2.1 **INULA RACEMOSA HOOK. F (ASTERACEAE)**

It is a stout herbaceous alpine perennial, 1.5 m tall, with very large basal leaves and usually terminally borne, yellow flower heads (Fig 1).

2.1.1 TAXONOMICAL HIERARCHY

- **Kingdom**: Plantae
- **Phyllum**: Magnoliophyta
- **Class**: Magnoliopsida
- **Order**: Asterales
- **Family**: Asteraceae
- **Tribe**: Inulae
- **Genus**: Inula
- **Species**: *Inula racemosa*

2.1.2 SYNONYM

- *Inula royleana* (C.B.Clarke)

2.1.3 VERNACULAR NAMES

- **English**: Inula, Indian elecampane, Sunspear
- **Sans & Hindi**: Pushkar mool
- **Kashmiri**: Poshkar, manurucha, mano

2.1.4 COMMERCIAL ADULTERANT/SUBSTITUTE

- *Saussurea lappa* Clarke (Asteraceae)

2.1.5 DISTRIBUTION

The plant is distributed in temperate alpine Himalayas at an altitude of 1,500-4,200 from Kashmir to Kumaon, Afghanistan to Central Nepal. It occurs wild among
strong alpine scrub vegetation in the cold arid habitat of NW Himalayas between
2,700-3,500 m in the eastern Ladakh (Leh) region of Kashmir.

Domesticated forms of this incipient cultigen is cultivated on borders of
agricultural fields of wheat, barley and buckwheat both in Kashmir and Lahaul valley
of Himachal Pradesh [1959]

*Inula racemosa* is a critically endangered species due to the fragile nature of
its habitat, and its exploitation due to commercial medicinal properties. The species is
facing the onslaught of indiscriminate over exploitation, habitat destruction and
competition. The populations of the species in the entire north western Himalayan
range are witnessing a speedy decline in density, dwindling both in size and number
[Parvaiz *et al.* 2006]

2.1.6 MORPHOLOGY

The plant is a stout shrub, bearing large leaves arranged in a racemose manner.
The stem is grooved and all vegetative parts are scabrid tomentose. Lower leaves are
narrowed to a winged leaf stack. Upper leaves are lanceolate and stem clasping. The
abaxial laminal face is densely tomentose. Radical leaves are 40 x 20 cm broad and
are elliptic lanceolate with long petioles. The cauline leaves are smaller, oblong and
semi aplexicaule. It also "dies very well" in the fall making a stately specimen with
shiny bronze foliage for winter interest.

The flowers are large, shady yellow daisies produced in mid to late summer.
They are borne on apical spike like cluster.

The fruits, slender achenes, 0.4 cm long, bearded with 0.75 cm long pappus
hairs. Root stock branched; fresh roots are irregularly fusiform (20-25 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 somewhat camphoraceous odour and have a bitter taste
[Chopra *et al.* 1956a].
2.1.7 ETHNOMEDICAL USES

Pushkarmool commercially is a very important medicinal plant of the North western Himalayas. The plant is used in Ayurveda as an expectorant and resolvent in indurations. Considered a ‘Rasayana’ (rejuvenator, immunomodulator) by Ayurvedic physicians, the drug according to Bhavaprakasha [Bhavaprakasha 1961] is bitter pungent in taste. When administered it mitigates vatakapha jwara (fever caused by vata pitta imbalance), sotha (swelling), arachi (anorexia), swasa (breathlessness) and parswasoola (pain in the sides of the chest).

The root is medicinal and considered a specific for cough, dyspnea, asthma, pleurisy, tuberculosis and chest pain especially pre cordial pain. The aqueous extract of the fresh or dry roots is given orally in rheumatic pains and liver problems. Externally a paste or liniment is used for relieving pain. The root is also used in
veterinary medicine as a tonic [2002]. The root forms an important ingredient of several polyherbal formulations for heart diseases and inflammatory conditions of spleen and liver [1978]. Along with Commiphora mukul, the drug combination called 'pushkar guggulu' is a popular anti obesity, hypolipidemic indicated in cardiac ailments.

Inula racemosa is used in Chinese medicine for abdominal distension and pain, acute enteritis and bacillary dysentery [Pharmacopoeia Committee of the Ministry of Health 1995].

2.1.8 BIOLOGICAL ACTIVITIES REPORTED

Root powder is reportedly hypoglycemic and hypocholesterolemic in human subjects [Tripathy et al. 1979]. It brought about a beneficial improvement in ST-T changes in ECG of patients with Ischemic heart disease (IHD) [Tripathy et al. 1984]. At 450 mg/kg it enhanced PGE₂ like activity in isoproterenol induced myocardial ischemia in rabbits.

In combination with guggulu it is anti anginal and hypolipidemic in patients with IHD [Ramji et al. 1991]. In multi herb combination with Terminalia arjuna and Commiphora mukul, it is reported to exert cardioprotective effect in isoproterenol induced myocardial ischemia in rats [Seth et al. 1998]. Inula racemosa with Gymnema leaf extract reduced corticosteroid induced hyperglycemia in mice [Gholap and Kar 2003].

Petroleum ether extract at 200 µg has been reported to exhibit negative chronotropic and positive ionotropic effect on isolated frog heart. At 400 mg/kg it is reported to have shown adrenaline induced beta blocking activity in rats [Tripathi et al. 1988].

The aqueous, methanolic and total aqueous extract showed better hepatoprotective activity than the petroleum ether extract at 100 mg/kg in rats and they were non toxic upto 10 g/kg. The LD₅₀ of pet ether extract is reportedly 1.5g/kg bw [Rao and Mishra 1997].
The alcoholic extract is non toxic upto 2100 ± 60 mg/kg i.p in rats and provided significant protection against egg albumin induced passive cutaneous anaphylaxis [Srivastava et al. 1999].

The crude alcoholic extract exhibited anti dermatophytic and anti cholinergic activities, the former reportedly localized in the hexane soluble fraction [Tripathi et al. 1978].

2.1.9 CONSTITUENTS ISOLATED

Chemical investigations of the genus Inula have shown that there are 2 main groups of plants. One containing sesquiterpene lactones, especially eudesmanolides and one containing simple thymol derivatives [Maxmuller H 1975].

Inula racemosa yields large amounts of sesquiterpene lactones, Alantolactone (ALT) and isoalantolactone (IALT) [Arora et al. 1980]. Dihydroalantolactone, dihydro isoalantolactone, inunolide [Raghavan et al. 1969], dihydroimunolide, neoalantolactone, isoalloalantolactone [Ravindranath et al. 1978], alloalantolactone [Prabha and Rastogi 1983], inunal, isoinunal [Kalsa et al. 1988], altantadiene and isoaltantadiene [Kalsa et al. 1989] are other sesquiterpene lactones isolated from the non polar fractions of the root.

Daucosterol and Beta sitosterol have also been reported in quantity from the roots [Tan et al. 1998].

1.3-2.6% essential oil is reported to be obtained from Inula racemosa from Kashmir and it is constituted of ca 60% sesquiterpenes, although the most abundant constituent is aplotaxene (hepta deca,1,8,11,14- tetraene ca 22%) apart from phenylacetonitrile (ca 2%) [Bokadia et al. 1986].

Roots of ‘mano’ from Kashmir is reported to yield 5.7-6.2% petroleum ether extract [Singh et al. 1959], while those from Lahaul valley, Himachal Pradesh reportedly yield 8.5%w/w constituted of 83% lactones. The major lactones ALT and IALT are in the ratio 4:6.
Investigation on the aerial parts of *Inula royleana* reported the presence of several other sesquiterpene lactones namely ivalin acetate, 2d-OH alantolactone, 1-desoxy-8-epi-ivangustin, 8-epi-isoivangustin, 9β-OH costunolide, 9 β-propionyl oxycostunolide, 9 β-(2-methylbutaryloxyl) costunolide, 4β-5α-epoxy-10 α, 14H-inuviscolide, 4β, 5α-epoxy-4,5-cis-inunolide, 4H-tomentosin, 4H carbrone [Ferdinand et al. 1978].

2.1.10 BIOLOGICAL ACTIVITIES OF ISOLATED CONSTITUENTS

Sesquiterpene lactones have received considerable attention because of their numerous biological activities [Picman 1986]. They are secondary plant metabolites that play an important role in protecting plants against pathogenic organisms, herbivorous insects or mammals. In addition, these compounds, exert their allelopathic effects on other flora and vertebrate poisoning [Vidari *et al.* 1976].

**Alantolactone and isoalantolactone** [Milman 1990]

ALT and IALT are typical representatives of the sesquiterpene lactones found in a number of plants of the family Compositae. A mixture containing both lactones and called helenin (or *Inula camphor*) has long been known. In antiquity Elecampane (*Inula helenium*), which contains ALT and IALT was added to food as a seasoning and in the middle ages it began to be used for medical purposes. Today this mixture serves as the active principle of the antiulcer drug Alanton. It is used in the treatment of gastric ulcers and duodenal ulcers. The drug exhibits an anti inflammatory action, decreases the proteolytic activity of the gastric juice and raises a lowered acid formation function of the stomach without appreciably affecting a normal or raised function. Alanton stimulates the formation of mucin and intensifies the regenerative capacity of the gastric mucosa. Helenin possesses pronounced hemostatic action. The results of experiments on animals with multiple injections have shown shortened clotting time at 3 mg/kg by 75%. ALT and IALT are secondary metabolites and have no obvious function in the basic metabolic processes and play an important role in protecting plants from phytophagous pests. ALT and IALT are reportedly antifeedant to granary pests [Streibl *et al.* 1983]
Effective as plant growth regulators at 15-20 mg/L ALT and IALT increased number of rootlets of *Phaseolus aureus* by a factor of 2-2.5 as compared with control experiment [Kaur and Kalsi 1985].

IALT is herbicidal on account of its lipophilicity as it gets incorporated into cell membrane and does not pass into the other parts of the plant [Dalvi et al. 1971].

As early as the 1930’s the toxicity of lactones ALT and IALT has been studied in mice. The minimum lethal dose for both compounds was 2000 mg/kg.

At doses of 100-200 mg/kg ALT and IALT increased the antioxidant activity of lipids, their action considerably exceeding the activity of α-tocopherol and ubiquinone.

It has been found in experiments in guinea pigs that helenin possesses an antitussive activity, but this is only half that of codeine.

Inspite of the anti inflammatory action exhibited by helenin, IALT in a concentration of 37 µM in an *in vitro* experiment did not inhibit the biosynthesis of prostaglandins. It has been shown that ALT inhibits the microsomal enzymes of the liver [Dalvi and Mcgowan 1982].

The antibacterial properties of ALT and IALT against a number of gram positive and gram negative bacteria have been studied and ALT is completely inhibitory to *B.subtilis*, while IALT exhibited weak activity in relation to *B.subtilis* and *B.vulgaris*. At concentrations of 31.2-62.5 and 31.2 µg/ml respectively, ALT and helenin possessed a pronounced inhibitory effect against pathogenic bacteria *S.aureus* and *Mycobacterium tuberculosis*. The antifungal activity of ALT and IALT has been studied in relation to more than 16 different cultures and both lactones inhibited the growth of all the fungi studied, but the effects for each individual culture differed greatly. Both ALT and IALT exhibited their greatest inhibitory effect on the growth of the zoophilic fungi *Microsporium cookie* and *Trichophyton mentagrophytes*.

Studies on SAR of several sesquiterpenes with respect to antibacterial and antifungal activities revealed multivalent reasons for their activity, inexplicable for
eg., by the presence or absence of an \( \alpha \)-methylene group in the lactone ring alone [Picman 1984].

The antiprotozoal properties of ALT and IALT in relation to the dysentery amoeba *Entamoeba histolytica* and a number of strains of *Trichomonas vaginalis* 46 have also been studied *in vitro*. Out of the 82 sesquiterpene lactones investigated, ALT and IALT were among the ten most active compounds.

Lactones ALT and IALT possess anthelmintic activity. The action of 12 nitrogen containing derivatives of ALT and IALT has been studied in relation to *Hirudo medicinalis* (leech) *Lumbricus terrestris* (earthworm) and *Ascaris suum* (helminth). The most active were the products of the addition of pyrrolidine to IALT and of 4-methyl piperidone to ALT.

Analysis of the activity of a number of sesquiterpene lactones in relation to the nematode *Meliodogyne incognito* has shown that the activity exhibited is connected to the presence of \( \alpha \)-methylene-\( \gamma \)-lactone group in the molecule. The result of the action of the lactone ALT on nematodes was 97% mortality.

It is known that compounds possessing anthelmintic activity frequently also exhibit anticarcinogenic activity. An investigation of the cytotoxic properties of helenin in comparison with the individual lactones ALT and IALT showed that the activity of helenin is connected with the presence of IALT in it [Ohta et al. 1977]. The model used was a culture of human epidermal carcinoma cells. The cytotoxicities of ALT and IALT have also been determined in *in vitro* experiments on lines of human lung carcinoma cells [Wordenbag et al. 1986]. LD\(_{50}\) for ALT was 4.6 \( \mu \)g/ml: and for IALT, 16 \( \mu \)g/ml. A dose of 50\( \mu \)g/ml completely suppressed the growth of cells.

Presence of the reactive group –CH=C=C=O is one of the main conditions for the biological activity of sesquiterpene lactones, and in particular, ALT and IALT. The mechanism of their cytotoxic effect is also treated as a Michael addition reaction between this grouping and the SH groups of enzymes and proteins [Kupchan et al. 1971]. The role of lipophilicity in the biological activity of the sesquiterpene lactones has been demonstrated. For example, for IALT, ivalin (2-OH alantolactone) and
ivasperin (1,2-dihydroxyalantolactone), cytotoxicity increases with an increase in lipophilicity [Abeysekara et al. 1985].

Many natural sesquiterpene lactones containing an α- methylene-γ- lactone grouping cause allergic contact dermatitis. The importance of the reactivity of the lactone grouping has been shown in model experiments using as examples the interaction of ALT with a number of amino acids (cysteine, tryptophan, histidine, lysine), as a result of which ALT lost its immunological reactivity [Dupuis et al. 1974]. At the same time there is information on the toxicity of both ALT and 11,13 dihydro alantolactone in relation to a culture of leukocytes *in vitro* [Dupuis and Brisson 1976]. The authors concerned put forward a hypothesis that the toxicity of ALT is not connected with α- methylene-γ- lactone grouping.

Thus the broad spectrum of the biological activities of alantolactone and isoalantolactone completely justifies the Russian name of the compound from which these compounds were isolated – devyasil (nine powers).

Alantolactone and isoalanto lactone, thus remain the object of active investigation both in relation to chemical properties and in relation to biological activity [Milman 1990].

**Other Lactones**

Alantodiene and isoalantodiene isolated from *Inula racemosa* have displayed biological activity as plant growth regulators, which not only initiate adventitious root formation in the stem cuttings of *Vignata radiate*, but also increase the nitrate reductase activity in the plant [Kalsa et al. 1988]. Isoinunal isolated from *Inula racemosa* displays considerable root initiation activity with hypocotyl cuttings of *Phaseolus aureus* [Prabha and Rastogi 1983]. Isoinunal and isoalloalantolactone were found to cause adventitious root formation on stem cuttings of *Phaseolus aureus*.
2.1.11 JUSTIFICATION FOR INCLUSION IN THE STUDY

*Inula racemosa* (IR) has been selected for inclusion in this study on the following grounds:

- Root is a reputed traditional drug indicated for precordial chest pain by Susruta the legendary physician/compiler of the ‘Susruta samhita’ a classic treatise on Ayurvedic medical practice
- Clinical trials of the root powder indicated its hypolipidaemic activity apart from effecting beneficial ST-T segment changes in ECG of IHD patients
- Alcoholic extract of the root is reportedly cardioprotective in isoproterenol induced myocardial ischaemia in rabbits
- Petroleum ether extract of the root has exhibited a negative chronotropic and positive ionotropic effect on isolated frog heart and has shown adrenaline induced beta blocking activity in rats
- The roots are rich in sesquiterpene lactones known for their powerful biological activity and generic inhibition of enzymes
- Alantolactone and isoalantolactone, the major constituents are attributed with a rich spectrum of bio activity
- Anti inflammatory activity of lactones is extensively reported
- The antioxidant activity of the lactones has also been reported
- the root has never been studied for anti atherosclerotic activity
- Demonstration of such an activity shall give scientific validation to traditional medicine claims and pave way for exploration of mechanism of action of the extracts and/or phytoisolates
2.2 LITERATURE ON *ERYTHRINA VARIEGATA* LINN. (LEGUMINOSAE)

A medium sized, quick growing tree reaching a height up to 60 ft, belonging to the family Leguminosae, Subfamily, Papilionaceae [Gamble 1935; Henry *et al.* 1987]. It is cultivated in gardens as an ornamental. A number of horticultural forms are recognized, among them the well known ones are forma alba with white flowers and forma parcelli with variegated leaves and bright orange to deep red coloured flowers [1952].

2.2.1 TAXONOMICAL HIERARCHY

- **Kingdom:** Plantae
- **Division:** Magnoliophyta
- **Class:** Magnoliopsida
- **Order:** Fabales
- **Family:** Fabaceae
- **Subfamily:** Faboidae
- **Tribe:** Phaseoleae
- **Genus:** *Erythrina*
- **Species:** variegata

2.2.2 SYNONYMN

*Erythrina indica*

2.2.3 VERNACULAR NAMES

- **English:** Tiger’s claw, Sunshine tree, Indian coral tree
- **Sans:** Mandar, parijata
- **Hin:** Dadap
- **Tel:** Badisa, modugu
- **Tam:** Kalyana murungai, Kalyana murukku
2.2.4 OTHER RELATED SPECIES


2.2.5 DISTRIBUTION

The genus Erythrina is distributed in the tropical and subtropical regions of the world and encompasses over 100 species. Erythrina variegata is native to tropical and subtropical regions of eastern Africa, southern Asia, northern Australia and the islands of the Indian ocean and the western Pacific ocean east to Fiji. The tree is found wild in deciduous forests throughout India especially the upper gangetic plains of India and Nepal [Sarragiotto et al. 1981]. About 8 indigenous species and 10 introduced ones occur in India. Many of the species of Erythrina are cultivated in India for their showy flowers; they are also grown in plantations as shade trees and for green manure.

2.2.6 GENERAL MORPHOLOGY

Erythrina is a genus of trees or shrubs, rarely herbs and usually armed with spines. Erythrina variegata is a medium sized, quick growing tree reaching a height up to 27 m (Fig 2). Tree bears coarse spines on trunk and branches, bark is smooth, yellowish or greenish grey, shining, peeling off in thin papery flakes; branchlets armed with small dark colored conical prickles upto 3rd or 4th year [Huxley 1992].

Leaves are variegated along major veins or not, trifoliate, variable in size with leaflet blades broadly triangular and upto 30 cm long. Leaflets are 4-6 in long and nearly as broad. Flowers appear in Jan- Mar and fruits ripen in May-July. Flowers large, white or bright orange to deep red, pea flower like, are borne in dense racemes upto 6-12 in long containing upto 12 seeds. Fruit a pod with large red seeds which are oblong, smooth, red to dark purple or brown [1952].

2.2.7 ETHNOMEDICAL USES

The leaves and tender shoots of the plant are eaten as pot-herb [Whistler and Elevitch 2006]. This plant has folkloric reputation for medicinal properties in India, China and
Indochina [Chopra et al. 1956b]. Different parts of the plant have been used in traditional medicine as a nervine sedative, collyrium in ophthalmia, anti asthmatic, anti epileptic, antiseptic and as an astringent [Mitscher et al. 1987].

![Figure 2. Indian Coral tree - habit](image)

The bark is used as febrifuge, antiseptic and for treatment of liver disorders. The leaves are reputedly stomachic, diuretic and able to provide pain relief in joints. In the islands of the South Pacific, it is used in the treatment of filariasis, as a remedy
for swollen armpits, swollen breasts, stomachache and coughs. In new guinea, an infusion of the root is used to treat bronchitis [1998].

*Erythrina variegata* is also used in folk medicine in southern parts of Japan and China as an anti bacterial, anti pyretic and as a collyrium. These properties are used in Chinese herbal medicine for the treatment of pyrexia, scabies and septicemia (College, 1977). The plant is used in Samoa in the treatment of inflammation and inflammation like processes [Weiner 1984]. The plant is specifically valued for its curare like action [Ghosal *et al.* 1972].

In India the leaves are used as a poultice to reduce fevers and is indicated as an antiobesity drug in Siddha system of medicine [Yoganarasimhan 2000].

2.2.8 BIOLOGICAL ACTIVITIES REPORTED

Different parts of the plant are reported with insecticidal, haemagglutinating activity, curaric, skeletal muscle relaxant, feeding deterrent, anti spasmodic and anti mycobacterial activity [Telikepalli *et al.* 1990a]. Leaf extract is reported to possess nematocidal property and is highly toxic to *Meliodogyne incognita* and *Tylenchorchynchus mashoodi* at 1:1 and 1:5 concentrations [Rajareddy and Sudarshanam 1987].

Root extracts possess anti microbial activity *in vitro* against *Staphylococcus aureus* and *Mycobacterium smegmatis* [Telikepalli *et al.* 1990a]. Alcoholic extract of stem bark of *Erythrina variegata* at 300-600 mg/kg for 14 weeks prevented ovariectomy induced increase in serum osteocalcin, alkaline phosphatase and urinary free deoxy pyridinoline levels. The extract also is reported to prevent histomorphometrically demonstrable estrogen deficiency and a decrease in trabecular thickness and area as observed in the tibial proxima [Zhang *et al.* 2007]. The extract also improved the energy absorption and stiffness of the midshaft of the rat femur, indicating ability of the plant extract to suppress the high rate of bone turnover induced by estrogen deficiency, inhibit bone loss and improve the biomechanical property of bone in ovariectomized rats. Extracts of various species of *Erythrina* exhibit curare like action which is attributable to the presence of hypaphorine [Marion 1960].
2.2.9 CONSTITUENTS ISOLATED

The plant is a rich source of alkaloids and they have been isolated from 50 species of the 105 known species of *Erythrina* [Marion 1960]. Alkaloids of tetracyclic erythrina type inclusive of tetrahydro isoquinoline type - Erythraline, erythratine, erythroidine, erysodine, erysotrine, erysotine, epierythritidine, 11- OH epierythritidine, 11-OH erysotrine, erythronine and hypaphorine are alkaloids isolated from the root and bark.

The plant is a prolific source of isoflavones, pterocarpans and biphenyls. Isoflavones erythrinins A,B and C, osajin and alpinum isoflavone in addition to the styrene oxyresveratrol and dihydro stilbene, dihydroxy resveratrol apart from linear pyrano isoflavones, robustone and 4-O- methyl alpinum isoflavone are isolated from the bark [Deshpande *et al.* 1977; Masouda *et al.* 1991].

Flowers contain erythritol, 7-methoxy 8-(15-OH pentadecyl)-coumarin, abyssinone, stigmoids A,B and C, alpinum isoflavone, erythrinin A,B and C, osajin, erythrabasin I, phaseollin, besides isoquinoline and isococcoline alkaloids, apart from 29-norcycloartenol, 3-β-acetoxy-β-norcholest-5-ene, docosanoic and capric acid [Sharma and Chawla 1992].

Seeds are rich in protein like chick-pea. They also contain isolectins (EVL I, EVL II and EVL III), kuntz-type trypsin inhibitors ETIa and ETIb and chymotrypsin inhibitor ECI [Dutta and Basu 1981]. Warangalone, Eryvarins F and G, [Tanaka *et al.* 2003] 5,7,4’-tri hydroxy-6-8-diprenyl isoflavone, erycristagallin, erythrybysin-II, phaseolin, phaseolidin, isobavachin, cinnamyl phenol, eryvaristyrene [Telikepalli *et al.* 1990b], diphenyl propan-1,2-diols, eryvarinols A and B [Tanaka *et al.* 2002] are the constituents isolated from the roots. Leaves are reported to have a total alkaloidal content of 0.11% constituting alkaloids erysovine, erysodine, erysotrine, erythrinine, and orientaline [Ghosal *et al.* 1972; Ghosal *et al.* 1970].

2.2.10 BIOLOGICAL ACTIVITIES OF CONSTITUENTS ISOLATED

Total alkaloids isolated form the bark showed a muscle relaxant activity and increased the sedative effects of hexabarbitol. The LD₅₀ in mice is 30.4mg/kg. Seeds
are a source of potential biopesticides. Lectins from the seeds are D-galactose binding and have haemagglutinating and leucoagglutinating property [Dutta and Basu 1981]. Some isoflavonoids exhibit anti bacterial, anti inflammatory activity [Telikepalli et al. 1990a]. Flavonoids abyssinone V, erycristaggallin and 4′-hydroxy-6,3′,5′-triprenyl flavonone have phospholiase A2 inhibitory activity [Hegde et al. 1977]. Isoflavones erythrinin B and euchrenone b₁₀ inhibit the Na⁺/H⁺exchange system [Kobayashi et al. 1997].

2.2.11 JUSTIFICATION FOR INCLUSION IN THE STUDY

- *Erythrina variegata (EV)* has folkloric/traditional medicine reputation for anti inflammatory activity in several Asian countries

- The plant is a rich source of alkaloids, some of which are of the tetrahydro isoquinoline group reported with estrogen agonist/antagonist effect [Lin et al. 2007]

- Cardioprotective effects of estrogen is well established and it is known that the direct effects of estrogen on the vasculature promote vasodilatation and inhibit the development and progression of atherosclerosis [Farhat et al. 1996].

- Ev like soyabean belongs to Leguminosae and is rich in isoflavonoids reported with a rich spectrum of biological activities like anti estrogenic, anti inflammatory, cardioprotective, anti oxidant and anti thrombotic activities

- Epidemiological reports have associated soy products with reduced incidence of breast and prostate cancer, cardiovascular disease, osteoporosis and lower cholesterol [Clarkson et al. 1995].

- Isoflavones being structurally similar to mammalian estradiol [Setchell and Adler 1988] are referred to as ‘phytoestrogens’. These are weakly estrogenic and in model systems, are shown be anti estrogens, competing for oestradiol at the receptor complex, yet they fail to stimulate a full estrogenic response after binding the nucleus [Tang and Adams 1980]. This raises the possibility that they may be protective in hormone related diseases such as breast cancer [Setchell et al. 1984].
Pharmacologically potent stryrene-resveratrol and dihydro stilbene di hydroxy resveratrol are reported in addition to a rich spectrum of isoflavonoids from the plant.

Some of the flavonoids isolated from the bark exhibited phospholipase A$_2$ (PLA$_2$) inhibitory activity. PLA$_2$ is an important enzyme in phospholipid catabolism, believed to be involved in a series of vital regulatory processes through its ability to release arachidonic acid for the subsequent biosynthesis of eicasanoids, implicated in the pathology of many diseases especially, those involving inflammation and allergy. Newer research indicates atherosclerosis to be an inflammatory disease. The ethnomedical usage of the plant as an anti inflammatory and the reported activity are the prime reasons for the inclusion of the plant in the study.

Root, bark, seeds and flowers have been investigated, but apart from alkaloids isolated, little or no work is reported for leaves which are indicated in Siddha medicine for anti obesity effect.

On the above cited grounds, leaves of EV are selected for evaluation of anti atherosclerotic potential.

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