PHYTOCHEMICAL PROFILE AND THERAPUTIC USES OF PLANT RHODEDENDRON ARBOREUM BELONGING TO THE HIGHER ALTITUDE: A REVIEW ARTICLE

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ABSTRACT: The tree Rhododendron arboreum is a member of the Ericaceae family. It is abundant in many vitamins, minerals, and uses, including making hydrating drinks, culinary colouring, decorations, and firewood. Blood dysentery, nose bleeding, asthma, stomachaches, blurred eyesight, fever, heart conditions, diabetes, gout, coughs, piles, and liver diseases are among the conditions it is traditionally used to cure. Researchers were able to isolate phenolics, triterpenoids, flavonols, flavonol glycosides, and sterols from this plant through phytochemical studies. Various biological properties, including antidiabetic, adaptogenic, antidiarrheal, anti-inflammatory, antinociceptive, antioxidant, anti-cancer, and anti-microbial, were demonstrated by the crude extracts and isolated components of this plant. The goal of the current review is to provide a thorough overview of the literature on the pharmacognosy, phytochemistry, and pharmacological applications of the plant being studied.

Keyword: Rhododendron arboreum , pharmacological activity, chemical constituent.

INTRODUCTION: The name 'RHODODENDRON' comes from the Greek words 'RHODO' and 'DENDRON', which signify rose and tree, respectively. The Rhododendron, also known as (Laligurans), is Nepal's national flower and Uttarakhand's state tree. Rhododendron arboreum is a spectacular evergreen shrub or small tree with bright red blooms that bloom in the spring. In local slang, it's known as 'Burans, Bras, Buras, or Barahke-phool [1].Rhododendron is a genus in the Ericaceae family with 1000 species worldwide, the majority of which are found in Nepal, India, China, and Malaysia. In India, there are 102 species. North America, Europe, Australia, India, Bhutan, Nepal, China, Myanmar, Thailand, Sri Lanka, Pakistan, and Tibet are all home to Rhododendron arboreum. Sikkim, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Jammu & Kashmir, Uttarakhand, West Bengal and Himachal Pradesh are among the Indian states that have it [2]. Rhododendron is a large genus that grows at high altitudes in the Western Ghats, and it is ecologically and economically significant in addition to its beautiful flowers [3] and traditional medicine plant having a variety of bioactive chemicals that can be utilized to treat infectious disorders. Botanists and horticulturists all over the world have become fascinated by rhododendrons. Rhododendron blossoms are considered sacred and are often donated in temples and monasteries [4]. In the Central Himalayan mountain region, the tree's blooms are edible and are used to make a pleasant drink. The local residents of the region utilise it to make household products, accents, fuel wood, agricultural implements and also having a therapeutic and nutritional benefit that is unique[5] Phytochemically, Alkaloids, flavonoids, glycosides, saponins, tannins, steroids, and phlobatanins are among the secondary metabolites are also present in Rhodedendron arboreum [6].The plant has traditionally been used to alleviate rheumatism, nasal bleeding, fever, wound healing, and amoebic dysentery[7]And also having a Anti-inflammatory and Anti-nociceptive, Hepatoprotective, Anti-diarrhoea, Anti-diabetic and Antioxidant or Adaptogenic activity [8]. People in the mountainous region have also used the flowers of this plant to make pickles, juice, jam, syrup, honey, squash, and other products [9].

VERNICULAR NAME:
Laligurans: Nepali, Gulamair: Pakistan ,Rosemaram: Tamil ,Buransh: Uttarkashi ,M'saakbai: Myanmar ,Harduli: Jammu & Kashmir, Metapen, Methu: Nagaland, Brass: Himachal Pradesh Udongsheng: Arunachal Pradesh[10].

TAXONOMIC CLASSIFICATION:
Kingdom: Plantae
Phylum: Magnolliophyta
Class: Angiospermae
Order: Ericales
Family: Ericaceae
Genus: Rhododendron
Species: Rhododendron arboretum.

CULTIVATION AND COLLECTION:

Rhododendrons often flourish in humid conditions with ample of soil moisture and humidity, and at elevations above 2800 m, they spend roughly three months covered in snow. Strong temperature drops during the winters at Permafrost-like conditions are produced in areas above 2800 metres. Rhododendron temperature range of 4.4-19 [10]. Both an abundance of organic materials and well-drained soil are desirable. These plants cannot survive in alkaline (lime) environments. Acidic soil and humus-rich soil are what rhododendrons often like (Cox and Cox, (1997). The plant loves light to medium (loamy) soil and needs an acidic, moderately moist soil. Rhododendron arboreum can thrive in semi-shadow (light woods) or no shade, although it needs protection from the sweltering afternoon sun. Consequently, a spot in the greenhouse or conservatory is needed [11]. Rhododendrons should be planted in an area that is protected from the wind and the midday sun [12]. Planting material that is actively growing is not recommended. The ideal months for planting are September through November and mid-April through mid-May [13].

CHEMICAL CONSTITUENTS:

Different phytochemicals have been discovered and isolated from R. arboreum's various parts. Painuli reported about 34 different compounds, among which the major compounds identified in the GC-MS analysis of the methanolic leaf extract56 were beta-amyrin, heptadecane, 22-stigmasten3-one, tetradecane, methyl ester, linoleic, linoleyl alcohol, beta-citronellol, dodecane, L-ascorbic acid, 2, 6-d 13 compounds were found in the investigation of ethanolic leaf extract, with 1-hexadecene, 1, 2, and 3-propanetriyl ester, 1-octadecanol, and docosanoic acid being the main[14]. In a different investigation, Gautam identified, chemicals in the chloroform, ethyl acetate, and hexane fractions, respectively[15]. Three hydroxy-4-(5-hydroxy-7-methoxy-4-oxo-4H-chromen-2-yl) flavonoids and Rutin, Pectolinaroside(=5-Hydroxy-6-methoxy2-(4-methoxyphenyl)),and 8S)-8,9-Dihydro-13,16dimethoxy10H8,11epoxy-4,7-etheno-1,3benzodioxacyclododecin10-one and two flavonoid glycoside Four-oxo-4H-chromen-7-yl 6-O-(Lrhamnopyranosyl)-D-glucopyranoside and terephthalic acid dimethyl ester, a phenol derivative, were found in the leaves[16]. 1971 saw the separation of phenolic components from alcoholic leaves by Harborne and Williams. Leucoanthocyanidinss[17], gossypetin, kempferol, azaleatin, caryatin, and quercetin were found as extracts using two-dimensional chromatography. Three triterpenoids (ursolic acid, -sitosterol, and lupeol) were found in the flowers and leaves[18], and the phenolic compounds quercetin, rutin, and coumaric acid were found in the methanolic leaf extract[19]. HPTLC also confirmed the presence of quercetin, syringic acid, epicatechin, and quercetin-3-O-galactoside in the methanolic.

Bark:

The bark's petroleum ether extract revealed the presence of taraxerol (C30H50O) and ursolic acid acetate, two triterpenoid compounds (C32H50O4). The bark's ether extract, which came after a petroleum ether extract, revealed the presence of betulinic acid (C30H48O3). The bark's acetone extraction produced leuco-pelargonidin (C15H14O6) [20].

LEAVES:

Glucoside, ericolin (arbutin) (C12H16O7), ursolic acid (C30H48O4), -amyrin (C30H50O), epifriedelinol (C30H52O), a novel triterpenoid called campanulin, quercetin, and hyperoside (C21H20O12) are reported to be present in green leaves (Orwa et al., 2009). Hyperoside (3-D -galactoside of quercetin), ursolic acid, and epifriedelinol, a triterpenoid molecule, were discovered through chemical investigation of the leaves of R. arboreum var. nilagiricum (Rangaswamy & Sambamurthy, 1959). Additionally, it has been observed that the leaves contain certain flavonoids, terephthalic acid dimethyl ester, and flavone glycoside [21].

FLOWER:

This species' flowers have been found to contain quercetin-3-rhamnoside, a crystalline chemical substance (Rangaswamy & Sambamurthy, 1960). Using high-performance thin-layer chromatography (HPTLC), three biologically active phenolic compounds, namely quercetin (C15H10O7), rutin (C27H30O16), and coumaric acid (C9H8O3), have been discovered in the flowers of R. arboreum[22].

PHARMACOLOGY activity:

Anti-inflammatory and anti-nociceptive properties:

In animal studies, the Rhododendron arboreum ethyl extract fraction shown strong anti-inflammatory and anti-nociceptive activity. Rhododendron arboreum extract (EERA) oral treatment (100, 200, and 400 mg/kg) showed dose-dependent effects onAt doses of 100, 200, and 400 mg/kg, there was a statistically significant increase in the hot plate reaction time (p 0.001). The flavonoids (hyperin), tannins, saponins, and other phytochemicals present either singly or in combination, as well as other phytochemicals, may all contribute to the extract's anti-inflammatory or nociceptive effects. The high concentration of flavonoids in the ethyl acetate extract may be responsible for the large level of anti-inflammatory activity of the extract [23].

Hepatoprotective action:

In both preventative and therapeutic scenarios, the ethyl acetate fraction of Rhododendron arboreum demonstrated considerable hepatoprotective potential against carbon tetrachloride (CCl4)-induced liver damage. In the CCl4-treated groups, fraction was given orally once day for 14 days at doses of 100, 200, and 400 mg/kg (II, III, IV, V and VI). Along with the activities of glutathione S-transferase (GST), glutathione reductase, hepatic malondialdehyde production, and glutathione content, the serum levels of glutamic oxaloacetic transaminase (SGOT), glutamate pyruvate transaminase (SGPT), alkaline phosphatase (SALP), -glutamyltransfer The significantly increased serum enzymatic activity of SGOT, SGPT, SALP, -GT, and bilirubin caused by CCl4 therapy were dose-dependently returned to normal. Additionally, ethyl acetate fraction substantially and dose-dependently

inhibited the rise in hepatic malondialdehyde production and the decrease in reduced glutathione level in the liver of CCl4-intoxicated rats mean time, glutathione reductase and GST activities that had fallen toward [24].

Anti-diabetic:
Rhododendron arboreum Sm flower anti-diabetic property was investigated, and active chemicals were extracted from it.Laligurans flower aqueous methanolic extract was discovered to have inhibitory action on rat intestinal -glucosidase. The aqueous methanolic extract shown inhibitory actions on -glucosidase in both the water-soluble and ethyl acetate-soluble parts, with the latter exhibiting higher activity. Through enzyme-assay-guided separation, the ethyl acetate-soluble part of the compound was converted into the glucosidase inhibitor quercetin-3-O-D-galactopyranoside (hyperin). The isolated substance exhibited a dose-dependent inhibition of -glucosidase activity, with IC50 values for sucrase and maltase of 1.66 mM and 0.76 mM, respectively. This study found that flowers have antidiabetic potential, which might be used to create diabetic medications, nutraceuticals, or functional foods [25].

Adaptogenic or antioxidant action:
By reducing the impact of acute and chronic stress-induced biochemical and physiological disturbance, the ethanolic extract of Rhododendron arboreum demonstrated considerable adaptogenic properties. Mice and rats were used in the investigation. For the measurement of adaptogenic activity, anoxia stress tolerance tests, swimming endurance tests, and immobilisation stress models were used. In comparison to the control group, concurrent treatment with ethanolic extract at doses of 250 and 500 mg/kg significantly increased anoxia stress tolerance and swimming endurance time. Similar to the stress control group during immobilisation stress, pre-treatment with the extract demonstrated a significant drop in blood glucose, cholesterol, and triglyceride levels. Significant weight loss is seen in the liver and adrenal glands, but there are no weight changes in the spleen or testes [26].

USES IN MEDICINE:
Gout and rheumatism have both been treated with tinctures made from dried Rhododendron arboreum leaves, according to the Homeopathic Materia Medica (Skidel, 1980). R. arboreum is a component of the Ayurvedic remedy "Asoka Aristha," which has oxytocin, estrogenic, and prostaglandin synthetase-inhibitory effects . According to legend, R. arboreum's dried blossoms are extremely effective at preventing diarrhoea and blood dysentery. The young leaves are believed to be both medicinal and deadly, causing intoxication when consumed in excessive numbers. They are applied to the forehead to relieve headaches. When fish bones are struck in the gullet, an acid-sweet corolla that is both fresh and dry is produced [27].

USES IN COMMERCE:
In mountainous places, sweet-and-sour tasting Rhododendron arboreum blossoms are used to make local brew, jams, jellies, and squash. It is a highly popular and tasty beverage that is used once day as a reviving aperitif and to ward off altitude sickness. The chutney known as barah ki chutney is made using fresh petals. To get rid of bed bugs, cover coats and mattresses with the leaf juice. The plant's wood is used to produce fuel and charcoal. For constructing "khukri" handles, packsaddles, gift boxes, gunstocks, and posts, R. arboreum's grained wood is employed (Paul et al., 2005). As a form of adornment, flowers and leaves are strung onto long ropes made of munja grass and hung around houses and temples [28].

CONCLUSION:
Many different plants with a wide range of uses enrich nature. The practise of growing plants for medicine has a very long history. The potential for using herbs and crude pharmaceuticals as a source of novel molecules for treating various diseases and disorders is expanding quickly. Botanists and horticulturists have always been intrigued by the plants that grow in mountainous areas, which have inspired them to explore new possibilities in medicinal treatment. There are many plants that are widely distributed around the world that have not yet been discovered and studied for their biological activity and pharmaceutical potency. Rhododendron arboreum is a significant plant of the hilly region with a wide range of medicinal and economic purposes, according to a thorough review of the literature. The herb showed anti-inflammatory, hepatoprotective, anti-diarrhetic,Saponins and flavonoids provide antioxidant effects.phytochemicals like tannins. The processing of fresh petals Prepare the well-known market item sharbat and sub-acidic jelly.Young leaves are deadly and cause massive amounts of intoxication. The plant holds a particular place in the people's economic & cultural lives. It is offered in temples and other religious buildings for ornamentation and embellishment. Plywood can be made from wood, which is also used to build tool handles, boxes, and posts. Visitors are drawn in by the visual splendour of the fully developed blooms weighing down trees throughout the flowering season. The plant has significant medical and commercial value.

REFERENCES:
1. Srivastava, P. (2012). Rhododendron arboreum: An overview. Journal of Applied Pharmaceutical Science, (Issue), 158-162.
2. Bhandary, M. R., & Kawabata, J. (2008). Antidiabetic activity of Laligurans (Rhododendron arboreum Sm.) flower. Journal of Food Science and Technology Nepal, 4, 61-63.
3. Giriraj, A., Irfan-Ullah, M., Ramesh, B. R., Karunakaran, P. V., Jentsch, A., & Murthy, M. S. R. (2008). Mapping the potential distribution of Rhododendron arboreum Sm. ssp. nilagiricum (Zenker) Tagg (Ericaceae), an endemic plant using ecological niche modelling. Current Science, 1605-1612.
4. Paul, A., Khan, M. L., Arunachalam, A., & Arunachalam, K. (2005). Biodiversity and conservation of rhododendrons in Arunachal Pradesh in the Indo-Burma biodiversity hotspot. Current science, 89(4), 623-634.

5. Negi, V. S., Maikhuri, R. K., Rawat, L. S., & Chandra, A. (2013). Bioprospecting of Rhododendron arboreum for livelihood enhancement in central Himalaya, India. Environment & We: International Jouranl of Science and Technology, 8, 61-70.
6. Sujin, R. M. (2019). Rhododendron arboreum Sm.: A review of its traditional uses, phytochemistry, and pharmacology. Ethnomedicinal Plants with Therapeutic Properties, 99-112.
7. Madhvi, S. K., Sharma, M., Iqbal, J., & Younis, M. (2019). Phytochemistry, traditional uses and pharmacology of Rhododendron arboreum: a review. Research Journal of Pharmacy and Technology, 12(9), 4565-4574.
8. Srivastava, P. (2012). Rhododendron arboreum: An overview. Journal of Applied Pharmaceutical Science, (Issue), 158-162.
9. Kumar, V., Suri, S., Prasad, R., Gat, Y., Sangma, C., Jakhu, H., & Sharma, M. (2019). Bioactive compounds, health benefits and utilization of Rhododendron: a comprehensive review. Agriculture & Food Security, 8(1), 1-7.
10. Verma, N., Singh, A. P., Amresh, G., Sahu, P. K., & Rao, C. V. (2010). Anti-inflammatory and anti-nociceptive activity of Rhododendron arboreum. J Pharm Res, 3(6), 1376-80.
11. Prakash, V. (2022). Determination of α-Amylase Inhibitory potential of leaf extracts of Rhododendron arboreum Sm. and Rhododendron campanulatum D. Don. Journal of Drug Delivery and Therapeutics, 12(1-S), 20-22.
12. Prakash, D., Upadhyay, G., Singh, B. N., Dhakarey, R., Kumar, S., & Singh, K. K. (2007). Free-radical scavenging activities of Himalayan rhododendrons. Current Science, 526-532.
13. Hariharan, V., & Rangaswami, S. (1966). CHEMICAL INVESTIGATION OF THE BARK OF RHODODENDRON ARBOREUM Sm. Current Science, 35(15), 390-391.
14. Jegan, B. S., & Selvaraj, D. (2016). Bioactive components of the leaves of Rhododendron arboreum sm. Ssp. Nilagiricum. World journal of pharmacy and pharmaceutical sciences, 5(7), 713-722.
15. Gautam, V., Kohli, S. K., Arora, S., Bhardwaj, R., Kazi, M., Ahmad, A., & Ahmad, P. (2018). Antioxidant and antimutagenic activities of different fractions from the leaves of Rhododendron arboreum Sm. and their GC-MS profiling. Molecules, 23(9), 2239.
16. Madhvi, S. K., Sharma, M., Iqbal, J., & Younis, M. (2019). Phytochemistry, traditional uses and pharmacology of Rhododendron arboreum: a review. Research Journal of Pharmacy and Technology, 12(9), 4565-4574..
17. Sonar, P. K., Singh, R., Khan, S., & Saraf, S. K. (2012). Isolation, characterization and activity of the flowers of Rhododendron arboreum (Ericaceae). E-Journal of Chemistry, 9(2), 631-636.
18. Shilajan, S., & Swar, G. (2013). Simultaneous estimation of three triterpenoids-ursolic acid, b-sitosterol and lupeol from flowers, leaves and formulations of Rhododendron arboreum Smith. Using validated HPTLC method. International Journal of Green Pharmacy (IJGP), 7(3).
19. Sharma, N., Sharma, U. K., Gupta, A. P., & Sinha, A. K. (2010). Simultaneous determination of epicatechin, syringic acid, quercetin-3-O-galactoside and quercitrin in the leaves of Rhododendron species by using a validated HPTLC method. Journal of food composition and analysis, 23(3), 214-219.
20. Hariharan, V., & Rangaswami, S. (1966). CHEMICAL INVESTIGATION OF THE BARK OF RHODODENDRON ARBOREUM Sm. Current Science, 35(15), 390-391.
21. Verma, N., Bansal, M. C., & Kumar, V. (2011). Pea peel waste: a lignocellulosic waste and its utility in cellulase production by Trichoderma reesei under solid state cultivation. Bioresources, 6(2), 1505-1519.
22. Swaroop, A., Gupta, A. P., & Sinha, A. K. (2005). Simultaneous determination of quercetin, rutin and coumaric acid in flowers of Rhododendron arboreum by HPTLC1. Chromatographia, 62(11), 649-652.
23. Verma, A., & Stellacci, F. (2010). Effect of surface properties on nanoparticle–cell interactions. Small, 6(1), 12-21.
24. Verma, N., Bansal, M. C., & Kumar, V. (2011). Pea peel waste: a lignocellulosic waste and its utility in cellulase production by Trichoderma reesei under solid state cultivation. Bioresources, 6(2), 1505-1519.
25. Bhandary, M. R., & Kawabata, J. (2008). Antidiabetic activity of Laligurans (Rhododendron arboreum Sm.) flower. Journal of Food Science and Technology Nepal, 4, 61-63.
26. Swamidasan, R., Prakash, T., Gol, D., Kamalesh, D. R., Dixit, P., & Chandrasekar, S. B. (2008, October). Adaptogenic activity of ethanolic extract of leaves of Rhododendron arboreum in mice and rats. In Indian journal of pharmacology (Vol. 40, pp. 152-152). A-108-109 KANARA BUSINESS CENTRE, GHAKTOPAR, MUMBAI, 400075, INDIA: MEDKNOW PUBLICATIONS.
27. Pradhan, U. C., & Lachungpa, S. T. (1990). Sikkim-Himalayan Rhododendrons. Primulaceae Books.
28. Chauhan, N. S. (1999). Medicinal and aromatic plants of Himachal Pradesh. Indus publishing.