

Acorus calamus: Parts used, Insecticidal, Anti-Fungal, Antitumour and Anti-Inflammatory Activity: A Review

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ABSTRACT

Acorus calamus is a herb used for the appetite and as an aid to the digestion. It is used for fevers, stomach cramps and cholera. Their rhizomes were used for toothache and powdered rhizome for congestion. The rhizome part is also used to treat several diseases like asthma and bronchitis and as sedative. Native tribes treated cough by making a decoction of the plant as a carminative and also for cholera. It is a main medicinal drug, which has the property of improving the memory power and intellect. *Acorus calamus* is used in the conditions of vata and kapha, stomatopathy, hoarseness, flatulence, dyspepsia, helminthiasis, amenorrhoea, dysmenorrhoea, nephropathy, calculi, stragury. *Acorus calamus* leaves, rhizomes and its essential oil has many biological activities like antispasmodic, carminative and also used for treatment of epilepsy, mental ailments, chronic diarrhea, dysentery, bronchial catarrh, intermittent and tumors. It also has the insecticidal, antifungal, antibacterial, tranquilizing, antidiarrhoeal, antidyslipidemic, neuroprotective, antioxidant, anticholinesterase, spasmolytic, vascular modulator activities. The parts used in most of the experimental studies are the leaves, roots and stem of the plant. The dry rhizome contains some of the yellow aromatic oil, calamus oil that are responsible for their medicinal and insecticidal properties. Studies were also done on their rhizome part and in its oils in order to identify the active constituents and its medicinal values.

Keyword: *Acorus calamus*, Insecticidal, Anti-fungal, Antitumour, Anti-inflammatory activity

INTRODUCTION

Mother earth has bestowed to the mankind and various plants with healing ability for curing the ailments of human being. This unique feature has been identified since pre historic times. The WHO has also estimated that 80% of the world population meets their primary health care needs through traditional medicine only^{1,2}. Medicinal plants are those plants possessing secondary metabolites and are potential sources of curative drugs with the very long list of chemicals and its curative nature. India is the eighth largest country having rich plant diversity with a total of around 47,000 species, of which more than 7500 species are being used as medicinal plants. Plant products are used as main source of medicine throughout the world for treating various human ailments. About 50% of the present day medicines in the United States of America are derived from natural sources especially from various plants. The use of traditional medicine in both developing and developed countries is significantly increasing in recent times. There is a growing demand for medicines of Ayurveda, Siddha, Unani and Homeopathy for domestic consumption and export purposes. The world trade in plant based drugs and its products are many fold expanding continuously; because the general awareness of the wide spread toxicity and harmful after effects associated with the long-term use of synthetic drugs and

antibiotics³⁻⁶. *Acorus calamus* is a tall perennial wetland monocot plant from the *Acoraceae* family. The scented leaves and rhizomes of sweet flag have been traditionally used as a medicine and the dried and powdered rhizome has a spicy flavour and is used as a substitute for ginger, cinnamon and nutmeg for its odor. It is known by a variety of names, including cinnamon sedge, flag root, gladdon, myrtle flag, myrtle grass, myrtle sedge, sweet cane, sweet myrtle, sweet root, sweet rush and sweet sedge. *A. calamus* is probably indigenous to India and now found across Europe, Southern Russia, Northern Asia Minor, China, Japan, Burma, Sri Lanka, and Northern USA. *Calamus* was valued as a stimulant, bitter herb for the appetite and as an aid to the digestion. In North America, the decoction was used for fevers, stomach cramps and colic; the rhizome was chewed for toothache and powdered rhizome was inhaled for congestion⁷⁻¹⁵. In Ayurvedic medicine *Calamus* is an important herb, and is valued as a "rejuvenator" for the brain and nervous system, and as a remedy for digestive disorders. The various extract of *Acorus calamus* is traditionally used for the anti-diabetes, anti-proliferative, immunosuppressive, hypolipidemic, mitogenic and anticarcinogenic activity towards human lymphocytes. The different extract forms possess the antispasmodic, anthelmintic, antifungal, antibacterial, fish toxin,

insecticidal, anti-diabetes, anti-proliferative, immunosuppressant, anti-diarrhoeal, antioxidant and hypolipidemic activities. The rhizomes and leaf part were found to possess the mitogenic and anti-carcinogenic activity towards human lymphocytes. The rhizomes are also used for treatment of epilepsy, mental ailments, chronic diarrhea, dysentery, bronchial catarrh, intermittent fevers, cough, throat irritations, bronchitis, as expectorant, and tumors¹⁶⁻¹⁸.

Parts used

The parts used are leaves, root (rhizome) and stem. In Asia, Sweet flag has been used for at least the last 2000 years. The ancient peoples of China used it to lessen swelling and for constipation. In Ayurvedic medicinal practice India, the rhizomes have been used to cure several diseases like fever, asthma and bronchitis, and as a sedative. Native tribes used it to treat a cough, made a decoction as a carminative and as an infusion for cholera. In Western herbal medicine the herb is chiefly employed for digestive problems such as gas, bloating, colic, and poor digestive function¹⁹. Calamus helps distended and uncomfortable stomachs and headaches associated with weak digestion. Small amounts are thought to reduce stomach acidity, while larger doses increase deficient acid production, a good example of how different doses of the same herb can produce different results. It is a good sedative so that the extract is used for epilepsy, insanity and as a tranquillizer along with *valeriana jatamansi* and *nardostacys grandiflora*. It is an ingredient of any Ayurvedic preparation "Brahmi Bati" (Budhivardhar) which is indicated in epilepsy, coma, and hysteria and in cases of mental retardation; the same uses are prescribed for an *Acorus* containing Unani drug "Ma'jun Baladur"²⁰.

Pharmacological activities

The rhizomes of *A. calamus* reportedly relieve stomach cramps, dysentery and asthma, and are used as: anthelmintics, insecticides, tonics and stimulants. Alcoholic rhizome extracts of *A. calamus* growing in KwaZulu-Natal, South Africa, were previously found to have anthelmintic and antibacterial activity Table 1. Using bioassay-guided fractionation, the phenylpropanoid β asarone was isolated from the rhizome. This compound was shown to possess anthelmintic and antibacterial activity. It has previously been isolated from *A. calamus*, and a related species, *A. gramineus*. Different varieties of *A. calamus* exhibit different levels of β -asarone, with the diploid variety containing none of the compound. Mammalian toxicity and carcinogenicity of asarones has been demonstrated by other researchers, supporting the discouragement of the medicinal use of *A. calamus* by traditional healers²¹. In medical research, more attention is paid to the antioxidant properties of medicinal plants to minimize the harmful effects of radicals.

Insecticidal activity

The insecticidal activities of compounds derived from the rhizomes of *A. gramineus* against four agricultural insect pests were examined using direct contact application method. The biologically active constituents of *A. gramineus* rhizomes were characterized as the phenylpropenes, *cis*- and *trans*-asarones by spectroscopic

analyses. Potencies varied according to insect species, compound, and dose. In a test with female adults of *Nilaparvata lugens*, *cis*-asarone caused 100, 83 and 40% mortality at 1,000, 500 and 250 ppm, respectively, whereas 67% mortality was achieved at 1,000 ppm of *trans*-asarone. Against 3rd instar larvae of *Plutella xylostella*, *cis*-asarone gave 83 and 50% mortality at 1,000 and 500 ppm, respectively, whereas *trans*asarone at 1,000 ppm showed 30% mortality. Against female adults of *Myzus persicae* and 3rd instar larvae of *Spodoptera litura*, *cis*- and *trans*-asarones both were almost ineffective at 2,000 ppm²². The *A. gramineus* rhizome-derived materials merit further study as potential insect-control agents or as lead compounds against *N. lugens* and *P. xylostella*.

Anti-fungal activity

β -asarone compound fraction obtained from the crude methanolic extract of *Acorus Calamus* rhizomes has been reported to possess the antifungal activity against the yeast strain of *Candida Albicans*, *Cryptococcus Neoformans*, *Saccharomyces Cerevisae* and also against *Aspergillus Niger*.

Antitumour

It was reported to be a potent antitumour agent against Daltons Ascites Lymphoma in mice by evaluating the tumour growth, toxicity and haematological parameters.

Anti-inflammatory activity

Acorus calamus is a traditional remedy for the inflammation problems but their biological function in the human skin cells not well characterized. *Acorus calamus* has been found to inhibit the expression of polyI:C-induced IL-6 and IL-8 which indicates their inhibitory effect on the expression of the cytokines which were likely to be in association with the suppression of NF- κ B activation and phosphorylation of IRF3 that shows the *Acorus calamus L.* may be used as a promising immunomodulatory agent in the inflammatory skin diseases²³.

Anti-oxidant activity

Acorus calamus extract showed a remarkable increased and decreased levels of certain parameters due to the exposure to noise-stress which ultimately proves their antioxidant activity. *Acorus calamus* has been found to render the protection against γ -radiation induced oxidative stress.

Antidiabetic activity

Acorus calamus, is widely used in the treatment of diabetes in the traditional folk medicine of America and Indonesia. Four fractions obtained from the radix of *Acorus calamus* were used for insulin releasing or alpha-glucosidase inhibitory action.

Larvicidal property

A. calamus carries huge potential as a mosquito larvicidal. This potential could be exploited for the development of safer and effective botanical mosquito larvicidal tool for the management of *Aedes aegypti*²⁴.

CNS activity

The methanol and acetone extract of the plant possess certain psychoactive substances that are found to be depressant in nature. The extract produced alterations in

Table 1: Major phytochemical compounds identified in *Acorus calamus*.

Part of plant	System	Effects	Country	Preparation	Ref.
Leaves	medicinal	Lessen swelling and for constipation prolongs the sleeping time reduces body temperature mitogenic and anticarcinogenic activity towards human lymphocytes	China	extract	15
Root (Rhizome)	medicinal	Lessen swelling and for constipation. fever, asthma and bronchitis, and as a sedative cough, made. Decoction, as a carminative and as an infusion for cholic. reportedly relieve stomach cramps, dysentery and asthma, and are used as: anthelmintics, insecticides, tonics and stimulants.	China India	extract	9
		antihelmintic and antibacterial activity	KwaZulu-Natal, South Africa	methanol extract	16
		Antimicrobial activity Insecticidal Congestion Toothache asthma and bronchitis and as sedative treated cough carminative and also for cholic memory power and intellect vata and kapha, stomatopathy, hoarseness, flatulence, dyspepsia, helminthiasis, amenorrhea, dysmenorrheal, nephropathy, calculi, stragury. treatment of epilepsy, mental ailments, chronic diarrhea, dysentery, bronchial catarrh, intermittent and tumors. tranquilizing, antidiarrhoeal, antidyslipidemic, neuroprotective, antioxidant, anticholinesterase, spasmolytic, vascular modulator activities. Antiulcer and cytoprotective. Antispasmodic		ethanol water extract	18
					9,22 24
Stem	medicinal	Lessen swelling and for constipation. antidiabetes, antiproliferative, immunosuppressive, hypolipidemic, mitogenic and anticarcinogenic activity towards human lymphocytes.	China	extract	18
Herb	herbal medicine	Digestive problems such as gas, bloating, colic, and poor digestive function. Helps distended and uncomfortable stomachs and headaches associated with weak digestion. Reduce stomach acidity. Larger doses increase deficient acid production. Epilepsy, insanity and as a tranquillizer along with <i>Valeriana jatamansi</i> and <i>Nardostacys grandiflora</i> .	Western	extract	19 13 17

the general behavioral pattern and does not induce any disturbances in the motor co-ordination. The methanol and acetone extract of the leaves of the plant possess CNS depressant activity which can be further utilized for its anticonvulsant research.

Pharmacologica action

Antibacterial activity

The leaf and rhizome part of *Acorus Calamus* is found to possess the antibacterial activity. The methanolic extract

of *Acorus Calamus* showed the inhibitory action against the bacterial strains of *Salmonella typhi*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Staphylococcus aureus*. β -asarone compound of *Acorus Calamus* has the highest inhibitory effect against *E.coli* strain at various concentration^{23,24}.

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REFERENCES

1. Asha DS, Deepak G. Antimicrobial activity of *Acorus calamus* (L.) rhizome and leaf extract. *Acta Biol. Szegediensis*. 2009; 53(1): 45-49.
2. Copping LG. Crop protection agents from nature. In: Natural products and analogins: The Royal Society of Chemistry, Cambridge, p. 1996; 501.
3. Hee-Kwon L, Chan P, Young-Joon A. Insecticidal activities of asarones identified in *Acorus gramineus* rhizome against *Nilaparvata lugens* (Homoptera: Elphacidae) and *Plutella xylostella* (Lepidoptera: Yponomeutoidae). *Appl. Entomol. Zool*. 2002; 37(3): 459-464.
4. Koul O, Smirle MJ, Isman MB. Asarones from *Acorus calamus* L. oil. Their effect on feeding behavior and dietary utilization in *Peridroma saucia*. *J. Chem. Ecol*. 1990; 16(6): 911-1920.
5. Manikandan S, Srikumar R, Jeya PN, Sheela DR. Protective effect of *Acorus calamus* LINN on free radicle scavengers and lipid peroxidation is discrete regions of brain against noise stress exposed rat. *Biol. Pharm. Bull*. 2005; 28(12): 2327-2330.
6. Al-Marzoqi AH, Hadi MY, Hameed IH. Determination of metabolites products by *Cassia angustifolia* and evaluate antimicrobial activity. *Journal of Pharmacognosy and Phytotherapy*. 2016; 8(2): 25-48.
7. Hameed IH, Hussein HJ, Kareem MA, Hamad NS. Identification of five newly described bioactive chemical compounds in methanolic extract of *Mentha viridis* by using gas chromatography-mass spectrometry (GC-MS). *Journal of Pharmacognosy and Phytotherapy*. 2015; 7 (7): 107-125.
8. Hussein HM, Hameed IH, Ibraheem OA. Antimicrobial Activity and spectral chemical analysis of methanolic leaves extract of *Adiantum Capillus-Veneris* using GC-MS and FT-IR spectroscopy. *International Journal of Pharmacognosy and Phytochemical Research*. 2016; 8(3): 369-385.
9. Kadhim MJ, Mohammed GJ, Hameed IH. In vitro antibacterial, antifungal and phytochemical analysis of methanolic fruit extract of *Cassia fistula*. *Oriental Journal of Chemistry*. 2016; 32(2): 10-30.
10. Altameme HJ, Hameed IH, Idan SA, Hadi MY. Biochemical analysis of *Origanum vulgare* seeds by fourier-transform infrared (FT-IR) spectroscopy and gas chromatography-mass spectrometry (GC-MS). *Journal of Pharmacognosy and Phytotherapy*. 2015; 7(9): 221-237.
11. Jasim AA, Hameed IH, Hapeep AM. Traumatic Events in an Urban and Rural Population of Children, Adolescents and Adults in Babylon Governorate – Iraq. *Research Journal of Pharmacy and Technology*. 2017; 10(9).
12. Hameed IH, Salman HD, Mohammed GJ. Evaluation of antifungal and antibacterial activity and analysis of bioactive phytochemical compounds of *Cinnamomum zeylanicum* (Cinnamon bark) using gas chromatography-mass spectrometry. *Oriental Journal of Chemistry*. 2016; 32(4).
13. Ubaid JM, Hussein HM, Hameed IH. Analysis of bioactive compounds of *Tribolium castaneum* and evaluation of anti-bacterial activity. *International Journal of Pharmaceutical and Clinical Research*. 2016; 8(7): 655-670.
14. Hadi MY, Hameed IH. Uses of Gas Chromatography-Mass Spectrometry (GC-MS) Technique for Analysis of Bioactive Chemical Compounds of *Lepidium sativum*: A review. *Research Journal of Pharmacy and Technology*. 2017; 10(9).
15. Hameed, I.H., Al-Rubaye A.F. and Kadhim, M.J. Antimicrobial Activity of Medicinal Plants and Urinary Tract Infections. *International Journal of Pharmaceutical and Clinical Research*. 2017; 8(11).
16. Kadhim WA, Kadhim, M.J., Hameed, I.H. Antibacterial Activity of Several Plant Extracts Against *Proteus Species*. *International Journal of Pharmaceutical and Clinical Research*. 2017; 8(11).
17. Hameed IH, Al-Rubaye AF, Kadhim MJ. Antimicrobial Activity of Medicinal Plants and Urinary Tract Infections. *International Journal of Pharmaceutical and Clinical Research*. 2017; 9(1): 44-50.
18. Al-Rubaye AF, Hameed IH, Kadhim MJ. A Review: Uses of Gas Chromatography-Mass Spectrometry (GC-MS) Technique for Analysis of Bioactive Natural Compounds of Some Plants. *International Journal of Toxicological and Pharmacological Research* 2017; 9(1); 81-85.
19. Kadhim MJ, Kaizal AF, Hameed IH. Medicinal Plants Used for Treatment of Rheumatoid Arthritis: A Review. *International Journal of Pharmaceutical and Clinical Research*. 2016; 8(12): 1685-1694.
20. Ubaid JM, Kadhim MJ, Hameed IH. Study of Bioactive Methanolic Extract of *Camponotus fellah* Using Gas Chromatography – Mass Spectrum. *International Journal of Toxicological and Pharmacological Research*. 2016; 8(6); 434-439.
21. Balakumbahan R, Kumanan K. *Acorus calamus*: An overview. *Journal of Medicinal Plants Research*. 2010; 4(25): 2740- 2745.
22. Hussein HM, Hameed IH, Ubaid JM. Analysis of the secondary metabolite products of *Ammi majus* and evaluation anti-insect activity. *International journal of pharmacognosy and phytochemical research*. 2016; 8(8): 1192-1189.
23. Hussein HM, Ubaid JM, Hameed IH. Inscticidal activity of methanolic seeds extract of *Ricinus communis* on adult of *callosobruchus maculatus* (coleopteran:brauchidae) and analysis of its phytochemical composition. *International journal of pharmacognosy and phytochemical research*. 2016; 8(8): 1385-1397.
24. Ubaid JM, Hussein HM, Hameed IH. Determination of bioactive chemical composition of *Callosobruchus maculatus* and investigation of its anti-fungal activity.

- International journal of pharmacognosy and phytochemical research*. 2016; 8(8): 1293-1299.
25. Kumar AV. Medicinal properties of *Acorus calamus*. *Journal of Drug Delivery & Therapeutics*. 2013; 3(3): 143.
26. Arasan E, Vijayalakshmi M, Garikapati D. *Acorus calamus* linn: Chemistry and Biology. *Research Journal of Pharm. and Tech.* 2009; 2 (2): 39-41.