A REVIEW ON THE PHYTOCHEMICAL, PHARMACOLOGICAL AND TRADITIONAL PROFILE ON THE RUBUS GENUS IN NORTH-EASTERN AND WESTERN PARTS OF INDIA

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Abstract

**Background:** Rubus is a diverse genus belonging to Rosaceae family. The genus Rubus is one of the less explored genera consisting of blackberries, raspberries, dewberries, etc. It is mostly consumed by the ethnic communities of India as a source of medicine. This genus has shown many health benefits to the people such as in antimicrobial infection, antidiabetic, hepatoprotective and many more.

**Objective:** The objective of the review is to explore the pharmacological, traditional and phytochemical aspects of the Rubus genus.

**Methods:** An extensive literature research was carried out using keywords ‘Rubus’ in combination with ‘northeast India’ and/or ‘pharmacological’ and/or ‘phytochemical’ and/or ‘traditional’ on search engines viz, web of science, PubMed, Science Direct, India biodiversity portal and Google Scholar.

**Discussion:** From the literature survey it was analysed that it is a very large genus of flowering plants widely available and having potential medicinal benefits. Used traditionally as a potential healer. Rubus has many important compounds present in them and thus researchers are testing out various pharmacological activities.

**Conclusion:** Further extensive researches can be carried out in this genus as the genus Rubus shows potential benefit as a future therapy.

**Keywords:** Rubus; Pharmacology; Antimicrobial activity; Anti-inflammatory activity; Traditional uses; Phytochemistry.

Introduction

Rubus is a diverse genus of flowering plants belonging to the family Rosaceae. This genus mainly consists of blackberries, raspberries, and dewberries. Most of these plants have a woody stem with prickles like roses [1,2]. Spines, bristles, and gland-tipped hairs are also common characteristics in this genus. The blackberries, and a variety of other Rubus species with piling or rambling growth habits, are known as brambles. Although the term bramble is not used for raspberry that grows like
upright canes, or for trailing or prostrate species, such as most dewberries, or various low-growing boreal, arctic, or alpine species. Most species are hermaphrodites except *Rubus chamaemorus*.

The genus *Rubus* has been known to possessed antioxidant activities, and provide prevention of various oxidative stress-associated diseases such as cancer, inflammation, and diabetes. In the past few years, the identification and development of phenolic and other components or extracts from various plants of the *Rubus* genus have become a major concern. [3-5] The genus *Rubus* contains a variety of plant forms. This genus exists from sea level to 4500m and is native to six continents. More than 740 species have been described worldwide. *Rubus* species include plants that are climbing, slow-growing, and upright shrubs. The leaves come in many shapes, including those similar to bamboo, maple, apple, hawthorn, and grape. The fruit colour ranges from white, yellow, orange, red, purple to black. More than 18 countries have established gene banks to preserve members of this genus.

**Fig 1:** *Rubus ellipticus*  
**Fig 2:** *Rubus moluccanus*

**Phytochemistry**

To date, this large genus which has more than 100 species have been investigated in order to identify chemical constituents of the plant. *Rubus* is characterized by their ability to synthesize and accumulate ellagitannin. Although it contains many other biologically active ingredients, such as flavonoids, anthocyanins, tannins, etc.
Compiling the list of components of *Rubus* species. A list of contents from different sources has been described below.

**Phenolic compounds**

Phenolic compounds represent structurally diverse classes of compounds having different kinds of conjugates. Plant phenols can occur mainly in conjugated forms with one or more sugar residues linked to hydroxyl groups. A direct linkage to the aromatic carbon of the sugar also exists. One of the largest plant metabolites is a phenolic compound and is very important for human diets. Due to the health benefits of plant-derived phenols, there has been an increased interest in the study of phenols. Soft fruits are a rich source of polyphenolic antioxidants and are widely distributed in the plant kingdom.

Berries of *Rubus* species such as raspberry, blackberry, etc provide delicious fruits that can be consumed raw or can also be taken in form of products such as jams, juices, and liquors. The extracts of these berries contain phenolic compounds that have shown to inhibit oxidation and inhibit the growth of pathogenic bacteria. Hydrolysable tannins such as Gallo and ellagitannins represent the major class of phenolic compounds in *Rubus* berries. The second most abundant class of pigmented berries are anthocyanins while compounds such as hydroxycinnamic acids, flavanols, flavan-3-ols, and proanthocyanins constitute the minor ones.[6-9]

Ellagitannins are the most widespread tannins reported in the *Rubus* genus. Analysis of extracts of raspberries (*Rubus ellipticus*) reported significant quantities of an ellagitannin, sanguin H-6, with lower levels of a second ellagitannin, lambertianin C. The fruits of *Rubus niveus* have shown higher tannins content which is related to the antioxidative property with anticarcinogenic, antimutagenic potentials of high molecular weight phenolics, which is important in protecting cellular oxidative damage.

**Flavonoids**

Flavonoids are known to be a complex group of polyphenolic plant metabolites. These are mainly found in the foods that human beings consume. Reports on the flavonic composition of the *Rubus*genus mainly consist of *R. ellipticus* (Figure 1) and *R. niveus*. Flavonoids are ubiquitous dietary chemicals with significant influence in vivo effects within the immune system comprising the inflammatory response. In case of flavonoid content *Rubus ellipticus* (Figure 1) was found to possessed higher flavonoid content in relation to *Rubus niveus* and *R. moluccanus* (Figure 2). Generally, blackberry leaves consist of higher flavonoid content than raspberry leaves. [10-12]
Anthocyanins

Anthocyanins are naturally occurring phenolic compounds. The colour appearance of many plants, flowers, and fruits is due to the presence of anthocyanins. These compounds are also of great importance due to their pharmacological activities. The extracts of berries of *Rubus* species have been found to contain high amounts of anthocyanins. The composition of anthocyanins of various fruits of the *Rubus* species is quite distinctive. [13-16] Wild raspberry (*R. moluccanus*) (Figure 2) contains a distinct spectrum of anthocyanins. The major components are cyanidin and cyanidin-3-sophoroside, with smaller quantities of other anthocyanins, including cyanidin-3-(2G-glucosylrutinoside), cyanidin-3-glucoside, cyanidin-3-rutinoside, and pelargonidin and its glycosides. The antioxidant capacity of *Rubus* fruits can be related to their phenolics, flavonoids, tannins and anthocyanin contents. Correlations and regression analysis between phenolics, flavonoids, tannins, anthocyanin's contents, and antioxidant activity obtained from *Rubus* spp. shows a positive correlation between all the estimated phytocompounds. [17,18]

Terpenoids

Terpenoids occur naturally and provide a variety of functions. The most widespread terpenoids reported in *Rubus* species are triterpenoids. Triterpenoids constitute a large, diverse group of active natural products derived from squalene. More than 4000 triterpenoids have been isolated so far and over 40 skeletal types have been identified. Reports on the triterpenoid composition of the *Rubus* genus are widely recorded in the literature.

The methanolic extract of *R. idaeus* has been found to yield novel ursane- and oleanane-type triterpenoids, such as olean-12-ene-3β,29-diol and urs-12-ene-3β,30-diol [19,20]. Reports on triterpene components of other species of *Rubus* have been found in the literature. Along with five known triterpene glycosides, a new triterpeneglucosyl ester named crataegioside, was also identified.

Pharmacological activity

Several types of research conclude the benefit of using *Rubus* spp. extracts, these include analgesic, anti-inflammatory, anti-carcinogenic, nephroprotective, antibacterial, and hypoglycaemic activities. Many pharmacological studies have pointed out the fractions of either a plant species of the *Rubus* genus or “a crude drug”. A number of studies, however, have focused on the bioactivity of specific isolated compounds (s). Some of these were isolated using bioassay-guided fractionation after previously detecting activity in the plant part.[19]

Anti-inflammatory and antioxidant activity
Traditional remedies are used for anti-inflammatory diseases. It is, therefore, crucial to evaluate the potential of herbal remedies for the discovery of novel bioactive compounds that might serve as leads for the development of potent drugs. Various research groups have initiated anti-inflammatory screening programs for plants used as anti-inflammatory agents in the treatment of several pathologies in traditional medicine all over the world, although other uses have also been suggested. Some of these studies focus on species belonging to the genus *Rubus*. [20-29]

A study conducted by Arun Kumar and Uma Shankar Sharma shows the presence of antioxidant property in *Rubusellipticus*(Figure 1). DPPH radical scavenging assay and reducing power methods were the two methods that were used to identify the in-vitro antioxidant activity of plant extracts. Fruit extracts of *Rubusellipticus*(Figure 1) have got profound antioxidant activity. The DPPH antioxidant assay involves the ability of DPPH which is a stable free radical, that decolorizes in the presence of antioxidants. An odd electron present in DPPH radical is responsible for the absorbance at 517 nm as well as for visible deep purple colour. DPPH is decolorized when it accepts an electron donated by an antioxidant compound which is further quantitatively measured by the changes in absorbance. All the fruit extracts of *R. ellipticus*(Figure 1) exhibited significant dose-dependent inhibition of DPPH activity. The study concluded that an ethanolic extract of *Rubusellipticus*(Figure1)fruits was a significant source of natural antioxidants, which aids in preventing the progress of various oxidative stress. [30-32]

Many researchers reported that the anti-inflammatory and antioxidant activities of the *Rubus* species are mainly due to triterpenoids and tannins. Some of these compounds were isolated by bioassay-guided fractionation procedures after previously detecting activity in the part of the plants.

**Anti-microbial activity**

The antimicrobial activity of *Rubusmoluccanus*(Figure 2)and*Rubusellipticus*(Figure 1) were evaluated by using the agar-disc diffusion method with minor modifications. It was observed that *Rubus* species displayed numerous secondary metabolites and the effects of the extract against some common pathogenic bacteria were investigated. The result demonstrated that *R. moluccanus*(Figure 2) and *R. alpestris* were effective against Gram-positive and Gram-negative bacteria. Various strains of bacteria such as S. aureus, B. subtilis, and E. coli were tested against the *Rubus* spp. extract and it was found that some phenolic compounds including flavone, quercetin, and naringenin were the primary potential compounds that contributed to the antibacterial activities against these bacterial strains. Other than this compounds such as anthocyanidin, pelargonidin, delphinidin, cyanidin, and cyanidin-3-glucoside in berry extracts were also able to inhibit the growth of E. coli.
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It has been found out that due to some genetic and environmental factors there is high variability in the phytochemicals content of *Rubus*. Methanol-water extracts of *R. moluccanus* (Figure 2), *R. fraxinifolius*, and *R. alpestris* fruits showed a significant number of phytochemicals, which contribute to antibacterial. Berries of the plant *Rubus moluccanus* (Figure 2) were reported to contain several biologically active chemicals and also reported to possess anti-microbial activities. The ethanolic extract of the leaves of *Rubus moluccanus* (Figure 2) was also found to possess similar compounds and exhibit significant antimicrobial and anthelmintic activities against the tested organisms. Therefore, the Pharmacological potential of the plant extract may be due to the same chemical compounds. [33]

**Other activities**

A variety of other pharmacological actions have been reported for the *Rubus* genus and compounds isolated from their species. Among the widespread traditional medicinal uses of some *Rubus* species (*Rubus ellipticus*) (Figure 1) is that of hypoglycemic agents in the management of diabetes mellitus. Jouad et al. investigated the hypoglycemic effect of *R. fruticosus* in normal and streptozotocin-induced diabetic rats. In both types of rats, single and repeated oral administration of the plant produced a decrease in blood glucose levels. However, treatments did not affect insulin secretion in either normal or streptozotocin-induced diabetic rats, indicating that the mechanism(s) by which this plant decreases blood glucose levels is extra-pancreatic. These findings indicate that *R. fruticosus* acts as a potential agent for lowering blood glucose levels. The hypoglycemic effect of five medicinal plants was studied on alloxan-induced diabetic rats. The results showed that each plant studied, including *R. niveus*, significantly lowered blood glucose. *R. niveus* also showed antinociceptive action within the writhing test in mice, and antispasmodic activity on isolated guinea-pig ileum and rat duodenum. [34-37]

The *in-vitro* study for relaxant activity was tested using extracts of dried raspberry (*R. idaeus*) leaves. The leaves of *R. idaeus* were prepared with different solvents and were tested on transmurally stimulated Guinea-pig ileum. Several pieces of evidence suggest that there are components of raspberry leaf extract that are responsible for relaxant activity in *in-vitro* gastrointestinal preparations. The compounds liable for this activity are reported to be the ellagitannins lambertianin C and sanguin H-6, a triterpenoid, triterpenoid glycosides, and an open chain alcohol glycoside [38]. Nephroprotective evaluation of *Rubus ellipticus* (Figure 1) fruit was performed on gentamicin and cisplatin-induced nephrotoxicity in rats. The pet ether and aqueous extract of the fruits are found to be less significant than the ethanolic extracts. The
nephroprotective activity of all the extracts against cisplatin and gentamicin-induced models may possibly due to the presence of phytoconstituents like carbohydrate, alkaloid, saponin, tannin, triterpenoids, flavonoids. [39-44]

**Traditional uses of Rubus**

*Rubus* has been known to be used traditionally all around the world. Some of the known traditional uses include treatment for wound healing, ulcers, gastrointestinal illness, diabetes and bacterial/fungal infection. Many *Rubus* species have also been used for analgesic, anti-inflammatory activities. [45-58]

**Table 1: Rubus species used traditionally by different communities**

<table>
<thead>
<tr>
<th>S.N o.</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Place of use/tribes</th>
<th>Parts used/preparations</th>
<th>Mode of action</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jutuli-poka, Katsol, Anshu, Wild raspberry</td>
<td><em>Rubus moluccanus</em></td>
<td>Dhemaji district (Assam)</td>
<td>Fruits, young shoots are taken.</td>
<td>Helps in enhancing fertility in female</td>
<td>[45]</td>
</tr>
<tr>
<td>2</td>
<td>Jetuli-poka</td>
<td><em>Rubus moluccanus</em></td>
<td>Koch-Rajbongshi and Rangia tribes of North kamrup (Assam)</td>
<td>Leaf extract</td>
<td>Taken orally to reduce headache</td>
<td>[46]</td>
</tr>
<tr>
<td></td>
<td>Species</td>
<td>Rubus genus</td>
<td>Ethnic communities</td>
<td>Uses</td>
<td>Reference</td>
<td></td>
</tr>
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<tr>
<td>3</td>
<td>Jejeli-poka</td>
<td>Rubus alceifolius</td>
<td>Root, tender shoot, fruit</td>
<td>Root to relieve pain in dysmenorrhea. Tender shoot for cough and pneumonia. Unripe fruit is rubbed over tongue to cure fungal infection.</td>
<td>[47]</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Soh-shiah</td>
<td>Rubus ellipticus</td>
<td>Khasi and Garo tribes of Meghalaya</td>
<td>Fruits and roots</td>
<td>Dysentery</td>
<td>[48]</td>
</tr>
<tr>
<td>5</td>
<td>Sohnepbah</td>
<td>Rubus micropetalus</td>
<td>Khasi traditional healers in Meghalaya</td>
<td>Fruits and stem</td>
<td>Fruits taken to cure cough. Crushed stem bark to cure mouth ulcers</td>
<td>[49]</td>
</tr>
<tr>
<td>6</td>
<td>Soh-shiah</td>
<td>Rubus ellipticus</td>
<td>East Khasi hills district (Meghalaya)</td>
<td>Roots</td>
<td>Taken for rheumatism, ulcer and skin infection.</td>
<td>[50]</td>
</tr>
<tr>
<td>7</td>
<td>Raspberry</td>
<td>Rubus ellipticus</td>
<td>Tripura</td>
<td>Fruit</td>
<td>Consumed as a table fruit</td>
<td>[51-53]</td>
</tr>
<tr>
<td>8</td>
<td>Heijampet, Yellow raspberry</td>
<td>Rubus ellipticus</td>
<td>Meitei commun</td>
<td>Fruits, leaves</td>
<td>Fruit against diarrhoea.</td>
<td>[54]</td>
</tr>
<tr>
<td>Number</td>
<td>Latin Name</td>
<td>English Name</td>
<td>Place of Use</td>
<td>Uses</td>
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<tr>
<td>9</td>
<td><em>Heijampeta muba, Ceylon blackberry</em></td>
<td>Rubus moluccanus</td>
<td>Manipur and roots</td>
<td>Root for dysentery. Leaves for abortifacient</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Meitei community of Manipur</td>
<td>Fruit, leaves and root</td>
<td>Fruit against diarrhoea and root for dysentery and leaves for abortifacient</td>
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<td></td>
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<tr>
<td>10</td>
<td><em>Lamhejampet</em></td>
<td>Rubus ellipticus</td>
<td>Manipur</td>
<td>Leaf</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Fresh tender leaves are chewed</td>
<td>Fresh tender leaves are chewed for tongue sores.</td>
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<td></td>
<td></td>
<td>for tongue sores.</td>
<td></td>
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<tr>
<td>11</td>
<td><em>Heimang</em></td>
<td>Rubus calycinus</td>
<td>Bishnupur district (Manipur)</td>
<td>Leaf</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Leaves and roots</td>
<td>Leaf for urinary complex and painful menstruation. Root used in colic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><em>Hmu-bel-bing</em></td>
<td>Rubus indotibetanus</td>
<td>Mizos of Mizoram</td>
<td>Fruit</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>To cure headache</td>
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</tbody>
</table>
A review on the *Rubus* genus

pharmacological activity of this genus. From those studies it was established that the plant species showed anti-inflammatory, analgesic, antioxidant and antimicrobial activities. Other activities such as relaxant, nephroprotective were also evaluated. *Rubus* has been known to be used traditionally all around the world. In north-eastern states of India, various tribal communities like the Koch Rajbanshi, Rangia tribes, Khasi tribes, Garo tribes and also the Meitei communities (of Meghalaya) are known to use some plant species of the genus *Rubus* for medicinal purposes such as skin disease, tongue sores, pneumonia, headaches, etc. Many more phytochemical, pharmacological studies can be researched further. This genus (i.e., *Rubus*) has not been explored much and further studies are required as it provides strong potential as a future therapy.

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