'-trimethoxy flavanone (Carasinone), 2'-hydroxy 2, 4, 4', 6'-tetramethoxy chalcone (Carasidin), 2',4' dihydroxy-2,4,6'-trimethoxy-chalcone (Carasin) have been isolated from heartwood⁵⁵ whereas narigenin, apigenin, β -sitosterol, sakuranetin, prunetin, genkwanin reported from stems. A flavone glycoside puddumin-A [7-O-(β -D-glucopyranosyl)-5-O-methylnaringenin]⁵⁶, genistein, prunetin⁵⁷, n-pentacosane, triacontane, noctacosanol, β -sitosterol, ursolic acid, oleic, palmitic and stearic acids, afzelin, kaempferitrin, naringenin, β -sitosterol- β -D-glucoside⁵⁷ have been reported from sapwood.



Phytochemical studies on the stem bark resulted in isolation and characterization of prunetin, sakuranetin, genistein, and genkwanin. In addition, some flavonoids and flavonoid-glycosides have also been reported from the ethanolic extract of the stem sapwood. Puddumin-B, a flavanone glycoside (naringenin-4'-methylether-7-O- β -D-galactoside) has been isolated from stem bark⁵⁷. Further, compounds namely padmakastein and its derivatives, β -sitosterol behenate, tectochrysin, genistein, leucocynidin, 4'-glucoside of genkwanin, chrysophenol, emodin, 8- β -D glucosides, orientalone, physcion, β -sitosterol glucoside⁵⁷, amygdalin, prunasetin (isoflavone), sakuranetin, puddumetin, flavanone^{53, 58}, sakuranetin (5,4'-dihydroxy-7-methoxy flavone) and its 5-glucoside, neosakuranin (2,4'-dihydroxy-4-methoxy-6-glucosidoxo chalcone), leucocyanidin⁴⁹, taxifolin⁸ have also been reported from the stem bark. Compound named tectochrysin, genistein, leucocyanadin, genkwanin, prunetin, Sakuranetin, genkwanin-4'-glucoside and naringenin 4'-methyl ether-7-O- β -D-glucoside, naringenin 4'-methyl ether 7-xyloside were reported from seeds of the plant^{59, 60}. Substitute of hydrocyanic acid amygdalin were reported from branches of the tree. From root bark of the plant, ursolic acid, stigmaterol, prunetinoside, glucogenkwanin, have been isolated and characterized⁶¹.

Quercetin-3-rhamnoglucoside, kaempferol were isolated from leaves⁵⁸ whereas naringenin-5-O- α -L-rhamnopyranoside, 4'-O-methyl-liquiritigenin-7-O- α -L-rhamnopyranoside, naringenin 4'-methylether 7-xyloside, β -sitosterol-3-O-D-galactopyranoside from seeds⁶². A compound characterized as 2, 4, 4'-dihydroxy-6-methoxy chalcone-4-O- β -D-glycopyranosyl (1 $\rightarrow$ 4)] α -L-rhamnopyranoside was isolated from fruits⁶³.

A new metabolite, prunol, belonging to the pentacyclic triterpenoid skeleton was isolated from the dichloromethane soluble fraction of the crude ethanolic extract of areal parts of *P. cerasoides*⁶⁴. A flavonoid glycoside 7-O- β -D-galactopyranosyl-5-O-methyl naringenin isolated from seeds⁶⁵.

Physicochemical analysis of the plant showed that the tree contains moisture 83 %, Total ash 3.11 %, total fiber 7.32 %, vitamin C 0.319 % and chlorophylls 0.133 mg/g⁶⁶. Seed kernel oil contains vegetable oils including unsaturated fatty acids, oleic acids, alpha-tocopherol and tocopherol-like components⁶⁷. In addition to, the components of the solid fraction include polyphenols, flavonoids, vegetable acids, and pro- and anthocyanidins, which could have useful therapeutic values in the prevention of many diseases⁵².

Analysis of exudates gum excreted from stems of the plant reported total carbohydrate content $73.72 \pm 2.44\%$ and protein content $2.33 \pm 1.25\%$. The gum showed the characteristic of a typical natural polysaccharide composed of monosaccharide including arabinose, galactose, glucose, rhamnose and xylose⁶⁸. Formulation of pH-sensitive mucoadhesive beads using natural gum

isolated from *P. cerasoides* in combination with sodium alginate for the controlled release of diclofenac sodium has been attempted⁶⁹. Molecular structures of chemical compounds isolated and characterized from different parts of the *P. cerasoides* are depicted in Fig.1:

Pharmacology

P. cerasoides is traditionally acclaimed for its high therapeutic value. However, the plant is not much explored pharmacologically. It is considered as anti-abortifacient, analgesic, carminative, conceptive, expectorant, antispasmodic, febrifuge, antioxidant and tonic^{70,71}. The plant and its active major chemical constituents have been investigated for some of the pharmacological activity described hereunder.

Antibacterial activity

P. cerasoides reported to have antibacterial activity against both gram positive and gram-negative bacteria. Antibacterial activity of ethanolic extract of *Prunus cerasoides* was examined with Gram positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli* and *Salmonella typhi*) and the extract recorded inhibitory action against all the bacteria⁷². Antimicrobial screening of aqueous extract from stem bark of the plant was carried out against various pathogenic microorganisms and results suggest that the aqueous extract could be a potential source to obtain new antimicrobials and effective herbal medicines to combat the problem of ever emerging microbial resistance⁷³.

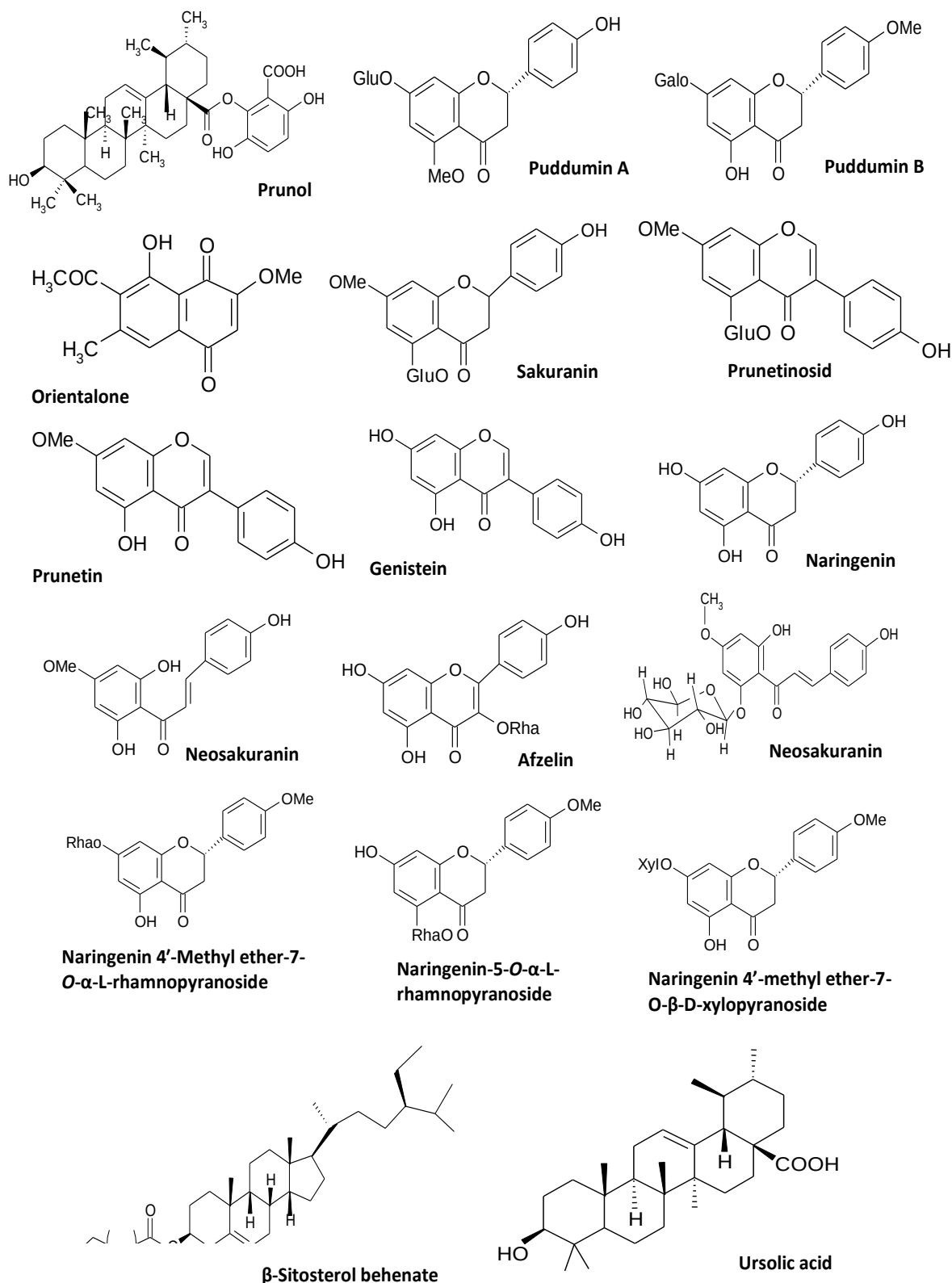
Diuretic activity

The seeds of *P. cerasoides* are traditionally known for treatment for urinary disorders, polyurea and the treatment of stone in the kidney⁷⁴. Puddumin-A a flavonone glucoside from *P. cerasoides* showed increased diuretic activity. Effects of leaf extract were investigated on prostate and urinary disorders. Three different fractions of methanolic extract were evaluated of activity against prostate disorder on rat. The Fraction III treated group shows the lessened effect of testosterone on the prostate gland enlargement comparing to that of group I and group II treated group. The leaf extract of *P. cerasoides* showed the capability to reduce the testosterone induced prostate weight of rat⁷⁵.

BPH protective activity

Protective effect of bark of *Prunus* species including *P. cerasoides* was evaluated against benign prostatic hyperplasia (BPH) and the results indicated a meaningful inhibitory effect of testosterone induced BPH by the bark of different species of *Prunus* in the and *P. cerasoides* as well⁷⁶.



**Figure 1:** Chemical Compounds isolated from *P. cerasoides*

Antioxidant activity

The wine made from fruits of *Prunus cerasoides* contains highest flavonoids and antioxidant compounds. Total antioxidant activity and polyphenol content were also found to be highest in wines made from the fruits which entail a better option for bio-utilization of this highly valuable wild fruit which are otherwise of no commercial value⁷⁷. The antioxidant properties of the gum were evaluated by DPPH and hydroxyl scavenging activities, reducing power and total phenolic contents which showed the gum possess antioxidant property⁶⁸. Chloroform, ethylacetate, acetone and methanol extracts of *P. cerasoides* leaves were evaluated for total phenol, total flavonoid and antioxidant activity. All the extracts exhibited varying degree of antioxidant efficacy in a concentration-dependant manner. Methanol extract however recorded the highest total phenolic content (6.26 ± 0.033 mg GAE/g of extract), total flavonoid content (3.86 ± 0.016 mg QE/g of extract) and free radical scavenging (antioxidant) activity (IC_{50} , 56.00 ± 0.242 µg/ml). Total phenolic content had positive correlation with antioxidant capacity. The study established leaves of *P. cerasoides* as rich sources of phenolic compounds and natural antioxidants⁷⁸.

Cytotoxic activity

The cytotoxic activity of ethanol extract of stem against brine shrimp resulting in LC₅₀ values of less than 200 µg/ml. 0.75 µg/ml were considered active against brine shrimp thus exhibited cytotoxicity against brine shrimp^[79].

CONCLUSION

In recent times, there has been resurgence of interest in herbal remedies, owing to the high cost and adverse side effects of modern synthetic drugs. Consequently researchers and pharmaceutical companies across the world are striving hard for developing new drugs from natural sources without any adverse effects. Phytochemical investigations have shown that *P. cerasoides* contains a number of different kinds of phytochemical compounds in various parts of the plants which are key factors for the various medicinal properties. The plant holds diverse ethnomedicinal significance and used to cure a variety of diseases in traditional medicine systems. Therefore, the plant can be a potential candidate for developing new drug formulation which can ultimately be beneficial for human being. However, pharmacological studies of the plant to validate its traditional medicinal claims and to explore further bioefficacies are inadequate. Thus, it is mandatory to fill the huge gap of traditional medicinal knowledge and insufficient pharmacological studies to hold the position of this plant in providing better medicinal values to the society. In this review article, effort has been taken to collect and collate the details regarding ethnomedicinal knowledge as well as phytochemical and pharmacological reports of *P. cerasoides* that will be helpful in furtherance of

pharmacological investigation. There are many areas to work on this plant for its full recognition; these can be only fulfilled with interest generated by research community through carrying out research on different uses of this plant.

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