INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH AND BIOMEDICAL ANALYSIS | ISSN: 2278 –2664
| APR-JUN 2015| VOLUME 4 | ISSUE 2 | 10-14
Available Online Through: www.ijprba.com

Review Article

CALAMUS AROMATICUS MEDICINAL REVIEW

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ABSTRACT
Calamus aromaticus is the synonym of Acorus calamus (Sweet flag*). Acorous* is a genus of monocot flowering plant family Acoraceae and order Acorales. Sweet flag has a very long history of medicinal use in Chinese and Indian herbal traditions.It is widely employed in modern herbal medicine as its sedative, laxative, diuretic,and carminativeproperties. It is used in Ayurveda to counter the side effects of all hallucinogens. Both roots and leaves of A. calamus have shown antioxidant, antimicrobial and insecticidal activities. Acorus Calamus was also known to many early American settlers and used for a number of diseases.

KEY WORDS
Calamus aromaticus, sedative, laxative, diuretic, and carminative properties.

INTRODUCTION
Acorus calamus commonly known as sweet flag belongs to family Araceae. *Acorus calamus* grows either as wild or cultivated crop throughout India ascending upto 180m in the Himalayas. Acorus calamus is now also found across Europe, in southern Russia, northern Asia Minor, southern Siberia, China, Indonesia, Japan, Burma, Sri Lanka, Australia, as well as southern Canada and the northern United States.

Common vernacular Name:

English	:Sweet flag, Sweet root
Hindi	:Bach, Gorbach
Telugu	:Vasa
Tamil	:Vashampu
Malayalam	:Vayampu
Sanskrit	:Vacha

These are longitudinally fissured with nodes, somewhat vertically compressed and spongy internally. Flowers are small and fragrant with pale green spadix; fruits are three-celled fleshy capsule. All parts of the plant contain volatile oil having terpenoids, calamine, calamenol, calamenone, eugenol, camphene, pinene and asaronaldehyde. Acorafuran is a sesquiterpenoid found in calamus oil. The rhizomes are utilized extensively by the Chinese, Indians and American Indians as well as by other cultures.Its roots and rhizomes are used in treatment of various ailments including mental disorders, such as hysteria, insanity, insomnia, melancholia, neurasthenia, epilepsy, diarrhoea and asthma. The leaves extract of *Acorus calamus* were studied for anti-inflammatory activity on keratinocyte HaCaT cells. The roots and rhizomes extracts of *Acorus calamus* have been reported with various pharmacological activities such as analgesic, cardiovascular, anticonvulsant, hypolipidemic, antispasmodic,

anti-inflammatory, antibacterial, antiulcer and cytoprotective activity. In most of studies the roots and rhizomes extracts of *A. calamus* reported for its CNS activities.

***Acorus calamus* Linn**
***Family*: Araceae**

Physical Characteristics:
Acorus calamus is a PERENNIAL growing to 1 m (3ft 3in) by 1 m (3ft 3in) at a medium rate.
It is hardy to zone (UK) 3 and is not frost tender. It is in flower from May to July, and the seeds ripen from Jul to August. The flowers are hermaphrodite (have both male and female organs) and are pollinated by Insects.
Suitable for: light (sandy), medium (loamy) and heavy (clay) soils. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers wet soil and can grow in water.

Edible Uses:
Edible Parts: Leaves; Root; Stem.
Edible Uses: Condiment.
The rhizome is candied and made into a sweetmeat. It can be peeled and washed to remove the bitterness and then eaten raw like a fruit. It makes a palatable vegetable when roasted[and can also be used as a flavouring. Rich in starch, the root contains about 1% of an essential oil that is used as a food flavouring. The root also contains a bitter glycoside. Some caution is advised, see the notes above on toxicity. The dried and powdered rhizome has a spicy flavour and is used as a substitute for ginger, cinnamon and nutmeg. A pinch of the powdered rhizome is used as a flovouring in tea. The young and tender inflorescence is often eaten by children for its sweetness. Young leaves - cooked. The fresh leaves contain 0.078% oxalic acid. The leaves can be used to flavour custards in the same way as vanilla pods. The inner portion of young stems is eaten raw. It makes a very palatable salad.

Medicinal Uses
Abortifacient; Anodyne; Antirheumatic; Aphrodisiac; Aromatic; Carminative; Diaphoretic; Emmenagogue; Febrifuge; Hallucinogenic; Homeopathy; Odontalgic; Sedative; Stimulant; Stomachic; Tonic; Vermifuge.
Sweet flag has a very long history of medicinal use in many herbal traditions. It is widely employed in modern herbal medicine as an aromatic stimulant and mild tonic. In Ayurveda it is highly valued as a rejuvenator for the brain and nervous system and as a remedy for digestive disorders. However, some care should be taken in its use since some forms of the plant might be carcinogenic. The root is anodyne, aphrodisiac, aromatic, carminative, diaphoretic, emmenagogue, expectorant,

febrifuge, hallucinogenic, hypertensive, sedative, stimulant, stomachic, mildly tonic and vermifuge. It is used internally in the treatment of digestive complaints, bronchitis, sinusitis etc. It is said to have wonderfully tonic powers of stimulating and normalizing the appetite. In small doses it reduces stomach acidity whilst larger doses increase stomach secretions and it is, therefore, recommended in the treatment of anorexia nervosa. However if the dose is too large it will cause nausea and vomiting. Sweet flag is also used externally to treat skin eruptions, rheumatic pains and neuralgia. An infusion of the root can bring about an abortion whilst chewing the root alleviates toothache. It is a folk remedy for arthritis, cancer, convulsions, diarrhoea, dyspepsia, epilepsy etc. Chewing the root is said to kill the taste for tobacco. Roots 2 - 3 years old are used since older roots tend to become tough and hollow. They are harvested in late autumn or early spring and are dried for later use. The dry root loses 70% of its weight, but has an improved smell and taste. It does, however, deteriorate if stored for too long. Caution is advised on the use of this root, especially in the form of the distilled essential oil, since large doses can cause mild hallucinations. See also the notes above on toxicity. A homeopathic remedy is made from the roots. It is used in the treatment of flatulence, dyspepsia, anorexia and disorders of the gall bladder. Bath oils containing calamus have caused redness of the skin (erythema) and dermatitis, particularly in hypersensitive individuals .

PHARMACOLOGICAL ACTIVITIES OF THE PLANT

ANTI-INFLAMMATORY ACTIVITY A large number of medicinal plants are known to be showing anti-inflammatory activities. Most plants and their products have the potential to alleviate diseases *via* modulation of immune responses. Studies have been carried about the anti-inflammatory potential of *Acorus spp.* A study by has revealed that ethanolic extract of A. calamus rhizome display anticellular and immunomodulatory properties . The ethanolic extracts of *A.calamus* inhibits proliferation of mitogen (phytohaemagglutinin; PHA) and antigen (purified protein derivative; PPD)-stimulated human Peripheral Blood Mononuclear Cells (PBMCs).

IMMUNO-MODULATORY

"Modulation of immune response to alleviate disease has been of interest since long. Plant extracts have been widely investigated for possible immune-modulatory properties. For a long time, the radix of *A. calamus* is being used in the therapy of diabetes in traditional folk medicine of America and Indonesia. A recent study investigated that *A. calamus* improves postprandial hyperglycemia and cardiovascular complications . It revealed that ethyl acetate fraction of *A. calamus* had insulin releasing and α-glucosidase inhibitory activities in vitro HTT-T15 cell line and in vivo glucose challenged normal mice . The hypoglycemic effects are due to insulin releasing and a-glucosidase inhibitory properties of *A. calamus* extract. There are reports on similar insulin sensitizing properties of ethyl acetate fraction of *A. calamus* in vitro and in vivo. Evaluation of the anti-cellular and immuno-modulatory properties of ethanolic extract of the plant's rhizome extract inhibited proliferation of mitogen [phyto-haemagglutinin; PHA] and antigen [purified protein derivative; PPD]-stimulated human peripheral blood mononuclear cells [PBMCs]". Although these preliminary reports have clearly indicated the potential of *A. calamus* for its application in the treatment of diabetes and cardiovascular complications, more research efforts needed for the investigation of other members of the species for their anti-diabetic or insulin sensitizing properties and elucidation of exact mechanism of action.

NEURO-PROTECTIVE ACTIVITY

Asarones isolated from *A. gramineus* have been evaluated for their neuro-protective properties and their mechanism of action in the primary cultured rat cortical cells. Commercially obtained α and β asarone and asarone isolated have been found to inhibit the toxicity induced by the N-Methyl-D-Aspartate (NMDA) in primary cortical cultures but the commercial α and β-asarone exhibited more potent inhibitions of the NMDA-induced toxicity. Furthermore, the toxicity induced by glutamate has also been inhibited, but with much less potency than the toxicity induced by NMDA. The study based on the receptor-ligand binding using a dependent NMDA receptor-channel blocker ['HlMK-801] revealed that asarone inhibited the specific bindings in a concentration-dependent fashion . Asarone exhibited neuro-protective action against the NMDA or Glu-induced toxicity through the blockade of NMDA receptor function. Acorus calamus rhizome extract prepared with ethanol: water (1: 1) has demonstrated neuro-protective effects in the middle cerebral artery occlusion-induced ischaemia in rats. Application of *A. calamus* rhizome extract has resulted in a significant improvement in neuro-behavioural performances such as, rota-rod performance and grid walking in the experimental rats. Free radicals and other ROS have been recognized as an important causative factor in the development of neurodegenerative disorders.

ANTI-OXIDANT PROPERTY

The properties of scavenging free radical of *A. calamus* has been found to be useful to overcome excess production of oxygen free radicals generated due to continuous exposure to loud noise which pose a serious health problem . Protective effect of ethyl acetate and methanolic extract of *A. calamus* against noise stress induced changes in the rat brain have also been reported. These extracts have shown to protect most of the changes induced by noise-stress in the rat brain. The protective effects were substantiated by measurement of the activities of enzymes super oxide dismutase, catalase, glutathione peroxidase, reduced glutathione as well as the level of vitamin C, E, protein thiols and lipid peroxidation . The antioxidant property of β-asarone found in *A. calamus* is believed to be responsible for counteracting the stress in the rat brain due to continuous exposure to noise. Though these studies have favored implication of α-asarone against noise-stress induced changes perhaps further studies involving clinical trials would be required for validation of efficacy of α-asarone in noisy environment in human subjects. Another study has revealed that *A. calamus* helped preventing the development of ferric chloride-induced epileptogenesis in rats by modulating antioxidant enzymes .

GUIDELINES ON USE OF *ACORUS CALAMUS*

The FDA interdicted the utilization of sweet flag owing to the potential carcinogenic effects of its essential oil, with particular reference to β-asarone [FDA, 1974]. β-Asarone has been demonstrated to be responsible for carcinogenic effects involving duodenal tumour induction , unscheduled DNA synthesis in hepatocytes as well as anti-proliferative and immunosuppressive central nervous system inhibitory , sedative and hypothermic effects . Wichtl says "It is not clear whether the observed carcinogenic effects in rats are relevant to the human organism" . However, most sources advise caution in ingesting strains other than the diploid strain. In reality β-asarone is not actually a carcinogen but it is a pro-carcinogen that is neither hepatotoxic nor directly hepato-carcinogenic. It must first undergo metabolic l'-hydroxylation in the liver before achieving toxicity. Cyrochrome P450 in the hepatocytes is responsible for secreting the hydrolyzing enzymes that convert β-asarone into genotoxic epoxide structure. Even with

the activation of these metabolites, the carcinogenic potency is very low due to the rapid breakdown of epoxide residues with hydrolase which leaves these compounds inert. Additionally, the major metabolite of β-asarone is 2,4,5-trimethoxyninnamic acid, a derivative which is not a carcinogen .

CONCLUSION:

Acorus calamus has a very long history and also numerous traditional, economic and ethno-botanical applications. Indian and Chinese cultures sweet flag has been included in preparations of many herbal formulations. Very few plants have gained such widespread use in diverse cultures. This can be attributed to the aromatic constituents and medicinal properties due to which the plant has surpassed all cultural barriers and has gained widespread use. Some of the uses involve the alkaloids and oils produced by the rhizomes. Even though FDA interdicted the utilization of sweet flag owing to the potential carcinogenic effects of its essential oil, with particular reference to β-asarone. In reality β-asarone is not actually a carcinogen, but it is a pro-carcinogen that is neither hepatotoxic nor directly hepato-carcinogenic. Based on these evidences further studies can be carried out so that the plant has beneficial applications in modern medicine.

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