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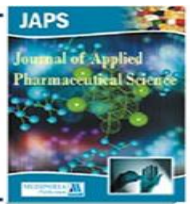

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RHODODENDRON ARBOREUM: AN OVERVIEW

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ABSTRACT

Rhododendron arboreum is an evergreen shrub or small tree with a showy display of bright red flowers. The name 'RHODODENDRON' is derived from the Greek word 'RHODO' means rose & 'DENDRON' means tree. Rhododendron is the national flower of Nepal & is known as (Laligurans) & the state tree of Uttarakhand. It is called 'Burans, Bras, Buras or Barah-ke-phool' in local dialect. It is widely popular for the processed juice of its flowers which have gained market popularity as rhodojuice / sharbat. The plant is found in the Himalayas from Kashmir eastwards to Nagaland. Various parts of the plant exhibited medicinal properties & is used for the treatment of various ailments. The present review is an effort to give the detailed survey of literature on its pharmacognosy, phytochemistry & pharmacological uses of the plant under study.

Keywords: Rhododendron arboreum, Burans, Pharmacognosy, Phytochemistry, Pharmacology.

INTRODUCTION

Rhododendron arboreum is one of the most stately and impressive rhododendron species. It is extremely variable in stature, hardness, flower color and leaf characteristics. It species name arboreum means tree like (Orwa *et al.*, 2009). Originally discovered in north central India the plant is found in the Himalayas from Kashmir to Bhutan & in the hills of Assam & Manipur at altitudes of 1200-400 m (Chauhan, 1999). It grows at elevations of 4500 to 10,500 ft & grows up to 40 to 50 ft high sometimes attaining over 100 ft (Rai & Rai, 1994). This is an evergreen much branched tree up to 14 m in height & 2.4 m in girth (Chauhan, 1999). Flowering season is from March-April/ June-September bearing deep red or crimson to pale pink flowers. The plant prefers light (sandy) to medium (loamy) soil & requires fairly moist & acidic soil. It can grow in semi shade (light woodland) or no shade, requires protection from hot afternoon sun thus requires a place in the green house or conservatory. The aesthetically appealing flowers owe its religious significance; it is considered sacred & offered in temples for ornamenting purposes. This plant holds the Guinness Record for World Largest Rhododendron & is widely popular for its medicinal benefits & economic value. A postal stamp was issued by the Indian Postal Department to commemorate this flower.

VERNACULAR NAMES

Nepali	:	Lali gurans
Garhwali	:	Burans
Kumaoni	:	Eras
Punjabi	:	Adrawal
Tamil	:	Billi
Kannada	:	Pu
Malayalam	:	Kattupoo varasu

Fig. 1: Rhododendron arboreum.

DESCRIPTION

The plant is taxonomically classified as.

Kingdom	:	Plantae
Phylum	:	Magnolliophyta
Class	:	Angiospermae
Order	:	Ericales
Family	:	Ericaceae
Genus	:	Rhododendron
Species	:	Rhododendron arboreum

Sub species

1) Rhododendron arboreum spp. *Arboreum* (red or rose red flowers) found in Western Himalayas
2) Rhododendron arboreum spp. *Cinnamomeum* (white, pink or red flowers) found in Central Himalayas.
3) Rhododendron arboreum spp. *Delavayii* (red flowers) found in Eastern Himalayas.
4) Rhododendron arboreum spp. *Nilagiricum* (red flowers) found in Nilgiri.
5) Rhododendron arboreum spp. *Zeylancium* (orange red flowers) found in Sri Lanka.

PHARMACOGNOSY

Trunk

The trunk is often much branched, crooked or gnarled (Orwa *et al.*, 2009). Bark is reddish brown, soft and rough, exfoliating in thin flakes (Chauhan, 1999).

Leaves

Leaves are oblong-lanceolate, 10-20 cm long and 3.6 cm wide. Crowded towards the ends of branches, petiole covered with white scales when young (Orwa *et al.*, 2009). It is glossy green, with deeply impressed veins from above white fawn, cinnamon or rusty brown felt is found at the under surface (Rai & Rai, 1994).

Flowers

The flowers of R. arboreum range in color from a deep scarlet, to red with white markings, pink to white. Bearing up to twenty blossoms in a single truss this rhododendron is a spectacular sight when in full bloom. It is reported that the bright red forms of this rhododendron are generally found at the lower elevations (Orwa *et al.*, 2009). Flowers are showy, red in dense globose cymes (Chauhan, 1999). Calyx- fine cleft, Corolla-tube spotted funnel shaped, Stamens-hypozygnous declining, Filaments-filiform, Anthers-ovate, Style-capitate (Paxton, 1834).

Fruit

Capsule-curved central column composed of fine lobes, ribbed, up to 3.8 cm long and 1.25 cm wide (Orwa *et al*., 2009).

Seeds

Seeds-minute, dark brown, compressed, thin linear having an obvolute membrane (Orwa *et al.*, 2009).

PHYTO-CHEMISTRY

Bark

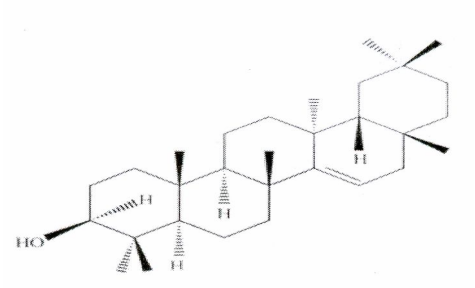
The petroleum ether extract of the bark indicated the presence of a single triterpenoid substance taraxerol ($C_{30}H_{50}O$) & ursolic acid acetate ($C_{32}H_{50}O_4$). The ether extract of the bark following petroleum ether extract showed the identity of betulinic acid ($C_{30}H_{48}O_3$). The acetone extract of the bark gave the substance leuco-pelargonidin ($C_{15}H_{14}O_6$). (Hariharan & Rangaswami, 1966).

Leaves

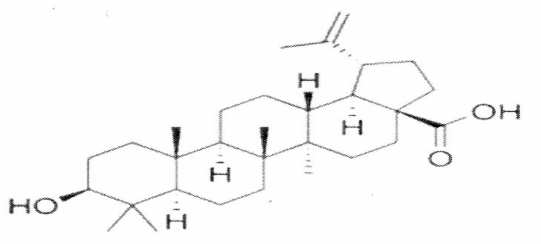
Green leaves are reported to contain glucoside, ericolin (arbutin) ($C_{12}H_{16}O_7$), ursolic acid ($C_{30}H_{48}O_4$), α-amyrin ($C_{30}H_{50}O$), epifriedelinol ($C_{30}H_{52}O$), a new triterpenoid named campanulin, quercetin & hyperoside ($C_{21}H_{20}O_{12}$) (Orwa *et al*., 2009). Chemical analysis of the leaves of R. arboreum var. nilagiricum revealed the presence of hyperoside (3-D -galactoside of quercetin), ursolic acid and epifriedelinol, a triterpenoid compound (Rangaswamy & Sambamurthy, 1959). The leaves are also reported to contain the flavone glycoside and dimethyl ester of terephthalic acid and certain flavonoids (Verma *et al.*, 2011).

Flowers

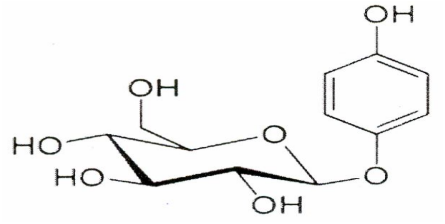
Quercetin-3-rhamnoside a crystalline chemical compound has been reported from the flowers of this species (Rangaswamy & Sambamurthy, 1960). Three biologically active phenolic compounds i.e. quercetin ($C_{15}H_{10}O_7$), rutin ($C_{27}H_{30}O_{16}$) and coumaric acid ($C_9H_8O_3$) have been reported in flowers of R. arboreum using high-performance thin-layer chromatography (HPTLC) (Swaroop *et al.*, 2005).



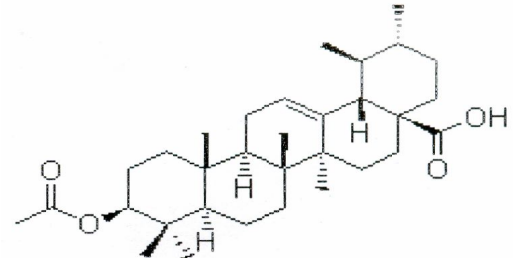
Taraxerol



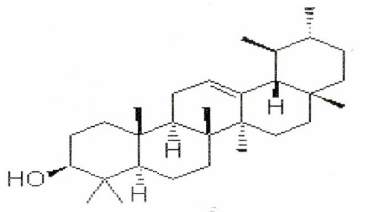
Betulinic Acid



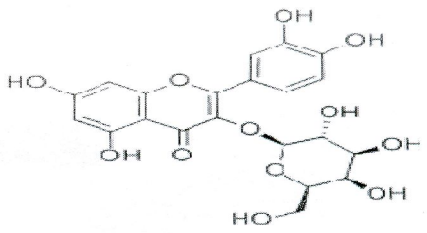
Arbutin



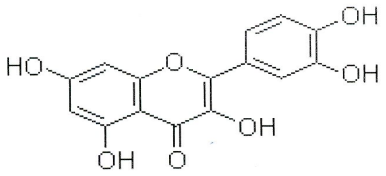
Ursolic Acid Acetate



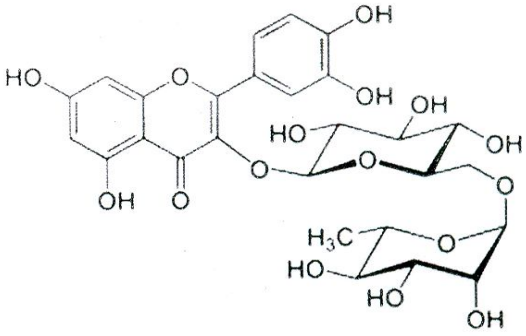
Amyrin



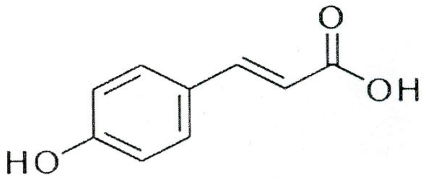
Hyperoside



Quercetin

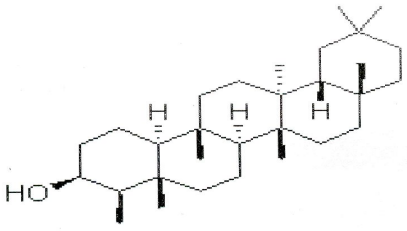


Rutin



Coumaric Acid

Fig. 3: chemical structures of the isolated compounds.



Epifridilenol

Fig. 2: chemical structures of the isolated compounds.

PHARMACOLOGY

I-Anti-inflammatory and Anti-nociceptive activity

The ethyl extract fraction of Rhododendron arboreum showed significant anti-inflammatory and anti-nociceptive potential in animal models. Oral administration of Rhododendron arboreum extract (EERA) (100, 200 and 400 mg/kg) exhibited dose dependent and significant anti-inflammatory activity in arachidonic induced hind paw edema ($p<0.01$), cotton pellet granuloma model of inflammation ($p<0.01$) and Freund's adjuvant-induced paw arthritis ($p<0.01$). A significant ($p<0.05$) anti-nociceptive activity was evidenced in mice, protection in acetic acid-induced writhing. EERA at the dose of 100, 200 and 400 mg/kg exhibited significant ($p<0.001$) resistance against analgesymeter induced pain in mice.

The hot plate reaction time was increased at a dose of 100, 200 and 400 mg/kg significantly ($p<0.001$). The anti-inflammatory or nociceptive effect of the extract may be due to the presence of flavonoids (hyperin), tannins, saponins and other phytochemicals present either as single or in combination. The significant level of anti-inflammatory activity of the ethyl acetate extract could be attributed to high amount of flavonoids present in the extract (Verma *et al.,* 2010).

II-Hepatoprotective activity

The ethyl acetate fraction of Rhododendron arboreum exhibited significant hepatoprotective potential against carbon tetrachloride (CCl_4)-induced liver damage in preventive and curative models. Fraction at a dose of 100, 200, and 400 mg/kg was administered orally once daily for 14 days in CCl_4-treated groups (II, III, IV, V and VI). The serum levels of glutamic oxaloacetic transaminase (SGOT), glutamate pyruvate transaminase (SGPT), alkaline phosphatase (SALP), γ-glutamyltransferase (γ-GT), and bilirubin were estimated along with activities of glutathione S-transferase (GST), glutathione reductase, hepatic malondialdehyde formation, and glutathione content. The substantially elevated serum enzymatic activities of SGOT, SGPT, SALP, γ-GT, and bilirubin due to CCl_4 treatment were restored toward normal in a dose-dependent manner. Meanwhile, the decreased activities of GST and glutathione reductase were also restored toward normal. In addition, ethyl acetate fraction also significantly prevented the elevation of hepatic malondialdehyde formation and depletion of reduced glutathione content in the liver of CCl_4 -intoxicated rats in a dose-dependent manner (Verma *et al.,* 2011).

III-Anti-diarrhoeal activity

The ethyl acetate fraction of Rhododendron arboreum (flowers) showed potent antidiarrhoeal activity. A simple sensitive high performance thin layer chromatography (HPTLC) method was used for the determination of hyperin in EFRA. The standardized fraction was investigated for castor oil, magnesium sulfate-induced diarrhoea, measurement of gastrointestinal transit using charcoal and castor oil-induced enteropooling. The concentration of hyperin in flowers of R. arboreum was found to be 0.148% by HPTLC. Oral administration of EFRA at 100, 200 and 400 mg/kg exhibited dose-dependent and significant ($P<0.05$-0.001) antidiarrhoeal potential in castor oil and magnesium sulfate-induced diarrhoea. EFRA at doses of 100, 200 and 400 mg/kg also produced significant ($P<0.05$-0.001) dose-dependent reduction in propulsive movement in castor oil-induced gastrointestinal transit using charcoal meal in rats. EFRA was found to possess an antienteropooling in castor oil-induced experimental animals by reducing both weight and volume of intestinal content significantly. The results showed that EFRA could, in a dose-dependent manner, reduce castor oil-induced diarrhoea as well as the number of diarrhoeal faeces and total weight of faeces, which could be taken as antidiarrhoeal activities. The ethyl acetate fraction of R. arboreum flowers was also found to reduce magnesium sulfate-induced diarrhoea significantly which could be due to increased absorption of water and electrolytes. The EFRA suppressed the propulsive movement or gastrointestinal transit of charcoal meal which clearly indicates that extract may be capable of reducing the frequency of stools in diarrhoeal conditions. The extract inhibits gastrointestinal motility in diarrhoea through anticholinergic effect. EFRA was found to possess an antienteropooling in castor oil-induced experimental animals by reducing both weight and volume of intestinal content. Phytochemical screening revealed the presence of numerous constituents such as flavonoids, saponins, tannins, phytosterols, reducing sugars and phenolic compounds. Hence tannins, reducing sugars and sterols may be responsible for mechanism of antidiarrhoeal activity of EFRA (Verma *et al.,* 2011).

IV-Anti-diabetic activity

Anti-diabetic activity was examined in (Rhododendron arboreum Sm) flower and active compounds were isolated from it. Aqueous methanolic extract of the flower of Laligurans was found to show inhibitory activity on the rat intestinal α-glucosidase. Both the water-soluble and ethyl acetate-soluble portions from the aqueous methanolic extract showed inhibitory activities on α-glucosidase, demonstrating higher activity by the ethyl acetate-soluble portion. From the ethyl acetate-soluble portion, α-glucosidase inhibitor quercetin-3-O-β-D-galactopyranoside (hyperin) was isolated through enzyme-assay guided separation. The isolated compound showed a dose dependent α-glucosidase inhibitory activity with IC_{50} values of 1.66 mM and 0.76 mM for sucrase and maltase, respectively. This study revealed that flower contains antidiabetic potential which property might be helpful to develop medicinal preparations, nutraceutical or functional food for diabetes and its complications (Bhandary & Kuwabata, 2008).

V-Antioxidant or Adaptogenic activity

The ethanolic extract of Rhododendron arboreum showed significant adaptogenic property as by mitigating the effect of acute and chronic stress induced biochemical and physiological perturbation. The study was conducted on mice and rats. Anoxia stress tolerance, swimming endurance, immobilization stress models were used for the evaluation of adaptogenic activity. Concomitant treatment with ethanolic extract at doses 250 and 500 mg/kg, showed marked increase in anoxia stress tolerance and swimming endurance time as compared to control group. Similarly, pre-treatment with extract showed marked decrease in blood glucose, cholesterol, triglycerides level as compared to stress control group in immobilization stress. Weights of liver and adrenal glands are markedly decreased, but no weight changes in spleen and testes were observed (Swamidasan *et al.,* 2008). Flavonoids isolated from the leaves of R. arboreum were found to have potent antioxidant property (Dhan *et al.,* 2007).

MEDICINAL USES

In Homeopathic Materia Medica, the tincture of dried leaves of Rhododendron arboreum has been used in gout &

rheumatism (Skidel, 1980). Ayurvedic preparation "Asoka Aristha," containing R. arboreum possesses oxytocic, estrogenic, and prostaglandin synthetase-inhibiting activity (Midlekoop & Labadie, 1983). The dried flowers of R. arboreum are supposedly highly efficacious in checking diarrhoea and blood dysentery (Laloo *et al.*, 2006). The young leaves are said to be poisonous (causes intoxication in large quantities) as well as medicinal and applied on the forehead to alleviate headache (Watt, 1892). The fresh and dried corolla that is acid-sweet in nature is given when fish bones get struck in the gullet (Pradhan & Lachungpa, 1990).

Formulations & Dosage

- Powder 1-3 gm
- Decoction 50-100 mL
- Ayurvedic preparations: Asoka Aristha, Rohitakyadi churna

COMMERCIAL USES

In hilly areas, the flowers of Rhododendron arboreum with sweet & sour taste are used in the preparation of squash, jams, jellies and local brew. It is a very common and pleasant drink, drunk once daily as refreshing appetizer & also to prevent high-altitude sickness. Fresh petals are used to prepare chutney known as barah ki chutney. The juice of the leaves is spread over cots and beds to get rid of bed lice. Wood of the plant is used to make charcoal & fuel. The grained wood of R. arboreum is used for making ‘khukri’ handles, packsaddles, gift-boxes, gunstocks and posts (Paul et al., 2005). Flowers & leaves are fitted in long ropes made of munja grass & tied around the houses including temples as decorations (Chauhan, 1999).

CONCLUSION

Nature is enriched with numerous plants of multifarious usage. The cultivation of plants for medicinal purposes is of extreme antiquity. The potential of herbs & crude drugs as source of newer compounds for management of various diseases & disorders is rapidly accelerating. Plants of hilly regions have always captured the attention of botanists & horticulturist urging them to unleash new dimensions in medical treatment. There are abundant plants all over the world which are yet to be explored & investigated for their biological activity & pharmacological potency. The detailed survey of literature revealed that Rhododendron arboreum is important plant of hilly region with extensive medicinal & commercial uses. The plant exhibited anti-inflammatory, hepatoprotective, anti-diarrhoeal, antidiabetic, antioxidant properties due to presence of flavonoids, saponins, tannins & other phytochemicals. Fresh petals are processed to prepare sub-acidic jelly & sharbat a famous market commodity. Young leaves are poisonous cause intoxication in large quantities.

The plant has a special place in the cultural & economic life of the people. It is offered in temples & religious places for ornamenting & decoration purposes. Wood is used to make tool handles, boxes and posts and is suitable for plywood. The aesthetic beauty of the fully blossomed flowers burdened on trees in the flowering season attracts the attention of visitors. The plant is of abundant medicinal & economic value

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