

Review on Phytochemical and phytotherapeutic properties of *Inula racemosa*

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ABSTRACT

From ancient times various diseases have treated by using medicinal plants and phyogenic products throughout the world. Crude extracts are now considered a valuable source for natural products used in the development of medicines against various diseases for the development of pharmaceutical preparations and for novel biomedical research. *Inula racemosa* mostly distributed in Asia in hilly areas. These plants are used for traditional medicine for several years for various diseases. These plants have been used in treating different diseases like gastric irritability, febrifuge, nervous depression, anthelmintic, liver compliants, jaundice, sores in eyes and fever etc. The present review aims to present a brief overview of the medicinal use as well pharmacological value of the plants focusing for the current research work on Lung cancer.

Keywords: *Inula racemosa*, Taxonomical classification, Phytochemical constituents and Phytotherapeutic effects.

INTRODUCTION

Worldwide traditional medicine are used based on the availability of plant species, plant based products, economic affordability and effective against certain diseases when compared to modern medicine. Traditional medicinal plants knowledge has been accumulated in course of many centuries based on various medicinal systems like Ayurveda, unani, homeopathy and siddha. Traditional knowledge about plants is important in herbal medicine as well as in pharmaceutical industry, since they provide the raw materials and other prerequisite information about plant based drugs [1].

Inula racemosa is known by different names around the world including the Indian sub-continent. Pushkarmul in malayalam, pushkara mulamu in telugu, pokharmul in hindi and gujarati, puskaramul in kanada, elicampene and Indian elecampane in English, gharsa in Persian, rasan in Arabic, azurro in Italian, blaweiris in German, padmapatra (leaves resembles leaves of lotous), kashmira (grows abundantly in Kashmir), poushkara, chiram, jiham, tirtha, dhira, padma, puskarahva, brahmatirtha, mulam, vatahva, phala, patraka, viram and sugandhikam.

Inula racemosa is distributed in temperate alpine Himalayas at an altitude of 1500 to 4200 from Kashmir to Kumaon, Afganistan to central Nepal. It occurs wild among alpine vegetation in cold habitat in Jammu and Khasmir, Himachal Pradesh, Utterpradesh, at an altitude range of 2800-3200 meters. Also outside India Afghanistan, Pakistan and Nepal. Plant cultivation has flourished due to its ayurvedic uses as a seasonal cash crop [2].

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. The fruit being slender achenes, 0.4 cm long, bewhiskered with 0.75 cm long pappus hairs. The flowers are bright yellow in colour with many in heads, 0.5-1 cm in diameter. The fresh roots has dull brownish skin with yellowish colour inside. It changes to greyish on drying. It has sweet and camphoreaceous odor and has a bitter taste. It blooms from July through September and get dries to a shiny bronze colour in early winter. It grows well in waterside or in the meadow garden.

The plant is commercially is a very important medicinal plant as described in Ayurveda. In Ayurvedic classics it is described as an effective medicine in the cases of swasa (breathlessness), kasa (cough), hikka (Hiccup) and parswasula (pain in the lateral sides of the chest). According to bhavaprakash it is bitter pungent in taste. When administered it mitigates vatakapha jwara (fever caused by vata pitta imbalance), sotha (swelling), aruchi (anorexia). The aqueous extract of the fresh or dry roots is given orally in rats to evaluate glucose homeostasis and liver problems [3].

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

Phytochemical Evaluation of *Inula racemosa*

Inula racemosa revealed the presence of racemosalactones A to E, alloalantolactone, isoalloalantolactone, inunal, isotelekin, 5- α -epoxyalantolactone, 5- α -epoxyisoalantolactone, isooinunal, telekin, 5- α -6- α -epoxyalantolactone, trinorsesquiterpenoids, (4R,5S,10S)-5-hydroxy-11,12,13-trinoreudesm-6-en-8-one, (4R,5R,10S)-5-hydroxy-11,12,13-trinoreudesm-6-en-8-one, (4R,5S,10R)-5-hydroxy-11,12,13-trinoreudesm-6-en-8-one, 11,12,13-trinoreudesm-5-en-7- β -8- α -diol, alantolactone, isoalantolactone, dihydroisolantolactone, dihydroepoxyalantolactone, alantodiene, isoalantodiene, 3-oxoalloalantolactone, dihydro-4(15)- α -epoxyisoalantolactone, 3- β -hydroxy-11- α ,13-dihydroalantolactone, 11- α -hydroxyeudesm-5-en-8- β ,12-olide, 11,13- dihydroalantolactone, 11,13- dihydroalantolactone,

macrophyllilactone E, 11,13- dihydro-2- α -hydroxyalantolactone, 11,13- dihydroivalin, 11- β -H-2- α -hydroxyeudesman-4(15)-en-12,8- β -olide, 11,12,13-trinoreudesman-5-ene-7- β ,8- α -diol, racemosin A, (7R,8R,10R)-8-hydroxyeudesman-4(5),11(13)-dien-12-oic acid, (4S,8R,10R)-13-dimethoxyeudesman-5(6),7(11)-dien-12,8-olide, (4S,8S,10R)-12-hydroxyeudesman-5(6),7(11)-dien-12,8-olide, 13-hydroxy-5-7(11)-eudesmadien-8,12-olide, 4- α -H-eudesman-11(13)-en-4,12-diol, 3-oxo-eudesman-4,11-dien-12,8- β -olide, 11- α ,13-dihydroalantolactone, [1(10)E]-5- β -hydroxygermacra-1(10),4(15),11-trien-8,12-olide, 2- α -hydroxyeudesman-4,11(13)-dien-12,8- β -olide, dehydroivangustin, 1-one-4-epi-alantolactone, 4- α ,13-dihydroxy-5,7(11)-eudesmadien-12,8-olide, septuplinolide, 13-acetyloxy-5,7(11)-eudesmadien-12,8-olide, n-decanyl docosdienoate, n-hexadecanyl behenate, eudesmanolide ester, 15-tricosterienyl eudesmanolide, 15-nonadecenyl eudesmanolide, 15-tetracosdienyl eudesmanolide, 15-tetracosterienyl eudesmanolide, 4,(15)- α -epoxyisotelekin, 4,(15)- α -epoxytelekin, 7-hydroperoxy-11- α -H,13-dihydroisoalantolactone, β -sitosterol, daucosterol, aplotaxene, phenylacetonitrile, epoxyalantolactone, 8-oxo-tri-nor-eudesman-6-en-5- α -ol and trinoreudesman-5-en-7- β ,8- β -diol [4].

Pharmacological Properties of *Inula racemosa*

Ethanol extract of the roots showed anti-inflammatory activity against carrageenan induced paw edema in rats. Ethanol extract showed significant effect at 200 mg/kg dose. The root ethanolic extract showed comparable effect with standard drug aspirin [5]. *Inula racemosa* root aqueous extract showed significant effect at a dose of 400 mg/kg against carrageenan induced paw edema, it was compared standard drug indomethacin [6].

Ethanol extract of the roots showed anti-analgesic activity against hot plate induced analgesia in rats. Ethanol extract showed significant effect at 200 mg/kg dose. The root ethanolic extract showed comparable effect with standard drug aspirin [5]. *Inula racemosa* root aqueous extract showed significant effect at a dose of 400 mg/kg against acetic acid induced writhings and tail immersion method [6].

Inula racemosa roots ethanolic extract was evaluated on colon, ovary, prostate, lung, CNS and leukemia cancer cell lines using sulphorhodamine-B dye and MTT assay for HL-60 cell line for *in vitro* cytotoxicity. The hexane fraction for colo-205, a colon cancer cell line and CNS cancer cell line (SF-295) showed cytotoxicity [7]. *Inula racemosa* roots methanol extract and all the isolated compounds were evaluated for their antiproliferative activities using human non-small-cell lung cancer (A-549), hepatocellular carcinoma (HepG-2) and human fibrosarcoma (HT-1080) cells using CCK-8 dye. All the tested compounds exhibited antiproliferative activities against human non-small-cell lung cancer A-549, hepatocellular carcinoma HepG-2 and human fibrosarcoma HT-1080 cells. Isolated compounds alantolactone and isoalantolactone were evaluated for antiproliferative activity against human umbilical vein endothelial cells (HUVECs) [8]. *Inula racemosa* roots ethanol extract evaluated for their cytotoxic activities using human lung cancer (A-549), human liver cancer (BEL-7402), human stomach cancer (BGC-823), human colon cancer (HCT-8) and human ovarian cancer (A-2780) cell lines using MTT assays. All the tested compounds exhibited moderate anti cancer activity [9]. Ethanolic root extract of *Inula racemosa* evaluated for LPS induced nitric oxide production in RAW264.7 macrophages showed significant activity [10].

Inula racemosa roots ethanol extract was evaluated against sulphorhodamine-B and MTT assay on normal human liver cell found effective [11].

Methanolic extract of *Inula racemosa* roots showed antifungal activity against *Aspergillus flavus*, *Aspergillus niger*, *Geotrichum candidum*, *Candida tropicalis* and *Candida albicans* [12]. Ethanolic and aqueous extracts of *Inula racemosa* roots revealed antibacterial activity against *E. coli*, *S. aureus* in disc diffusion method. The aqueous extract of plant exhibited significant antibacterial activity in MIC method [13].

Hydroalcoholic extract of roots of *Inula racemosa* roots exhibited hepatoprotective therapeutic effect. The root extract decreased increased levels of alanine transaminase, aspartate transaminase, alkaline phosphatase, and lactate dehydrogenase [7]. Ethanolic root extract of *Inula racemosa* evaluated for *in vitro* hepatoprotective activity by using Chang cell line (normal human liver cells) against carbon tetrachloride induced hepatotoxicity. The extract treated cells showed highly significant activity by increased percentage viability [11]. Isoalantolactone was an isolated compound from *Inula racemosa* screened for hepatoprotective activity in CCl₄ induced liver toxicity wistar rats. The degree of protection was measured using biochemical parameters like SGOT, SGPT, ALP and bilirubin. The tested compound showed significant efficacy and it was comparable with standard drug silymarin [14].

Inula racemosa root ethanol extract was evaluated mast cell stabilizing activity against degranulation of rat peritoneal mast cell induced by compound egg albumin. The extract showed significant inhibition and also comparable with standard drug kitotifen [15]. Alcoholic extract of *Inula racemosa* root was evaluated for type-I hypersensitivity in rats. The extract showed significant protection against egg albumin induced passive cutaneous anaphylaxis [11]. Antihistamine potential of hydroalcoholic extract of *Inula racemosa* root was evaluated by blockade of histamine induced contractions of isolated tracheal chain of guinea pig. The extract showed emoliation from bronchial asthma effect [16].

Ethanolic root extract of *Inula racemosa* showed mosquito larvicidal activity against *Aedes albopictus* and *Asian tiger* mosquitos [17]. Daily oral administration of *Inula racemosa* root ethanolic extract in albino rats significantly showed effect on lipid peroxide and reduced glutathione content in blood and liver with antioxidant potential [18]. *Inula racemosa* root extract having (Anti-asthmatic activity) antagonistic activity on histamine induced contraction, milk induced eosinophilia, leucocytosis and protection against mast cell degranulation in wistar rats. Petroleum ether extract of the plant exhibited significant antagonistic effect on histamine induced contraction as compared to its ethanol and aqueous extract. Significant Anti-asthmatic effect was observed in Petroleum ether extract treated mice in milk induced eosinophilia [19].

Aqueous root extract of *Inula racemosa* showed protective effect against 4-nitroquinoline-1-oxide-induced DNA damage and apoptosis in mice bone marrow cells, which was measured by the use of Annexin V-FITC assay kit [20]. Adaptogenic potential of *Inula racemosa* root extract was investigated in the force swim test model in albino mice. It showed significant decrease in the immobility period with simultaneous increase in antioxidant markers, adrenaline and serotonin levels [11]. Petroleum ether extract of the plant

root blocked adrenergic β -receptor activity in rats. Root extract reduced plasma insulin and glucose levels and significantly neutralize adrenaline induced hyperglycaemia [21].

Endocrine response of *Inula racemosa* roots ethanol extract was evaluated in relation to glucose homeostasis in rats. The root extract lowers blood glucose level and enhances liver glycogen without increasing plasma insulin level in rats [22]. *Inula racemosa* root powder was screened for anti-diabetic activity as part of clinical trials in 15 patients of age above 35 years. These patients were suffered with diabetes mellitus like polyuria, polydipsia and polyphagia etc. treated with one table spoonful for three times a day of root powder. After treatment blood glucose level of all patients was found to be normal [23]. *Inula racemosa* root evaluated for the amelioration of dexamethasone (corticosteroid) induced hyperglycaemia in mice. The increased glucose levels were significantly decreased along with T3 and T4 [24 and 25].

The effect of glucose metabolism in albino rats was ameliorated by *Inula racemosa* root ethanol extract. Blood glucose, plasma insulin and liver glycogen levels were significantly reverted back to normal levels after the 16th hour of drug administration. Liver glycogen levels were increased significantly as compared to control group at 4th hour of after drug administration [26]. The blood glucose levels of alloxan induced hyperglycemia rats was significantly reversed by methanolic root extract [27]. Hydroalcohol extract evaluated against isoproterenol induced myocardial infraction in rats for cardioprotective potential. The rats treated with isoproterenol exhibited myocardial infraction, such as decreased arterial pressure, heart rate, contractility, relaxation along with increased left ventricular end diastolic pressure as well as decreased endogenous myocardial enzymatic and non-enzymatic antioxidants. Significantly restored the reduced glutathione and endogenous antioxidant enzymes superoxide dismutase, catalase, glutathione peroxidase from the heart [28].

CONCLUSION

From the above mentioned detailed literature survey it is clearly understood that different solvents extracts of *Inula racemosa* have different traditional and pharmacological uses. The pharmacological uses of these plants extracts reported for their anti-inflammatory, antianalgesic, colon, ovary, prostate, lung, CNS and leukemia cancer inhibiting activity, antiproliferative activities, antifungal, anti microbial, antilaval, hyperglycaemia, cytotoxicity, anti-diabetic, antioxidant and hepatoprotective activity etc.

All these above mentioned literature review relates the potential benefits of using these plants as medicine for microbial infection, acute inflammation, anti proliferative, diabetes associated with oxidative stress. Moreover, these literature reports warrant and provide us a new avenue for the commencement of our research work in these medicinal plants for screening their anti cancer effect and oxidative stress by using different animal and cell line models.

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