



## WILD FOOD PLANTS OF HIMACHAL PRADESH : A REVIEW

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### Abstract

Edible parts of various wild plants like flowers, fruits, seeds, stem and bark have been used traditionally to prepare a range of food products. Physicochemical analysis of these parts has revealed their richness in nutrients and phytochemicals. Processing of wild produce can help to meet the increasing energy and nutrients demand of the population along with income generation. Phytochemicals of these plants possess medicinal properties and are used traditionally to cure a plethora of diseases like cough, cold, congestion, fever, toothache, arthritis, jaundice, nephritis, regulation of blood pressure and diabetes. The utilization of wild produce in the commercial food preparations can enhance functional properties of food and can pave way for the development of nutraceuticals.

**Key words :** Food plants, traditional foods, phytochemicals, antinutrients.

### Introduction

Himachal Pradesh in India is blessed with diverse topography with latitude ranging from 30° 22' 40" N to 33° 12' 40" N and longitude from 75° 45' 55" E to 79° 04' 20" E. The sea level height ranging from 350 meters to 6975 meters give it vivid climatic conditions (Himachal Forest Statistics, 2013). All these factors make this state a home of 675 species of wild food plants (Kala, 2007; Reddy *et al.*, 2007; Samant and Dhar, 1997). Hill folks depend on forest harvest to meet their food and medicinal needs and almost all parts *viz.* leaves, buds, bark, flowers and roots are used for these purposes. Medicinal properties of wild produce are attributed to their phytochemicals like tannins, saponins, flavonoids, terpenes, alkaloids and sterols (Negi and Dave, 2010; Kaur *et al.*, 2011; Paranthaman *et al.*, 2012; Ozen *et al.*, 2017). Their curative properties make them strong contestant as protective foods (Rai *et al.*, 2004; Sathyavathi and Janardhanan, 2014). Local people are also aware about toxic components present in wild produce and have developed traditional techniques to lower down toxicants to a safer limit. The documentation of edible wild plants, parts fit for consumption, their composition and mode of usage can help researchers to better understand the potential of wild produce in designing functional foods

and nutraceuticals. In addition to this, it adds more options to the fresh produce market and can help to meet the prevailing challenge of production to achieve 160 million tons of vegetables for recommended requirement by 2020 (Rai, 2006; Kar and Borthakur, 2008).

### Distribution and traditional uses

There are total 675 edible wild plant species in Himachal Pradesh (Kala, 2007; Reddy *et al.*, 2007). Various parts of these plants like fruits, leaves, stems, bark are used for food purposes. Various edible plants/trees and their edible parts has been discussed in table 1.

### Fruits

Plants like *Prunus armeniaca* L., *Elaeagnus umbellata* (Thunb), *Morus alba* L., *Salanum nigrum* L., *Fragaria indica* Andr., *Malus baccata* (L) Borkh, *Juglens regial*, *Hippophae Salcifolia* D. Don, *Berberis lyceum* Royle, *Moringa oleifera* Lam. are edible. *Prunus armeniaca* L. (Chulti shadi) is mainly distributed in upper hills *i.e.* 3000 m above sea level and found in Kullu and Manali. The fruits are covered with short hairs and have a color ranging from yellow to red; red colour is on the side most exposed to the sun. The fruits range in taste from sweet to tart and is consumed either fresh, or in the form of chutney. A local wine is also prepared by the fermentation of ripe fruits. *Elaeagnus umbellata*

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(Ghaiyin) is distributed at height of 1300 to 1800 m above the sea level and found majorly in Kullu. The fruits are small in size and can be enjoyed only on full ripeness as raw fruits are astringent. Ripe fruits can be processed into jam or dehydrated to dried fruits (Chauhan *et al.*, 2016). *Morus alba* L. (Toot) is another wild tree of Himachal with edible fruits. It is found in the high altitudes of 2815 to 3177 m above the sea level. Immature fruits are white, green, or pale yellow depending on the variety. The fruit turns to dark purple or black color on ripening. Fully ripe fruits are sweet in taste and are dried or fermented into wine (Upadhyay, 2013). *Solanum nigrum* L. (Dhakh) is a wild plant found in the Palampur region of Kangra district. It is distributed from temperate to tropical region up to 3500 m above the sea level. Young immature fruits are dull green in colour and changes to black colour on maturity. Unripe fruits contain a toxic substance salanine and hence should only be consumed when fully ripe (Chauhan *et al.*, 2016). *Fragaria indica* Andr. (Strawberries) is located at 1000 m above the sea level (Payadas and Kaska, 1990). Its fruits are bright red in colour and are known as wild strawberries. The fruit contains very low amount of sugar and is usually bland in taste, however, taste ranges from sweet to tart. *Malus baccata* (L) Borkh (Siberian crab apple) is distributed at a height of 2740 m above sea level and found in Shimla, Kullu, Kinnaur, Lahual and Spiti. Fruits are red to yellow in color and are eaten fresh or after drying. *Juglens regia* (Khod, Walnut) is distributed in Kullu, Kinnaur, Chamba, Mandi and Solan. It lies at a height range 800 m to 2300 m from the sea level. Unripe fruits are covered with green husk. After the removal of husk, wrinkly walnut shell appears. Fruits are eaten fresh and give oily taste (Chauhan *et al.*, 2016). *Hippophae Salicifolia* D. Don (Chhuchha, Seabuckthorn) is native to Lahaul, Kinnaur and Kullu. It is a small tree ranging from 9 to 12 m in height (Kishore and Sharma, 2006). Fruits are sour and alcoholic in taste and have an orange appearance. They can be eaten raw or mixed with a sweet juice like apple or grape juice. Fruits are rich source of vitamin C, but its excess consumption may cause crack in tongue (Chauhan *et al.*, 2016). *Berberis lycium* Royle (Karmashal) grows in dry hot places in the western Himalayas at an altitude of 900 to 2700 m above the sea level and found in Chamba, Hamirpur and Kangra. Its fruits are called berries and ripe berries are consumed fresh or used for the preparation of juice. Juice prepared from berries is slightly acid in flavor and has higher acceptability (Gupta *et al.*, 2015). *Moringa oleifera* Lam. (Drumstick tree) found in Bilaspur, Una, Hamirpur. It grows best at an altitude of 600 meters above sea but

can be found up to 1000 meters in Himalayas. Unripe fruits are white in color and changes to brown after reaching maturity. They are delicious, and can be eaten raw. The seeds separated from fruits can be used as salad or cooked as vegetable (Pandey *et al.*, 2011). Fruits of *Zanthoxylum armatum* DC. are used to make chutney known as dunkcha (Kala *et al.*, 2005).

### Leaves

Plants like *Juniperus indica* Bertol., *Moringa oleifera* Lam., *Rumex hastatus* D. Don, *Urtica hyperborea* Jacquem. Ex Wedd. are edible. *Juniperus indica* Bertol. (Bhitaru) mainly grows in range of 3300 to 4000 m above the sea level and is found mainly in Lahaul and Spiti, Kullu, Kinnaur and Shimla. Dried leaves are used for dhoop (incense) preparation and an extract of fresh leaves are used in the fermentation of ingredients for the wine known locally as balma (Makhuri *et al.*, 2000). Pods of *Moringa oleifera* Lam. (Drumstick tree) leaves are garnished with mustard seeds, ground to paste, cooked like beans and are consumed with rice (Pandey *et al.*, 2011). *Rumex hastatus* D. Don (Almora) is mainly distributed in the range 635 to 1646 m above sea level. The tree is found in Chamba, Kullu, Hamirpur, Lahual and Spiti. Leaves are sour in taste and are eaten raw as salad or made into *Chutney* (Singh *et al.*, 2014). *Urtica hyperborea* Jacquem. Ex Wedd. (Chogya, Zacchout) found in Mandi, Kinnaur, Manali, Kangra and Kullu. For cooking, leaves are boiled in water and then salt and chili powder are added. Young shoots are also used to prepare soups (Singh *et al.*, 2014). *Rumex nepalensis* Sprengel (Jangali palak, Shamo) is an herb native to Mandi and Kullu. Tender leaves are boiled, water decanted and are cooked as *sabji* (cooked vegetable). However, mature leaves are considered toxic because due to the high levels of oxalic acid (Singh *et al.*, 2014). Kangshu is a local dish prepared from leaves of *Ficus palmate* along with bamboo shoots. Leaves of other plants like *Capsella bursapastoris* Medic. (Chibotey), *Eremurus himalaicus* Baker (Chem, Macho, Pret, Yamkan), *Fagopyrum esculentum* (Fafra, Oglu, Buckwheat), *Lathyrus sativus* Linn (Jhala), *Nasturtium officinale* R. B (Balkhu, Bolgu) are cooked as vegetables.

### Seeds

Seeds of *Aesculus indica*, *Carum carvi* L., *Lathyrus sativus* Linn., *Zanthoxylum armatum* DC are edible. *Aesculus Indica* (Khanor) is found in Mandi, Shimla, Dharampur, Kasauli and Dharamsala regions of state. It is distributed up to about 3000 m above the sea level. Seeds are bitter in taste and hence need debittering before consumption. To remove bitterness, seeds are separated

**Table 1 :** Various wild trees found in Himachal, their distribution, food applications and medicinal uses.

Name	Flowering time	Fruiting time	Distribution	Food applications	Medicinal uses	References
<i>Acacia catechu</i> (Khair)	June-October	June-August	Mandi, Hamirpur Kangra, Solan, Sirmour, Una, Chamba, Shimla and Bilaspur	Bark mixed with milk is taken to cure cold and cough. Heartwood is boiled with other ingredients to prepare the decoction. It is taken as tea by the pregnant ladies to keep warm body.	Wood extract called <i>catechu</i> is used in medicine for sore throat and diarrhoea. Concentrated aqueous extract known as khayer gum used as Ayurvedic medicine. Katha after drying is applied on lemon slice and taken regularly with empty stomach to cure piles.	Singh and Lal (2006)
<i>Aesculus indica</i> (Khanor)	April-May	September-October	Mandi, Shimla, Dharampur, Kasauli, Dharamsala	Fruits are edible. Flour is mixed with wheat flour to make chapattis and <i>hahwa</i>	Treatment of skin diseases Rheumatis Relief of headache.	Chauhan <i>et al.</i> (2016)
<i>Allium stracheyi</i> Baker (Jimbu)	July-August	September-November	Kullu, Lahaul and spiti, Mandi, Shimla, Bilaspur, Sirmour, Kangra	Ground into powder with the root of <i>Saussurea costus</i> and fried with <i>ghee</i> As a condiment in the pulses and vegetable known locally as <i>faran</i> .	Used to cure stomach ache Ethanol extract of the plant used for the treatment of inflammation and the associated pain.	Maikhuri <i>et al.</i> (2000)
<i>Amaranthus cuadatus</i> L. (Champayang, Damkhon)	September-December	September-December	Shimla, Kullu, Kinnaur	Tender leaves are eaten raw or cooked as spinach.	Fluid extract of the plant is used as an astringent internally in the treatment of ulcerated mouth and throat. Juice of the roots is used to relieve headaches.	Singh <i>et al.</i> (2014)
<i>Betula utilis</i> D. Don. (Bhojpatra)	May-July	September-October	Chamba, Kullu	Dried resin extracted from the bole is ground into powder and used as an important constituent of the traditional <i>namkeen</i> tea.	Part of the bark is applied to cuts, wounds and burns. Water boiled with bark is taken in cases of jaundice and used as drops to relieve earache. <i>Namkeen</i> tea used to cure colds and coughs.	Maikhuri <i>et al.</i> (2000)
<i>Capsella bursapastoris</i> Medic. (Chibotey)	August	November	Kinnaur, Kullu, Chamba	Tender leaves are cooked as vegetable.	Tea or tincture for the treatment of disorder of the skin, locomotor system, cardiovascular system and gynecologic problems.	Singh <i>et al.</i> (2014)
<i>Carum carvi</i> L. (Kala jeera)	July-September	October-November	Lahaul, Mandi, Shimla, Bilaspur, Sirmour, Kangra	Spice and condiment	Herbal tea prepared from the seeds is used as remedy for digestive disorders, heartburn, and loss of appetite and to dispel worms.	Maikhuri <i>et al.</i> (2000)
<i>Corylus jacquemontii</i>	April-May	September	Shimla	Nuts are edible	Enhance memory and used as brain tonic.	Chauhan <i>et al.</i> (2016)

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<i>Dipsacus inermis</i> Wall (Wapal hath)	July-September	July-September	Kinnaur, Solan, Chamba, Lahaul	Tender leaves are cooked as vegetables			Powder of whole plant is used in sore throat. Root paste is used for treatment of leucoderma, fractured bones and muscles.	Singh <i>et al.</i> (2014)	
<i>Elaeagnus umbellata</i> Thunb (Ghaiyin)	April-May	June-July	Kullu	Fruits are edible			Seeds are used in the treatment of coughs.	Chauhan <i>et al.</i> (2016)	
<i>Eremurus himalaicus</i> Baker (Chem, Macho, Pret, Yamkand)	June-July	–	Kullu, Shimla, Sirmour, Kinnaur	Tender leaves are cooked as vegetables			Young shoots are cooked and used as digestive. Powdered roots and boiled leaves are used by tribals to cure fever, dysentery and diabetes	Singh <i>et al.</i> (2014)	
<i>Fagopyrum esculentum</i> (Fafra, Ogla, Buckwheat)	July-September	August-October	Kinnaur, Solan, Palampur, Shimla	Tender leaves are cooked as vegetables Seed are ground to flour Flour of the seeds is used for making local dishes called 'Hodh', 'Dhoo' or 'Bro' and 'RangKhobra'.			Taken as tea for a wide range of circulatory problems Relief form pain.	Singh <i>et al.</i> (2014) Negi and Subramani (2015)	
<i>Ficus palmata</i> fross (Feru)	March-April	June-October	Kangra, Kullu, Shimla, Mandi	Cooked fruit used as vegetable Leaves of <i>ficus</i> used to make <i>Kangshu</i> (a local dish)			Treatment of constipation, diseases of lungs and bladder Sap is used in the treatment of warts. Latex used to cure toothache and moles	Chauhan <i>et al.</i> (2016)	
<i>Hippophae Salicifolia</i> D. Don (Chhuchha, Seabuckthorn)	April-May	June-September	Lahaul, Kinnaur, Kullu	Fruits are eaten fresh			Treatment of cardiac disorders Applied to the sin to heal burns.	Chauhan <i>et al.</i> (2016)	
<i>Juniperus indica</i> Bertol. (Bhitaru)	January-February	September-October	Lahaul and spiti, Kullu, Kinnaur, Shimla	Fresh leaves are used in the fermentation of ingredients for the wine known locally as <i>balma</i> .			Leaves of Juniper are used to increase appetite. Cure stomachache, killing microorganisms of stomach, controlling dysentery, piles, bronchitis etc. Fruit is used for curing Asthma, old bronchitis, lever and bone marrow related diseases.	Makhuri <i>et al.</i> (2000)	
<i>Lathyrus sativus</i> Linn. (Jhala)	June-July	August-September	Kangra, Kinnaur	Tender leaves are used for making vegetable and immature seeds are eaten by children.			The oil from the seeds is a powerful cathartic and is used locally in homeopathic medicine.	Singh <i>et al.</i> , 2014	

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<i>Moringa oleifera</i> Lam. (Drumstick tree)	March-May	April-June	Solan (Darlaghat), Una Hamirpur	Fruits and leaves are used as vegetable. Pods garnished with mustard seeds paste are cooked like beans and consumed with rice.	Stem and the root for the treatment of ear infection.	Pandey <i>et al.</i> (2011)
<i>Morus alba</i> L. (Toot)	March-April	April-August	Solan, Kangra, Chamba, Bilaspur	Ripe fruits are edible	Fruits are used to treat prematurely grey hair, "tomify" the blood, treat constipation and diabetes. The bark is used to treat cough, wheezing, edema and to promote urination. It is also used to treat fever, headache, red dry and sore eyes.	Upadhyay (2013)
<i>Nasturtium officinale</i> R. Br.	May-October	July-October	Lahaul and Spiti Kangra, Kinnaur	Fresh leaves are cut, washed and fried in oil to prepare vegetables.	The leaves are antiscorbutic, stimulant and stomachic. Treatment of Tuberculosis. Freshly pressed juice has been used internally and externally in the treatment of chest and kidney complaints, inflammations of the skin etc.	Singh <i>et al.</i> (2014)
<i>Prunus armeniaca</i> L. (Chulti shadi)	March-April	June-August	Kullu, Manali	Fresh fruit used for making chutney Ripe fruits are edible or fermented to make local wine. Dried fruits are used for making local beverages called 'Chul Rak' or 'Chul Phasur' and local dishes 'Chul Phanting'.	Fruits are excellent for anaemia due to its high content of iron. Good remedy for constipation.	Chauhan <i>et al.</i> (2016) Negi and Subramani (2015)
<i>Prunus mira koehne</i> (Behmi)	March-April	June-July	Shimla, Sirmaur	Fruits and oil are edible.	Fruits have been applied to treat irregular menstruation and fractures because of their potential to remove blood stasis and enhance blood circulation.	Chauhan <i>et al.</i> (2016)
<i>Phytolacca acinosa</i> Roxb (Jorbo, Jorga, Jorba)	July-August	December-April	Chamba, Lahaul and spiti, Mandi, Kullu, Kinnaur	Tender leaves are cooked as vegetable.	Root is used internally in the treatment of urinary disorders, nephritis and abdominal distension.	Singh <i>et al.</i> (2014)
<i>Rumex hastatus</i> D. Don (Almora)	March-November	March-November	Chamba, Kullu Lahaul and Spiti, Hamirpur	Raw leaves are eaten raw like salad or made into <i>Chutney</i> and pickles	Roots regulate blood pressure. Used against microbial skin diseases, bilious complaints and jaundice.	Singh <i>et al.</i> (2014)
<i>Rumex nepalensis</i>	April-August	August-October	Mandi, Kullu	Tender leaves are made into vegetable	A paste of the root is applied to swollen gums. Juice of the leaves is applied externally	Singh <i>et al.</i> (2014)

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<i>sprengei</i> (Jangali palak, Shamo)							to relieve headache.		Chauhan <i>et al.</i> (2016)
<i>Salanum nigrum</i> L.(Dhakh)	Through-out year	Through-out year	Palampur, Kangra	Fruits are edible			Gum used in the treatment of bronchitis, inflammation, heavy female discharge and wounds. Leaf juice cures worms, treatment of gout		Chauhan <i>et al.</i> (2016)
<i>Sonchus oleraceus</i> Linn. (Puyanu)	May-June	August-October	Kangra, Kullu, Chamba, Kinnaur Mandi, Sirmaur	Cooked fresh as vegetables and also sun-dried for future Consumption			Juice of plant used for cleaning and healing ulcers. The latex in the sap is used in the treatment of warts. The leaves are applied as a poultice to inflammatory swelling.		Maikhuri <i>et al.</i> (2000)
<i>Taxus wallichiana</i> Zucc. (Thuna)	March-May	September-October	Kullu, Kinnaur Lahual and spiti, Shimla	Fruits are edible, Bark and needles are used for making tea.			Tea used for cough and congestion.		Chauhan <i>et al.</i> (2016)
<i>Taxus baccata</i> L. subsp. <i>wallichiana</i> (Thuner)	August-October	August-October	Lahual and Spiti, Mandi, Shimla, Bilaspur, Solan, Sirmaur, Chamba	The bark of the tree is used in the preparation of <i>namkeen</i> (salty) tea.			Treat eye diseases, Keeps body warm during winter.		Maikhuri <i>et al.</i> (2000)
<i>Urtica hyperborea</i> Jacquem. Ex Wedd. (Chogya, Zacchout)	May-August	—	Kinnaur, Kullu, Mandi, Manali, Kangra	Cooked as vegetable, young shoots used to prepare soups.			Fresh leaves are cooked and eaten for fever, cough and cold.		Singh <i>et al.</i> (2014)
<i>Zanthoxylum armatum</i> DC (Timar)	March-April	June-October	Manali, Kangra, Kullu	Seeds are ground into a powder and used as a condiment. Fruit is used to make chutney (like a sauce), which is known as <i>dunkcha</i> .			The tree used to get relief from toothache. In Ayurveda, it is used for skin diseases, loss of smell, heaviness and pain in head and arthritis.		Chauhan <i>et al.</i> , (2016); Kala <i>et al.</i> (2005)

from the fruits and crushed to get smaller pieces in order to remove bitterness. Crushed seeds are kept in a big bamboo basket, and then placed under running water. These seeds are stirred daily to enhance the cleaning process and to prevent spoilage of seeds. After washing, seeds are dried and beaten into flour, called *Tattawakher* (Rajasekaran and Joginder, 2009). The flour is mixed with wheat flour to make chapattis and is also used to make *halwa* (porridge). *Carum carvi* L. (Kalla jeera) is found at the altitude of 2740 to 3660 m above the sea level and found in Lahaul, Mandi, Shimla, Bilaspur, Sirmaur and Kangra. Paste of seeds of *kala jeera* and *sindhi* salt is used to cure stomach pain. Seed is also used as a spice and condiment (Maikhuri *et al.*, 2000). *Lathyrus sativus* Linn (Jhala) is found in Kangra and Kinnaur. Seeds, boiled and consumed as pulse, are also used in traditional bread making (Muehlbauer and Tullu, 1997). *Zanthoxylum armatum* DC (Timar) is distributed between 1000 to 2100 m above sea level and found in Manali, Kangra and Kullu. Seeds are ground into a powder and used as condiment. This seed is also an ingredient of the famous Chinese 'five spice' mixture (Chauhan *et al.*, 2016). Flour of the Seeds of *Fagopyrum esculentum* are used in making local dishes called 'Hodh', 'Dhoo' or 'Bro' and 'Rang Khobra' (Negi and Subramani, 2015). *Prunus persica*, (L) Batsch (Kirol, Aru) is a tree with edible seeds and is found in a range of 1000 to 2000 m above the sea level. This tree is widely distributed in Himachal and is found in Chamba, Kullu, Manali, Mandi, Kinnaur, Lahaul and Spiti, Bilaspur, Shimla and Kangra districts. Oil extracted from the seed kernels is edible and is also used externally as a massage to keep the body warm during the winter season (Maikhuri *et al.*, 2000).

### Bark

*Taxus baccata* L. subsp. *Wallichiana* (Thuner) grows from sea level up to 425 m and found in Lahaul and spiti, Mandi, Shimla, Bilaspur, Solan, Sirmaur and Chamba. The bark of the tree is ground into powder, boiled with water and mixed with salt and ghee to prepare namkeen tea. This tea is known to keep body warm during the winters (Maikhuri *et al.*, 2000). *Taxus Wallichiana* Zucc. (Thuna) is an evergreen tree distributed at the altitude ranges from 1800 to 3300 m above the sea level and found in Kullu, Kinnaur, Shimla, Lahaul and Spiti districts. Its bark and needles are used in tea preparations (Chauhan *et al.*, 2016). *Acacia catechu* (Khair) is a tree distributed at the altitude of 1300 m above the sea level and found in Mandi, Hamirpur, Kangra, Solan, Sirmaur, Una, Chamba, Shimla and Bilaspur. Bark mixed with milk is taken to cure cold and cough. Katha (an extract from its wood) after drying is applied on lemon slice and taken

regularly with empty stomach to cure piles. Heartwood is boiled with other ingredients to prepare the decoction. It is taken as tea by women to keep body warm (Singh and Lal, 2006).

### Nutritional composition of edible part of wild trees in Himachal Pradesh

Wild trees are rich source of nutrients like carbohydrates, proteins, fat, dietary fiber, minerals and vitamins. The nutritional composition of the edible parts of wild trees is given in table 2.

Among the various edible parts of trees, seeds are the richest source of carbohydrates, followed by leaves and fruits respectively. Among seeds *Lathyrus sativus* Linn. has the highest content of carbohydrates and proteins i.e. 72.91% and 25.6%, respectively (Tamburino *et al.*, 2012). Seeds of *Carum carvi* L. and *Amaranthus cuadatus* L. are the richest source of fat and has a fat content in the range of 10-21%. Fruits on fresh basis are fair source of nutrients as compare to seeds, however, the drying has been reported to increase the content of nutrients in the fruits. Fruits of *Hippophae salcifolia* D. Don are the richest source of protein i.e. 34.6% while, *Prunus armeniaca* L, *Juglens regia* and *Ficus palmate* fross are reported to be rich in dietary fiber (17 – 19%) (Ercisli and Orhan, 2007; Ali and Abbasi, 2011; Bachheti *et al.*, 2012). The highest fat content of 62.84% was in *Juglens regia* (Khod) (Caglaritmark, 2003). Edible leaves are also rich source of carbohydrate and the content ranges from 24.50 to 63.1%. Among edible leaves, the highest content of carbohydrates i.e. 63.1% has been reported in drumstick leaves (Verma and Nigam, 2014). Leaves are also good source of proteins, dietary fibre and minerals. But the fat content is comparatively lower than seeds and fruits. The flower of *Bombax ceiba* is richest source of vitamin C (Garg *et al.*, 2011; Bhogaonkar *et al.*, 2016). Roots of *Rumex nepalensis* Sprengel are rich in carbohydrates (48.62%) and fats (15.57%) (Hameed and Dastagir, 2009). The stem of *Rumex hastatus* D. Donis excellent source of carbohydrates (24.50%) and dietary fiber (19.26%) (Hameed and Dastagir, 2009; Singh *et al.*, 2013).

### Phytochemical content and their medicinal use

Plants are rich source of phytochemicals and are used to cure various diseases. Phytochemicals are naturally occurring and biologically active plant compounds (Saxena *et al.*, 2013). They play an important role in plant growth, defense against pathogens and have disease inhibition capabilities. Various phytochemicals like flavonoid, alkaloids, tannins, phenol, sterol, saponins, terpenoids etc. possess medicinal values. Major

**Table 2 :** Nutritional composition of various edible parts of wild trees.

Plant/Tree	Edible part	Macronutrients (%)	Major Minerals (mg/100g)	References
<i>Aesculus indica</i> (Horse chestnut)	Seeds	Carbohydrates- 67.74 Proteins- 0.39 Fat-Traces Dietary fibre- 8.1 Total minerals- 1.93	Zinc-705.90 Potassium-81.00 Phosphorus-9.00 Iron-8.50 Calcium-8.20 Manganese-0.50 Copper-0.60	Rafiq <i>et al.</i> (2015) Mishra <i>et al.</i> (2018)
<i>Amaranthus cuadatus</i> L.(Damkhon)	Seeds	Carbohydrates- 64 Proteins- 14 Fat-10 Dietary fibre- 8 Total minerals- 2.5	Calcium -370.3 Potassium -341.9 Magnesium-65.87 Iron-12.23 Zinc -0.91	Pedersen <i>et al.</i> (1987), Kachiguma <i>et al.</i> (2015)
<i>Carum carvi</i> L.	Seeds	Carbohydrates- 49.90 Proteins- 19.77 Fat-13-21 Dietary fibre- 13-19 Total minerals- 5-7		Sedlakova <i>et al.</i> (2003)
<i>Lathyrus sativus</i> Linn. (Jhala)	Seeds	Carbohydrates- 72.91 Proteins- 25.6 Fat-1.67 Dietary fibre- 0.6 Total minerals- 3		Tamburino <i>et al.</i> (2012)
<i>Ficus palmata fross</i> (Feru)	Fruit (Fresh basis)	Carbohydrates- 6 Proteins- 1.7 Fat-1.02 Dietary fibre- 17.81 Total minerals- 0.9		Joshi <i>et al.</i> (2014)
<i>Juglens regia</i> L. (Khod)	Fruit (Fresh basis)	Carbohydrates- 18.67 Proteins- 13.77 Fat-62.84 Dietary fibre- 18 Total minerals- 1.81	Potassium- 462.76 Calcium- 110.86 Magnesium- 108.99 Phosphorus- 62.19 Manganese- 4.63 Sodium- 4.47 Iron- 3.24 Zinc-2.64 Nickel- 0.24	Caglaritmark (2003), Özcan (2009)
<i>Morus alba</i> L. (Toot)	Fruit (Dry basis)	Carbohydrates- 61.69 Proteins- 17.50 Fat-1.10 Dietary fibre- 14.05 Total minerals- 12.16	Iron – 2.82 Copper – 0.031 Chromium – 0.057	Ercisli and Orhan (2007), Khan <i>et al.</i> (2009)
<i>Prunus armeniaca</i> L. (Apricot)	Fruit (Fresh basis)	Carbohydrates- 24.50 Proteins- 6.05 Fat-4.50 Dietary fibre- 19.26 Total minerals- 6.23	Phosphorous -472 Calcium - 330.0 Magnesium -370.0 Zinc - 3.79 Iron - 3.6 Potassium - 0.017 Sodium - 0.034	Ali and Abbasi (2011), Bachheti <i>et al.</i> (2012)

Table 2 continued...



Table 2 continued...

<i>Elaeagnus umbellata</i> Thunb (Ghaiyin)	Fruit (Fresh basis)	Carbohydrates- 8.34 Proteins- 4.0 Fat-2.3 Dietary fibre- 5.9 Total minerals- 2.9	Phosphorus- 54 Potassium- 346 Calcium- 49 Magnesium-33 Iron-7	Khattak (2012), Parmar and Kaushal (1982)
<i>Hippophae salcifolia</i> D.Don (Chhuchha)	Fruits (Fresh basis)	Proteins- 34.6	Potassium- 149.99 Calcium- 38.3 Iron- 1.1 Magnesium- 4.77	Rajchal (2009)
<i>Capsella bursapastoris</i> Medic. (Chibotey)	Leaves (Dry basis)	Carbohydrates- 44.1 Proteins- 35.6 Fat-4.2 Dietary fibre- 10.2 Total minerals- 16.1	Calcium-935 Phosphorus-240 Magnesium-155 Potassium-1923 Sodium- 44 Sulfur-136 Zinc-2382 Iron- 25455 Copper-1253 Cadmium-8.0 Manganese -4783	Ali-Esmail (2015), Tuncturk <i>et al.</i> (2015)
<i>Sonchus oleraceus</i> Linn. (Puanu)	Leaves (Dry basis)	Carbohydrates- 44.1 Proteins- 35.6 Fat-4.2 Dietary fibre- 10.2 Total minerals- 16.1	Magnesium- 0.610 Calcium -2.992 Potassium-4.558 Phosphorus-0.352 Sodium-0.05 Iron-19.3 Zinc-30 Copper -13 Manganese- 191	Guil-Guerrero <i>et al.</i> (1998), Jimoh <i>et al.</i> (2011)
<i>Moringa oleifera</i> Lam. (Drumstick tree)	Leaves (Dry basis)	Carbohydrates- 63.11 Proteins- 17.01 Fat-2.11 Dietary fibre- 7.09 Total minerals- 7.93	Potassium - 2170 Sodium - 273 Magnesium - 11 Phosphorus – 136 Calcium - 2640 Iron - 17.5 Manganese - 5.18 Zinc – 1.37 Copper - 0. 71	Verma and Nigam (2014)
<i>Rumex hastatus</i> D. Don (Almora)	Stems (Dry basis)	Carbohydrates- 24.50 Proteins- 6.05 Fat-4.50 Dietary fibre- 19.26 Total minerals- 6.23	Sodium-0.59 Magnesium-0.46 Silicon-1.32 Sulfur-0.45 Phosphorus-0.27 Calcium-1.51 Potassium-6.10 Iron-0.58	Hameed and Dastagir (2009), Hameed <i>et al.</i> (2008), Singh <i>et al.</i> (2013)
<i>Rumex nepalensis</i> Sprengel (Jangali palak)	Roots	Carbohydrates- 48.62 Proteins- 11.12 Fat-15.57 Dietary fibre- 13.50 Total minerals- 4.75	Silicon-117 Potassium-346	Hameed and Dastagir (2009), Hameed <i>et al.</i> (2008)

**Table 3 :** Phytochemicals present in edible part of wild trees.

Flower	Part used for consumption	Phytochemical reported	References
<i>Aesculus indica</i> (Khanor)	Leaves	Tannins – 5% Saponin - 13.4%	Kaur <i>et al.</i> (2011)
<i>Amaranthus cuadatus</i> L. (Damkhon)	Leaves	Flavonoids : Gallic acid - 0.083 µg/g Caffeic acid - 0.004 µg/gm Rutin - 0.019 µg/gm Ferulic - 0.001 µg/gm Quercetin - 0.001 µg/gm	Paranthaman <i>et al.</i> (2012)
<i>Capsella bursapastoris</i> Medic. (Chibotey)	Whole plant (dry plant)	Flavonoids: Quercetin-6-C-glucoside- 793.90 mg/kg Quercetin-6-C-glucoside- 426.26mg/kg Kaempferol-3-O-rutinoside–2314.61 mg/kg Quercetin- 16.36 mg/kgKaemferol- 16.01 mg/kg	Grosso <i>et al.</i> (2011)
<i>Carum carvi</i> L. (Kala Jeera)	Seeds	Limonene - 1.5 – 51.3% Carvone - 44.5 – 95.9% β-Myrcene - 0 – 0.4 %	Raal <i>et al.</i> (2012)
<i>Elaegnus umbellate</i> Thunb (Ghaiyin)	Fruits	Alkaloids – 12.6 mg/g Saponins – 21.2 mg/g Tannin – 126.3 mg/g Flavanoids - 0.36 mg/g Carotenoid - 1.99 mg/g	Ozen <i>et al.</i> (2017), Khattak, (2012)
<i>Nasturtium officinale</i> R. Br. (Balkhu, Bolgu)	Whole plant	Flavonoid – 96.2 mg/g	Bahramikia and Yazdanparast (2010)
<i>Prunus armeniaca</i> L. (Apricot)	Fruit	Tannins - 0.06-0.10%	Raj <i>et al.</i> (2012)
<i>Zanthoxylum armatum</i> DC (Timar)	Stem bark  Fruits  Leaves	Tannins – 28.62 ± 0.13 mg/g Phenols – 16.48 ± 1.33 mg/g Flavonoid – 18.33 ± 1.22 mg/g Alkaloids – 0.10-19.60 ± mg/g Sterols – 13.83 ± 0.29 mg/g Saponins – 14.78 ± 0.10 mg/g  Alkaloids – 25.07 ± 0.21 mg/g Sterols – 164.92 ± 0.10 mg/g Saponins – 28.60 ± 0.10 mg/g Tannins – 35.5 ± 0.5 mg/g Phenols – 21.68 ± 0.44 mg/g Flavonoids – 22.8 ± 0.21 mg/g  Alkaloids – 15.60 ± 0.10 mg/g Sterols – 71.60 ± 0.10 mg/g Saponins - 21.57 ± 0.12 mg/g Tannins – 34.43 ± 0.21 mg/g Phenols – 11.66 ± 0.33 mg/g Flavonoids – 13.68 ± 0.66 mg/g	Ullah <i>et al.</i> (2017)

phytochemicals and their medicinal application has been described in table 3. *Aesculus indica* contains alkaloids, cardiac glycosides, flavonoids, tannins, sterols and triterpenoids and it is used for the treatment of skin diseases, rheumatism and relief of headache (Kaur *et*

*al.*, 2011). *Amaranthus cuadatus* L. contains flavonoids like gallic acid, caffeic acid, rutin, ferulic and quercetin and fluid extract of the plant is used as an astringent internally in the treatment of ulcerated mouth and throat. Juice of the roots is used to relieve headaches

**Table 4 :** Commercial medicines prepared from wild plants.

Trees	Part used	Medicines	Manufacturer	Reference
<i>Achyranthes aspara</i> Linn.	Whole plant	Kshara Gorochandi Gulika	AVN, Kottakkal Arya Vaidya Sala.	Jadav <i>et al.</i> (2015)
<i>Asparagus adscendens</i> Roxb.	Root	Xytone capsules	Ajmera pharmaceuticals Pvt. Ltd. Indore.	Easyayurveda (2017)
<i>Bauhinia variegata</i> Linn.	Stem bark, Flower	Kanchnar guggal	AVN, Alva pharmacy, swadrshi pharmacy.	Easyayurveda (2014)
<i>Berberis asistala</i> DC.	Root	Darubaridra	Neeraj Enterprises Hyderabad, an herbal manufacturing unit.	Srivastava <i>et al.</i> (2006)
<i>Cedrus deodara</i>	Bark	Devadarvadi Kasaya	Nagarjun Pharmaceutical Pvt. Ltd.	Easyayurveda (2014)
<i>Cissampelos pareira</i> Linn.	Root, Stem	Pyshyanuga churna	AVN Ayurveda Formulations Pvt. Ltd.	Kaur <i>et al.</i> (2016)

**Table 5 :** Effective treatments to reduce antinutritional factors present in wild produce.

Name	Antinutrients	Treatment to reduce antinutritional factors	Reference
<i>Aesculus Indica</i>	Oxalate – 3.74 µg/g Phytates – 0.36 µg/g Tannins – 12.40 mg/g Saponins – 2.03 g/100g	Microwave treatment for 2.5 minute reduces the content of oxalate, phtates, tannins and saponins by 95.45%, 91.67%, 68.14%, 87.19%, respectively.	Rafiq <i>et al.</i> (2016)
<i>Junglans nigra</i>	Tannins – 0.15% Oxalate – 0.059% Phytate - 0.016% Saponins - 4.31% Steriod – 0.34% Trypsin inhibitor - 0.22% Phenol - 1.831%	Roasting at 120°C for 50 minutes reduces the content of tannins, oxalate, phtates, saponins by 80.66%, 94.91%, 93.75%, 75.87%, respectively. Toasting at 140°C for 50 minutes reduces steroids by 94.11%, trypsin inhibitors by 84.54% and phenols by 35.77%.	Nwosu <i>et al.</i> (2005)
<i>Lathyrus sativus</i> Linn.	Tannin - 1.3% Phytic acid - 6.52% Trypsin inhibitor - 31.42 (TIUmg protein <sup>-1</sup> ) β-ODAP (3-N-Oxalyl-L-2, 3-diaminopropionic acid)- 1.28%	Fermentation of <i>Lathyrus</i> seed reduces tannins by 80.7%, phytic acid by 85.1%, while trypsin inhibitor is unaffected. Extrusion of the seeds reduces β-ODAP level by 46.09%.	Ramachandran and Ray (2008)
<i>Moringa oleifera</i>	Tannins – 1.4% Phytate - 3.1% Total phenols – 3.4% Saponins – 5.0%	Extraction of <i>Moringa</i> leaves reduced the tannin by 100%, phytate by 19.35%, total phenols by 52.94% and saponins by 96%.	Nikolaus <i>et al.</i> (2001)

(Paranthaman *et al.*, 2012). Whole plants of *Capsella bursapastoris* Medic. and *Nasturtium officinale* R. Br. are rich in phytochemicals. *Capsella bursapastoris* Medic. contains flavonoids such as qercetin-6-C-glucoside, qercetin-3-O-glucoside, kaempferol-3-O-rutinoside, qercetin, kaempferol and its herb has been used as tea or tincture for the treatment of disorder of the skin, locomotors system, cardiovascular system and gynaecologic problems (Ali-Esmail, 2015). *Nasturtium officinale* R. Br. contains flavonoids and its leaves exhibit

antiscorbutic, stimulant and stomachic properties. The plant has been used in the treatment of Tuberculosis. The freshly pressed juice has been used internally and externally in the treatment of chest and kidney complaints and inflammations of the skin (Bahramikia and Yazdanparast, 2010).

The seeds of *Carum carvi* L. contains limonene, carvone and β-Myrcene and an herbal tea prepared from the seeds is used as an herbal remedy for digestive

disorders, heartburn, and loss of appetite and to dispel worms (Pooja and Singh, 2014; Raal *et al.*, 2012). *Elaeagnus umbellate* Thunb contains alkaloids, steroids, terpenoids, saponins and its flowers are astringent. The seeds are used in the treatment of coughs (Ozen *et al.*, 2017 and Khattak, 2012). Fruits of *Prunus armeniaca* L. are excellent for treatment of anaemia due to their high content of iron. It is also a good remedy for constipation and helps in maintaining good health (Raj *et al.*, 2012). The bark of *Acacia catechu* contains terpene such as camphor and phytol. Extract of its wood called *Catechu*, is used in medicine for sore throat and diarrhea. The concentrated aqueous extract, known as *khayer gum* used as Ayurvedic medicine (Negi and Dave, 2010). The stem bark, fruit and leaves of *Zanthoxylum armatum* DC contains tannins, phenols, flavonoid, alkaloids, sterols and saponins. Its extracts are used to get relief from toothache. It has numbing effect on teeth and gums. In Ayurveda, it is used for skin diseases, loss of smell, heaviness and pain in head and arthritis (Ullah *et al.*, 2017).

#### Medicinal formulations from wild trees

Depending upon the composition different parts of plants are used as herb or formulation of traditional medicines. The various commercial medicines prepared using these wild trees are described in Table 4. Every part of *Achyranthes aspara* Linn. is used in the treatment of diseases like like *kshara* and *gorochandi gulika*. Medicines prepared from this tree are also effective in curing fever, pneumonia, cough, cold, asthma and also for the treatment of memory loss (Jadav *et al.*, 2015). Roots of *Asparagus adscendens* Roxb. are used in the preparation of *Xytone* capsules. These capsules are used in the treatment of stress (Easyayurveda, 2017). A medicine known as *kachnar guggal* is prepared from stem, bark and flower of *Bauhinia variegata* Linn. These medicines are used for curing wound, skin disease (Easyayurveda, 2014). Roots of *Berberis asistala* DC. are used in preparation of medicine known as *darubaridra* which is used for the treatment of diabetes, swelling, wound, urinary tract disease, pain and itching disorder related to eyes (Srivastava *et al.*, 2006). Bark of *Cedrus deodara* is used in the preparation of *devadarvadi* and *kasaya* medicines (Easyayurveda, 2014). Roots and stems of the *Cissampelos pareira* Linn. is used in *Pyshyanuga churna*, which is used for curing leucorrhoea, menstrual disorder and the treatment of uterine infection (Kaur *et al.*, 2016).

#### Limitations and solutions

Some of the phytochemicals present in the wild

produce also act as antinutrients and hence decrease the absorption and utilization of nutrients present in food. It is important to reduce antinutrients to a safer limit to increase their nutritional value. Various traditional methods of food preparation like cooking, extraction, fermentation of food are known to decrease the antinutrients. The major antinutrients found in plants and the ways for their removal are described in table 5. *Aesculus indica* contains antinutrients like oxalate, phytate, tannin and saponin in a higher amount. To reduce these factors, microwave treatment for 2.5 minutes has been reported to be the most effective by Rafiq *et al.* (2016). *Lathyrus sativus* Linn contains a large number of antinutritional substances of which the most frequently occurring are tannin, phytic acid, trypsin inhibitor and  $\beta$ -ODAP ( $\beta$ -Oxalyl-diamino-propionic acid). Fermentation of *Lathyrus* seed reduces tannin and phytic acid approximately by 80% and extrusion of the seeds results in the more reduction of  $\beta$ -ODAP level approximately by 46.09% (Ramachandran and Ray, 2008). Raw leaves of *Moringa oleifera* are rich in phytate, total phenol, saponins and tannins. However, the juice extracted from leaves contains no tannins (Nikolaus *et al.*, 2001). Roasting for 50 minutes at 120°C has been found effective in reducing the antinutrients like tannins, oxalates, phytates and saponins in *Junglans nigra*. However, for reducing steroids and trypsin inhibitors, toasting at 140°C for 50 minutes is found to be effective (Nwosu *et al.*, 2005).

#### Future prospects

Utilization of edible parts of wild trees can provide an alternate source of nutrition to meet the increasing food supply and food security demands of the country. Physicochemical analysis of the wild produce suggests them as a potential and economic source for the development of nutraceuticals and functional foods. Commercialization of wild produce can generate income for hill folks with the additional benefits of forest conservation. However, the presence of anti-nutrients is a limitation with wild produce and scientific interventions in terms of processing techniques can minimize the same. Development of new food recipes and nutraceuticals are needed to enhance the utilization of wild produce. This review vividly suggests the incorporation of wild produce into regular consumption to add variety to the diet and meet food and nutritional security of the population.

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