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Rhododendron: traditional vs modern, benefits for Himalayan Communities

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ABSTRACT

The *Rhododendron* dispersed all over the globe is an evergreen tree with light pink or deep red flowers, belongs to heather family *Ericaceae* which is recognized for its splendid flowers. The variety is generally dispersed contain high socioeconomic veneration and has been nominated as the state flower of Himachal Pradesh, Nagaland (India) and national flower of Nepal and also the state tree of Uttarakhand, the 27 state of the Republic of India. It is widely distributed between 77^0 35' & $81^0$01' East longitude, and $28^0$44' & $31^0$28' N Latitude. One of the *Rhododendron arboreum* is socioeconomically, nutraceutically, and medicinally a very significant plant species. In addition to its vast horticultural significance which generally used for plantations in the streets hilly areas or vessels for its aesthetically importance and decorative plant for gardens, it is a rich source of secondary metabolites due to which different fractions of the plant show therapeutic properties used for curing of several diseases. The plant flowers are conventionally consumed by the communities residing in the hilly area to make squash, honey, syrup, pickle, jam, juice and to treat several diseases and conditions like headache, diarrhea, inflammation, bacterial, and fungal infections. This review emphasizes on the nutritional, therapeutic and pharmacological properties of *Rhododendron* via manufacturing high value products to improve the livelihood of rural cultivator's and ethnic communities with more career opportunities.

Key words: *Himalayan communities, Pharmacological profile, Rhododendron arboreum, Socioeconomic life, Traditional knowledge.*

Introduction

Nature gives us an access to utilize diverse groups of plants with various uses and benefits that include fruits, flowers, other plant parts of therapeutic and nutritive value besides their ornamentation, and aesthetic value. Nowadays, the new plants are cultivated for therapeutic, commercial importance. Researchers are exploring the endangered plants which are consumed for their potential health and therapeutic purposes traditionally. India is recognized for its ancient Indian ayurvedic system and its enormous natural diversity which for the investigation of different plants for common healthcare. *Rhododendron* is one such plant that is gaining a unique position in the cultural as well as socioeconomic life of the Himalayan communities. The visitors attracted by the fascinating beauty of the fully blossomed flowers in the flowering season. Due to these reasons its flower has been permitted as the state flower of Nagaland, Himachal Pradesh (India) and national flower of Nepal (Srivastava, 2012). India has been recognized as a treasure house of aromatic and therapeutic plant variety. *Rhododendron* is one of the naturally occurring plants which hold several health benefits for instance of treatment and prevention of ailments linked with heart, dysentery, constipation, fever, detoxification, diarrhea, inflam-

mation, asthma, and bronchitis (Nisar *et al.,* 2013). The flower limited availability to researchers and processors in food and pharmaceutical sectors, among few exemptions therefore did not so far utilize it. This assessment focuses on locality, manufacture, distribution, composition, therapeutic properties, consumption and future potential of the *Rhododendron* with the aim of distributing the details related to it.

Introduction and distribution

Rhododendron primarily belongs in northern hemisphere genus dispersing from Europe to North America, Japan to Asia whereas from the north of the Equator (Fig. 1). The Britain has first record for the cultivation of *R. hirsutum* in 1650. The first documentation of discovery and recognition of *R. arboreum* species in India from Srinagar, Kashmir in 1796, however there is no genuine evidence of its introduction before 1817 (Milleville, 2002). Due to diverse species of its variety taxonomists have prepared different classifications based on morphological facts that are leaves, hair, flowers, etc. It includes 1200 species which is scattered all over the North America, Western Europe, Northeast Eurasia and Asia (Popescu and Kopp, 2013). Among all the *Rhododendron* variety, *R. arboreum* is broadly scattered and most normally establish subspecies revealed via Major General Thomas Hardwicke (Srivastava, 2012). *R. arboreum* has unique feature of three diverse colours of flower scattered from Sri Lanka and Nepal, Kashmir to Southeast Tibet (Kumar and Srivastava, 2002).

Characteristics and distribution of *R. arboreum* subspecies:

- *R. arboreum* spp. Nilagiricum (red flowers) found in Nilgiri.
- *R. arboreum* spp. Cinnamomeum (white, pink or red flowers) found in Central Himalayas.
- *R. arboreum* spp. Delavayii (red flowers) found in Eastern Himalayas.
- *R. arboreum spp.* Arboreum (red or rose red flowers) found in Western Himalayas.

It has also been generally cultivated in various parts of the globe due to its commercial, medicinal values, and tribal uses, which covers huge section of Southeastern Asia, Northwestern Himalaya throughout Central and Western China, Eastern Ti-

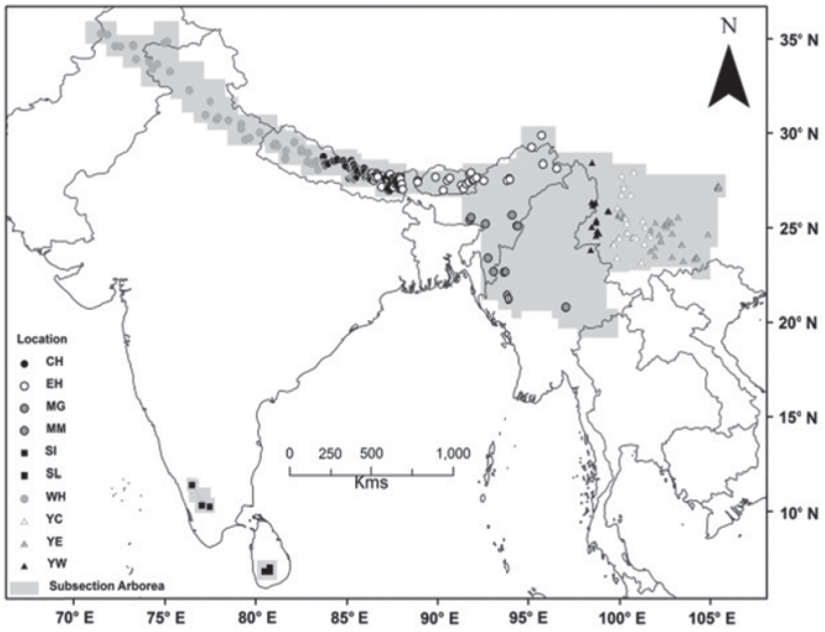

Fig. 1. Distribution range of the subsection *arborea* (section Ponticum and genus *Rhododendron*) in the South Asia, Southeast, Hengduan Mountains and Himalayas. The inset confirms the altitudinal distribution of *R. delavayi* (R. del) and *R. arboreum* (R. arb); sites were acquired from herbarium collections of tree *rhododendron* specimens. *R. delavayi* was explained in East Yunnan (YE); West Yunnan (YW), and Central Yunnan (YC). *R. arboreum* was explained in the remaining sites [Meghalaya—MG, Eastern Himalayas—EH, Central Himalayas—CH, Northeast India and adjoining hills of Sri Lanka—SL, Myanmar—MM, South India—SI, and Western Himalayas—WH] (Rawat *et al.,* 2017; Ranjitkar *et al.,* 2014).

bet, Nepal, Bhutan, Sikkim, Arunachal Pradesh, and Upper Burma (Kumar *et al.,* 2019).

Rhododendron arboreum chemical composition

Various minerals are present in *Rhododendron* such as lead, arsenic, nickel, molybdenum, copper, zinc, manganese, chromium, sodium, cadmium, and cobalt etc, which play an essential role in maintaining certain physicochemical processes vital for life. Molybdenum, manganese, zinc, copper, and iron are significant cofactors found in the configuration of certain enzymes and are crucial in several biochemical pathways. Sodium plays a vital role in maintaining the osmotic equilibrium between interstitial fluids and cells (Soetan *et al.,* 2010). *Rhododendron* plant parts contain phytochemicals which shows that the entire plant is a "mine of phytochemical," which is a non-nutritive but plant chemical have preventive or disease protective properties (Mohammad *et al.,* 2011). The plant have huge amount of secondary metabolites for instance glycosides, flavonoids, alkaloids, betulinic. Betulinic acid, lupeol, ursolic acid, β –sitosterol, saponins, gallic acid, amyrin, phenols, epifriedelanol, friedelin, quercetin, tannins, steroids, phlobatannins, anthraquinones, terpenoids, phlobatanins, reducing sugars, picen-3-yl acetate, 22-stigmasten-3-one, beta-amyrin, and linoleyl alcohol (Rawat *et al.,* 2018; Painuli *et al.,* 2016; Roy *et al.,* 2014; Nisar *et al.,* 2013; Nisar *et al.,* 2011; Sharma *et al.,* 2010). Plant contains secondary metabolites which play an important role in human healthiness.

Rhododendron conventional knowledge and utilization

Conventional knowledge is the foundation for numerous scientific researches, generation of new knowledge and commercial products. In such circumstances the local tribal groups of people have evolved knowledge and technique to protract livelihood and life with limited and locally available bio-resources. In India, mountainous states like Arunachal Pradesh, Sikkim etc. in India recently, the investigators took inquisitiveness in the consumption of the *Rhododendron* flower for the production of valuable foodstuffs but only some products exist in the bazaar. Few scientific canvassers have been prepared for the consumption of this flower, limited availability in limited places (only hilly areas) and the delicate character of the flower. Several types of the potential goods which can be manufacture from its flower are recommended in this review which will unlock a novel opportunity for the investigators and processors to utilize this flower commercially with value addition. Refreshing drink (juice) is manufacture from *Rhododendron* flower assumed to impart huge therapeutic significance. *Rhododendron* juice extraction can be made by two methods that is hot pressing and cold pressing although conventionally hot-pressing technique for juice extraction is used through the processor (Hillsjester, 2014). *R. arboreum* dried and fresh corolla used to eliminate fish bones get stuck in the throat (Rana *et al.,* 2015). Rural and hilly areas population of Nepalese and India utilize leaves, flowers, petals in diabetes treatment, healing external wound, anti-inflammatory, rheumatism, headache, nose bleeding, fever, stomach diseases, diarrhea, dysentery, digestive and respiratory disorder, vomit and loss of appetite, treatment of menstrual disorders, and use as heart tonic, get rid of bedbugs (Yadav *et al.,* 2014; Sharma and Samant 2014; Srivastava, 2012). Plant wood is used in making 'khukri' handles, charcoal for fuel, packsaddles, gift-boxes, gunstocks and posts (Chandra and Saklani, 2015). In hilly areas, flowers are used for the preparation of jellies, squash, jams, juice, and local brew, Asoka Aristha which possesses oxytocic, estrogenic, and prostaglandin synthetase-inhibiting activity, lipid peroxides, cardiac markers, antioxidants, isoproterenol-induced myocardial necrosis, potent dose-dependent analgesic action against peripheral, and central analgesic models (Ruderash *et al.,* 2012); (Verma *et al.,* 2012). Decoction of root treats early phase of cancer infection (Zhasa *et al*. 2015). *R. arboreum* shows different pharmacological properties including antimicrobial activity, antidiabetic activity and screening phytochemical (Chauhan *et al.,* 2016; Chandra and Saklani, 2015) (Fig 2).

Pharmacological properties of Rhododendron plant

Anti-inflammatory activity

The methanolic and ethyl acetate extract prepared from *R. arboreum* exhibited antinociceptive and anti-inflammatory effects due to the presence of saponins, flavonoids (hyperin), phytochemicals and tannins (Nisar *et al.,* 2014).

Hepatoprotective activity

The present of quercetin related phenolic, saponins, and flavonoids components present in *R. arboreum* (flower) ethyl acetate extract and (leaves) ethanolic extract have hepatoprotective activity (Verma *et al.,* 2011; Mani *et al.,* 2008).

Adaptogenic activity

Gallic acid and quercetin compounds obtained from methanolic extract of leaves revealed strong anti stress activity, adaptogenic activity, and antioxidant activity (Roy *et al.,* 2014).

Antioxidant activity

R. arboreum (petals) leaves be has high value polyphenols, quercetin, and flavonol which act as natural antioxidant activity to utilize in pharmaceutical industry, preventive medicine, nutraceuticals, and foodstuff (Bhandari and Rajbhandri, 2014; Acharya *et al.,* 2011; Mani *et al.,* 2008).

Immunomodulatory activity

R. arboreum (flower and Leaves) alcoholic extract revealed cell and humoral mediated immune responses in mice having effective anti-microbial, immunosupressive, anti-tumor, and immunomodulatory properties (Rawat *et al.,* 2018; Sonar *et al.,* 2013; Sonar *at el.,* 2012).

Anticancer activity

R. arboreum flowers and leaves alcoholic extracts confirmed major inhibition against MCF-7 breast cancer cell lines due to the presence of three terpenoids (one sterol β-Sitosterol, 10-Epoxyglutinane, ursolic acid-3) and two flavonids (Rutin, Quercetin) (Sonar *et al.,* 2012).

Antidiarrheal activity

The ethyl acetate extract of *R. arboreum* flowers possess strong antidiarrheal activity due to the presence of reducing sugars, sterols, and tannins (Verma *et al.,* 2011).

Antidiabetic activity

Active compounds from bark of *R. arboreum* discovered are extremely effective and selective inhibitors of α glucosidase act as antidiabetic agent which is higher than standard inhibitor acarbose. Flower

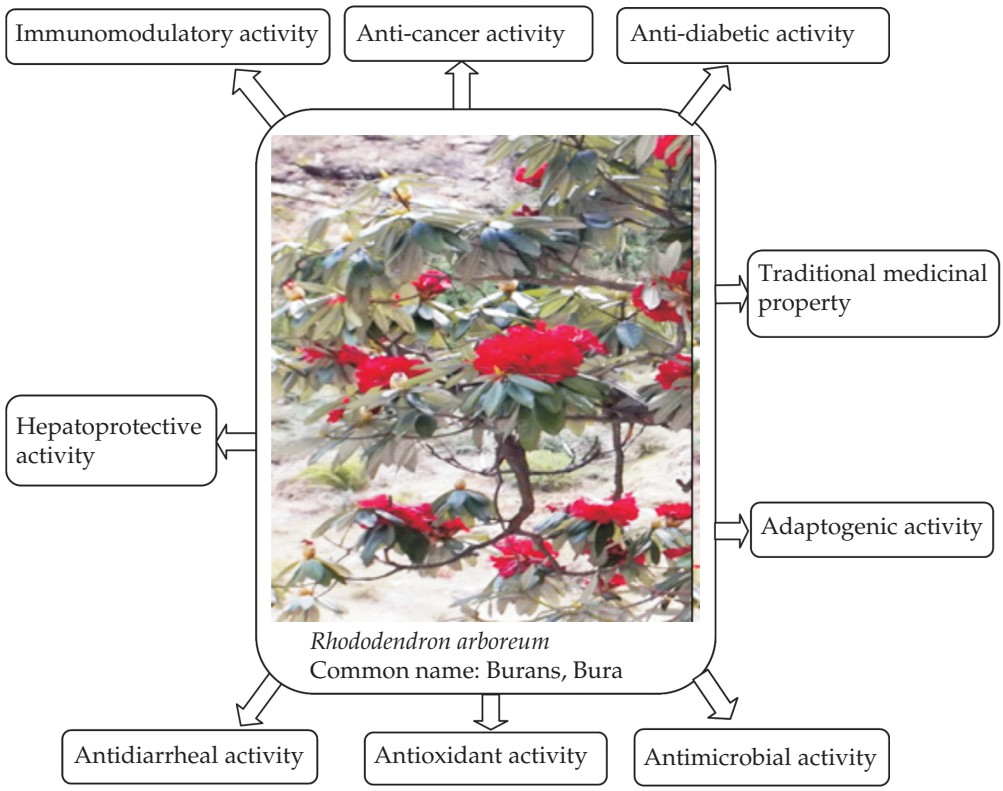

Fig. 2. Various pharmacological activities of *Rhododendron arboreum* (Rawat *et al.,* 2017)

aqueous methanolic extract and its active compound reveal anti-diabetic activity due to presence of quercetin-3-O-β-D-galactopyranoside (hyperin), ethanolic extract decreasing gluneogenesis (Raza *et al.,* 2015; Verma *et al.,* 2012).

Conclusion

Plants of *Rhododendron* contain several health benefits along with antimicrobial activities and have full potency to be consumed in the food and brew industry (Fig. 3). The investigators further investigated this plant while it is still underutilized and lack of proper perseveration to make it available during the year. Investigators aimed to evaluate the therapeutic properties as well as discovering various perspectives used for the utilization of flower of *Rhododendron* and enthusiastic that this review will draw the canvassers to investigate in this field for the value addition which might facilitate in the enrichment of economy and employment for the future generation.

This flower utilization commercial for the improvement of value added food and several pharmaceutical products can facilitate in the availability of these flower/flower-based manufacturing product supplies throughout the year. This provides enormous potential of employment which can facilitate in the sustainable improvement of rural mountain ethnic community. The production of lifesaving drug can also prepare from plant which might offer infinite opportunities for developing improved marketing tactics. Buildup of imperishable consumption of this plant can seize an excellent future for local employment for farmers. Further researches done for value addition are still required for generating awareness regarding its high curative and nutritive value between semi-urban, urban, and rural purchasers for resolving the problem /prevalence of undernourishment and socioeconomic progress (Chandra and Saklani, 2015). This review describes the concise future potential of this flower for the development of broad range of food products which requires further investigation by the canvassers for their continuation in the open market and food manufacturing.

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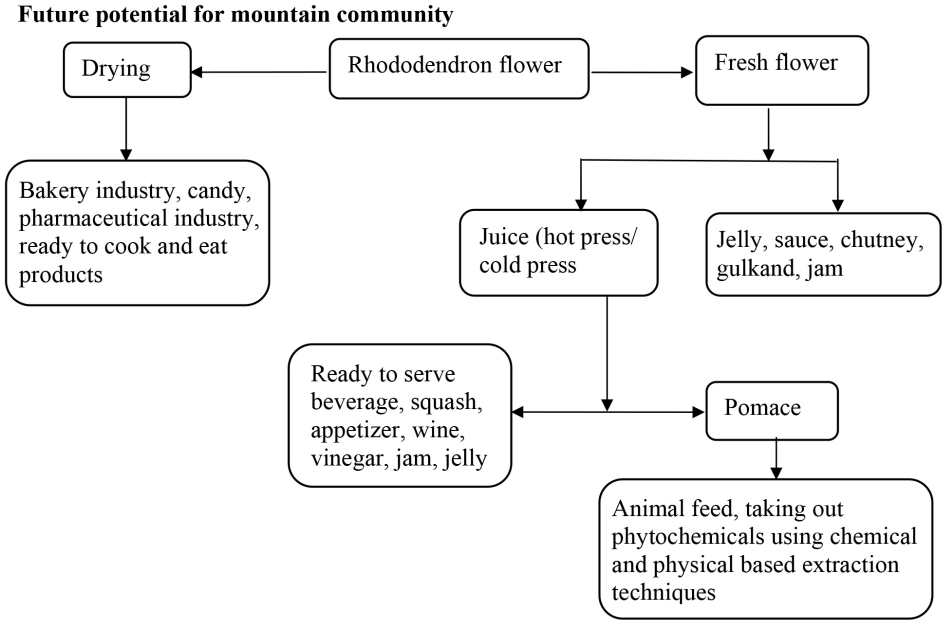

Fig. 3. Future potential of *Rhododendron arboreum* flower (Kumar *et al.,* 2019; Hillsjester 2014)

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