

REVIEW ARTICLE

Clinical Trials and Ethnomedicinal Uses of *Acorus calamus* – A Review

T N Shivananda* and N N Reddy

Sri Krishnadevaraya College of Horticultural Sciences, Anantapuramu, Andhra Pradesh, India

Email: *tnsihr@gmail.com

ABSTRACT

Acorus calamus (Araceae) is a perennial herb, distributed across many countries and continents is a unique medicinal plant used in treating many ailments. It contains several aromatic oils in the rhizome of which asarone, eugenol are primary active principles known to have multiple uses in aroma therapy, curing human ailments especially disorders related to nervous system and also in plant protection. Reviews on the herb used in the treatment of diabetes, obesity, anxiety, hypertension, memory impairment, sedation, insomnia, hypnotic, increasing antibodies, cardio vascular diseases, anti-inflammatory, anti-convulsant, antioxidant and antidepressant are presented with clinical observations. The ethnomedicinal uses of *A calamus* in Asian continent consisting India, Sri Lanka, Nepal, China, Russia are reported. In other continents such as Europe, Africa the herb is used as traditional medicine and the uses are listed.

Key words: *Acorus calamus*, clinical trials, ethnomedicinal uses,

Received 24.12.2023

Revised 02.02.2024

Accepted 11.02.2024

How to cite this article:

T N Shivananda and N N Reddy. Clinical Trials and Ethnomedicinal Uses of *Acorus calamus* – A Review. Adv. Biores., Vol 15 (2) March 2024: 33-41.

INTRODUCTION

Acorus calamus is popularly known as sweet flag, sway or muskrat root. In addition, it is also known as beewort, bitter pepper root, calamus root, flag root, gladdon, myrtle flag, myrtle grass, myrtle root, myrtle sedge, pine root, sea sedge, sweet cane, sweet cinnamon, sweet grass, sweet myrtle, sweet root, sweet rush, and sweet sedge, sweet cane and sweet grass [1]. It is referred by different names in different languages. Bach, Safed Bach, Ghorbach (Hindi); Okhidak (Manipuri); Vekhand (Marathi); Vashambu, Pullai valathi (Tamil); Vaambu, Vashampa (Malayalam); Baje, Vacha, Athi Baje, Kavana, Dagade, naaru beru (Kannada); Bach, Ghora bach (Bengali); Bach (Assamese); Hnim Rimtui (Mizo); Vacha, Vachaa Bacha, Bhadra (Sanskrit); Bhojo (Nepali) [2]. *A calamus* is found in as many as 42 countries ranging in altitude as high as 1800 m to 900 m above sea level. The herb is known to be originated from India.

Plant description

Acorus belongs to the family Araceae (Araceae) and its technical name is *Acorus calamus* L. It is an herbaceous perennial plant growing to a height of nearly 2 m and its leaves are erect yellowish brown, radical, with pink sheathing at their bases, sword-shaped, flat and narrow, tapering into a long acute point, and have parallel veins. The leaves have smooth edges which can be wavy or crimped. The solid triangular flower stem rise from the axils of the outer leaves. A semi-erect spadix emerges from one side of the flower stem. The spadix is solid, cylindrical, tapers at each end and is 5 to 10 cm length. A covering spathe, as is usual with Araceae is absent. The spadix is densely crowded with tiny greenish yellow flowers. Each flower contains six petals and stamens enclosed in a perianth with six divisions, surrounding a three celled, oblong ovary with a sessile stigma. The flowers are sweetly fragrant. The fruit is a berry filled with mucus, which when ripe falls into water and disperse by floating. In Asian countries it fruits sparingly and propagates itself mainly by growth of its rhizome, forming colonies [3].

Chemical composition

The leaves and rhizome contain a volatile oil which has characteristic odor and aroma. Apart from medicinal uses the oil is used in aroma therapy, foods, alcoholic beverages and bitters. It is widely used in

India, China, European countries and worldwide. The main constituents of oil are beta asarone (nearly 75%), methyl isoeugenol (nearly 40%) and alpha asarone, saponins, lectins, sesquiterpenoids, ligands and steroids. The chemical composition may vary according to plant type (diploid, triploid or tetraploid), geographical distribution. The dried powder is also used as insecticide [3]. Nearly 145 constituents have been isolated and identified, including phenylpropanoids, sterols, triterpene glycosides, sesquiterpenoids, triterpenoid saponins, alkaloids and monoterpenes from *A. calamus*. Phenylpropanoids (chiefly, asarone and eugenol) and sesquiterpenoids are considered to be the principal effective compounds [4].

Medicinal properties

The herb has been utilized for centuries in various traditional health systems like Ayurveda, Unani, Siddha, and Chinese medicine to address a wide range of health issues including bronchitis, chest pain, nervous disorders, diarrhea, digestive problems, flatulence, gas, indigestion, rheumatism, sedative, appetite loss, colic, cramps, cough, fever, inflammation, depression, tumors, hemorrhoids, skin diseases, numbness, general debility, and vascular disorders. Additionally, the herb is recognized for its insecticidal, larvicidal, antibacterial, mutagenic, cytotoxic, hepatoprotective, anticonvulsant, neuroleptic, smooth relaxant, and smooth muscle stimulant properties. [5, 6]. *A. calamus* is known to possess several properties which are useful to mankind. The herb is extensively used in traditional health practices. In rural parts of many countries such as India, Tibet, China, Burma, Pakistan, Nepal, Russia and Indo Malayan countries the herb is a household herb. The herb is known to possess antidiabetic, anti-obesity, antioxidant, anti-inflammatory and immunomodulatory properties as confirmed by clinical and pre-clinical reports. Also, it is reported to alleviate the metabolic and neurological disorders, such as anticonvulsant, antidepressant, antihypertensive, anti-inflammatory, immunomodulatory, neuroprotective, cardioprotective, and anti-obesity effects. Metabolic disorders are characterized by hypertension, hyperglycaemia, abdominal obesity, and hyperlipidaemia, which may worsen the neurological disease risk. Improper diet (high calorie intake), lifestyle (e.g., smoking, chronic alcohol consumption, sedentary habits), affect the liver and can further lead to fatty liver disease. In this review article we present the latest results available from the published literature.

Antidiabetic

Diabetes has assumed a status of general disorder amongst public. India accounts to nearly 17% of the total number of diabetes patients in the world, thus often India is referred to as “diabetes capital of the world.” As per the estimates nearly 80 million people are suffering from diabetes in India and the numbers may rise to 135 million by 2045 [7]. At global level 425 million people are suffering from diabetes [8]. There are over 1200 plants in local health traditions identified to treat diabetes but only 30 percent of them are investigated pharmacologically and chemically [9]. Over a period, the antidiabetic plants have been shortlisted to be just over hundred plants that are usefully made use in therapy. The plants used in alleviating diabetes can be single plant or in combination with other plants. However the efficacy of herb depends on the active principle in the herb, the synergistic effects of other herbs to treat the disorder. Comparative evaluation of several India herbs has been done and found that *A. calamus* is possessing antidiabetic property [10]. Several clinical studies have been conducted to consider that *A. calamus* is a promising herb to treat Type 2 diabetes mellitus [11, 12].

Antiobesity

According to the fifth round of survey conducted between 2019 and 2021 by National Family Health Survey (NFHS), in India, about 6.4 percent of women and 4.0 percent men, aged between 15 – 49 are found to be obese. Similarly, around 17.6 percent of women and 18.9 percent men are considered overweight in the same age group but not obese [13]. Obesity is a great health concern since it leads to failure of many vital organs in the body. Thus, obesity is considered a dreadful silent killer amongst many ailments. According to a study, about 650 million people were obese in 2016, and nearly 23.6 million are expected to die from cardiovascular diseases by the year 2030 [14]. Some of the complexities such as hypertension, hyperglycaemia, abdominal obesity, and hyper-lipidaemia can be characterised as metabolic disorders. These disorders also contribute greatly to human ill health. They may cause serious concern and risk to human life. Sedentary life style, intake of high calories, alcoholic addiction, smoking addiction etc also contributes to risking of human life [15]. *A. calamus* is a promising herb to treat obesity complexities in humans. Studies conducted in beta asarone treated rats recorded weight loss and also inhibited metabolic transformations [16]. In *in vitro* investigations the aqueous extract has demonstrated lipid lowering activity through inhibition of pancreatic lipase percentage [17]. *A. calamus* powder administered on 24 patients of both sexes with hyperlipidemia resulted in significant reduction in skinfold depth, fatigue, and excessive hunger [18]. A combination of drugs namely *A. Calamus*, *Cyperus rotundus*, *Cedrus deodara*, *ginger*, *Aconitum Heterophyllum*, *T. chebula* when administered on 30 obese patients of both sexes aged 14–50 years, a significant improvement in extreme sleep, body heaviness,

fatigue, and excessive hunger was reported [19]. In clinical trials 20 obese patients of both sexes were treated with *Acorus calamus* rhizome powder, for studying the antiobesity property of the herb. Significant results and improvement in extreme sleep, body heaviness, fatigue, and excessive hunger are reported by the authors [20].

Anxiety

Anxiety is considered as a type of mental health condition that makes it difficult to get through the day. The symptoms include feelings of nervousness, panic and fear as well as sweating and a rapid heartbeat. Thus anxiety is certainly a disorder which warrants medication [21]. A calamus has been found to effectively treat anxiety related problems and several publications are in the public domain. 70% hydro-alcoholic extract of *A. calamus* was found effective to treat anxiety which is a present-day mania on many youths especially in unemployed youth. 33 patients of both sexes (20 male and 13 female) with anxiety disorder were treated with the drug and found that there was a significant reduction of anxiety and stress-related disorder [22].

Hypertension

Hypertension, commonly referred as high blood pressure is a common ailment but can be serious if not treated appropriately at right time. If the pressure on blood vessels of a person is high ie., 140/190 or higher, then, that person is suffering from hypertension [23]. Rhizomes of *A. calamus* is known to possess antihypertensive effect as per the results obtained from the clinical data using rats. The herb was tried on its own and as well in combination with *Gymnema sylvestre*. Results have showed that the antihypertensive effect was better in combination with *G. sylvestre* than *A. calamus* alone [24]. A combination of *A. calamus*, *C. pluricaulis*, *Bacopa monnieri*, *T. cordifolia*, *C. fistula*, *A. indica*, *S. lappa*, *Tribulus terrestris* (Shankhapushpyadi Ghana Vati) administered on 20 hypertensive patients of both sexes, recorded significant relief in raised systolic blood pressure, diastolic blood pressure [25].

Memory impairment

With aging, loss of memory is also a serious concern of health and often referred as dementia. The symptoms of memory impairment are many folded. A person keeps asking the same question repeatedly. Forgetting the common words while speaking and trying hard to recollect. It could be mixing up of words which may be totally unconnected. Taking long time to complete familiar tasks. Or it could be misplacing items in a totally unconnected place. These are few symptoms of dementia of a person. The magnitude of the problem can vary person to person or with time it could assume a severe proportion even forgetting a family member also [26]. Several trials have been conducted using *A. calamus* in combination with other drugs to evaluate the efficacy of *A. calamus* in treating dementia in humans. A combination of *A. calamus*, *Tinospora cordifolia*, *Achyranthes aspera*, *Embelia ribes*, *Convolvulus pluricaulis*, *T. chebula*, *S. lappa*, *Asparagus racemosus*, cow ghee, and sugar (Guduchyadi Medhya Rasayana) was tried on 138 patients of both sexes aged 55–75 years with senile memory impairment. The results were highly encouraging to record significant improvement in terms of recall memory, cognitive impairment, amnesia, concentration ability, depression, and stress [27].

Sedative effect

Sedation, also known as "monitored anesthesia care". Sedation is a condition where the patient is made to feel drowsy and relaxed. Depending on the requirement of a patient different levels of sedation are administered [28]. The dried aqueous extract exhibited anti-hyperthermic and sedative effect without producing any respiratory depression. This clinical trial was conducted on 40 healthy volunteers, of both sexes aged between 18–50 years with a pre-medicant for anesthesia [29].

Insomnia

Insomnia is a disorder of sleeplessness. There could arise a problem in falling asleep or staying asleep with insomnia³⁰. This leads to many connected disorders related to nervous problems, hence treating insomnia is as important as any other ailment. A combination of drugs of *A. calamus*, *Valeriana wallichii*, *N. jatamansi* was tested against insomnia and other related disorders. Accordingly, a trial was conducted consisting of 24 insomnia patients of both sexes aged 18–75 years. Results showed a significant effect of drug on patients suggesting significant improvement in sleep duration, in the initiating time of sleep, and in quality of sleep [31].

Tranquilizer and hypnotic

Hypnotics are medications used to induce, extend, or improve the quality of sleep, and to reduce wakefulness during sleep. The most commonly used hypnotics include benzodiazepine receptor agonists (BzRAs), antidepressants, antipsychotics, antihistamines, and melatonin (or melatonin receptor agonists) [32]. Hypnotics are used for the treatment of insomnia which is characterized by difficulties with falling asleep or maintaining sleep. Many drugs are used as hypnotics such as benzodiazepines and Z-drugs. There is also a possibility of using plant-based drugs and they have also been found useful to be

used as hypnotic drugs. A drug Brahmyadiyoga which is a combination of *A. calamus*, *Centella asiatica*, *Rauvolfia serpentina*, *Saussurea lappa*, *Nardostachys jatamansi*, was found to serve as brain tonic, tranquillizer, hypnotic, and sedative. The clinical trials were conducted on 10 schizophrenia patients³³ of both sexes aged 18–40 years.

Increasing immunoglobulin levels

Immunoglobulins are called antibodies. Antibodies are proteins that the immune system makes to fight germs, such as viruses and bacteria. When the body is exposed to germs, the body makes unique antibodies that are specifically designed to destroy only those germs³⁴. There are good number of plant drugs which can aid and support the body to increase antibodies. Bala – a combination of *A. calamus*, *Emblica officinalis*, *E. ribes*, *T. cordifolia*, *Piper longum*, *Glycyrrhiza glabra*, *C. rotundus*, *A. heterophyllum* was found to significantly improve in immunoglobulin levels after 6 months³⁵ in 24 neonates of both sexes, weighing 2.5–3 kg body weight.

Mental balance

Mental balance can be defined as the healthy psychological state of someone with good judgment. The psychological state of someone who is functioning at a satisfactory level of emotional and behavioural adjustment can be considered as a healthy person [36]. Several trials have been conducted to assess few drugs which are known to support mental balance. A drug having a combination of *A. calamus*, *T. cordifolia*, *Hedychium spicatum*, *C. pluricaulis*, *E. ribes*, *ginger*, *A. aspera*, *T. chebula*, and cow ghee known as Vachadi Ghrita was administered on 90 healthy individuals of both sexes aged 40–50 years for assessment of cognition. The clinical trial results demonstrated that there was a significant change in the mental balance score, holding of like and different pairs, late-immediate memory, and also improved digestion [37].

Ischemic heart disease

Technically ischemic means that an organ (e.g., the heart) is not getting enough blood and oxygen. Ischemic heart disease, also called coronary heart disease (CHD) or coronary artery disease, is the term given to heart problems caused by narrowed heart (coronary) arteries that supply blood to the heart muscle³⁸. Coronary heart disease (CHD) is the most common type of heart disease, in USA killing approximately 382,820 people annually. Every year about 805,000 Americans have a heart attack [39]. According to WHO reports, cardiovascular diseases (CVDs) are the leading cause of death globally, taking an estimated 17.9 million lives each year [40]. The number of deaths due to heart attacks in India has remained consistently over 25,000 in the last four years⁴¹ and heart attacks account to 28 percent of deaths in India. *Acorus calamus* rhizome powder administered on 45 ischemic heart disease patients, was found to have an improvement of chest pain, dyspnoea on effort, reduction of the body mass index, improved ECG: reduced serum cholesterol, reduced serum LDL, and increased serum HDL [42].

Anti-Inflammatory and Immunomodulatory Effect

Commonly associated diseases with chronic inflammation are multiple and few of them are cardiovascular disease, diabetes, malignancy, auto-immune disease, chronic hepatic and renal diseases. Any agent which fights against these inflammatory diseases is called as anti-inflammatory. Clinical trials conducted with *A. calamus* have proven anti-inflammatory and immunomodulatory. Methanolic extract of the rhizome prevented the VCAP-1 an intercellular expression on the surface of mouse myeloid leukaemia and murine endothelial cells [43]. Butanolic fraction inhibited phospholipase C (PLC) pathway in platelets presumably acting on protein kinase [44].

Anticonvulsant Effect

Anticonvulsant drugs are those which prevent convulsions by controlling abnormal electrical activity in the brain. Anticonvulsants are used to treat epilepsy and other seizure disorders [45]. The methanol extract showed anticonvulsant effects [46] through gamma-aminobutyric acid (GABA) pathway in the central nervous system. The raw and processed rhizome exhibited notable anticonvulsant activity by minimizing the span of the tonic extensor period in rats, whereas the processed rhizome showed better therapeutic activity than the raw [47].

Antioxidant effect

Antioxidants are man-made or natural substances that may prevent or delay some types of cell damage. Antioxidants scavenge free radicals from the body cells and prevent or reduce the damage caused by oxidation [48]. The protective effect of antioxidants continues to be studied around the world. Antioxidants are found in many foods including fruits and vegetables. Studies conducted to assess *A. calamus* for its antioxidant property found significant effects. The in vitro antioxidant activity of acetone, acetonitrile, alcoholic, and aqueous extracts of *A. calamus* rhizomes exhibited free radical scavenging activity. Strong antioxidant effect was noticed in the acetone extract, followed by acetonitrile and methanol, while in the aqueous extract, recorded poor antioxidant activity [49]. The aqueous extract

exhibited superior antioxidant effects in metal ion chelation, lipid peroxidation, and DPPH assays [50,51]. Ethanol and hydro-alcoholic extracts of *A. calamus* roots and rhizomes were studied for antioxidant potential against DPPH compared with butylated hydroxyanisole (BHA) and silymarin. Ethanol and hydro-alcoholic extracts showed free radical scavenging activity of 59.13 ± 18.95 and 56.71 ± 19.54 , respectively [52,53,54]. The essential oil isolated from *A. calamus* showed strong antioxidant efficacy against the β -carotene/linoleic acid bleaching test and DPPH free radicals [55]. The methanol extract of the *A. calamus* rhizome was evaluated against the free radical scavenging activity, and found to be IC₅₀ value at 704 $\mu\text{g/mL}$. The IC₅₀ of the essential oil was 1.68 $\mu\text{g/mL}$, which showed virtuous free radical scavenging activity in the DPPH test [56].

Antidepressant

Antidepressants are a type of medicine used to treat clinical depression. They are used to treat a number of disorders such as anxiety, post-traumatic stress disorder etc [57]. Few reports comprising of *A. calamus* suggesting positive effects of antidepressant are presented. Interaction of the methanolic *A. calamus* rhizome extract with the adrenergic, dopaminergic, serotonergic, and GABAergic system was found responsible for the expression of antidepressant activity [58]. In another study, the methanolic *A. calamus* leaf extract showed significant activity through a reduction in the immobility period in the tuberculin skin test and forward surgical teams [59]. Through interaction with the adrenergic and dopaminergic system, the hydro-alcoholic extract was normalized to the over-activity of the hypothalamic pituitary adrenal axis [60]. Sobers capsules (a herbo-mineral formulation containing *A. calamus*) were evaluated by tail suspension and forced swimming tests in mice. At the oral dose of 50 mg/kg for 14 days, capsules exhibited insignificant impact on locomotor activity, and caused antidepressant effects in experimental animals [61]. Tensarin (the traditional medicine of Nepal containing *A. calamus*) was evaluated for the anxiolytic effect in mice using the open field test (OFT), activity monitoring along with the passive avoidance test. At all three dose levels (50, 100, 200 mg/kg), Tensarin produced an anxiolytic effect in a dose-dependent way by an improvement in rearing, number of passages, and duration of the period employed by mice [62].

Ethnomedicinal uses

In rural India the herb is used to treat many ailments and few of the results are reported herewith. The paste obtained from rhizome of *A. calamus* is used against eczema in many countries along with the leaves of *Azadirachta indica* and paste of *Curcuma aromatica* rhizomes [63]. The paste obtained for the rhizomes of *A. calamus* and *Curcuma aromatica* and seeds of *Argemone Mexicana* is applied to treat many types of skin diseases [63]. The paste of rhizome of *A. calamus* is used in treating cough, stuttering, ulcer, fever, dermatitis, scab and sores [64]. The rhizome paste is given with cow milk to treat gastric disorders [65]. Rhizome paste of *A. calamus* along with fruits of *Myristica fragrans* and *Calunarejan spinosa* is given in mother's milk to children to treat cold, cough and fever [66]. Infusion of dried rhizomes (collected and stored in the autumn season) is consumed to serve as carminative, flavoring, tonic and also to treat head lice infestation [67,68]. The paste of *A. Calamus* rhizome is given with honey to cure Epilepsy, dysentery, mental illnesses, diarrhoea, kidney and liver disorders [69]. Rhizomes are used to treat wounds, fever and body pains [70,71]. In some parts of the country fresh ground rhizomes is mixed with hot water and given for 3 days to treat dysentery [72]. Dried powder of *A. Calamus* rhizomes is used as stimulant [73]. The rhizome paste of *A. calamus* is used to treat external injuries [74], stomach ache, wherein the ash of the *A. calamus* rhizomes is applied as dermal application [75]. Similarly, the root paste with coconut husk juice as external application serves as otitis [76], and fresh leaves as option [77]. The rhizome is used in treating several neurological disorders, gastrointestinal problems, respiratory ailments, to increase menstrual flow, as analgesic, contraceptive, herpangina [78,79,80].

In Pakistan, the whole plant is used against diarrhoea as oral source. Also, it is used as colic [81]. In Nepal the infusion of roots is administered against blood pressure [82]. Similarly, the juice prepared from the rhizomes is used against cough, headache, snake bite, sore throat and pain, dysentery [83]. The rhizome is also against neurological and respiratory complications [84]. Whole plant of *A. calamus* is used in Malaysia against Rheumatism, diarrhoea, dyspepsia, and hair loss [84]. In Tibet the herb is used against many ailments. The dried rhizome of *A. calamus* is given with *Saussurea lappa*, *Ferula foetida*, *Terminalia chebula*, *Cuminum cyminum*, *Inula racemose* and *Zingiber officinale* for treating fever and gastrointestinal complications [85]. The rhizomes are used against cancer treatment [86]. In China, The Chinese traditional health system is highly popular and herbs are used in their health systems. Accordingly *A. calamus* rhizome is used in treating gastrointestinal, respiratory, neuroprotective, analgesic, contraceptive and cancer complications [87,88,89]. The rhizome of *A. calamus* squeezed with stem of *Coccinia cordifolia* in water is given to patients to treat against Antipyretic and ear-related disease. The rhizome of *A. calamus* with vinegar, *Alpinia galanga*, *Zingiber purpureum* is administered to detoxify the body. External

application of rhizome paste is used in herbal baths as analgesic⁹⁰. The rhizome paste is used against haemorrhage⁹¹. Further, the rhizome is also used as aphrodisiac by administering through oral [92] and as an hallucinating agent by mixing with Indian hemp and *Podophyllum pleianthum* [93]. The rhizome is used as dermal care agent to obtain fair skin by using leaves of *A. calamus* with *Artemisia vulgaris* [94]. In Indonesia, the rhizomes are used through oral means to treat gastrointestinal ailments [95] and rhizomes blended with chalk and magnesium oxide⁹⁶. In England, the rhizomes are used to treat gastrointestinal problems and as well antibacterial and analgesic agent. Rhizomes are also used against dysentery, and chronic catarrh along with *Gentiana campestris* [97]. Rhizomes are also used against malaria [98]. In Europe the rhizome of *A. calamus* is widely used against obesity, gastrointestinal problems, respiratory complication [99,100]. In Republic of South Africa the rhizome is used as tooth powder, tonic and aphrodisiac. Gastrointestinal problems are also treated using the rhizome¹⁰¹. In Germany rhizome is used to increase menstrual flow and as well for gastrointestinal complications [102,103]. In Java, the rhizome is used to increase lactation [104]. In Lithuania, the rhizome is used to treat chest pain and diarrhoea⁹⁷. In Lithuania, Rhizomes and leaves are taken with sugar for treating chest pain and diarrhoea⁹⁷. To get relief from pain, gout and rheumatism, the leaf decoction is applied externally to get relief¹⁰⁵. In New Guinea the rhizome is used orally to treat miscarriage¹⁰⁶. In Philippines the decoction of *Acorus* rhizome is used orally to treat gastrointestinal disorders and as well rheumatism in elderly people¹⁰¹. In Russia traditional health healers use rhizome as oral syrup to treat typhoid, syphilis, baldness, fever and cholera [107]. In Thailand rhizomes are used to treat fever and as well as blood purifier¹⁰⁸. In Turkey the herb is used both internally to treat cough, tuberculosis and externally to treat wounds [109]. The rhizome is also used to treat gastrointestinal disorders [110] in Turkey. In Arab countries also the herb is used in gastrointestinal complications and as well to treat tuberculosis [111,112]. The rhizome decoction is taken internally. In Brazil the decoction of rhizome is consumed internally to treat parasitic worms in the stomach [113]. In Argentina the rhizome is consumed internally to cure dysmenorrhea [114]. In USA the rhizome is used to treat many ailments such as gastrointestinal disorders, respiratory disorder and as well as abortifacient, stimulant, tonic [115]. In Korea the rhizome is used by traditional health healers to enhance life span and as well to improve memory [116]. In Sri Lanka the rhizomes are administered to treat worm infestation and cough along with milk in the form of paste [117].

CONCLUSION

The perennial herb *Acorus calamus* is pharmacy by itself since it can cure many ailments. The herb is used in many countries and continents for its unique medicinal properties which are detailed in the paper. The references which are spread out have been put in a place for clear understanding of the herb and for better usage and furtherance of more trials to prospect the herb.

REFERENCES

1. https://en.wikipedia.org/wiki/Acorus_calamus
2. <http://www.flowersofindia.net/catalog/slides/Sweet%20Flag.html>
3. https://en.wikipedia.org/wiki/Acorus_calamus
4. Vineet Sharma, Rohit Sharma, DevNath Singh Gautam, Kamil Kuca, Eugenie Nepovimova and Natália Martins. (2020). Role of Vacha (*Acorus calamus* Linn.) in Neurological and Metabolic Disorders: Evidence from Ethnopharmacology, Phytochemistry, Pharmacology and Clinical Study. *J Clin Med. Apr*; 9(4): 1176.
5. Sandeep B. Rajput, Madan B. Tonge, S. Mohan Karuppaiyil. (2014). An overview on traditional uses and pharmacological profile of *Acorus calamus* Linn. (Sweet flag) and other *Acorus* species. *Phytomedicine*. Volume 21, Issue 3, Pages 268-276
6. Raja Arasan Elaya, Vijaya Lakshmi and Devalarao Garikapati. (2009). *Acorus calamus* Linn.: Chemistry and Biology. *Research Journal of Pharmacy and Technology*. Volume 2(2): 256-261
7. <https://theprint.in/health/1350501>
8. Toniolo, A.; Cassani, G.; Puggioni, A.; Rossi, A.; Colombo, A.; Onodera, T.; Ferrannini, E. 2019. The diabetes pandemic and associated infections: Suggestions for clinical microbiology. *Rev. Med. Microbiol.* 30, 1–17
9. Alarcon-Aguilar FJ, Roman-Ramos R, Flores-Saenz JL, Aguirre-Garcia F. 2002. Investigation on the hypoglycaemic effects of extracts of four Mexican medicinal plants in normal and Alloxan-diabetic mice. *Phytotherapy Research*. 16(4):383–386. doi:10.1002/ptr.914.
10. Kar A, Choudhary BK, Bandyopadhyay NG. (2003). Comparative evaluation of hypoglycaemic activity of some Indian medicinal plants in alloxan diabetic rats. *Journal of Ethnopharmacology*. 84(1):105-108. doi:10.1016/s0378-8741(02)00144-7
11. Liu, Y.X.; Si, M.M.; Lu, W.; Zhang, L.X.; Zhou, C.X.; Deng, S.L.; Wu, H.S. (2015). Effects and molecular mechanisms of the antidiabetic fraction of *Acorus calamus* L. on GLP-1 expression and secretion in-vivo and In-vitro. *J. Ethnopharmacol.* 166, 168–175.

12. Si, M.M.; Lou, J.S.; Zhou, C.X.; Shen, J.N.; Wu, H.H.; Yang, B.; Wu, H.S. (2010). Insulin releasing and alpha-glucosidase inhibitory activity of ethyl acetate fraction of *Acorus calamus* In-vitro and in-vivo. *J. Ethnopharmacol.* 128, 154–159.
13. <https://theprint.in/health/indians-are-growing-fatter-and-the-problem-is-biggest-for-wealthy-women-shows-nfhs-data/1350501/>
14. Younossi, Z.M. (2019). Non-alcoholic fatty liver disease-A global public health perspective. *J. Hepatol.* 70, 531–544
15. Farooqui, A.A.; Farooqui, T.; Panza, F.; Frisardi, V. (2012). Metabolic syndrome as a risk factor for neurological disorders. *Cell. Mol. Life Sci.* 69, 741–762
16. Thakare, M.M.; Surana, S.J.(2016). β -Asarone modulate adipokines and attenuates high fat diet-induced metabolic abnormalities in Wistar rats. *Pharmacol. Res.* 103, 227–235.
17. Karthiga, T.; Venkatalakshmi, P.; Vadivel, V.; Brindha, P. (2016). In-vitro anti-obesity, antioxidant and anti-inflammatory studies on the selected medicinal plants. *Int. J. Toxicol. Pharmacol. Res.* 8, 332–340
18. Singh, A.K.; Ravishankar, B.; Sharma, P.P.; Pandaya, T. (2017). Clinical study of anti-hyperlipidaemic activity of vacha (*Acorus calamus* linn) w.s.r to sthaulya. *Int. Ayurvedic Med. J.* 5, 1–8
19. Soni, P.; Sharma, C. (2012). A clinical study of Vachadi Churna in the management of obesity. *Int. J. Ayurveda Allied Sci.* 1, 179–186
20. Paradkar, S.R.; Pardhi, S.N. (2019). Clinical evaluation of lekhaneya effect of vacha (*acorus calamus*) and musta (*Cyperus rotundus*) in medoroga wsr to obesity: A comparative study. *Res. Rev. J. Pharmacogn.* 3, 1–8
21. <https://my.clevelandclinic.org/health/diseases/9536-anxiety-disorders>
22. Bhattacharyya, D.; Sur, T.K.; Lyle, N.; Jana, U.; Debnath, P.K. (2011). A clinical study on the management of generalized anxiety disorder with Vaca (*Acorus calamus*). *Indian J. Tradit. Knowl.* 10, 668–671
23. <https://www.who.int/news-room/fact-sheets/detail/hypertension>
24. Singh, D.K.; Kumar, N.; Sachan, A.; Lakhani, P.; Tutu, S.; Shankar, P.; Dixit, R.K. 2017. An experimental study to see the antihypertensive effects of *Gymnema sylvestre* and *Acorus calamus* in wistar rats and its comparison with amlodipine. *Asian J. Med. Sci.* 8, 11–15.
25. Mishra, J.; Joshi, N.P.; Pandya, D.M. (2012). A comparative study of Shankhapushpyadi Ghana Vati and Sarpagandhadi Ghana Vati in the management of "Essential Hypertension". *Ayu* 33, 54–61
26. <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/in-depth/memory-loss/art-20046326>
27. Kulatunga, R.D.H.; Dave, A.R.; Baghel, M.S. (2012). Clinical efficacy of Guduchyadi Medhya Rasayana on senile memory impairment. *Ayu* , 33, 202–208
28. <https://www.uclahealth.org/medical-services/anesthesiology/types-anesthesia>
29. Pande, D.N.; Mishra, S.K. (2009). Vacha (*Acorus Calamus*) as an ayurvedic premedicant. *Ayu* 30, 279–283
30. <https://www.nhlbi.nih.gov/health/insomnia>
31. Sharma, Y.; Upadhyay, A.; Sharma, Y.K.; Chaudhary, V. (2017). A randomized clinical study to evaluate the effect of Tagaradi yoga in the management of insomnia. *Indian J. Tradit. Knowl.* 16, S75–S80
32. <https://www.sciencedirect.com/topics/neuroscience/hypnotic>
33. Ramu, M.G.; Senapati, H.M.; Janakiramaiah, N.; Shankara, M.R.; Chaturvedi, D.D.; Murthy, N.N. (1983). A pilot study of role of brahmyadiyoga in chronic unmada (schizophrenia). *Anc. Sci. Life* 2, 205–207
34. <https://medlineplus.gov/lab-tests/immunoglobulins-blood-test/>
35. Appaji, R.R.; Sharma, R.D.; Katiyar, G.P.; Sai, P.A. (2009). Clinical study of the Immunoglobulin Enhancing Effect of "Bala compound" on Infants. *Anc. Sci. Life* 28, 18–22
36. <https://www.vocabulary.com/dictionary/mental%20balance>
37. Pawar, M.; Magdum, P. (2018). Clinical study of assessment of therapeutic potential of Vachadi ghrita, a medicated ghee formulation on healthy individual's cognition. *Int. J. Pharm. Sci. Res.* 9, 3408–3413
38. <https://www.ncbi.nlm.nih.gov/books/NBK209964/>
39. https://www.health.ny.gov/diseases/cardiovascular/heart_disease/
40. https://www.who.int/health-topics/cardiovascular-diseases#tab=tab_1
41. <https://news.abplive.com/science/world-heart-day-2022>
42. Mamgain, P.; Singh, R.H. (1994). Control clinical trial of the lekhaneya drug vaca (*Acorus calamus*) in case of ischemic heart diseases. *J. Res. Ayurveda Siddha* 15, 35–51
43. Tanaka, S.; Yoichi, S.; Ao, L.; Matumoto, M.; Morimoto, K.; Akimoto, N.; Zaini bin Asmawi, M. (2001). Potential immunosuppressive and anti-inflammatory activities of Malaysian medicinal plants characterized by reduced cell surface expression of cell adhesion molecules. *Phytother. Res.* 15, 681–686
44. Ahmed, S.; Gul, S.; Zia-Ul-Haq, M.; Stanković, M.S. (2014). Pharmacological basis of the use of *Acorus calamus* L. in inflammatory diseases and underlying signal transduction pathways. *Bol. Latinoam. Caribe Plantas Med. Aromát.* 13, 38–46
45. <https://www.cancer.gov/publications/dictionaries/cancer-terms/def/anticonvulsant>
46. Jayaraman, R.; Anitha, T.; Joshi, V.D. (2010). Analgesic and anticonvulsant effects of *Acorus calamus* roots in mice. *Int. J. PharmTech Res.* 2, 552–555
47. Bhat, S.D.; Ashok, B.K.; Acharya, R.N.; Ravishankar, B. (2012). Anticonvulsant activity of raw and classically processed Vacha (*Acorus calamus* Linn.) rhizomes. *Ayu*, 33, 119–122
48. <https://medlineplus.gov/antioxidants.html>

49. Bahukhandi, A.; Rawat, S.; Bhatt, I.D.; Rawal, R.S. (2013). Influence of solvent types and source of collection on total phenolic content and antioxidant activities of *Acorus calamus* L. *Natl. Acad. Sci. Lett.* 36, 93–99
50. Karthiga, T.; Venkatalakshmi, P.; Vadivel, V.; Brindha, P. (2016). In-vitro anti-obesity, antioxidant and anti-inflammatory studies on the selected medicinal plants. *Int. J. Toxicol. Pharmacol. Res.* 8, 332–340
51. Manju, S.; Chandran, R.P.; Shaji, P.K.; Nair, G.A. (2013). In-vitro free radical scavenging potential of *Acorus calamus* L. rhizome from Kuttanad Wetlands, Kerala, India. *Int. J. Pharm. Pharm. Sci.* 5, 376–380
52. Elayaraja, A.; Vijayalakshmi, M.; Devalarao, G. (2010). In-vitro free radical scavenging activity of various root and rhizome extracts of *Acorus calamus* Linn. *Int. J. Pharm. Biol. Sci.* 1, 301–304
53. Govindarajan, R.; Agnihotri, A.K.; Khatoon, S.; Rawat, A.K.S.; Mehrotra, S. (2003). Pharmacognostical evaluation of an antioxidant plant-*Acorus calamus* Linn. *Nat. Prod. Sci.* 9, 264–269
54. Sujitha, R.; Bhimba, B.V.; Sindhu, M.S.; Arumugham, P. (2013). Phytochemical Evaluation and Antioxidant Activity of *Nelumbo nucifera*, *Acorus calamus* and *Piper longum*. *Int. J. Pharm. Chem. Sci.* 2, 1573–1578
55. Shukla, R.; Singh, P.; Prakash, B.; Dubey, N.K. (2013). Efficacy of *Acorus calamus* L. essential oil as a safe plant-based antioxidant, Aflatoxin B 1 suppressor and broad-spectrum antimicrobial against food-infesting fungi. *Int. J. Food Sci. Tech.* 48, 128–135
56. Loying, R.; Gogoi, R.; Sarma, N.; Borah, A.; Munda, S.; Pandey, S.K.; Lal, (2019). M. Chemical Compositions, In-vitro Antioxidant, Anti-microbial, Anti-inflammatory and Cytotoxic Activities of Essential Oil of *Acorus calamus* L. Rhizome from North-East India. *J. Essent. Oil Bear. Plants* 22, 1299–1312
57. <https://www.nhs.uk/mental-health/talking-therapies-medicine-treatments/medicines>.
58. Pawar, V.S.; Anup, A.; Shrikrishna, B.; Shivakumar, H. (2011). Antidepressant-like effects of *Acorus calamus* in forced swimming and tail suspension test in mice. *Asian Pac. J. Trop. Biomed.* 1, S17–S19
59. Pushpa, V.H.; Padmaja, S.K.; Suresha, R.N.; Vaibhavi, P.S.; Kalabharathi, H.L.; Satish, A.M.; Naidu, S. (2013). Antidepressant Activity of Methanolic Extract of *Acorus calamus* Leaves in Albino Mice. *Int. J. Pharm. Tech.* 5, 5458–5465
60. De, A.; Singh, M.S. (2013). *Acorus calamus* linn. Rhizomes extract for antidepressant activity in mice model. *Adv. Res. Pharm. Biol.* 3, 520–525
61. Bhat, S.D.; Ashok, B.K.; Acharya, R.N.; Ravishankar, B. 2012. Anticonvulsant activity of raw and classically processed Vacha (*Acorus calamus* Linn.) rhizomes. *Ayu* 33, 119–122.
62. Rauniar, G.P.; Deo, S.; Bhattacharya, S.K. (2007). Evaluation of anxiolytic activity of tensarin in mice. *Kathman. Univ. Med. J.* 5, 188–194
63. Kingston C., Jeeva S., Jeeva G.M., Kiruba S., Mishra B.P., Kannan D. (2009). Indigenous knowledge of using medicinal plants in treating skin diseases in Kanyakumari district, Southern India. *Indian J. Tradit. Knowl.* 8:196–200.
64. Pradhan B.K., Badola H.K. (2008). Ethnomedicinal plant use by Lepcha tribe of Dzongu valley, bordering Khangchendzonga Biosphere Reserve, in north Sikkim, India. *J. Ethnobiol. Ethnomed.* 4:1–18.
65. Usher G. (1984). *Spilanthes Acmella*, a Dictionary of Plants Used by Man. CBS Publishers and Distributors; New Delhi, India: p. 38
66. Sharma P.K., Chauhan N.S., Lal B. (2004). Observations on the traditional phytotherapy among the inhabitants of Parvati valley in western Himalaya, India. *J. Ethnopharmacol.* 92:167–176.
67. Ghosh A. 2008. Ethnomedicinal plants used in West Rarrh region of West Bengal. *Nat. Prod. Rad.* 7:461–465.
68. Natarajan B., Paulsen B.S., Korneliusson V. (2000). An ethnopharmacological study from Kulu District, Himachal Pradesh, India: Traditional knowledge compared with modern biological science. *Pharm. Biol.* 38:129–138.
69. Nisha M.C., Rajeshkumar S. (2010). Survey of crude drugs from Coimbatore city. *Indian J. Nat. Prod. Resour.* 1:376–383
70. Ragupathy, S.; Steven, N.G.; Maruthakkutti, M.; Velusamy, B.; Ul-Huda, M.M. (2008). Consensus of the 'Malasars' traditional aboriginal knowledge of medicinal plants in the Velliangiri holy hills, India. *J. Ethnobiol. Ethnomed.* 4, 8–16
71. Tomar, A. 2009. Folk medicinal uses of plant roots from Meerut district, Uttar Pradesh. *Indian J. Tradit. Knowl.* 8, 298–301
72. Rajith, N.P.; Ramachandran, V.S. (2010). Ethnomedicines of Kurichyas, Kannur district, Western Ghats, Kerala. *Indian J. Nat. Prod. Resour.* 1, 249–253
73. Barbhuiya, A.R.; Sharma, G.D.; Arunachalam, A.; Deb, S. (2009). Diversity and conservation of medicinal plants in Barak valley, Northeast India. *Indian J. Tradit. Knowl.* 8, 169–175
74. Kadel, C.; Jain, A.K. (2008). Folklore claims on snakebite among some tribal communities of Central India. *Indian J. Tradit. Knowl.* 7, 296–299
75. Buktapa, N.R.; Sharma, A.K. (2010). Wild medicinal plants used by local communities of Manali, Himachal Pradesh, India. *Ethnobot. Leafl.* 3, 259–267
76. Kingston, C.; Nisha, B.S.; Kiruba, S.; Jeeva, S. (2007). Ethnomedicinal plants used by indigenous community in a traditional healthcare system. *Ethnobot. Leafl.* 11, 32–37
77. Jain, A.; Roshnibala, S.; Kanjilal, P.B.; Singh, R.S.; Singh, H.B. (2007). Aquatic /semi-aquatic plants used in herbal remedies in the wetlands of Manipur, Northeastern India. *Indian J. Tradit. Knowl.* 6, 346–351
78. Poonam, K.; Singh, G.S. (2009). Ethnobotanical study of medicinal plants used by the Taungya community in Terai Arc Landscape, India. *J. Ethnopharmacol.* 123, 167–176

79. Shrestha, P.M.; Dhillon, S.S. (2003). Medicinal plant diversity and use in the highlands of Dolakha district Nepal. *J. Ethnopharmacol.* 86, 81–96
80. Khatun, M.A.; Harun-Or-Rashid, M.; Rahmatullah, M. (2011). Scientific validation of eight medicinal plants used in traditional medicinal systems of Malaysia: A review. *Am. Eurasian J. Sustain. Agric.* 5, 67–75
81. Satyavati, G.V.; Raina, M.K.; Sharmal, M. (1976). *Medicinal Plants of India*; Indian Council of Medical Research: New Delhi, India, Volume I, pp. 14–16
82. Jain, S.K. (1968). *Medicinal Plants*; National Book Trust: New Delhi, India
83. Malhi, B.S.; Trivedi, V.P. (1972). Vegetable antifertility drugs of India. *Q. J. Crude Drug Res.* 12, 19–22
84. Singh, M.P.; Malla, S.B.; Rajbhandari, S.B.; Manandhar, A. (1979). Medicinal plants of Nepal retrospect's and prospects. *Econ. Bot.* 33, 185–198
85. Lama, S.; Santra, S.C. (1979). Development of Tibetan plant medicine. *Sci. Cult.* 45, 262–265
86. Burang, T. (1979). Cancer therapy of Tibetan healers. *Comp. Med. East West* 7, 294–296
87. Wallnofer, H.; Rottauscher, (1965). *A Chinese Folk Medicine and Acupuncture*; Bell Publishing Co, Inc: New York, NY, USA,
88. Agarwal, S.L.; Dandiya, P.C.; Singh, K.P.; Arora, R.B. (1956). A note on the preliminary studies of certain pharmacological actions of *Acorus calamus*. *J. Am. Pharm. Assoc.* 655–656
89. Duke, J.A.; Ayensu, E.S. (1985). *Medicinal Plants of China*; Reference Publications, Inc: Algonac, MI, USA, 44
90. Perry, L.M.; Metzger, (1980). *J. Medicinal Plants of East and Southeast Asia*; MIT Press: Cambridge, UK, 45
91. Boissya, C.L.; Majumder, R. (1980). Some folklore claims from the Brahmaputra Valley (Assam). *Ethnomedicine* 6, 139–145-46
92. Dragendorff, G. (1898). *Die Heilpflanzen der Verschie Denen Volker und Zeiten*; F. Enke: Stuttgart, Germany, PP-47
93. Li, H.L. (1977). Hallucinogenic plants in Chinese herbals. *Harv. Univ. Bot. Mus. Leafl.* 25, 161–177-48
94. Shih-Chen, L. (1973). *Chinese Medicinal Herbs*; Georgetown Press: San Francisco, CA, USA, PP 49
95. Hirschhorn, H.H. (1983). Botanical remedies of the former Dutch East Indies (Indonesia) I: Eumycetes, Pteridophyta, Gymnospermae, Angiospermae (Monocotyledones only). *J. Ethnopharmacol.* 7, 123–156
96. Wren, R.C. (1956). *Potter's New Cyclopaedia of Botanical Drugs and Preparations*; Sir Isaac Pitman and Sons, Ltd: London, UK,
97. Grieve, M. A. (1971). *Modern Herbal*; Dover Publications, Inc: New York, NY, USA, 1971; Volume II
98. Wheelwright, E.G. (1974). *Medicinal Plants and Their Stor*; Dover Publications, Inc: New York, NY, USA,
99. Moerman, D.E. (1981). *Geraniums for the Iroquois*; Reference Publications, Inc: Algonac, MI, USA,
100. Jochle, W. (1974). Menses-inducing drugs: Their role in antique, medieval and renaissance gynecology and birth control. *Contraception* 10, 425–439
101. Watt, J.M.; Breyer-Brandwijk, M.G. (1962). *The Medicinal and Poisonous Plants of Southern and Eastern Africa*; E. & S. Livingstone Ltd.: London, UK
102. Herrmann, G. 1956. Therapy with medicinal plants in present medicine. *Med. Monatsschr. Pharm.* 10, 79
103. Burkill, I.H. 1996. *Dictionary of the Economic Products of the Malay Peninsula*; Ministry of Agriculture and Cooperatives: Kuala Lumpur, Malaysia, Volume 1.
104. Motley, T.J. (1994). The Ethnobotany of Sweet Flag, *Acorus calamus* (Araceae). *Econ. Bot.* 8, 397–412
105. Krochmal, A.; Krochmal, (1975). *C. A Guide to the Medicinal Plants of the United States*; Quadrangle/The New York Times Book Co: New York, NY, USA
106. El'Yashevych, O.H.; Cholii, R. (1972). Some means of treatment in the folk medicine of L'Vov. *Farmatsevtichnyi Zhurnal* 27, 78
107. Barton, B.H.; Castle, (1877). *T. The British Flora Medica*; Chatto and Windus: Piccadilly, London, UK
108. Mokkhasamit, M.; Ngarmwathana, W.; Sawasdimongkol, K.; Permiphphat, U. 1971. Pharmacological evaluation of Thai medicinal plants. (Continued). *J. Med. Assoc. Thail.* 54, 490–504
109. Krochmal, A.; Krochmal, C. A (1975). *Guide to the Medicinal Plants of the United States*; Quadrangle/The New York Times Book Co: New York, NY, USA,
110. Harris, B.C. (1972). *The Complete Herbal*; Barre Publishers: Barre, MA, USA, 1972
111. Caius, J.F. (1986). *The Medicinal and Poisonous Plants of India*; Scientific Publishers: Jodhpur, India
112. Clymer, R.S. (1963). *Nature's Healing Agents*; Dorrance and Company: Philadelphia, PA, USA
113. Clymer, (1963). *R.S. Nature's Healing Agents*; Dorrance and Company: Philadelphia, PA, USA, 1963
114. Manfred, L. (1947). *Siete Mil Recetas Botanicas a Base de Mil Trescientas Plantas*; Edit Kier: Buenos Aires, Argentina,
115. Dobelis, I.N. (1986). *Magic and Medicine of Plants*; The Reader's Digest Association, Inc.: Pleasantville, New York, NY, USA
116. Kumar, H.; Song, S.Y.; More, S.V.; Kang, S.M.; Kim, B.Y. (2013). Traditional Korean East Asian Medicines and Herbal Formulations for Cognitive Impairment. *Molecules* 18, 14670–14693
117. Napagoda, M.T.; Sundarapperuma, T.; Fonseka, D.; Amarasiri, S.; Gunaratna, P. (2019). Traditional Uses of Medicinal Plants in Polonnaruwa District in North Central Province of Sri Lanka. *Scientifica* 1–12.

Copyright: © 2024 Author. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.