



Inula racemosa: A Brief Review on Phytochemical and Pharmacological Profile

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ABSTRACT

Medicinal plants based traditional systems of medicines are playing important role in providing health care to large section of population, especially in developing countries. *Inula racemosa* a traditional medicinal plant, also known as orris root which belong to the family Asteraceae, native to the Himalayas. It gathered significant attention in traditional medicine and modern pharmacology due to its varied therapeutic attributes including anti-hypertensive, anti-carcinogenic, cardioprotective, expectorant, anti-inflammatory properties. The diverse range of pharmacological effects exhibited by *Inula racemosa*, particularly the bioactivities of alantolactone and isoalantolactone, underscores the plant's importance and the possibility of discovering novel chemical compounds for further application. This article is an attempt to collect and review all the data concerning systemic scientific study of ethnopharmacology of *Inula racemosa*, its isolated phytoconstituents and bioactivity of extracts present in the plant.

Keywords: *Inula racemosa*, Alantolactone, Isoalantolactone, Pharmacological activity.

INTRODUCTION

The medicinal plants are mostly used for curing of human diseases employing phytochemical constituents. Phytochemicals are naturally present in the medicinal plants, leaves, vegetables and roots, which have defence mechanism and protect humans from various diseases. ^[1] Herbal medicine still cover up about 70–80% primary healthcare treatment of persons in the developing country of the world. ^[2] According to WHO definition, phytomedicine or herbal medicine defines the culmination of knowledge, skill, and practices based on theories and experiences native to different cultures, explicable or not, used in the preservation of and restoration to health, as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illnesses. ^[3]

Among most important medicinal plants in India, *Inula* is a large genus of about 90 species of flowering plants belonging to family Asteraceae. The *Inula racemosa* is one of the most important medicinal and ornamental plants mentioned in Ayurvedic scriptures. The plant is common to Kashmir in India because it grows in temperate and alpine western Himalayas ranging from 1300 to 4500 meter of elevation. ^[4] It is known to be used in traditional medicine throughout the world, especially in East Asia and Europe. Apart from being used for other ailments, the plant extract and its isolated active constituents show promising activity against abdominal pain, acute enteritis, bacillary dysentery, expectorant and tonic. ^[5]



Fig 1: Plant of *Inula Racemosa*



TAXONOMICAL CLASSIFICATION^[6]

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Super division	: Spermatophyta
Division	: Magnoliophyta
Class	: Magnoliopsida
Sub class	: Asteridae
Order	: Asterales
Family	: Asteraceae
Genus	: <i>Inula</i>
Species	: <i>Inula racemosa</i>

SYNONYMS^[7]

- *Inula royleana* C.B. Clarke

VERNACULAR NAMES^[8]

Table 1: Vernacular names

SL NO	LANGUAGES	VERNACULAR NAMES
1	Malayalam	Puskara
2	Tamil	Pushkarmulam
3	English	Orris root
4	Hindi	Pohakar mul
5	Kannada	Pushkara moola
6	Telugu	Pushkara mulamu
7	Marathi	Pokhar mool

BOTANICAL DESCRIPTION^[9,10,11]

Inula racemosa is a perennial herb grows up 0.5 to 1.5 meters in height, the stem is grooved, rough and very hairy. The leaves of the plants are large, elliptical, and 3-6 cm long with 2-3 cm breadth, having long petioles. Flowers are very large 3.8 to 5 cm in diameter Outer bracts broad, tips triangular, bent back, inner bracts linear, sharp pointed. They are shady yellow daisies produced in mid to late summer. These borne on apical spike like cluster and have bisexual florets.

Root stock of *Inula racemosa* is branched and are irregularly fusiform (20 to 25 x 5 cm). Sometimes a number of roots are found in the collar zone, though usually few occur in each clump. These roots have a dull brownish skin with yellowish colour inside. They possess a sweet and camphoraceous odour and have a bitter taste. Surface of the root is rough due to longitudinal striations and cracks, scars of lateral rootlets. Fractures of the root are short and smooth. The fruits of *Inula racemosa* are cylindrical, hairless and pappus are 8 mm long and reddish in colour.



Fig 2: Flower



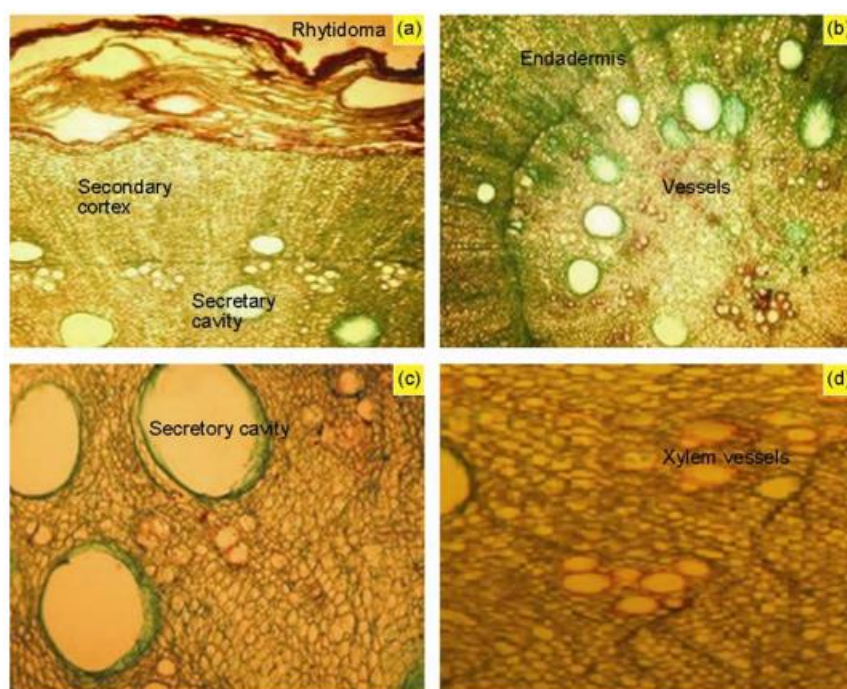
Fig 3: Stem



Fig 4: Leaves

MICROSCOPICAL STUDIES

Mature root shows a wavy outline due to development of rhytidome. The cork composed of 8 to 12 layers of thick-walled, tangentially elongated, rectangular cells, some filled with reddish-brown contents. The secondary cortex 1 or 2 layers or absent. Secondary phloem consists of sieve elements and parenchyma having secretory cavities and traversed by medullary rays. Cambium is not distinct, wood occupies bulk of root consisting of vessels, tracheids, fibres, parenchyma, secretory cavities and medullary rays. The vessel has reticulated thickenings, a few fibres occur in small patches adjacent to vessels and abundant in xylem parenchyma, thin-walled. A few small tracheids are present. Parenchyma in general contain granular, slightly yellowish or colourless inulin granules and also a few yellowish oil globules. Starch grains either absent or very rarely seen in cortical and ray cells. Also, yellowish resinous masses present in secretory canals. ^[12]

Fig 5: Microscopic characters of root of *Inula racemosa*:

(a)-T S of Root-Periphery, (b)-T S of root-centre, (c)-Secretory cavity, (d)-Xylem vessels



The powder exhibited a brown hue, possessed an acrid taste, and felt coarse to the touch. Even when squeezed between two blotting sheets, it didn't quickly get greasy. If the paper was left out in the open for too long or warmed slightly, it would show obvious oil stains. In the presence of UV light, the powder did not fluoresce; but, when dissolved in water, different organic solvents or mild potassium hydroxide solutions, its extracts showed green fluorescence. Mild foaming was seen when the powder was shaken with water. As it stood, the mixture split in two: a layer of clear brown liquid on top and a layer of solid, greyish-brown particles below. The powder displayed many diagnostic features when examined under a microscope, as shown in Figure 6.

These included thick-walled fibre pieces with both round and pointed ends and a very narrow central lumen, thick-walled but nonlignified cells slightly longer than broad and with simple, brown resinous masses of various shapes and sizes, rectangular parenchymatous cells, fragments of fibres with thick walls but rather broad central lumens and pointed ends, rectangular cells with an irregular pattern of thickening of their walls. ^[13]

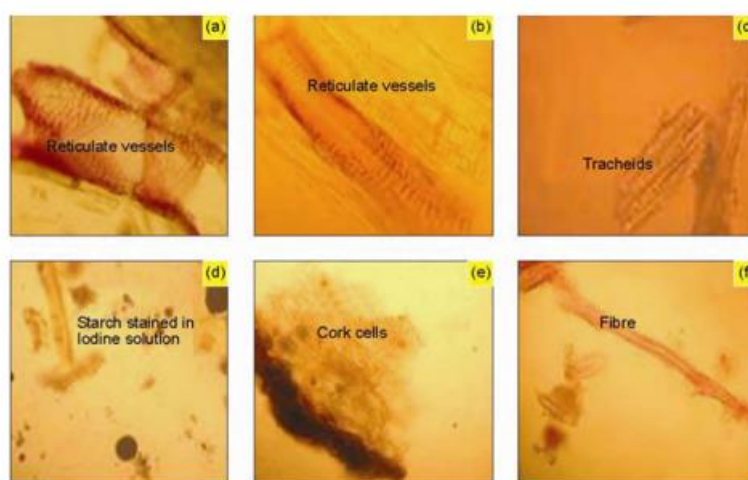


Fig 6: Powder microscopy of root of *Inula racemosa*:

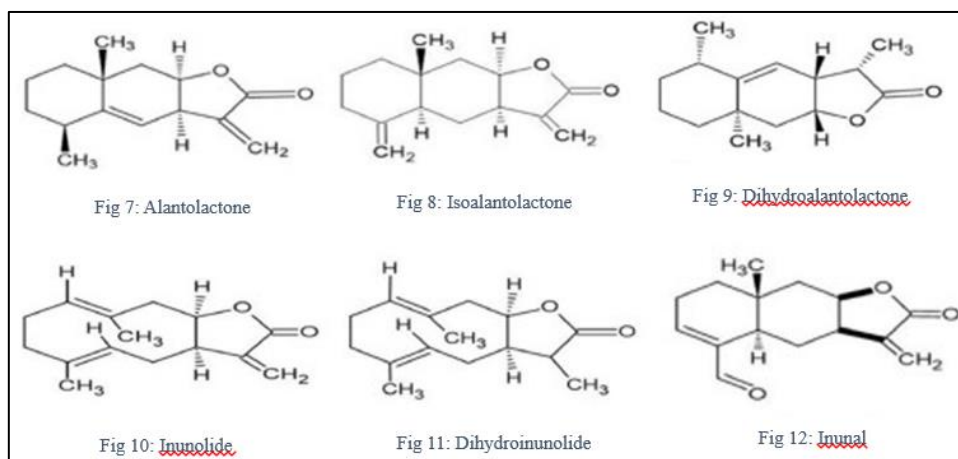
(a, b)-Reticulate vessels, (c)-Tracheids, (d)-Starch stained in Iodine solution, (e)-Cork, (f)-Fibre

CHEMICAL CONSTITUENTS ^[14,15]

Inula racemosa yields large amounts of sesquiterpene lactones. Alantolactone (ALT), Isoalantolactone (IALT), Dihydroalantolactone, Dihydroisoalantolactone, Inunolide, Dihydroinunolide, Neoalantolactone, Isoalloalantolactone, Alloalantolactone, Inunal, Isoinunal, Alantodiene and Isoalantodiene are sesquiterpene lactones isolated from the non-polar fractions of the root. Daucosterol, D-mannitol and β -sitosterol have also been reported in good quantities from the roots.

Sesquiterpene lactones are important because of their various biological activities and generic inhibition of enzymes. The main sesquiterpene lactones found in *Inula racemosa* are ALT and IALT. A mixture containing both the lactones is called Helenin. This mixture is the active principle of drug Alanton which is used for ulceration. The drug is anti-inflammatory, anti-proteolytic and is used to regulate the acidic function of the stomach. Alanton also promotes mucin formation and stimulates the regenerative capacity of the gastric mucosa.

Inula racemosa also contains various flavonoids, including quercetin, kaempferol, and apigenin derivatives. Flavonoids are well-known antioxidants with anti-inflammatory, anti-allergic, and anti-cancer properties. The herb also contains essential oils with aromatic compounds such as camphor, pinene, and borneol. Phenolic compounds, including phenolic acids and phenolic glycosides, are found in *Inula racemosa* and contribute to its antioxidant activity. These compounds help scavenge free radicals and protect cells from oxidative damage.



TRADITIONAL USE ^[16]

Expectorant, anti-tubercular agent, anti-hyperglycemic agent, anti-hyperlipidemic agent, anti-anginal agent, anti-dermatophytic agent, hepatoprotective agent, for treating acute enteritis, for treating bacillary dysentery, for treating abdominal pain.

PHYTOCHEMICAL SCREENING ^[17]

The dried and coarsely powdered roots of *Inula racemosa* was subjected to successive extraction in Soxhlet apparatus with different solvents in increasing order of their polarity, viz; petroleum ether (60/80), ethyl acetate, methanol, hydroalcohol and water. The extracts of *Inula racemosa* were subjected to phytochemical screening to identify various constituents like alkaloids, glycosides, tannins, carbohydrates, saponins, flavonoids, proteins, phytosterols and terpenoids, present in them.

Table 2: Preliminary phytochemical study on *Inula racemosa* root extracts

Tests	Name of the Test	Pet-ether extract	Ethyl acetate extract	Methanol extract	Hydro alcoholic extract	Aqueous extract
Alkaloids	Mayer's test	-	-	-	-	-
	Tannic acid test	-	-	-	-	-
	Wagner's test	-	-	-	-	-
	Dragendroff's test	-	-	+	-	-
	Hager's test	-	-	-	-	-
Glycosides	Borntrager's test	-	-	-	-	-
	Keller Kiliani test	+	-	+	-	+
	Legal's test	-	-	+	+	-
Tannins	Ferric chloride test	-	-	-	+	+
	Lead acetate test	-	-	+	+	+
Carbohydrates	Molisch's test	+	+	++	+	+
	Benedict's test	-	+	+	+	+
	Fehling's test	+	+	+	+	+
	Barford's test	-	+	+	+	+
Flavonoids	Alkaline test	-	+	-	-	-
	Zinc test	-	-	-	-	-
Protein	Ninhydrin test	-	-	-	-	-
	Millon's test	-	-	-	-	+
	Lead acetate test	-	-	-	-	-



Saponins	Froth test	+	+	+	+	+
	Foam test	+	+	+	+	+
Terpenoids	Salkowski test	+	+	-	-	-
Sterols	Salkowski test	+	+	-	-	-

It was observed that the major components of *Inula racemosa* were glycosides, tannins, sterols, terpenoids and saponins. However, alkaloids were likely present. Cardiac glycosides, terpenoids, sterols were mainly present in petroleum ether extract whereas tannins, glycosides, carbohydrates, proteins, etc. were mainly present in ethyl acetate, methanol, hydroalcoholic and aqueous extract.

PHARMACOLOGICAL ACTIVITY

ANTI-HYPERTENSIVE ACTIVITY

Yuan R et al. (2025) ^[18] investigated on the regulatory effect of alantolactone on blood pressure by inducing hypertension on Sprague–Dawley rats by angiotensin II (1000 mg/kg/min) administration and the anti-hypertensive activity was evaluated by administration of 5 mg/ml alantolactone and the results showed that alantolactone exhibited a significant reduction in blood pressure compared to the model group, hence it has the potential to be an effective therapy for angiotensin II-induced hypertension.

ANTI-FUNGAL ACTIVITY

Bhat S et al. (2024) ^[19] evaluated the anti-fungal property of methanol, acetone and dimethyl sulfoxide extracts of *Inula racemosa* by using *Bipolaris oryzae* as the test organism and anti-fungal activity was determined by inoculation of 20% methanol, acetone and dimethyl sulfoxide extracts of *Inula racemosa* to petri plates containing *Bipolaris oryzae* and incubating them at 25±1 °C for 6 days, and the percent inhibition was found to be 90.33% for methanol extract, 81.67% for acetone extract, and dimethyl sulfoxide extracts had less of an effect on test organism.

ANTI-CARCINOGENIC ACTIVITY

Yin SS et al. (2023) ^[20] studied on the activity of isoalantolactone in chronic myeloid leukemia by treating imatinib-sensitive and imatinib-resistant cells with different concentrations of isoalantolactone (2.5, 5, 10, 20, 40, and 80 µmol/l) and examined them for proliferation and apoptosis, and it was found that isoalantolactone inhibits the proliferation and induces apoptosis and BCR-ABL protein degradation in imatinib-resistant cells, hence it can be used as a potential drug to treat chronic myeloid leukemia.

CARDIOPROTECTIVE ACTIVITY

Liu M et al. (2022) ^[21] investigated one the cardioprotective effects of alantolactone on isoproterenol-induced cardiac injury on adult male Sprague–Dawley rats by administering 25 and 50 mg/kg doses of alantolactone and the cardioprotective activity was evaluated by comparing it with the standard drug isoprenaline (85 mg/kg) and it was found that alantolactone protected isoproterenol-induced rats against myocardial damage, effectively reduced oxidative stress, and calcium overload.

ANTI-OBESITY ACTIVITY

Jung YS et al. (2022) ^[22] investigated on the two sesquiterpene lactones, alantolactone and isoalantolactone; the major constituents of *Inula* species for their action on adipocytes. The activity was studied on preadipocyte cell by inducing their cell differentiation through 0.5 mmol/l 3-isobutyl-1-methylxanthine, 1 µmol/l dexamethasone, and 5 µg/ml insulin and treating them with ethanolic root extract of *Inula helenium*, and by performing bromodeoxyuridine cell proliferation assay it was found that the ethanolic root extract of *Inula helenium* inhibits adipogenesis so it has potential as a therapeutic option for obesity.

ANTI-ARTHRITIC ACTIVITY

Chen HL et al. (2021) ^[23] investigated on the anti-arthritis effect of alantolactone; a bioactive compound isolated from *Inula* species (*Inula helenium*) by administering 25 and 50 mg/kg alantolactone to female mice which has arthritis induced by intradermal injection of 2 mg/ml bovine type II collagen and the clinical symptoms of arthritis and various inflammatory mediators levels were evaluated and it was found that alantolactone treated mice has shown reduced levels of pro-inflammatory cytokines, such as TNF-α, IL-6 and IL-17 as compared to vehicle treated group, which proves the anti-arthritis activity of *Inula* species.



ANTI-PSORIATIC ACTIVITY

Chuo WH et al. (2021) ^[24] evaluated the anti-psoriatic potential of alantolactone by administering imiquimod cream (62.5 mg/day) to female BALB/c mice to induce psoriasis and treating them with alantolactone cream (10 mg/mL and 20 mg/mL) and upon evaluating, it was found that alantolactone treatment significantly reduced TNF- α , IL-6, IL-1 β , IL-8, IL-17A, and IL-23 in skin lesions as compared to the vehicle group, hence it can be used as an anti-psoriatic agent.

HEPATOPROTECTIVE ACTIVITY

Mangathayaru K et al. (2015) ^[25] studied on the hepatoprotective activity of isolated compound isoalantolactone and evaluated its activity against chloroform induced liver injury in male wistar rats, at a dose of 100 mg/kg and compared the effect with standard drug silymarin (10 mg/kg) and reported that isoalantolactone significantly reduced the levels of serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, alkaline phosphatase and bilirubin similar to silymarin treated animal group, showing its hepatoprotective activity.

CONCLUSION

Inula racemosa, commonly known as Orris root or Pushkarmulam is a species native to the Himalayan region, particularly found in temperate and Sub Alpine regions. It belongs to the family Asteraceae. It represents as a symbol of healing and resilience. The medicinal chemistry of *Inula racemosa* is potential as a valuable source of bioactive compounds with diverse therapeutic property. Most of the compounds isolated from the roots of *Inula racemosa* belong to sesquiterpene lactone category which have a wide range of biological activities. The sesquiterpene lactones mainly include alantolactone and isoalantolactone and other constituents including glycosides, tannins, sterols, terpenoids and saponins, providing a wide range of pharmacological properties including anti-inflammatory, anti-microbial, hepatoprotective and immunomodulatory effect. Quality control measures and standardization efforts are imperative to ensure safety, efficacy and availability of *Inula racemosa*. The collective evidence from pharmacological investigations underscores the potential of *Inula racemosa* as a valuable natural remedy, signalling the need for further research and clinical validation to fully harness its health benefits.

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