

Nutraceutical potential of *Rubus ellipticus*: a critical review on phytochemical potential, health benefits, and utilization

Short title: *Rubus ellipticus*: a review

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Abstract

*Yellow Himalayan raspberry or Hisalu/Hinsar (*Rubus ellipticus*), belonging to family Roseaceae, is listed in top ten wild edible medicinal plant. It comprises about 1500 species distributed all over India as well as world. The fruit is round yellow cluster of drupelets type and contains numerous compounds (protein, lipids, carbohydrates, fibre) and phytochemicals (anthocyanin, phenolics, antioxidants, ascorbic acid, flavonoids) as well as minerals (phosphorus, potassium, calcium, magnesium). Because of these, it possesses many health benefits and traditionally being utilized for curing fever, cough, sore throat and coronary heart diseases. Beside fruits, folks also utilize the paste/powder of leaves, shoots and roots for the effective treatments of wounds, bone fracture, stomach-ache, bacterial infection and tumours. Owing to the good blend of acids (malic, citric, tartaric) and sugars, it have ability for its utilization in food product development i.e. jams, squash, wine, vinegar, juice, etc. However, it is still unable to get its identity due to its negligence by the processors and researchers. The aim of the present review is to focus on the*

composition, health benefits of different parts and its potential applications in food industry to attract the processors and researchers and thus, the theme of the review will be achieved.

Keywords: *Rubus ellipticus; Phytochemicals; nutritive value; utilization*

Introduction

It is truly said that nature is the best physician as the natural healing force within each of us is the greatest force to recover from any disease in getting well. Nature itself is the cure of various illnesses but the need is to identify the healing source and to utilize the same for human welfare. Even today the medicinal plants are considered as a cheap source of medicine and drugs by the majority of population. Various trees, plants, shrubs and herbs have been used since ancient times for curing of different ailments. *Rubus ellipticus* is one of them, which belongs to the genus *Rubus* and *Rosaceae* family having more than 750 species. The plant is well known for its pharmacological properties, and has been categorized under top ten wild edible medicinal plants (Pandey and Bhatt, 2016).

Rubus ellipticus, commonly called yellow Himalayan raspberry is also known by various other names viz. Indian raspberry tree (AlQahtani et al., 2017), Cheeseberry (Wu et al., 2013) etc. It is a thicket which attains height upto 3m and forms a thorny shrub having pink or white petals. The plant is invasive in Australia, Hawaii, U.S.A. and was first naturalized in Queensland in 1912 and then in many other countries namely, tropical Africa, England, West Indies, tropical regions of Southern America (Wu et al., 2013, Wu et al., 2014). Being invasive, it is capable of replacing the native vegetation of a particular area in which it is growing. It has been categorized as one of the major threats in Ola'a Forest Tract of Hawaii's Volcanos National Park where it

has displaced the native vegetation and plant species including *Rubus hawaiiensis*, which is native Hawaiian raspberry whereas in Queensland it is declared as noxious plant (Wu et al., 2013). Beside this, the plant exhibit various biological properties such as anti-inflammatory, analgesic, antipyretic, antiproliferative, antitumor, antioxidant, anticonvulsant, etc. and has immense ethnomedicinal value because of its numerous compounds (George et al., 2013; Saini et al., 2013; Badhani et al., 2015; George et al., 2015). It is thus being used traditionally but it is losing its identity in the modern era due to the negligence of researchers and processors. This review majorly focus on the area and distribution of *Rubus ellipticus*, its composition and nutritive value, medicinal properties, utilization and future prospective with the aim of dispersing the facts related to it.

Area and production

Rubus ellipticus is a weedy wild raspberry, makes its presence in wet forests, and grows vigorously in sunny open pastures as well as deep rain forests; because of this, it grows abundantly in the forests at high altitudes like Himalaya and Nilgiris region. Beside these all, plant is very hard and has the ability to adapt and grow under the biotic and abiotic environmental factors by developing the natural resistance mechanism (George et al., 2013). The plant was first naturalized in Queensland and is native to Southern Asia, South east Asia, South western China, Sikkim, Myanmar, Bhutan, Laos, Pakistan, Sri Lanka, Nepal, Philippines, Vietnam, Thailand and India (distributed in Himalayan foothills, Nilgiri and Penisular hills region) (Wu et al., 2013). In Australia, the plant is confined to coastal strips of the Southern Queensland whereas bit of it is found in Central coastal region of New South Wales (Wu et al., 2014). It is categorized under world's 100 worst invasive species (Lowe et al., 2000). It grows

along roadsides, hillsides, in thickets, slopes, mountain valleys, sparse forests at an altitude of 300-2600 m (Wu et al., 2014; Ding et al., 2008). The blooming season of the plant is from March to April (Pandey and Bhatt, 2016), whereas the fruiting season is from April to May (Ding et al., 2008) bearing golden yellow fruits. The plant grows in the region where annual rainfall ranges from 2000 to 6500 mm.

Composition and nutritive value

The major components contributing towards the composition of *Rubus ellipticus* fruit are moisture and carbohydrates. Beside these, the fruit also contain numerous minerals (Saklani et al., 2012; Ahmad et al., 2015). The proximate composition of *Rubus ellipticus* is given in Table 1. Phytochemical screening of fruit yields flavonoids, glycosides, steroids, phenols, tannins, antioxidants, anthocyanin, ascorbic acid, and resin (Saklani et al., 2012; Karuppusamy et al., 2011) (Table 1). The qualitative analysis of amino acid screening of *Rubus ellipticus* fruit showed the presence of L-Hydroxyproline, DL Iso-leucine, DL Valine, DL-2-Aminobutyric acid, L-Cystein hydroxyl, DL-Nor-leucine, DL Alanine, L-Glutamic acid, L-Arginine, DL-Aspartic acid, L-Cysteinhydroxychloride, L-Leucine, L-Lysine monochloride, DL-Methionine, DL-Threonine, L-tyrosine. Due to high content of fibre, fats, minerals, proteins, 200 gm of fruit is sufficient to fulfil the daily nutritional requirement of an individual (Saklani et al., 2012).

Table 1. Proximate composition of fruit of *Rubus ellipticus* on dry basis

Parameters	Values	Reference
Physico-chemical attributes (On dry basis, %)		
Moisture	66.36-80.6 (wet basis)	(Andola and

Crude protein	3.68 ± 0.04 (wet basis) and 4-4.37 (dry basis)	Purohit, 2010;
Ash	1.30 ± 0.05 (wet basis) and 2.97-4.1 (dry basis)	Saklani et al.,
Carbohydrates	27.12± 0.12 (wet basis) and 72.7-86.4 (dry basis)	2012; Ahmad et
Crude fibres	2.35 ± 0.05 (wet basis) and 3.53-7.9 (dry basis)	al., 2015)
Crude fat	0.96 ± 0.20 (wet basis) and 7.10 (dry basis)	
Energy value (Kcal/100 g)	370.7-374 (dry basis)	
Phytochemicals		
Anthocyanin (CGE/100 g)	1.71±0.08	(Karuppusamy
Total phenolics (GAE/100 g)	72.0±1.25	et al, 2011)
Antioxidant activity (DPPH µg/ml)	196.4±1.80	
Ascorbic acid (AAE/100 g)	1.05± 0.03 (wet basis) and 44.0±4.95 (dry basis)	
Total flavonoids (QE/100 g)	86.4±2.04	
Minerals (mg/100 g, on wet basis)		
Phosphorus	0.20	(Saklani et al.,
Potassium	1.82	2012)
Calcium	0.95	
Magnesium	5.60	
Minerals (mg/100 g, on dry basis)		
Potassium	680.16±1.27	(Ahmad et al.,
Nitrogen	700±0.08	2015)
Phosphorus	1.26±0.001	
Sodium	89.43±0.01	

Calcium	450.1±0.22
Magnesium	118.72±0.48
Iron	4.249±0.15
Zinc	12.77±0.05
Copper	0.020±0.01
Lead	0.02±0.18
Manganese	1.948±0.03
Chromium	0.47±0.19

Medicinal properties of plant *Rubus ellipticus*

Rubus ellipticus is rich in phytochemicals and is traditionally being used as a source of medicine. Every part of the plant (Fig. 1) is rich in one or more essential component which can be used either in manufacturing of drugs or the part itself can be used in various forms such as laxative, decoction and many more. The complete plant is astringent in nature and is used to lower down the body temperature during fever, especially during typhoid (Pandey and Bhatt, 2016). The fruit possess laxative properties and is thus used in traditional medicinal system of Tibet and in folk medicinal system (George et al., 2013). The fruit of *Rubus ellipticus* (edible part) is a rich source of natural antioxidants, which helps in reducing the oxidative stress and thereby protects the body against degenerative diseases including cancer upon the direct consumption. The young roots and shoots of the plant are effective during stomach ache, abdominal pain, colic pain, etc. In Unani and Ayurveda, antifertility property of plant *Rubus ellipticus* has been reported (Pandey and Bhatt, 2016). The plant is also used for wound healing, gastralgia, dysentery, ulcer, diabetes mellitus, antifertility, analgesic, antimicrobial and epilepsy

(Vadivelan et al., 2009). Various biological activities (medicinal value) and traditional uses of *Rubus ellipticus* are given in Table 2 and 3 respectively.



Fig. 1 Different parts of *Rubus ellipticus*

Table 2.Biological activities of *Rubus ellipticus*

Sr. No.	Plant part	Biological activity	Key findings	References
1	Fruits	Antidiabetic activity	Fruit extract of <i>Rubus ellipticus</i> exhibit anti diabetic effects in experimental models of diabetes mellitus.	(George et al., 2015)
		Antioxidant activity	Highest antioxidant activity was noticed in acetone extract (619.3 mg CE/100 g) whereas the antioxidant activity through acidic methanol and methanol was 502.2 mg CE/100 g and 521 mg CE/100g respectively.	(Saini et al., 2013)
		Antiproliferative activity	The methanol and acetone extract of fruit exhibits significant antiproliferative activity against C33A cells.	(Saini et al., 2013)
2.	Leaves	Nephroprotective activity	The ethanolic, petroleum ether and aqueous extract of fruit exhibits nephroprotective potential and improves the histological derangements.	(Pandey and Bhatt, 2016)
		Larvicidal activity	The aqueous extract (1 mL) of leaves along with 249 mL of	(AlQahtani et

	dechlorinated water exhibit larvicidal activity against <i>Culex quinquefasciatus</i> , <i>Aedes aegypti</i> , <i>Anopheles stephensi</i> . (al., 2017)
Ovicidal activity	The leaf extract of <i>Rubus ellipticus</i> was found to be toxic against <i>Culex quinquefasciatus</i> , <i>Aedes aegypti</i> , <i>Anopheles stephensi</i> .
Antitumor activity	Methanolic extract of <i>Rubus ellipticus</i> leaf showed significant reduction in volume of solid tumor in Swizz albino mice. (George et al., 2015)
Wound healing property	<i>Rubus ellipticus</i> methanolic extract aids in faster healing of wound in Swizz albino mice when used in 1% and 2% concentration. (George et al., 2015)
Antioxidant activity	100 µg/ml methanolic extract of <i>Rubus ellipticus</i> inhibited 71.08 % of Nitric oxide free radicals as compared to rutin. (George et al., 2015)
Antipyretic activity	Methanolic leaf extract of <i>Rubus ellipticus</i> leaves at 200 and 400 mg/kg significantly decreased the rectal temperature. (George et al., 2013)

Anti-inflammatory activity	Methanolic leaf extract of <i>Rubus ellipticus</i> leaves at 200 and 400 mg/kg inhibited the increase in thickness of paw edemata in rats which were carrageenan induced.	(George et al., 2013)
Analgesic activity	Methanolic leaf extract of <i>Rubus ellipticus</i> leaves at 200 and 400 mg/kg possessed significant analgesic activity against writhing in animals treated with aspirin	(George et al., 2013)
Anticonvulsant activity	The leaves of <i>Rubus ellipticus</i> possess anticonvulsant activity against electrically induced convulsions.	(Pandey and Bhatt, 2016)
Antifertility and anti-implantation activity	Alcoholic extract of leaves in female Wistar albino rats decreased the implantation sites and increased resorption sites which signify the early abortifacient activity.	(Pandey and Bhatt, 2016)
3. Root and shoot activity	Antiprotozoal activity was observed against <i>Entamoeba histolytica</i>	(Patel et al., 2014)

Table 3.Traditional uses of plant *Rubus ellipticus*

Sr. No.	Plant Part	Traditional use	Reference
1.	Fruits	<ul style="list-style-type: none"> • Fruit possess febrifuge, laxative properties and is used as carminative. • It is eaten during indigestion. • Being fibrous in nature, it helps in digestive process. • Fruit juice is given during fever, to bring the body to normal temperature. • Fruit juice is taken in case of sore throats, cold and for colic. • Ripened fruits are used as laxative and are used to treat constipation when taken as decoction. 	<p>(Amjad and Arshad, 2014; Pandey and Bhatt, 2016)</p> <p>(Kala, 2005)</p> <p>(Pandey and Bhatt, 2016)</p> <p>(Doyydaitis, 2017)</p>

- The paste of young fruits is advised during gastritis, dysentery and diarrhoea. (Pandey and Bhatt, 2016)
2. Root
- The juice is considered to be effective against infection in urinary tract. (Uprety et al., 2010)
 - Children are given root juice decoction to get rid of stomach worms and for other gastric problems. (Long and Li, 2004; Singh et al., 2011; Pandey and Bhatt, 2016)
 - The juice is given in case of kidney problems. (Hazarika and Pongener, 2018)
 - Root juice is given during fevers, diarrhoea and dysentery. (Pandey and Bhatt, 2016)
 - Root paste, when applied aids in healing wounds at faster pace. (Pandey and Bhatt, 2016)
 - Root paste is applied as poultice during treatment of bone fracture.
 - During headache, root paste is applied on forehead to get relief.
3. Shoot
- The juice of the shoots is effective during colic pains. (Patel et al., 2004)
 - Decoction of young shoots is advised during stomach ache. (Hazarika and

- Pongener, 2018)
- Young shoots can be chewed directly to get relief from stomach pain. (Pandey and Bhatt, 2016)
4. Bark
- Root bark decoction is advised during stomach ache. (Hazarika and Pongener, 2018)
 - Inner bark of the plant is used as anti-diuretic and kidney tonic. (Pandey and Bhatt, 2016)
 - Inner bark is helpful during vaginal discharge and during the weakening of senses. Renal tonic is made from inner bark which is useful in treatment of micturition during sleep. (Pandey and Bhatt, 2016)
 - During summer, the inner bark is used to increase sweating as diuretic and diaphoretic.
 - Bark is used in cough, cold and various blood disorders. (Wangchuk et al., 2017)
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Modern uses

The fruit of *Rubus ellipticus* are not only edible but are also delicious and have the ability to be utilized in food industry as a very good substrate. The antioxidant potential of this fruit i.e., *Rubus ellipticus* makes it useful for the development of various supplemented probiotic products (Kumar and Kumar, 2016). Beside all these, nowadays it is also used for manufacturing of purplish blue coloured dyes (Pandey and Bhatt, 2016). But, the scientific intervention in the processing of this crop is a lacking issue and this crop is still unexplored, and needs to be exploited with the passage of time for the development of wide range of food products. Owing to its composition, berries can be utilized for development of the numerous food products (juice, squash, jam, jelly, preserve and candy) and pharmaceutical products (Fig. 2) with the intervention of researchers and processors for their wide popularization.

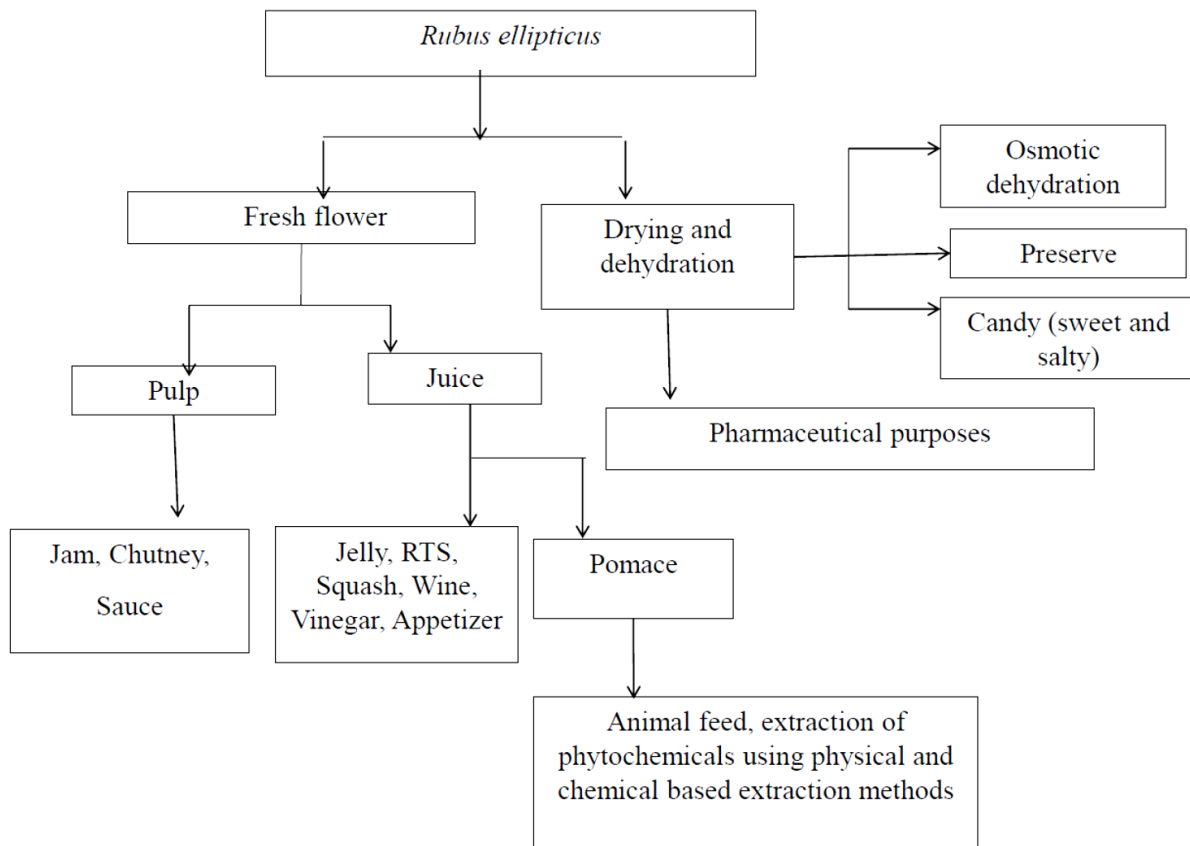


Fig. 2 Future prospective of *Rubus ellipticus*

Conclusion

Rubus ellipticus berries are not available throughout the year and have the limited availability at few places only as per its habitat. So, in order to preserve the fruit and make it available throughout time, it's processing and preservation can be used as a weapon which may help in enhancement of the employment of rural people. More research is still required for attracting the food processors and industrialists for its value addition and creating awareness about its high nutritive and medicinal value among consumers.

Abbreviations

CGE/100g: cyanidin-3-glucoside equivalents per 100 g; Gallic Acid Equivalent per 100 g; DPPH: 2,2-diphenyl-1-picrylhydrazyl; ascorbic acid equivalent per 100 g; QE/100g: quercetin equivalent per 100 g; CE/100g: catechin equivalent per 100 g; $\mu\text{g/ml}$: microgram/ml; mg/kg : milligram per kilogram.

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