Traditional uses of wetland medicinal plant *Acorus calamus*: review and perspectives

Ashwani Kumar, Pradeep Kumar, Varun Kumar, Manish Kumar

Faculty of Bioscience, Shri Ram College Muzaffarnagar, UP-251002 (INDIA).

Introduction

*Acorus calamus* (also called Sweet Flag or Calamus, among many common names[1]) is a tall perennial wetland monocot of the Acoraceae family, in the genus *Acorus*. In spite of common names that include the words "rush" and "sedge," it is neither a rush or sedge.[2] The scented leaves and more strongly scented rhizomes have traditionally been used medicinally and to make fragrances and the dried and powdered rhizome has been used as a substitute for ginger, cinnamon and nutmeg.[2][3] In addition to "sweet flag" and "calamus" other common names include beewort, bitter pepper root, calamus root, flag root, gladdon, myrtle flag, myrtle grass, myrtle root, myrtle sedge, pine root, rat root, sea sedge, sweet cane, sweet cane, sweet cinnamon, sweet grass, sweet myrtle, sweet root, sweet rush, and sweet sedge.[1] Common names in Asia include: "vacha"; "bacch" (Unani); "bajai," "gora-bach," "vasa bach" (Hindi); "vekhand" (Marathi); "vashambu" (Tamil); "vadaja," "vasa" (Telugu); "baje" (Kannada); "vayambu" (Malayalam); "bhutanashini," "jatila" (Sanskrit).[2]

Botanical information

There are three cytotypic forms distinguished by chromosome number: a diploid form (2n=24), an infertile triploid form (2n=36), and a tetraploid form. Probably indigenous to most of Asia, the triploid form *Acorus calamus* var. *calamus* (also known as var. *vulgaris* or var. *verus*) has now been introduced across Europe, Australia, New Guinea, South Africa, Réunion and North America.[2][3][4][5][6][7][8] The tetraploid form *Acorus calamus* var. *angustatus* is native throughout Asia, from India to Japan and the Philippines and from Indonesia to Siberia.[14] The diploid form *Acorus americanus* or *Acorus calamus* var. *americanus* is found in northern subarctic North America and scattered disjunct areas throughout the Mississippi Valley, and furthermore diploids are also found in Mongolia, central Siberia (Buryatia), Gilgit–Baltistan in Pakistan (claimed by India) and northern Himachal Pradesh in India.[9][10][11],[12][13] In older USA literature the name *Acorus americanus* may be used indiscriminately for all forms of *Acorus calamus* occurring in North
America, irrespective of cytological diversity (i.e. both the diploid and triploid forms).\textsuperscript{[19]} The recent treatment in the Flora of China from 2010, which is followed in the Tropicos database system, considers all varieties to be synonyms of a single taxonomically undifferentiated species, pointing to morphological overlap in the characteristics singled out by Thompson.\textsuperscript{[15],[16],[17],[18]} \textbf{Fig. 1}. It is furthermore also cytotypically diverse, with an array of different karyotypes.\textsuperscript{[14],[19],[20]} A further hexaploid form exists in central and northwestern Yunnan and Kashmir. This form has not been given taxonomic status. At least 3 different karyotypes have been classified as hexaploid: 2n=66 in Yunnan and 2n=54 and 2n=72 in Kashmir.\textsuperscript{[21],[22]}

\textbf{Fig. 1} \textit{Acorus calamus}: Regeneration of planlets, fruiting and wild population of plant.

Uses as Herbal medicine and Recreational Drug
Sweet flag has a very long history of medicinal use in Chinese and Indian herbal traditions.[23] The leaves, stems, and roots are used in various Siddha and Ayurvedic medicines.[24] It is widely employed in modern herbal medicine as its sedative, laxative, diuretic, and carminative properties. It is used in Ayurveda to counter the side effects of all hallucinogens.[25] Sweet Flag, known as "Rat Root" is one of the most widely and frequently used herbal medicines amongst the Chipewyan people.[26] It is believed by some that calamus is a hallucinogen. This urban legend is based solely on two pages of a book written by Hoffer and Osmund entitled *The Hallucinogens*. The information on these two pages came from anecdotal reports from two individuals (a husband and wife) who reported that they had ingested calamus on a few occasions. None of the components in calamus are converted to TMA (trimethoxyamphetamine) in the human organism. To date there is no solid evidence of any hallucinogenic substances in calamus. [27][28]

*A. Calamus* has been an item of trade in many cultures for thousands of years. It has been used medicinally for a wide variety of ailments, and its aroma makes calamus essential oil valued in the perfume industry. The essence from the rhizome is used as a flavor for pipe tobacco. When eaten in crystallized form, it is called "German ginger". In Europe *Acorus calamus* was often added to wine, and the root is also one of the possible ingredients of absinthe. It is also used in bitters. [29] In Lithuania Ajeras (Sweet flag) is added to home baked black bread. In Britain the plant was also cut for use as a sweet smelling floor covering for the packed earth floors of medieval dwellings and churches, and stacks of rushes have been used as the centrepiece of rushbearing ceremonies for many hundreds of years.[30]. For the Penobscot people this was a very important root. Teton-Dakota warriors chewed the root to a paste, which they rubbed on their faces. It was thought to prevent excitement and fear when facing an enemy.[31] The Potawatomi people powdered the dried root and placed this up the nose to cure catarrh.[32]

**Modern Research and Chemistry**

*Acorus calamus* shows neuroprotective effect against stroke and chemically induced neurodegeneration in rats. Specifically, it has protective effect against acrylamide induced neurotoxicity.[33] Both roots and leaves of *A. calamus* have shown antioxidant,[34] antimicrobial and insecticidal activities. *Acorus calamus* may prove to be an effective control measure against cattle tick, Rhipicephalus (Boophilus) microplus.[35] A recent study showed that beta-asarone isolated from *Acorus calamus* oil inhibits adipogenesis in 3T3-L1 cells and thus reduces lipid accumulation in fat cells.[36] Both triploid and tetraploid *A. calamus* contains alpha-asarone. Other phytochemicals include: Beta-asarone[37][38][39] eugenol[3] Diploids do not contain beta-asarone (β-asarone).[40]
Antioxidant, antimicrobial, phytochemical, and clinical aspects of Acorus calamus:

Bamboo leaves (Phyllostachys pubescens Mazel ex J. Houz (Poacea)) have a long history of food and medical applications in Asia, including Japan and Korea. They have been used as a traditional medicine for centuries. We investigated the mechanism of anti-inflammatory activity of a bamboo leaf extract (BLE) on tumor necrosis factor-alpha (TNF-α)-induced monocyte adhesion in human umbilical vein endothelial cells (HUVECs). Exposure of HUVECs to BLE did not inhibit cell viability or cause morphological changes at concentrations ranging from 1 µg/ml to 1mg/ml. The results indicate that BLE may be clinically useful as an anti-inflammatory or anti-oxidant for human cardiovascular disease including atherosclerosis. [41]

The antibacterial activity was evaluated using disc diffusion assay method against 12 bacteria (both gram positive and gram negative). The results of the present investigation suggest that most of the studied plants are potentially good source of antibacterial and anticancer agents. [42] The present study was conducted to evaluate the antioxidant and immunostimulant effects of The Carica papaya fruit aqueous extract (CPF,Caricaceae) against acrylamide induced oxidative stress and improvement of Immune functions which affected by free radicals liberating acrylamide in rats. Sixty male wistar albino rats (195-230g) were assigned to four groups (fifteen/group). Thus, this study suggests that acrylamide-induced oxidative stress in rats can be ameliorated by administration of CPF aqueous extract.[43]

Panax ginseng Meyer has been widely used as a tonic in traditional Korean, Chinese, and Japanese herbal medicines and in Western herbal preparations for thousands of years. In the past, ginseng was very rare and was considered to have mysterious powers. Today, the efficacy of drugs must be tested through well-designed clinical trials or meta-analyses, and ginseng is no exception. In the present review, we discuss the functions of ginseng described in historical documents and describe how these functions are taken into account in herbal prescriptions. The present review on the functions of ginseng in traditional prescriptions helps to demystify ginseng and, as a result, may contribute to expanding the use of ginseng or ginseng-containing prescriptions.[44]

Cadmium is one of the elements found to damage antioxidant systems in mammals. To ameliorate cadmium toxicity and to prevent oxidative stress, natural products may be useful. In Indian ethnobotanical practice, a mixture of 17 herbal products is used to fortify the reproductive system of women after parturition and to recover ovarian oxidative stress. Oral administration of this extract to rats exposed to cadmium was useful in reversing oxidative stress. Two different doses of cadmium (50 ppm and 200 ppm) were given to Wistar rats aged 45 and 65 days. An herbal extract derived from 17 plants was administered orally every day at a dose level of 200 mg/kg of body weight to the rats exposed to cadmium. A battery of enzymes involved in antioxidant activity in the ovary, including superoxide dismutase (SOD), catalase, glutathione peroxidase (GPx) and glutathione-s-transferase (GST) were measured in the control, cadmium-exposed rats without treatment and in the cadmium-exposed rats treated with herbal extract. The reduction in SOD, catalase, GPx and GST activity after cadmium exposure improved significantly in the rats treated with the
herbal extract (p < 0.05). The decrease of antioxidant enzyme due to cadmium exposure was reversed significantly with herbal extract administration. The synergistic effect of each bioactive compound in different herbal extracts requires further study. [45]

As much as the popularity of ginseng in herbal prescriptions or remedies, ginseng has become the focus of research in many scientific fields. This review summarizes the most recent advances in ginseng analysis in the past half-decade including emerging techniques and analytical trends. Ginseng analysis includes all of the leading analytical tools and serves as a representative model for the analytical research of herbal medicines.[46]

Hypertension is a major public health problem of this era. Hypertension related morbidity and mortality rates have dramatically increased over the last 25 years. Stressful life style is one of the leading causes of Hypertension. The treatment of hypertension remains a primary goal in the effort to reduce morbidity and mortality from cardiovascular disease, stroke and kidney disease. In this study, 20 patients were randomly divided in two groups and treated along with restricted diet pattern for 8 weeks. Patients of Group A received poly-herbal compound formulation Shankhapushpyadi Ghana Vati (2gm/day). It was found that, relief in overall symptoms (63.93%) elevated blood pressure (8.91% in Systolic blood pressure and 8.44% in diastolic blood pressure). In group-B, with Sarpagandhadi Ghana Vati (2gm/day) the percent relief was better on elevated blood pressure (12.00% in Systolic blood pressure and 11.02% in diastolic blood pressure). When data is subjected in between both the groups, it is found that, both drugs are equally effective. [47]

The rhizome of Vacha (Acorus calamus) has been used in Ayurvedic medicine for the treatment of various ailments, such as epilepsy, headache, eye disorders, insomnia, loss of memory, etc. Previous studies demonstrated that Vacha rhizome is having significant anticonvulsant activity against various induced seizures models in experimental animals. Ayurvedic pharmacopoeia of India has advocated Shodhana (purificatory procedures) to be done prior to its use. In the present study a comparative anticonvulsant activity of raw and Shodhita (classically processed) Vacha rhizomes were screened against Maximal Electro Shock (MES) seizure model to assess the effect of classical purificatory procedure on pharmacological action of Vacha. Phenytoin was used as standard antiepileptic drug for comparison. Pretreatment with both raw and classically processed Vacha samples exhibited significant anticonvulsant activity by decreasing the duration of tonic extensor phase. Further classically processed Vacha statistically decreased the duration of convulsion and stupor phases of MES-induced seizures. The results obtained from the present study clearly confirmed the anticonvulsant activity of raw Vacha and subjecting to classical Shodhana procedure did not alter the efficacy of Vacha rhizomes instead it enhanced the activity profile of the Vacha.[48]

Ashwagandharishta, an Ayurvedic classical formulation, is the remedy for Apasmara (epilepsy), Murchha (syncope), Unmada (psychosis), etc. Recent studies in animal models have shown that n-3 PUFAs can raise the threshold of epileptic seizures. The indigenous medicinal plant, called Atasi (Linum usitatissimum Linn.) in Ayurveda, or flax seed, is the best plant source of omega-3 fatty acids. The present study is designed to investigate whether
Ashwagandharishta and Atasi taila (flax seed oil) protect against maximal electroshock (MES) seizures in albino rats. Further, a possible protective role of flax seed oil as an adjuvant to Ashwagandharishta in its anticonvulsant activity has also been evaluated in the study. MES seizures were induced for rats and seizure severity was assessed by the duration of hind limb extensor phase. Phenytoin was used as the standard antiepileptic drug for comparison. Both flax seed oil and Ashwagandharishta significantly decreased convulsion phase. Pre-treatment with flax seed oil exhibited significant anticonvulsant activity by decreasing the duration of tonic extensor phase. Contrary to the expectations, pre-treatment with flax seed oil as an adjuvant to Ashwagandharishta failed to decrease the tonic extensor phase; however, it significantly decreased the flexion phase (P < 0.001) and duration of the convulsions (P < 0.05). Both the drugs exhibited an excellent anti-post-ictal depression effect and complete protection against mortality.[49]

The antimelanogenic and antioxidant activities of the essential oil extracted from the leaves of Acorus macrospadiceus (Yamamoto) F. N. Wei et Y. K. Li have never been explored. The essential oil effectively inhibited mushroom tyrosinase activity (EC50 = 1.57 mg/mL) and B16F10 tyrosinase activity (IC50 = 1.01 mg/mL), decreased the melanin (EC50 = 1.04 mg/mL), and depleted the cellular level of the reactive oxygen species (ROS) (EC50 = 1.87 mg/mL). The essential oil effectively scavenged 2,2-diphenyl-1-picryl-hydrazyl (DPPH) (EC50 = 0.121 mg/mL) and 2,2′-azino-bis (3-ethylbenzthiazoline-6-sulphonic acid) ABTS+ radicals (EC50 = 0.122 mg/mL). It also exhibited an apparent reducing power (EC50 = 0.021 mg/mL) and metal-ion chelating activity (EC50 = 0.029 mg/mL). The chemical constituents of the essential oil are ethers (55.73%), ketones (19.57%), monoterpenes (7.82%), alcohols (3.85%), esters (3.77%), sesquiterpenes (3.72%), and aromatic compounds (2.85%). The results confirm that A. macrospadiceus essential oil is a natural antioxidant and inhibitor of melanogenesis.[50]

Kai-xin-san (KXS), a Chinese herbal decoction being prescribed by Sun Simiao in Beiji Qianjin Yaofang about 1400 years ago, contains Ginseng Radix et Rhizoma, Polygalae Radix, Acori tatarinowii Rhizoma, and Poria. KXS has been used to treat stress-related psychiatric disease with the symptoms of depress for forgetfulness in ancient China until today. However, the mechanism of its antidepressant action is still unknown. Here, the chronic mild-stress-(CMS-) induced depressive rats were applied in exploring the action of neurotrophic factors and its corresponding receptors in the brain. The results suggested that the anti-depressant-like action of KXS might be mediated by an increase of neurotransmitters and expression KXS could serve as alternative medicine, or health food supplement, for patients suffering from depression.[51]

Rasagenthi Mezhugu (RGM) is a herbomineral formulation in the Siddha system of traditional medicine and is prescribed in the southern parts of India as a remedy for all kinds of cancers. However, scientific evidence for its therapeutic efficacy in cervical cancer is lacking, and it contains heavy metals. The chloroform fraction (cRGM) induced DNA damage and apoptosis. Mitochondria-mediated apoptosis was indicated. Though both the cells responded to the treatment, ME-180 was more responsive. Thus, this study brings up
scientific evidence for the efficacy of RGM against the HPV-mediated cervical cancer cells and, if the toxic heavy metals are the limitation in its use, cRGM would be a suitable candidate as evidence-based complementary and alternative medicine for HPV-positive cervical cancers.[52]

Some investigator represent a systematic review of existing research that aims to assess the efficacy and safety of herbal medications (HM), as either monotherapy or adjunct to orthodox medications (OM), mainly comprised of cholinesterase inhibitors, for vascular dementia (VaD). They included 47 studies conducted in mainland China, each testing different HM. Of 43 HM monotherapy studies, 37 reported HM to be significantly better than OM or placebo; six reported similar efficacy between HM and OM.Thirty most commonly used herbal constituents, including Rhizoma Chuanxiong (Chuanxiong in Chinese), Radix Polygoni Multiflori (Heshouwu in Chinese) and Radix Astragali (Huangqi in Chinese) were ranked. Further multi-center trials with large sample sizes, high methodological quality and standardized HM ingredients are necessary for clinical recommendations to be made.[53]

Based on the history of use, there was strong clinical support that Radix polygalae is memory improving. Pharmacological investigation also indicated that all the five ingredients mentioned above can elicit memory-improving effects in vivo and in vitro via multiple mechanisms of action, covering estrogen-like, cholinergic, antioxidant, anti-inflammatory, antiapoptotic, neurogenetic, and anti-Aβ activities. Furthermore, 11 active principles were identified, including sinapic acid, tenuifolin, isoliquiritigenin, liquiritigenin, glabridin, ferulic acid, Z-ligustilide, N-methyl-beta-carboline-3-carboxamide, coniferyl ferulate and 11-angeloylsenkyunolide F, and catalpol. It can be concluded that TCM has a potential for complementary and alternative role in treating senile dementia. [54]

Obesity plays a central role in the insulin resistance syndrome, which is associated with hyperinsulinemia, hypertension, hyperlipidemia, type 2 diabetes mellitus, and an increased risk of atherosclerotic cardiovascular disease. The present study was done to assess the effect of Gymnema sylvestre extract (GSE) in the high fat diet (HFD)-induced cellular obesity and cardiac damage in Wistar rats.Adult male Wistar rats (150–200 g body weight) were used in this study. HFD was used to induce obesity. Body mass index, hemodynamic parameters, serum leptin, insulin, glucose, lipids, apolipoprotein levels, myocardial apoptosis, and antioxidant enzymes were assessed. Organ and visceral fat pad weights and histopathological studies were also carried out. Further, mean arterial blood pressure, heart rate, serum leptin, insulin, LDH, LDL-C, total cholesterol, triglycerides, and apolipoprotein-B levels were enhanced significantly, whereas serum HDL-C, apolipoprotein-A1 levels and cardiac Na+ K+ ATPase, antioxidant enzymes levels were significantly decreased.The present study has demonstrated the significant antiobesity potential of GSE in murine model of obesity. [55]

On treatment of aqueous solutions containing chloroauric acid or silver nitrate with root extract of T. decandra, stable gold or silver nanoparticles were rapidly formed. The results show varied susceptibility of microorganisms to the gold and silver nanoparticles. It is believed that phytochemicals present in T. decandra extract reduce the silver and gold ions into metallic nanoparticles. [56]
A preparative gas chromatography (pGC) method was developed for the separation of isomers (cis- and trans-asarone) from essential oil of *Acorus tatarinowii*. The oil was primarily fractionated by silica gel chromatography using different ratios of petroleum ether and ethyl acetate as gradient elution solvents. And then the fraction that contains mixture of the isomers was further separated by pGC. [57]

In benign prostatic hyperplasia (BPH) there will be a sudden impact on overall quality of life of patient. This disease occurs normally at the age of 40 or above and also is associated with sexual dysfunction. Thus, there is a need of update on current medications of this disease. Medications including watchful waitings, Alpha one adrenoreceptor blockers, 5-alpha reductase inhibitors, combination therapies including tamsulosin-dutasteride, doxazosin-finasteride, terazosin-finasteride, tolterodine-tamsulosin and rofecoxib-finasteride were found. Herbal remedies such as *Cernilton*, *Saxifraga stolonifera*, *Zi-Shen Pill* (*ZSP*), *Orbignya speciosa*, *Phellodendron amurense*, *Ganoderma lucidum*, *Serenoa Repens*, *pumpkin extract* and *Lepidium meyenii* (Red Maca) have some improvements on BPH are included. Medications with combination therapies are still needs more investigation to establish as preference in initial stage for fast symptom relief reduced prostate growth and obviously reduce need for BPH-related surgery. Due to lack of proper evidence Phytotherapies are not gaining much advantage. MITs and TURP are expensive and are rarely supported by healthcare systems.[58]

*Diabetes mellitus* is a complicated metabolic disorder that has gravely troubled the human health and quality of life. Conventional agents are being used to control diabetes along with lifestyle management. However, they are not entirely effective and no one has ever been reported to have fully recovered from diabetes. Numerous medicinal plants have been used for the management of *diabetes mellitus* in various traditional systems of medicine worldwide as they are a great source of biological constituents and many of them are known to be effective against diabetes. This review focuses on the various plants that have been reported to be effective in diabetes. A record of various medicinal plants with their established antidiabetic and other health benefits has been reported. These include *Allium sativa*, *Eugenia jambolana*, *Panax ginseng*, *Gymnema sylvestre*, *Momrodica charantia*, *Ocimum sanctum*, *Phyllanthus amarus*, *Pterocarpus marsupium*, *Trigonella foenum graecum* and *Tinospora cordifolia*. All of them have shown a certain degree of antidiabetic activity by different mechanisms of action.[59]

Cognitive dysfunction is a major health problem in the 21st century, and many neuropsychiatric disorders and neurodegenerative disorders, such as schizophrenia, depression, Alzheimer’s disease dementia, cerebrovascular impairment, seizure disorders, head injury and Parkinsonism, can be severely functionally debilitating in nature. In course of time, a number of neurotransmitters and signaling molecules have been identified which have been considered as therapeutic targets. Conventional as well newer molecules have been tried against these targets. Phytochemicals from medicinal plants play a vital role in maintaining the brain’s chemical balance by influencing the function of receptors for the major inhibitory neurotransmitters. In traditional practice of medicine, several plants have been reported to
treat cognitive disorders. In this review paper, we attempt to throw some light on the use of medicinal herbs to treat cognitive disorders. In this review, we briefly deal with some medicinal herbs focusing on their neuroprotective active phytochemical substances like fatty acids, phenols, alkaloids, flavonoids, saponins, terpenes etc. The resistance of neurons to various stressors by activating specific signal transduction pathways and transcription factors are also discussed.[60]

Cognitive deficits that present with many of neuropsychiatric conditions and/or alone as developmental deficit demand use of nootropics to boost cognitive abilities. Recently there is a tremendous urge to explore medicinal plants globally for improving cognitive function as well as their multi-dimensional utility in various conditions. Present paper is a review to update knowledge on pharmacological properties, major chemical constituents, therapeutic actions, preclinical studies, safety and possible mode of action of the selected herbs from ayurvedic pharmacopoeia. Concurrently, it opens up for further research and standardization on nootropic herbs.[61]

Gastro duodenal ulcer is a common disorder of the gastrointestinal tract. Several Indian medicinal plants have been traditionally and extensively used to prevent different diseases. In the present research studies, Bael fruit (Aegle marmelos (AM), family: Rutaceae) which are also called as Bilva in ancient Sanskrit was used as a herbal drug and its antioxidative role in aspirin-induced gastroduodenal ulceration in albino rat was evaluated using essential biochemical parameters. Patients and Methods:: Mucosal thickness (MT), ulcer index (UI), different biochemical parameters, such as aspartate aminotransferase (AST), alanine aminotransferase (ALT), catalase (CAT), superoxide dismutase (SOD), reduced glutathione (GSH), and lipid peroxidation (LPO) were measured in all the groups, to study the possible involvement of antioxidants with gastroduodenal protection. Results:: A significant decrease in MT, SOD and CAT activities and GSH level and a significant increase in UI, AST, ALT, and ALP activities and LPO level were observed in aspirin treated stomach and duodenum of albino rats. Conclusions::: Pretreatment with AM fruit pulp extract for 14 consecutive days showed the reverse effects of aspirin suggesting gastro-duodenal protective and anti-ulcerogenic properties of AM through its antioxidant mechanism[62].

Snake envenomation is a global public health problem, with highest incidence in Southeast Asia. Inadequate health services, difficult transportation and consequent delay in antivenom administration are the main reasons for high mortality. Adverse drug reactions and inadequate storage conditions limit the use of antivenom venom. The medicinal plants, available locally and used widely by traditional healers, therefore need attention. A wide array of plants and their, active principles have been evaluated for pharmacological properties. However numerous unexplored plants claimed to be antidotes in folklore eeebe studied. The present article reviews the current status of various medicinal plants for the management of snake bite.[63]

A petroleum ether extract of Kadsura longipedunculata enhanced the GABA-induced chloride current (IGABA) by 122.5 ± 0.3% (n = 2) when tested at 100 μg/ml in Xenopus
laevis oocytes expressing GABA A receptors (α1β2γ2S subtype) in two-microelectrode voltage clamp measurements. Thirteen compounds were subsequently identified by HPLC-based activity profiling as responsible for GABA A receptor activity and purified in preparative scale. 6-Cinnamoyl-6,7-dihydro-7-myrceneol and 5,6-dihydrocuparenic acid were thereby isolated for the first time. The determination of the absolute stereochemistry of these compounds was achieved by comparison of experimental and calculated EC spectra. All but one of the 13 isolated compounds from *K. longipedunculata* potentiated IGABA through GABA receptors composed of α1β2γ2S subunits in a concentration-dependent manner. Potencies ranged from 12.8 ± 3.1 to 135.6 ± 85.7 μM, and efficiencies ranged from 129.7 ± 36.8% to 885.8 ± 291.2%. The phytochemical profiles of petroleum ether extracts of *Kadsura japonica* fruits (114.1 ± 2.6% potentiation of IGABA at 100 μg/ml, n = 2), and *Schisandra chinensis* fruits (inactive at 100 μg/ml) were compared by HPLC-PDA-ESIMS with that of *K. longipedunculata*. [64]

A novel result of the current research is the development and implementation of a unique functional phylogenomic approach that explores the genomic origins of seed plant diversification. We first use 22,833 sets of orthologs from the nuclear genomes of 101 genera across land plants to reconstruct their phylogenetic relationships. One of the more salient results is the resolution of some enigmatic relationships in seed plant phylogeny, such as the placement of Gnetales as sister to the rest of the gymnosperms. In using this novel phylogenomic approach, we were also able to identify overrepresented functional gene ontology categories in genes that provide positive branch support for major nodes prompting new hypotheses for genes associated with the diversification of angiosperms. For example, RNA interference (RNAi) has played a significant role in the divergence of monocots from other angiosperms, which has experimental support in Arabidopsis and rice. This analysis also implied that the second largest subunit of RNA polymerase IV and V (NRPD2) played a prominent role in the divergence of gymnosperms. This hypothesis is supported by the lack of 24nt siRNA in conifers, the maternal control of small RNA in the seeds of flowering plants, and the emergence of double fertilization in angiosperms. Our approach takes advantage of genomic data to define orthologs, reconstruct relationships, and narrow down candidate genes involved in plant evolution within a phylogenomic view of species' diversification.[65]

A total of 470 papers directly related to research on the *Panax species* were retrieved by performing internet searches with the keywords Panax and ginseng as the search terms. The publications were categorized as follows: 399 research articles, 30 reviews, 30 meeting abstracts, 7 proceedings, and 4 letters. The majority of these publications were published by scientists from Korea (35.7%), China (32.3%), and the USA (11.3%). Scientists from a total of 29 nations were actively involved in conducting ginseng research. A total of 43.6% of the publications were categorized as pharmacodynamic studies. The effects of ginseng on cerebrovascular function and cancer were the two most common topics considered in the pharmacodynamic studies. More than half of the ginseng studies assessed the use of *P. ginseng*. A total of 23 countries participated in studies specifically related to *P. ginseng*, and
more than 80% of these studies originated from Korea and China. A total of 50 topics within the pharmacodynamics category were examined in association with the use of P. Ginseng.[66]

Inflammation, although first characterized by Cornelius Celsus, a physician in first century Rome, it was Rudolf Virchow, a German physician in nineteenth century who suggested a link between inflammation and cancer, cardiovascular diseases, diabetes, pulmonary diseases, neurological diseases and other chronic diseases. Extensive research within last three decades has confirmed these observations and identified the molecular basis for most chronic diseases and for the associated inflammation. The transcription factor, Nuclear Factor-kappaB (NF-κB) that controls over 500 different gene products, has emerged as major mediator of inflammation. Thus agents that can inhibit NF-κB and diminish chronic inflammation have potential to prevent or delay the onset of the chronic diseases and further even treat them. In an attempt to identify novel anti-inflammatory agents which are safe and effective, in contrast to high throughput screen, we have turned to “reverse pharmacology” or “bed to benchside” approach. We found that Ayurveda, a science of long life, almost 6000 years old, can serve as a “goldmine” for novel anti-inflammatory agents used for centuries to treat chronic diseases. The current review is an attempt to provide description of various Ayurvedic plants currently used for treatment, their active chemical components, and the inflammatory pathways that they inhibit.[67]

Tetrahydrocannabinol (THC) has been the primary focus of cannabis research since 1964, when Raphael Mechoulam isolated and synthesized it. More recently, the synergistic contributions of cannabidiol to cannabis pharmacology and analgesia have been scientifically demonstrated. Other phytocannabinoids, including tetrahydrocannabivarain, cannabigerol and cannabichromene, exert additional effects of therapeutic interest. Innovative conventional plant breeding has yielded cannabis chemotypes expressing high titres of each component for future study. This review will explore another echelon of phytotherapeutic agents, the cannabis terpenoids: limonene, myrcene, α-pinene, linalool, β-caryophyllene, caryophyllene oxide, nerolidol and phytol. Terpenoids share a precursor with phytocannabinoids, and are all flavour and fragrance components common to human diets that have been designated Generally Recognized as Safe by the US Food and Drug Administration and other regulatory agencies. Terpenoids are quite potent, and affect animal and even human behaviour when inhaled from ambient air at serum levels in the single digits ng·mL−1. They display unique therapeutic effects that may contribute meaningfully to the entourage effects of cannabis-based medicinal extracts. Particular focus will be placed on phytocannabinoid-terpenoid interactions that could produce synergy with respect to treatment of pain, inflammation, depression, anxiety, addiction, epilepsy, cancer, fungal and bacterial infections (including methicillin-resistant Staphylococcus aureus). Scientific evidence is presented for non-cannabinoid plant components as putative antidotes to intoxicating effects of THC that could increase its therapeutic index. Methods for investigating entourage effects in future experiments will be proposed. Phytocannabinoid-terpenoid synergy, if proven, increases the likelihood that an extensive pipeline of new therapeutic products is possible from this
Prasaplai is a medicinal plant mixture that is used in Thailand to treat primary dysmenorrhea, which is characterized by painful uterine contractility caused by a significant increase of prostaglandin release. Cyclooxygenase (COX) represents a key enzyme in the formation of prostaglandins. Former studies revealed that extracts of Prasaplai inhibit COX-1 and COX-2. In this study, a comprehensive literature survey for known constituents of Prasaplai was performed. A multiconformational 3D database was created comprising 683 molecules. Virtual parallel screening using six validated pharmacophore models for COX inhibitors was performed resulting in a hit list of 166 compounds. 46 Prasaplai components with already determined COX activity were used for the external validation of this set of COX pharmacophore models. 57% of these components were classified correctly by the pharmacophore models. These findings confirm that the virtual approach provides a helpful tool (i) to unravel which molecular compounds might be responsible for the COX-inhibitory activity of Prasaplai and (ii) for the fast identification of novel COX inhibitors.

The capacity for fast-growth recovery after de-submergence is important for establishment of riparian species in a water-level-fluctuation zone. Recovery patterns of two wetland plants, Alternanthera philoxeroides and Hemarthria altissima, showing ‘escape’ and ‘quiescence’ responses, respectively, during submergence were investigated. Methods: Leaf and root growth and photosynthesis were monitored continuously during 10 d of recovery following 20 d of complete submergence. Above- and below-ground dry weights, as well as carbohydrate concentrations, were measured several times during the experiment. Both species remobilized stored carbohydrate during submergence. Although enhanced internode elongation depleted the carbohydrate storage in A. philoxeroides during submergence, this species resumed leaf growth 3 d after de-submergence concomitant with restoration of the maximal photosynthetic capacity. In contrast, some sucrose was conserved in shoots of H. altissima during submergence, which promoted rapid re-growth of leaves 2 d after de-submergence and earlier than the full recovery of photosynthesis. The recovery of root growth was delayed by 1–2 d compared with leaves in both species. Conclusions: Submergence tolerance of the escape and quiescence strategies entails not only the corresponding regulation of growth, carbohydrate catabolism and energy metabolism during submergence but also co-ordinated recovery of photosynthesis, growth and carbohydrate partitioning following de-submergence.

The aqueous leaves extract of Sesbania sesban (L) Merr. (Family: Fabaceae) was evaluated for its antidiabetic potential on normal and streptozotocin (STZ)-induced diabetic rats. In the chronic model, the aqueous extract was administered to normal and STZ-induced diabetic rats at the doses of 250 and 500 mg/kg body weight (b.w.) p.o. per day for 30 days. The fasting Blood Glucose Levels (BGL), serum insulin level and biochemical data such as glycylated hemoglobin, Total Cholesterol (TC), Triglycerides (TG), High Density Lipoproteins (HDL) and Low Density Lipoproteins (LDL) were evaluated and all were compared to that of the known anti-diabetic drug glibenclamide (0.25 mg/kg b.w.).
statistical data indicated significant increase in the body weight, liver glycogen, serum insulin and HDL levels and decrease in blood glucose, glycosylated hemoglobin, total cholesterol and serum triglycerides when compared with glibenclamide. Thus the aqueous leaves extract of *Sesbania sesban* had beneficial effects in reducing the elevated blood glucose level and lipid profile of STZ-induced diabetic rats.[71]

To investigate the anticonvulsant and muscle relaxant activity of ethanolic extract of stems of *Dendrophthoe falcata* in mice. Materials and Methods:: The ethanolic extract of stems of *D. falcata* (100, 300 and 500 mg/kg, p.o.) was studied for its anticonvulsant effect on maximal electroshock-induced seizures and muscle relaxant activity at the same dose level using rotarod and traction test in mice. Results:: Preliminary phytochemical analysis revealed presence of proteins, carbohydrates, glycosides, steroids, triterpenes, flavonoids, tannins and phenolic compounds. *D. falcata* ethanolic extract (DFEE)(100, 300 and 500 mg/kg, p.o.) significantly (P<0.001) inhibited seizures induced by MES, reduced the duration of Hind limb tonic extensor phase (HLTE) and a decline in motor coordination. Conclusion:: The ethanolic extract possesses anticonvulsant activity and muscle relaxant activity.[73]

This paper summarizes our research for herbal extracts with potent antioxidant activity obtained from a large scale screening based on superoxide radical (O2•−)-scavenging activity followed by characterization of antioxidant properties. Firstly, scavenging activity against O2•− was extensively screened from ethanol extracts of approximately 1000 kinds of herbs by applying an electron spin resonance (ESR)-spin trapping method, and we chose four edible herbal extracts with prominently potent ability to scavenge O2•−. They are the extracts from *Punica granatum* (Peel), *Syzygium aromaticum* (Bud), *Mangifera indica* (Kernel), and *Phyllanthus emblica* (Fruit). These extracts were further examined to determine if they also scavenge hydroxyl radical (•OH), by applying the ESR spin-trapping method, and if they have heat resistance as a desirable characteristic feature. Experiments with the Fenton reaction and photolysis of H2O2 induced by UV irradiation demonstrated that all four extracts have potent ability to directly scavenge •OH. Furthermore, the scavenging activities against O2•− and •OH of the extracts of *P. granatum* (peel), *M. indica* (kernel) and *P. emblica* (fruit) proved to be heat-resistant. The results of the review might give useful information when choosing a potent antioxidant as a foodstuff. For instance, the four herbal extracts chosen from extensive screening possess desirable antioxidant properties. In particular, the extracts of the aforementioned three herbs are expected to be suitable for food processing in which thermal devices are used, because of their heat resistance.[73]

With growing use of anticancer complementary and alternative medicines (CAMs) worldwide, there is a need to assess and screen commercially available natural products for relative tumoricidal properties under standard experimental conditions. In the current study, we screened and ranked 264 traditional Chinese and Egyptian herbal medicines for tumoricidal potency against malignant neuroblastoma in vitro. The data obtained show that tumoricidal potencies of plants were randomly dispersed throughout similar orders, families and genera under the Division: *Magnoliophyta, class: Magnoliopsida, subclasses: Asteridae, Caryophyllidae, Dilleniidae, Hamamelididae, Magnoliidae and Rosidae*. The most potent
plant extracts (LC50 < 0.08 mg/ml) were prepared from gromwell root also known as ‘Hong Tiao Zi Cao’ (Lithospermum Erythrorhizon) Family (Boraginaceae) > beth root (Trillium Pendulum), Family (Liliaceae) and galbanum (Ferula Galbaniflua), Family (Apiaceae). Gromwell root is traditionally used in the preparation of Chinese medicinal tea. In addition, galbanum was highly regarded for its sacred and medicinal value according to ancient texts and the bible. Future research will be required to isolate and identify chemical constituents within these plants which are responsible for tumoricidal effect.[74]

Cognitive disorders such as amnesia, attention deficit and Alzheimer’s disease are emerging nightmares in the field of medicine because no exact cure exists for them, as existing nootropic agents (piractam, tacrine, metrifonate) have several limitations. The present study was undertaken to investigate the effect of Prunus amygdalus (PA) nuts on cognitive functions, total cholesterol levels and cholinesterase (ChE) activity in scopolamine-induced amnesia in rats. Materials and Methods:: The paste of PA nuts was administered orally at three doses (150, 300 and 600 mg/kg) for 7 and 14 consecutive days to the respective groups of rats. Piracetam (200 mg/kg) was used as a standard nootropic agent. Learning and memory parameters were evaluated using elevated plus maze (EPM), passive avoidance and motor activity paradigms. Brain ChE activity and serum biochemical parameters like total cholesterol, total triglycerides and glucose were evaluated. Results:: It was observed that PA at the above-mentioned doses after 7 and 14 days of administration in the respective groups significantly reversed scopolamine (1 mg/kg i.p.)-induced amnesia, as evidenced by a decrease in the transfer latency in the EPM task and step-down latency in the passive avoidance task. PA reduced the brain ChE activity in rats. PA also exhibited a remarkable cholesterol and triglyceride lowering property and slight increase in glucose levels in the present study. Conclusion:: Because diminished cholinergic transmission and increase in cholesterol levels appear to be responsible for the development of amyloid plaques and dementia in Alzheimer patients, PA may prove to be a useful memory-restorative agent. It would be worthwhile to explore the potential of this plant in the management of Alzheimer’s disease.[75]

Root extracts of Decalepis hamiltonii were tested for insecticidal activity against the stored products pests, Rhyzopertha domonica, Sitophilus oryzae, Stigobium panicueum, Tribolium castaneum and Callosobruchus chinensis, in residual and contact toxicity bioassays. Methanolic extract showed LC50 value of 0.14mg/cm2 for all the test species in a filter paper residual bioassay. The extract was effective as a grain protectant for wheat and green gram. Reduction of F1 progeny was observed in treated grain stored for 3–4 months. The extract did not affect the germination of the treated grains. Our results indicate that methanolic extracts of D. hamiltonii has a potential to control stored product pests and could serve as a natural grain protectant.[76] Present study evaluated the anticholinesterase activity of cold and hot aqueous extracts of Ficus racemosa stem bark against rat brain acetylcholinesterase in vitro. Both the cold aqueous extract (FRC) and the hot aqueous extract (FRH) exhibited a dose dependent inhibition of rat brain acetylcholinesterase. FRH showed significantly higher (P ≤ 0.001) cholinesterase inhibitory activity compared to FRC; however, both the extracts did not
show 50% inhibition of AChE at the doses tested (200-1000 μg ml−1). The IC50 values of 1813 and 1331 μg ml−1 were deduced for FRC and FRH, respectively (calculated by extrapolation using Boltzmann’s dose response analysis).[77]

The aim of the study was to explore the trends and rationale of use of memory and vitality-enhancing medicines (MVEM) in the Gujarat region. A prospective pharmacoepidemiological study involving pharmacists of Gujarat region was carried out in the year 2005. Pharmacists (n = 351) working in general and Ayurvedic medical stores were selected from 12 districts of Gujarat region. The pharmacists were explained about the objective of the study and were given a pretested, validated questionnaire. Outcome Measures:: The questionnaire included the questions regarding herbal MVEM used most commonly, percentage sale of herbal MVEM – sold with or without prescriptions – age group of patients and professional groups who used these drugs most commonly. The number of individuals using MVEM was highest in the age group of 11–20 years (17.54%), followed by the 21–40 years group (17.12%), supporting the results that the professional group of students (17.29%) and the persons of business or service class (15.29%) are the highest users of these medicines. Evaluation of various constituents in the marketed polyherbal MVEM revealed that Brahmi (Bacopa monniera), Shankhpushpi (Evolvulus alsinoides), Ashwagandha (Withania somnifera), Jatamansi (Nardostychos jatamansi), Vacha (Acorus calamus) and Amla (Phyllanthus emblica) were the common ingredients in the polyherbal preparations. This study highlights commonly used Ayurvedic medicines that can be explored for safely enhancing memory and vitality performance. Hence, detailed and scientifically designed research on these drugs would help to identify safe and effective drugs for enhancing the same. [78]

Traditional systems of medicines need more evidence-based studies on both crude drugs and purified phytomolecules. Utilization of natural products as pharmacological tools could lead to a number of new major therapeutically active metabolites. Lead molecules are further screened for their potential in terms of quality control, safety assessments, and studies about molecular pharmacology and their related properties. Identification, and quality and safety evaluation of natural products is a fundamental requirement of industry and other organizations dealing with natural health products (NHPs). Marker analysis, based on chemoprofiling and development of characteristic fingerprints for individual plants, could help to develop uniform standardization tools. Beside such evaluations of clinical parameters, safety profiles as well as drug–herb and herb–herb interactions are the most important parameters for assessment and promotion. With the steady growth of the NHPs, advanced analytical- and mechanism-based screening should be considered for their promotion and value addition in every way for the betterment of healthcare. Thus, there is an urgent need for the development of international co-ordination to promote and develop NHPs, including their assessment, perspectives, pharmacovigilance, and potential harmonization of regulation, quality control and clinical uses. [79]

Ayurveda, the Indian holistic healthcare system encompasses traditional medicines with a principle of creating harmony and maintaining balance within the natural rhythms of the body. Rasayana is one of the branches of Ayurveda frequently used as rejuvenant therapy to
overcome many discomforts and prevent diseases. It has been reported that rasayanas have immunomodulatory, antioxidant and antitumor functions. However, the genotoxic potential of many rasayanas remains to be evaluated. The present study was undertaken to assess the role of Brahma rasayana (BR) on genotoxicity in vivo in a mouse test system. The older mice (9 months) were orally fed with rasayana for 8 weeks. The treated groups showed no signs of dose-dependent toxicity at the dosage levels tested. The body weight loss/gain and feed consumption were unaffected at tested doses. Furthermore, sperm abnormalities and chromosomal aberrations were insignificant in the treatment group when compared to controls. However, there was a marginal increase in sperm count in the BR treated animals. These findings clearly indicate that there are no observed adverse genotoxic effects elicited by BR in experimental animals such as mice.[80]

Over the past 20 years the Fundacion Salud de Ayurveda Prema Argentina has spread the knowledge of Ayurveda throughout Latin America. The Fundacion is based in Buenos Aires in the Argentine Republic, where it now runs courses in two of the country’s major medical schools - at the School of Medicine of the University of Buenos Aires, and the National University of Cordoba’s School of Medicine. Based on a MoU with Gujarat Ayurveda University, at Jamnagar, Gujarat, the Fundacion has been accredited as a Collaborating Center for teaching, assistance and research in the field of Ayurvedic Medicine in Argentina. This has led to successful missions to other countries in the region where the Fundacion and its associates have been able to start dialogues with governments, and in places hold sizeable courses. The knowledge of Ayurveda is now spreading throughout South and Central America and hardly a country remains untouched by it.[81]

To investigate the effect of the methanolic extract of *Erythrina variegata* (Linn.) var Orientalis (Fabaceae) seeds (MEEV) in reducing the cholesterol levels and as well as antioxidant in experimentally induced hyperlipidemic rats. Doses of 200 and 400 mg/kg of the extract were evaluated for its effect on lipid profile, HMG-CoA reductase, and on antioxidant enzymes in high-fat diet (HFD) induced hyperlipidemia. The elevated levels of total cholesterol, triglycerides, low-density lipoprotein, and very low density lipoprotein due to HFD was reduced by concurrent treatment with MEEV (200 and 400 mg/kg) significantly (P<0.001). A significant reduction (P<0.004) in high-density lipoprotein was noticed in HFD fed groups; however, a nonsignificant increment was produced by the administration of MEEV (400 mg/kg). The HMG-CoA reductase activity was increased in HFD fed animals significantly (P<0.001) and was reduced by MEEV 400 mg/kg significantly (P<0.001). There was a noticed increase in the body weight and mesenteric fat pad weight in HFD fed group (P<0.001), which was reduced by the administration of MEEV (200 and 400 mg/kg). The antioxidant enzymes such as superoxide dismutase and catalase were reduced significantly in the HFD fed group, whose levels were increased significantly (P<0.001) by the administration of MEEV (200 and 400 mg/kg). Lipid peroxidation was increased in HFD fed animals, which was reduced significantly (P<0.001) by the treatment with MEEV (200 and 400 mg/kg).[82]
Alpinia purpurata or red ginger was studied for its phytochemical constituents as part of our growing interest on Philippine Zingiberaceae plants that may exhibit antimycobacterial activity. The hexane and dichloromethane subextracts of the leaves were fractionated and purified using silica gel chromatography to afford a mixture of C28–C32 fatty alcohols, a 3-methoxyflavone and two steroidal glycosides. The two latter metabolites were spectroscopically identified as kumatakenin (1), sitosteryl-3-O-6-palmitoyl-β-D-glucoside (2) and b-sitosteryl galactoside (3) using ultraviolet (UV), infrared (IR), electron impact mass spectrometer (EIMS) and nuclear magnetic resonance (NMR) experiments, and by comparison with literature data. This study demonstrates for the first time the isolation of these constituents from A. purpurata. In addition to the purported anti-inflammatory activity, its phytomedicinal potential to treat tuberculosis is also described.[83]

Concomitant increases in O2 and irradiance upon de-submergence can cause photoinhibition and photo-oxidative damage to the photosynthetic apparatus of plants. As energy and carbohydrate supply from photosynthesis is needed for growth, it was hypothesized that post-submergence growth recovery may require efficient photosynthetic acclimation to increased O2 and irradiance to minimize photo-oxidative damage. The hypothesis was tested in two flood-tolerant species: a C3 herb, Alternanthera philoxeroides; and a C4 grass, Hemarthria altissima. The impact of low O2 and low light, typical conditions in turbid floodwater, on post-submergence recovery was assessed by different flooding treatments combined with shading. Methods: Experiments were conducted during 30 d of flooding (waterlogging or submergence) with or without shading and subsequent recovery of 20 d under growth conditions. Changes in dry mass, number of branches/tillers, and length of the longest internodes and main stems were recorded to characterize growth responses. Photosynthetic parameters (photosystem II efficiency and non-photochemical quenching) were determined in mature leaves based on chlorophyll a fluorescence measurements. Key Results: In both species growth and photosynthesis recovered after the end of the submergence treatment, with recovery of photosynthesis (starting shortly after de-submergence) preceding recovery of growth (pronounced on days 40–50). The effective quantum yield of photosystem II and non-photochemical quenching were diminished during submergence but rapidly increased upon de-submergence. Similar changes were found in all shaded plants, with or without flooding. Submerged plants did not suffer from photoinhibition throughout the recovery period although their growth recovery was retarded. Conclusions: After sudden de-submergence the C3 plant A. philoxeroides and the C4 plant H. altissima were both able to maintain the functionality of the photosynthetic apparatus through rapid acclimation to changing O2 and light conditions. The ability for photosynthetic acclimation may be essential for adaptation to wetland habitats in which water levels fluctuate. [84]

Animals can adapt their behavior to predictable temporal fluctuations in the environment through both, memory-and-learning processes and an endogenous time-keeping mechanism. Hippocampus plays a key role in memory and learning and is especially susceptible to oxidative stress. In compensation, antioxidant enzymes activity, such as Catalase (CAT) and Glutathione peroxidase (GPx), has been detected in this brain region. Daily rhythms of
antioxidant enzymes activity, as well as of glutathione and lipid peroxides levels, have been described in brain. Learning how vitamin A deficiency affects the circadian gene expression in the hippocampus may have an impact on the neurobiology, nutritional and chronobiology fields, emphasizing for the first time the importance of nutritional factors, such as dietary micronutrients, in the regulation of circadian parameters in this brain memory-and-learning-related region.[85]

To evaluate the antioxidant status of chicken during cold stress and to investigate if there are any beneficial effects of Brahma Rasayana supplementation in cold stressed chicken. Materials and Methods:: Activities of enzymatic and levels of non-enzymatic antioxidants in blood / serum and liver tissue were evaluated in chicken exposed to cold (4 ± 10C and relative humidity of 40 ± 5%, for six consecutive hours daily, for 5 or 10 days). The antioxidant properties of Brahma Rasayana (BR) supplementation (2 g/kg daily, orally) during cold stress was also studied. Results:: There was a significant (P < 0.05) decrease in antioxidant enzyme in the blood, such as, superoxide dismutase (SOD), glutathione peroxidase (GPX), glutathione reductase (GR), and serum reduced glutathione (GSH) in cold stressed chicken. Serum and liver lipid peroxidation levels were significantly (P < 0.05) higher in cold stressed untreated chickens when compared to the treated and unstressed groups. There was also a significant (P < 0.05) increase in the antioxidant enzymes in the blood, such as, catalase (CAT) and SOD, in the liver CAT and SOD, and in GPX and GR in BR-treated cold stressed chicken, when compared to the untreated controls. Conclusions:: Results of the present study conclude that in chicken, BR supplementation during cold stress brings about enhanced actions of the enzymatic and non-enzymatic antioxidants, which nullify the undesired side effects of free radicals generated during cold stress.[86]

Chemical analyses of ancient organics absorbed into pottery jars from the beginning of advanced ancient Egyptian culture, ca. 3150 B.C., and continuing for millennia have revealed that a range of natural products—specifically, herbs and tree resins—were dispensed by grape wine. These findings provide chemical evidence for ancient Egyptian organic medicinal remedies, previously only ambiguously documented in medical papyri dating back to ca. 1850 B.C. They illustrate how humans around the world, probably for millions of years, have exploited their natural environments for effective plant remedies, whose active compounds have recently begun to be isolated by modern analytical techniques. [87]

The findings indicate no pattern of tumoricidal effects by diverse plants with similar families/genus under the classes Pinopsida, Equisetopsida, Lycopodiosida, Filicosida, Liliopsida Monocotyledons or Magnoliopsida Dicotyledons. The results indicate that many of the most commonly used CAMs exhibited relatively weak tumoricidal effects including cats claw, astragalus, ginseng, echinacea, mistletoe, milk thistle, slippery elm, cayenne chamomile, don quai, meadowsweet, motherwort and shepherd's purse. The data demonstrate that the most potent plant extracts were randomly dispersed within the plantae kingdom (LC50 = 31-490 μg/mL) in order of the lowest LC50 Dioscorea villosa (Dioscoreaceae) > Sanguinaria canadensis (Papaveraceae) > Dipsacus asper (Dipsacaceae) > Populus balsamifera (Salicaceae) > Boswellia carteri (Burseraceae) > Cyamopsis psoralioides
(Fabaceae) > Rhamnus cathartica (Rhamnaceae) > Larrea tridentate (Zygophyllaceae) > Dichroa febrifuga (Hydrangeaceae) > Batschia canescens (Boraginaceae) > Kochia scoparia (Chenopodiaceae) > Solanum xanthocarpum (Solanaceae) > Opopanax chironium (Umbelliferae) > Caulophyllum thalictroides (Berberidaceae) > Dryopteris crassirhiza (Dryopteridaceae) > Garcinia cambogia (Clusiaceae) > Vitex agnus-castus (Verbenaceae) > Calamus draco (Arecaceae). These findings show tumoricidal effect by extracts of wild yam root, bloodroot, teasel root, bakuchi seed, dichroa root, kanta kari, garcinia fruit, mace, dragons blood and the biblically referenced herbs: balm of gilead bud, frankincense and myrrh gum. In Amazonian floodplain forests, >1000 tree species grow in an environment subject to extended annual submergence which can last up to 9 months each year. Furthermore, underwater growth has also been observed in several species in the field and under experimental conditions. The present article assesses how these remarkable plants react to submergence and discusses physiological mechanisms and anatomical adaptations that may explain their success. [88]

Anthracnose disease is one of the major economic constraints to chilli production worldwide, especially in tropical and subtropical regions. Accurate taxonomic information is necessary for effective disease control management. In the Colletotrichum patho-system, different Colletotrichum species can be associated with anthracnose of the same host. Little information is known concerning the interactions of the species associated with the chilli anthracnose although several Colletotrichum species have been reported as causal agents of chilli anthracnose disease worldwide. The ambiguous taxonomic status of Colletotrichum species has resulted in inaccurate identification which may cause practical problems in plant breeding and disease management. Although the management and control of anthracnose disease are still being extensively researched, commercial cultivars of Capsicum annum that are resistant to the pathogens that cause chilli anthracnose have not yet been developed. This paper reviews the causal agents of chilli anthracnose, the disease cycle, conventional methods in identification of the pathogen and molecular approaches that have been used for the identification of Colletotrichum species. Pathogenetic variation and population structure of the causal agents of chilli anthracnose along with the current taxonomic status of Colletotrichum species are discussed. Future developments leading to the disease management strategies are suggested.[89]

Plants have been used as a source of medicine throughout history and continue to serve as the basis for many pharmaceuticals used today. Although the modern pharmaceutical industry was born from botanical medicine, synthetic approaches to drug discovery have become standard. However, this modern approach has led to a decline in new drug development in recent years and a growing market for botanical therapeutics that are currently available as dietary supplements, drugs, or botanical drugs. Most botanical therapeutics are derived from medicinal plants that have been cultivated for increased yields of bioactive compounds. The phytochemical composition of many plants has changed over time, with domestication of agricultural crops resulting in the enhanced content of some bioactive compounds and diminished content of others. Plants continue to serve as a valuable source of therapeutic
compounds because of their vast biosynthetic capacity. A primary advantage of botanicals is their complex composition consisting of collections of related compounds having multiple activities that interact for a greater total activity.[90]

A total of 48 egg type male chickens of local strain were divided into six groups (n = 8) for the study. Three groups were fed with BR orally at the rate of 2 g/kg bw daily for 10 days prior to and during the period of experiment. Two of the four groups that were exposed to heat stress (HST i.e. to a temperature of 40 ± 1°C and relative humidity of 80 ± 5% in an environmental chamber) for 4 h daily for 5 or 10 days, received BR orally. The other two groups remained as BR treated and untreated non-heat stressed (NHST) controls. Chemical composition of Gongronema latifolium leaves was determined using standard methods. Aqueous and methanol G. latifolium extracts were tested against thirteen pathogenic bacterial isolates. Crude protein, lipid extract, ash, crude fibre and nitrogen free extractives obtained are: 27.2%, 6.07%, 11.6%, 10.8% and 44.3% dry matter respectively. Potassium, sodium, calcium, phosphorus and cobalt contents are 332, 110, 115, 125 and 116 mg/kg respectively. Dominant essential amino acids are leucine, valine and phenylalanine. Aspartic acid, glutamic acid and glycine are 13.8%, 11.9% and 10.3% respectively of total amino acid. Saturated and unsaturated fatty acids are 50.2% and 39.4% of the oil respectively. Palmitic acid makes up 36% of the total fatty acid. Extracts show no activity against E. faecalis, Y. enterolytica, E. aerogenes, B. cereus and E. agglomerans. Methanol extracts were active against S. enteritidis, S. cholerasius ser typhimurium and P. aeruginosa (minimum inhibitory concentration (MIC) 1 mg; zone of growth inhibition 7, 6.5 and 7 mm respectively). Aqueous extracts show activity against E. coli (MIC 5 mg) and P. aeruginosa (MIC 1 mg) while methanol extracts are active against P. aeruginosa and L. monocytogenes. G. latifolium has potential food and antibacterial uses. Cure of cognitive disorders such as amnesia, attention deficit and Alzheimer's disease is still a nightmare in the field of medicine. Nootropic agents such as piracetam, aniracetam and choline esterase inhibitors like Donepezil® are being used to improve memory, mood and behavior, but the resulting side effects associated with these agents have made their use limited. [91]

This review attempts to summarize the current status of botanical screening efforts, as well as in vivo studies of their effectiveness and toxicity. The structure and antimicrobial properties of phytochemicals are also addressed. Since many of these compounds are currently available as unregulated botanical preparations and their use by the public is increasing rapidly, clinicians need to consider the consequences of patients self-medicating with these preparations. Hypoxia caused higher activity of ascorbate peroxidase, whereas activities of monodehydroascorbate reductase, dehydroascorbate reductase, and glutathione reductase were diminished or only slightly influenced. Under anoxia, activities of ascorbate peroxidase and glutathione reductase decreased significantly to 39 and 62%, respectively. However, after re-aeration of hypoxically or anoxically pretreated roots, activity of enzymes approached the control levels. This corresponds with the restoration of the high reduction state of ascorbate and glutathione within 16 to 96 h of re-aeration, depending on the previous duration of
anoxia. Apparently, anoxia followed by re-aeration more severely impairs entire plant metabolism compared with hypoxia, thus leading to decreased viability. [92]

_Acorus calamus_ (family: Araceae), is an indigenous plant, traditionally it is used as an ingredient of various cocktail preparations and for the management of severe inflammatory disorders in Indian system of medicine. Present study investigated the attenuating role of _Acorus calamus_ plant extract in chronic constriction injury (CCI) of sciatic nerve induced peripheral neuropathy in rats. Methods: Hot plate, plantar, Randall Selitto, Von Frey Hair, pin prick, acetone drop, photoactometer and rota-rod tests were performed to assess degree of thermal, radiant, mechanical, chemical sensation, spontaneous motor activity and motor coordination changes respectively, at different time intervals i.e., day 0, 1, 3, 6, 9, 12, 15, 18 and 21. Tissue myeloperoxidase, superoxide anion and total calcium levels were determined after 21st day to assess biochemical alterations. Histopathological evaluations were also performed. Hydroalcoholic extract of _Acorus calamus_ (HAE-AC, 100 and 200 mg/kg, p.o.) and pregabalin (10 mg/kg, p.o.) were administered from the day of surgery for 14 days.

Results: CCI of sciatic nerve significantly induced thermal, radiant, mechanical hyperalgesia and thermal, chemical, tactile allodynia, along with increase in the levels of superoxide anion, total calcium and myeloperoxidase activity. [93]. To evaluate the antibacterial activity of 21 plant essential oils against six bacterial species. 

Methods:: The selected essential oils were screened against four gram-negative bacteria (_Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus vulgaris_) and two gram-positive bacteria _Bacillus subtilis_ and _Staphylococcus aureus_ at four different concentrations (1:1, 1:5, 1:10 and 1:20) using disc diffusion method. The MIC of the active essential oils were tested using two fold agar dilution method at concentrations ranging from 0.2 to 25.6 mg/ml. Results:: Out of 21 essential oils tested, 19 oils showed antibacterial activity against one or more strains. Cinnamon, clove, geranium, lemon, lime, orange and rosemary oils exhibited significant inhibitory effect. Cinnamon oil showed promising inhibitory activity even at low concentration, whereas aniseed, eucalyptus and camphor oils were least active against the tested bacteria. In general, _B. subtilis_ was the most susceptible. On the other hand, _K. pneumoniae_ exhibited low degree of sensitivity. Majority of the oils showed antibacterial activity against the tested strains. However Cinnamon, clove and lime oils were found to be inhibiting both gram-positive and gram-negative bacteria. Cinnamon oil can be a good source of antibacterial agents. [94]

Peanut allergy is characterized by increased levels of peanut-specific IgE in the serum of most patients. Thus, the most logical therapy would be to inhibit the IgE production by committed B-cells. This study aims to investigate the unreported anti-IgE effects of Chinese herbal extracts of _Rubia cordifolia_ (Qiancao) and _Dianthus superbus_ (Qumai). Seventy herbal extracts were tested for their ability to reduce IgE secretion by a human B-cell line. Those with the lowest inhibitory concentration 50 (IC50) values were tested in a mouse model of peanut-anaphylaxis. Anaphylactic scores, body temperature, plasma histamine and peanut-specific-immunoglobulins were determined. _Rubia cordifolia_ and _Dianthus superbus_ inhibited the in vitro IgE production by a human B-cell line in a dose-dependent manner and
the in vivo IgE production in a murine model of peanut allergy without affecting peanut-
specific-IgG1 levels. After challenge, all mice in the sham groups developed anaphylactic
reactions and increased plasma histamine levels. The extract-treated mice demonstrated
significantly reduced peanut-triggered anaphylactic reactions and plasma histamine levels.
Conclusion: The extracts of *Rubia cordifolia* and *Dianthus superbus* inhibited the IgE
production in vivo and in vitro as well as reduced anaphylactic reactions in peanut-allergic
mice, suggesting potentials for allergy treatments. [95] Oxidative damage caused by free
radicals plays an important role in the causation and progression of many diseases, including
aging. Free-radical damage is countered by many mechanisms, including both active
antioxidant enzymatic activity in our body and passive antioxidants. A critical evaluation of
rasayana chikitsa will likely provide urgently needed, actual stimulants of our physiological
antioxidant responses and not just more passive antioxidants to add to an already large
catalog. [96]

Alzheimer's disease is a devastating neurodegenerative condition currently affecting over 5
million elderly individuals in the United States. There is much evidence suggesting that
certain dietary lifestyles can help to prevent the possibly treat Alzheimer's disease. In this
paper, we discuss how certain cardiovascular and diabetic conditions can induce an increased
susceptibility for Alzheimer's disease and the mechanisms through which this occurs. We
further discuss how the consumption of certain foods or food components can help to reduce
one's risk for Alzheimer's disease and may possibly be developed as a therapeutic agent. Low
oxygen stress often occurs during the life of green organisms, mostly due to the
environmental conditions affecting oxygen availability. Both plants and algae respond to low
oxygen by resetting their metabolism. The shift from mitochondrial respiration to
fermentation is the hallmark of anaerobic metabolism in most organisms. The microalga
*Chlamydomonas reinhardtii* responses to low oxygen seem to have evolved independently of
higher plants, posing questions on how the fermentative metabolism is modulated. In this
review, we summarize the most recent findings related to these topics, highlighting promising
developments for the future. [98]

During evolution, plants have developed mechanisms to cope with and adapt to different
types of stress, including microbial infection. Once the stress is sensed, signaling pathways
are activated, leading to the induced expression of genes with different roles in defense.
Mosses (Bryophytes) are non-vascular plants that diverged from flowering plants more than
450 million years ago, allowing comparative studies of the evolution of defense-related genes
and defensive metabolites produced after microbial infection. The study was aimed at
investigating the antimelanogenic and antioxidant properties of essential oil when extracted
from the leaves of *Artemisia argyi*, then analyzing the chemical composition of the essential
oil. The results indicated that essential oil extracted from *A. argyi* leaves decreased melanin
production in B16F10 cells and showed potent antioxidant activity. The essential oil can
thereby be applied as an inhibitor of melanogenesis and could also act as a natural antioxidant
in skin care products. The aim of this study was to investigate radioprotective effect of the
polysaccharides from soybean meal (SMP) against X-ray radiation-induced damage in mouse
spleen lymphocytes. MTT and comet assay were performed to evaluate SMP’s ability to prevent cell death and DNA damage induced by radiation. The results show that, X-ray radiation (30 KV, 10 mA, 8 min (4 Gy)) can significantly increase cell death and DNA fragmentation of mouse spleen lymphocytes. Pretreatment with SMP for 2 h before radiation could increase cell viability, moreover, the SMP can reduce X-ray radiation-induced DNA damage. The percentage of tail DNA and the tail moment of the SMP groups were significantly lower than those of the radiation alone group (p < 0.05). These results suggest SMP may be a good candidate as a radioprotective agent.

Phoenix dactylifera L. (date palm), being economically very important, is widely cultivated in the Middle East and North Africa, having about 400 different cultivars. [99]

Boiling water extracts of 66 selected Chinese medicinal herbs were screened for their anticyanobacterial activity against Microcystis aeruginosa by the soft-agar overlayer (SAO) method. Results indicated that extracts from 16 materials could inhibit the growth of this bacterial species. The results suggested that highly efficient anticyanobacterial compounds must be involved in the inhibitory activities. The final result are indicated these three extracts (from Malaphis chinensis, Cynips gallae-tinctoriae and Fructus mume) had the potential to be developed as algicides due to their remarkably anticyanobacterial activities. The present study was aimed to investigate in vivo, in vitro anti-diabetic activity of aqueous extract of Terminalia paniculata bark (AETPB) and characterize its possible phytoconstituents responsible for the actions. Type 2 diabetes was induced in rats by streptozotocin-nicotinamide (65 mg/kg–110 mg/kg; i.p.) administration. In conclusion, the above actions might be responsible for the antidiabetic activity of AETPB due to presence of gallic acid and other biomarkers. [100]

The boreal forest of Canada is home to several hundred thousands Aboriginal people who have been using medicinal plants in traditional health care systems for thousands of years. A total of 546 medicinal plant taxa used by the Aboriginal people of the Canadian boreal forest were reported in the reviewed literature. Future ethnobotanical research endeavours should focus on documenting the knowledge held by Aboriginal groups that have so far received less attention, particularly those of the western boreal forest. Aqueous and organic (hexane, chloroform, and methanol) extracts of siliquae, stems and leaves, and seeds of Cleome arabica L. (Brassicales: Capparidaceae) were evaluated in the laboratory for their antifeeding and insecticidal effect on larvae of the cotton leafworm, Spodoptera littoralis (Boisduval) (Lepidoptera, Noctuidae), using a leaf dipping bioassay with castor bean, Ricinus communis L.(Malpighiales: Euphorbiaceae), leaf discs. This study evaluates the effect of the administration of Pistacia lentiscus L. essential oil (E.O.), a mixture of terpenes and sesquiterpenes, on modifications of fatty acid profile and endocannabinoid (eCB)congener concentrations induced by transient bilateral common carotid artery occlusion (BCCAO) in the rat frontal cortex and plasma. This study was undertaken to provide pharmacological basis for the medicinal use of Viola odorata Linn. in hypertension and dyslipidemia using the in vivo and in vitro assays. To overcome this problem, the proteomic base method was used to study protein profiles of the plant model, Curcuma comosa Roxb. Alzheimer’s disease
(AD) is an age-related neurodegenerative disorder, characterized clinically by insidious onset of memory and cognition impairment, emergence of psychiatric symptoms and behavioral disorder, and impairment of activities of daily living (ADL). Traditional Chinese medicine (TCM) is practiced in the Chinese health care system for more than 2,000 years. [101]

Conclusion
Even though, this studies supports the different pharmacological activities of Sweet flag. Experiments will have to be conducted in future to exploit the full potential activities of this crop and this plant species has to properly identified and conserved to avoid the extinct condition. In the past few decades pioneer work in identification, documentation and recognition of traditional medicine has been done in India. Investigation of traditional medicine is very important for the welfare of rural and tribal communities for the treatment of conventional illness. Many different pharmacological activities are attributed to it like antioxidant activity, hypolipidemic activity, hepatoprotective, antifertility and antifungal activity. Various traditional uses are also known to be possessed by the plant like in rheumatism, bronchial asthma, leprosy, as cardiotonic and many more. Many activities are not studied till date and needs attention to explore further medicinal properties of the plant. As *Acorus calamus* has been successfully used in many health problems since a long time it provides a wide area of interest for the research purposes in development of newer drug molecules. The therapeutic potential should also be seen in combination with other medicinal agents. It has also been studied extensively from the point of phytochemical and pharmacological aspects which lead to the interest particularly in the area of antioxidant, antimicrobial and hypoglycemic actions. In recent years it has been noticed that more emphasis of research is on traditional medicines which have proven its authentification against treating various diseases.

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References


Full Paper-onlineresearchjournalsssm.in Impact Factor 2.5
4. Randall, R.P.; *The introduced flora of Australia and its weed status*; CRC for Australian Weed Management; Glen Osmond; September 2007;


17. S. Asha Devi; Deepak Ganjewala, "Antioxidant Activities of Methanolic Extracts of Sweet-Flag (Acorus calamus) Leaves and Rhizomes" *Journal of Herbs, Spices & Medicinal Plants* Volume 17, Issue 1, 2011, Pages 1 – 11


19. Meng-Hwan Lee, , Yun-Yu Chen, , Jung-Wei Tsai,Sheue-Chi Wang, Takashi Watanabe and Ying-Chieh Tsai, Inhibitory effect of β-asarone, a component of


27. Wichtl, Max, Herbal drugs and phytopharmaceuticals: a handbook, 2004


Full Paper-onlineresearchjournalsssm.in Impact Factor 2.5


97. Hyun-Ja Jeong, In-Young Choi, Min-Ho Kim, Decreases the inflammatory response in peripheral blood mononuclear cells from patients with cerebral infarction through an NF-κB dependent mechanism. *J Neuroinflammation.* 7: 85, 2010.


