International Journal of Pharmacognosy and Pharmaceutical Sciences

ISSN Print: 2706-7009
ISSN Online: 2706-7017
IJPPS 2022; 4(1): 18-26
www.pharmacognosyjournal.net
Received: 01-01-2022
Accepted: 16-01-2022

Nikam Yogesh Prabhakar
Assistant Professor, Department of Pharmacognosy, Abasaheb Kakade College of B. Pharmacy, Boodhegaon Maharashtra, India

Anil Baburao Badnale
Assistant Professor, Department of Pharmacognosy, Abasaheb Kakade College of B. Pharmacy, Boodhegaon Maharashtra, India

Suhas R Daswadikar
Department of Pharmaceutical Sciences, Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, Maharashtra, India

Aashwini Annasaheb Gholkar
Assistant Professor, Department of Pharmaceutics, SBSPM's B. Pharmacy College, Ambajogai, Maharashtra, India

Snehal Shekhar Patil
Lecturer, Department of Pharmacognosy, Sanjivani College of Pharmacy, Kopargaon, Maharashtra, India

Corresponding Author:
Nikam Yogesh Prabhakar
Assistant Professor, Department of Pharmacognosy, Abasaheb Kakade College of B. Pharmacy, Boodhegaon Maharashtra, India

Potent ethanomedicinal plant *Semecarpus anacardium* Linn: A review

Nikam Yogesh Prabhakar, Anil Baburao Badnale, Suhas R Daswadikar, Aashwini Annasaheb Gholkar and Snehal Shekhar Patil

DOI: https://dx.doi.org/10.33545/27067009.2022.v4.i1a.36

Abstract
Semecarpus anacardium Linn. a potent ethanomedicinal plant belonging to *Family- Anacardiaceae*, commonly known as 'Bhallatak' or 'bhilawa'. It has potent medicinal value in ayurveda and siddha system of medicine.bhilawa is being used traditionally and ethanobotanically for several treatments. Phytochemical analysis of *Semecarpus anacardium* nut shows biologically active compounds such as biflavonoids, phenolic compounds, bhilawanols, minerals, vitamins and amino acids, which shows various medicinal properties. Traditional healers and physicians use formulations of *Semecarpus anacardium* in their clinical practice. In market there are number of formulations among them commonly used formulations are *Amritbhallatak Avaleha*, *Bhallatakasav*, *Suran vatak*, *Bhallatak Parpati*, *Sanjeevani Vati*, *Narsimha choorna*, etc. Several experiments have proved pharmacological activities of *Semecarpus anacardium* as anti-atherogenic, antioxidant, anti- inflammatory, hypoglycemic, antimicrobial, anti-reproductive, CNS stimulant, anticarcinogenic and hair growth promoter activities.

Keywords: *Semecarpus anacardium*, shodhana, bhallatak, toxicity and antidotes

Introduction
The India has wide range of traditional knowledge of herbal medicines and such knowledge is gaining widespread acceptance globally. In Ayurveda system of medicine, almost all medicinal preparations are derived from plants, which may in simple form of raw plant materials or in the refined form of crude extracts, mixtures, etc. In other parts of the world, the term Complementary and Alternative Medicine is used for various forms of traditional drugs. Complementary and Alternative Medicine (CAM) can be defined as any treatment used in conjugation (complementary) or in place of (alternative) standard medical treatment. In the recent years complementary and alternative medicine (CAM) being used worldwide for the treatment and prevention of many aliments which are noncommunicable and chronic in nature. *Semecarpus anacardium* Linn. Belonging to family: Anacardiaceae is distributed in sub-Himalayan region, tropical and central parts of India. *Semecarpus anacardium* (SA) is a deciduous tree, medium in size. The tree is normally 12-15 m in height. The leaves are large and simple; they are up to 60 cm long and 30 cm wide. The bark is deep brown in colour and it is quite rough in texture. The flowers are dull greenish yellow in colour. The ripe fruits are black in colour, fruits are quite smooth and shiny in texture however, it is toxic in nature. The nut is about 1 inch long [1]. In Ayurvedic, Unani and Siddha system of medicine, it is called as Bhallataka, Bhilaavaa, and Serankottai respectively. The parts generally used are detoxified nut and oil. The main aim of this review is to further highlight recently discovered pharmacological effects and applications of *Semecarpus anacardium*.

Synonyms [2]

Table 1: languages and common names of *S. Anacardium*

Language	Common names	Language	Common names
Ayurveda	Agnimukh, Bhallatak	Hindi	Bhilawa, Bhilawan
Siddha	Serangkottai	Marathi	Bibba
Sanskrit	Agnimukh, Bhallatak	English	Marking nut, Oriental cashewnut
Urdu	Baladur, Bhilavan	Gujrati	Bhilamo
Latin	*Semecarpus anacardium* linus	Punjabi	Bhilawa
Oriya	Bhollataki, Bholai	Kannada	Karee geru
Malyalum	Alakkucheru, Thenkotta	Tamil	Senkottai, Tatamkottai

Taxonomical Classification [1]
Kingdom: *Plantae*
Subkingdom: *Tracheobionta*
Super division: *Spermatophyta*
Division: *Magnoliophyta*
Class: *Magnoliopsida*
Subclass: *Rosidae*
Order: *Sapindales*
Family: *Anacardiaceae*
Genus: *Semecarpus*
Species: *Anacardium*

Geographical availability

Semecarpus anacardium is found in several parts of the world right from the outer Himalayas to the Coromandel Coast Africa, East Asia to Indian subcontinent, western peninsula, Indo–Malaysian region, North Africa & in countries such as China, Nepal, India, N. Australia. It is available in hotter region in inda up to the altitude of 3500ft and in places such as Maharashtra, Karnataka, Konkan, Bihar, West Bengal, Orissa, Kanara forest of Tamil Nadu, Madhya Pradesh, etc. *Semecarpus anacardium* plants grows naturally in the tropical region having dry climate [2].

Plant morphology

It is a medium sized average growing deciduous (shedding off leaves at particular season) tree of around 10-15 m height. Leaves are 30-60 cm long, 12-30 cm wide, large and simple, alternative and obviate-oblong, glabrous above and less pubescent below. The leaf base is heart shaped, rounded, narrowed into the stalk. Flowers are greenish white in colour, in panicles. The plant appears with new leaves in May and June, it can be easily recognized by large leaves and the red blaze exuding resin, which blackens on exposure to air. The fruits of plant ripens from December to March, ripen fruits are shining black in colour and is 2–3 cm broad. It is a moderate shade bearer, obliquely ovoid or oblong drupe, 2.5 to 3.8 cm long, compressed, held on an orange colored receptacle form of the disk, the base of the 4 calyx and the extremity of the peduncle. However, fruits are toxic in nature. The nut is about 1 inch long, ovoid and smooth lustrous black. It is frequently found in drier rather than damp localities. No specific soil affinity. The bark is dark grey in colour, quiet rough in texture and exudes an irritant brown colour secretion on incising. Seed appears brown in colour and its kernel is eatable after removing the pericarp but sometimes may cause cutaneous eruption and seed oil has high medicinal value. Seeds are generally collected during December- march [2].

Fig 1: flowering stage of plant *Semecarpus anacardium*

Fig 2: ripe fruit nuts of *Semecarpus anacardium*

Properties

Bhallataka is sweet and astringent in taste. It is extremely heat generating [3].

Phytochemistry

The most significant components of the *S. anacardium* Linn. Are bhilwanols, phenolic compounds, biflavonoids, sterols and glycosides. Bhilwanol from fruits is a mixture of cis- and transisomers of ursuhenol; this compound consists mainly of 1,2-dihydroxy-3(pentadecadienyl 8′,11′)benzene and 1,2-hydroxy-3(pentadecadienyl 8′)benzene. Other components isolated are, anacardoside, semecarpetin, nallaflavanone, jeediflavanone, semecarpuflavanone, galluflavanone, anacarduflavone mono-olefin I, diolefin II, bhilawanol-A, bhilawanol-B, amentoflavone tetrahydroamentoflavone semicarpol, anacardic acid, tetrahydrobustaflavone, O-trimethyl biflavanone A1, O-trimethyl biflavanone A2, O-tetramethyl biflavanone A1, O-hexamethyl bichalcone A, O- dimethyl biflavanone B, O-heptamethyl bichalcone B1, O-hexamethyl bichalcone B2, O-tetramethyl biflavanone C., phenolics [1, 4].

Shodhana Sanskara of Bhallataka

It is the process in which specific substances are treated with process like rubbing, steaming etc. so as to remove its harmful or toxic effects is known as *shodhanasanskara* (purification process). Poisonous plant drugs are subjected to *shodhanasanskara*, before its therapeutic use. This *shodhanasanskara* process reduces toxicity of poisonous plant considerably. *Semecarpus anacardium* is one such toxic plant which is still used in the Indian system of medicine. bhilawanols as the toxic chemical components present in it plant. Sodhana (detoxification/purification) process involves the purification as well as reduction in the levels of toxic principles [5].

The various methods used for purification of fruits are as follows with gomutra

The fruits of *Semecarpus anacardium* contains tarry oil in its pericarp which consist of 90% anacardic acid and 10% of cardol and other phytoconstituents are bhilwanols, semecarpol and anacardol. Bhilwanol and anacardic acid these two constituents are responsible for blisters, irritation, contact dermatitis and toxicity. In this purification process the fruits of *Semecarpus anacardium* are soaked in gomutra for about seven days and after removing fruits are rubbed with brick powder or brick gravels and finally washed with water. The coconut oil can be used to avoid dermatitis during processing of *Semecarpus anacardium* nuts. In this process the decarboxylation of oil occurs, anacardic acid converted to anacardol which is less toxic. It might be possible that the oil get reduced due to the soaking of fruits in gomutra. The brick gravel have absorbent property so irritant oil is absorbed from fruits. The process of purification does not affect on amount of total flavonoid and total carbohydrate content, however considerable decrease reported of total phenolic content. The antioxidant effect of *Semecarpus anacardium* decreases but the drug safety profile increases [6].

With gomutra and cow milk

In this method the thalamus part of the fruit was removed with a steel knife. Then, the nuts were subjected to fresh cow urine daily for 7days followed by cow milk daily for 7 days followed by rubbing thoroughly with brick powder for 3 days. During the treatment with cow urine and cow milk, the nuts were washed with water daily before adding fresh cow urine or milk. After removing nuts from cow milk or urine such fruits were rubbed with brick gravels and kept in contact with it for 3-4 days On the final day (18th day), the nuts were washed with hot water to remove the brick

powder. This shodhana procedure was repeated three times [5].

With Brick Powder

The ripened *Bhallataka* fruits which are submerged in water are selected for *shodhanasanskara*. The fruits which floats on water such fruits were rejected. *Bhallataka* fruits and *Ishtika churna* (Brick powder) are filled up in a *pottali* (small cotton bag) made up of 3-4 folds of cotton cloth. This *pottali* is rubbed by hand by applying moderate pressure. When brick powder become wet with oil and the skin of *Bhallataka* fruit is peeled off, it is washed with hot water. In this process *Bhallataka* becomes *Shuddha* (pure) [7].

With Coconut water

Bhallataka fruits are cut in two pieces and placed in *Dolayantra* (swing apparatus) is heated for about 1-2 hrs. In this process *Bhallataka b*ecomes shuddha. Precaution during *Shodhana sanskara*- Coconut oil should be applied on face, hand, legs and other exposed parts of body to avoid harmful effects [7].

Frying method

The fruits (200 g) were randomly selected and taken in an iron pan and heat was given from below by charcoal ignition. After heating smoke started coming from the nuts after 4-5 minutes. Then burning charcoal was put on the pan containing Bhallataka nuts. Immediately the hot nuts caught fire. After 2 minutes the fire was extinguished by removing the burning nuts from the pan to the floor and spreading it immediately with a long ladle to extinguish the fire. Then the nuts were allowed to cool and stored in air tight glass container for further studies. The same procedure was repeated thrice [8].

***Bhallatak* formulations**

Charak, *Sushrut* and *Vagbhatt*, these are main three treatises of *Ayurveda* have described diverse formulations of *Bhallatak*. *Charak* describes 10 different types of *Bhallatak* formulations in *Rasayanavidhi*, while *Sushrut* and *Vagbhatt* have indicated the use of about 1,000 seeds of *Bhallatak* during the schedule of one therapeutic course of *Vardhman prayog*. *Bhallatak* is being used currently in some of the formulations as a major or minor ingredient. The commonly used formulations are *Amritbhallatak Avaleha*, *Bhallatakasav*, *Suran vatak*, *Bhallatak Parpati*, *Sanjeevani Vati*, *Narsimha choorna*, etc.Before using, *Bhallatak* for medical purpose, it is subjected to the process of *shodhana* (purification and detoxification) [4].

Table 2: Commonly used formulations containing *Bhallatak* as an ingredient (tsf = teaspoonful)

Name of the	Nature of	Average dose	Common
Amrut	Electuary	1 to 2 tsf × 2	General tonic &
Bhallatakasava	Wine	2 to 4 tsf × 2	Neuralgia &
Suran vatak	Pills	2 pills (500 mg	Piles &
Sanjeevani Vati	Pills	2 pills (250 mg	Dysentery &
Bhallatak Parpati	Powder	250 mg × 3	Rheumatic
Narsimha Choorna	Powder	1 to 2 gm × 2	General

Precaution while consuming Formulation of *Bhallataka*

Pathya- milk & rice and ghee should be consumed in large quantity. *Varjya* (Avoid)- Walking in sun, excess sexual intercourse, meat consumption, salt, exercise, and oil massage. Contraindication of *Bhallataka* Formulations in- *Pitta* diseases, Hemorrhagic tendency, Pregnancy, Child, old age, Diarrhea, Nephritis & summer season [7].

Current status

Bhallatak is toxic in nature, due to the toxic activities and allergic effects the use of traditional knowledge is decreasing generation by generation, most of the peoples are not aware about importance and proper use of *Semecarpus anacardium*, so that now a day's peoples are avoiding to gardening it in surrounding area. Now *Semecarpus anacardium* plant has become a wild plant, it founds only in forest area. Day by day the quantity of this plant is decreasing, it is need to aware it's importance and proper use to society otherwise it will become rare and we will loss one of the important plant from the dictionary of Indian medicinal plants [3].

Toxicity and antidotes

In *Ayurveda Bhallatak* is classified under the category of toxic plants. *Bhallatak* is usually avoided in pediatric age group, pregnant women, predominant *pitta prakruti* persons and also in certain diseased conditions such as bleeding diatheses, renal function disorder, history of vesications and past history of intolerance to *Bhallatak*. It is known to have a narrow therapeutic range. The common adverse events of bhallatak are generalized itching, vesication, erythematous patches, mucocutaneous papular eruptions, stomatitis, gastritis, proctitis, urethritis, etc. Practitioners are known to use several antidotes either locally or systemically [4].

Table 3: traditionally used antidotes of Bhallatak

Traditionally used antidotes for Bhallatak toxicity	
Systematic	**Local**
Coconut albumen	Sesame oil
Coconut water	Coconut oil
Tamarind leaves	Ghee
Sesamum seeds	Resin ointment
Sarivadi gana	Coriander
Durvadi gana	Gopichandan

Pharmacological Activity

Analgesic Activity

Ilanchezhian Rangasamya have observed the analgesic activity of three different extracts such as petroleum ether, chloroform and methanol extracts of *Semecarpus anacardium* was investigated by tail flicking method.

They have used acetyl salicylic acid (aspirin) as the standard reference. The methanol extract at 50 mg/kg showed a significant analgesic activity. They found that methanol extract was more potent than the petroleum ether and chloroform extracts [9].

Arul studied the effect of ethanolic extract of dried ripe nuts of *Semecarpus anacardium* on blood glucose level. they have investigated the effect in both normal and streptozotocin-induced hyperglycemia in rats. The ethanolic extract of *Semecarpus anacardium* 100 mg/kg reduced the blood glucose of normal rats but showed no antihyperglycemic activity [10]. Krishnamurthy developed Kalpamrutha (KA), a modified Siddha preparation, which contains *Semecarpus anacardium*, Emblica officinalis and honey they have studied variations in lipids, lipid-metabolizing enzymes and lipoproteins in cancerous animals. Also studied the effect of kalpamrutha on the lipid

metabolism, they studied the effect of kalpamrutha and *Semecarpus anacardium* on increased levels of total cholesterol, free cholesterol, phospholipids, triglycerides and free fatty acids and decreased levels of ester cholesterol in plasma, liver and kidney, and found level to normal in cancer-suffering animals [11].

Hepatoprotective Effect

Abirami studied the plant to understand the antioxidant and protective effect of *Semecarpus anacardium* against lead acetate induced toxicity. He analysed the phytochemicals such as flavanoids, alkaloids, resins, tannins, carbohydrates, proteins present in the plant which are probably responsible for the hepatoprotective efficacy [12].

Anthelmintic Activity

Pal have studied anthelmintic activity of different extracts of nuts of semecarps anacardium on adult Indian earthworm (*Pheritima posthuma*). They found that petroleum ether, chloroform extracts of *Semecarpus anacardium* shows better anthelmintic activity than ethanol and aqueous extracts of *Semecarpus anacardium* [13].

Anti-Cancer Activity

Mathivadhani studied *Semecarpus anacardium* nut extract for inhibitory effect on human breast cancer cell line (T47D). At the molecular level, it showed decrease in Bcl and increase in Bax, cytochrome c, caspases and PARP cleavage, and ultimately by internucleosomal DNA fragmentation [14].

Sugapriya showed restoration of energy metabolism in leukemic mice treated by *Semecarpus anacardium* nut milk extract. *Semecarpus anacardium* treatment was compared with standard drug imatinib mesylate.

*Semecarpus anacardium*nut extract administered to leukemic animals which shown result of clearance of the leukemic cells from the bone marrow and internal organs [15].

Arulkumaran investigated the protective efficacy of preparation named as Kalpaamruthaa (which includes *Semecarpus anacardium* nut milk extract, dried powder of *emblica officinalis* fruit and honey) on the per- oxidative damage and abnormal antioxidant levels.

Kalpaamrutha semearpus anacardium containing preparation shown anticarcinogenic activity in dimethyl benzanthracene-initiated mammary carcinoma [16].

Prabhu studied the anti-mutagenic effect of *Semecarpus anacardium* under *in vivo* condition. For this study they have selected mice which were intraperitoneally treated with 500 and 250 mg/kg of *Semecarpus anacardium*, which showed a significant inhibition of induced aberrations at the 12 h pretreatment period. The results shows reduction of induced chromosome aberrations clearly, hence *Semecarpus anacardium* serves as an antioxidant because of the presence of flavonoid and its administration may be protective and therapeutic [17]. *Krishnarajua* found that aqueous extracts of medicinal plants were screened for their cytotoxicity using brine shrimp lethality test. Out of the 120 plants tested, SA (Anacardiaceae) showed significant cytotoxicity with LD50 of 29.5 µg [18].

Joseph studied the anticancer effect of Ayurvedic preparation made from SA nuts. He had given the ayurvedic preparation containg *Semecarpus anacardium* to one group and its nut milk extract to another group. he found that after 154 days of experiment both liver enzymes and hepatocellular carcinoma (HCC) marker were increased in preparation treated group along with neoplastic changes in liver and were decreased in *Semecarpus anacardium* milk extract treated group. The Ayurvedic drug showed positive correlation with the action of doxorubicin. This study demonstrated the efficacy of SA milk extract for the treatment of hepatocellular carcinoma [19].

Neuroprotective Activity

Farooq evaluated the beneficial effects of *Semecarpus anacardium* nuts extract, on central nervous system (CNS) mainly for its locomotor and nootropic activities. Vinutha studied that loss of cholinergic cells, particularly in the basal forebrain is accompanied by the loss of neurotransmitter acetyl choline (ACh). The *Semecarpus anacardium* is effective in prolonging the half-life of acetylcholine through inhibition of ACh esterase. *Semecarpus anacardium* is useful in treating cognitive decline, improving memory [20].

Anti-Inflammatory Activity

Sushma studied an anti-inflammatory activity of ethanolic extract of fruit nuts of *Semecarpus anacardium* plant in albino rats by carrageenan induced rat paw edema model. Ethanolic extract of *Semecarpus anacardium* fruit nut exhibited a dose dependent anti-inflammatory activity [21].

Ramprasath investigated that *Semecarpus anacardium* significantly decreased the carrageenan-induced paw edema and cotton pellet granuloma [22]. Satayavati and Bajpai reported the anti-inflammatory activity of *Semecarpus anacardium* for both immunological and non-immunological origin [23].

Premlatha have been reported *Semecarpus anacardium* for immunemodulatory potency, anti-oxidative, membrane stabilizing, tumor marker regulative, glucose level restoring and mineral regulation properties of nut extract in hepatocellular carcinoma and found potent effect against hepatocarcinogen aflatoxin B1 [24].

Salvem observed that ethyl acetate extract of SA led to the isolation of major active principle, tetrahydroamentoflavone (THA), a biflavonoid. The *in vitro* cycloxygenase (COX-1)-catalyzed prostaglandin biosynthesis assay of THA gave an IC50 value of 29.5 µg (COX-1) and 40.5% inhibition at 100 g/mL (COX-2). The *in vivo* carrageenan-induced paw edema assay resulted in dose-dependent anti-inflammatory effect and the activity was comparable to the ibuprofen [25].

Bhitre prepared the methanolic, ethanolic, chloroform, ethyl acetate and petroleum ether extracts of fruit nuts of *Semecarpus anacardium* and studied the anti-inflammatory activity using the technique of carrageenan-induced paw oedema in albino rats. The extract showed significant anti-inflammatory activity comparable to aspirin [26]. Crude ethanolic extract of *SA* nuts was studied by singh for its anti-inflammatory activities *in vitro* using peripheral blood and synovial fluid mononuclear cells of healthy individuals and rheumatoid arthritis (RA) patients. *Semecarpus anacardium* extract shows inhibition of the spontaneous and LPS-induced production of pro inflammatory cytokines IL-1beta and IL-12p40 but had no effect on TNF-alpha and IL-6 production, both at protein and mRNA level. The crude extract also suppressed LPS induced nuclear translocation of transcription factors [27].

Kalpaamruthaa (KA), an indigenous-modified Siddha formulation, consists of *Semecarpus anacardium* nut milk

extract and fresh dried powder of *Emblica officinalis* fruit along with honey. Kalpaamruthaa was found to be nontoxic up to the dose level of 2000 mg/kg. Further, kalpaamruthaa has been reported for its potent antioxidant analgesic, antipyretic and non-ulcerogenic properties.

Mythilypriya studied the anti-inflammatory activity of *Semecarpus anacardium* in adjuvant-induced arthritic rat (AIA) model with reference to mediators of inflammation (lysosomal enzymes) and its effect on proteoglycans. The activities of various enzymes and levels of plasma protein bound carbohydrate components of glycoproteins were determined and it was found to be elevated in arthritic rats compared to control animals [28].

Antioxidant Activity

Shanmugam observed that rats treated with Kalpaamruthaa showed normal lipid peroxide level and antioxidant defences of *Semecarpus anacardium* [29].

Veena measured antioxidant status in blood, and vital organs (liver, kidney and breast tissue) of control and experimental animals. In cancer condition, lipid peroxidation (LPO) was increased and antioxidant levels were decreased. when drug (*Semecarpus anacardium* and kalpaamrutha) administered, it was found that decreased lipid peroxidation and increased antioxidant activity [30].

Sahoo investigated the antioxidant activity of ethyl acetate extract of stem bark of *Semecarpus anacardium*. Ethyl acetate extract shown the stronger antioxidant activity (due to presence of highest total phenolic content of 68.67% measured as pyrocatechol equivalent) compared to the other hexane, chloroform and methanol extracts.

The isolation of the ethyl acetate extract of *Semecarpus anacardium* stem bark yielded a bright yellow solid crystal, which was identified as butein. This compound exhibited antioxidant activity (IC50 values of 43.28 ± 4.34 µg/ml) [31].

Antimicrobial Activity

Sharma studied antifungal activity of *Semecarpus anacardium* against (*Aspergillus fumigatus* and *Candida albicans*) at 400 mg/ml concentration. It was found that both the fungi showed inhibition in growth, reduction in size of cells and sporulation also decreased [32].

Sharma investigated that its nut oil show significant antimicrobial activity against several Gram positive bacteria (Bacillus subtilis, Staphylococcus aureus) and Gram negative bacteria (Proteus vulgaris, *E. coli*) [33].

Mohanta prepared the aqueous and organic solvent extracts of the plant and screened for antimicrobial (disc diffusion method) and phytochemical properties. The petroleum ether (PEE) and aqueous extract fractions (AQE) showed inhibitory activity against *Staphylococcus aureus* (10 mm) and *Shigella flexneri* (16 mm) at 100 mg/ml, respectively while chloroform extract showed inhibition against *Bacillus licheniformis, Vibrio cholera* and *Pseudomonas aeruginosa*. The ethanol extract showed inhibition to *Pseudomonas aeruginosa* and *S. aureus* [34].

Nair found that the alcoholic extract of dry nuts of *Semecarpus anacardium* (Bhallatak) showed bactericidal activity *in vitro* against three gram negative strains (*Escherichia coli, Salmonella typhi* and *Proteus vulgaris*) and two gram positive strains (*Staphylococcus aureus* and *Corynebacterium diphtheriae*). Studies showed that the alcoholic extracts of different parts of the plant (leaves, twigs and green fruit) also possess anti-bacterial properties. No dermatotoxic effect (irritant property) was observed in the mouse skin irritant assay [35].

Anti-Spermatogenic Effect

Semecarpus anacardium extract feeding in male albino rats caused Anti-spermatogenic effect evidenced by reduction in numbers of spermatogenic cells and spermatozoa. Sharma studied reduction in sperm density in cauda epidydamis may be due to changes in the androgen metabolism. Meiotic and post meiotic germ cells were highly sensitive to androgen concentration and the alteration in androgen level in testes may affect the transformation of spermatocytes to spermatids [36].

Narayan reported that the water extract of the aerial part of *Semecarpus anacardium* exhibited a spermicidal activity. The administration of ethanolic extract of *Semecarpus anacardium* fruit leads to spermatogenic arrest in albino rats. The significant reduction in the sperm motility and sperm density was observed. The fruit extract feeding also caused marked reduction in the number of primary spermatocytes, secondary spermatocytes and spermatids. These results clearly show the anti spermatogenic activity of *Semecarpus anacardium* [37].

SA extract feeding caused anti-spermatogenic effect evidenced by reduction in numbers of spermatogenic cells and spermatozoa in male albino rats [38].

Antiatherogenic Effect

Mary observed that the imbalance between the pro oxidants and antioxidants is the main cause of development of atherosclerosis. *Semecarpus anacardium* shows antioxidant property. It has capacity to scavenge the super oxide and hydroxyl radicals at low concentrations [39].

Hypolipidemic and Hypocholesterolemic Activity

Tripathi have observed that *Semecarpus anacardium* nut extract oil fraction at a dose of 1 mg/100g body weight significantly reduced serum cholesterol levels and increased HDL cholesterol levels in the rat fed with atherogenic diet [40].

Memory Enhancing Effect

Semecarpus anacardium improves memory by increasing cholinergic function [41]. Methanolic extract of the nuts of

Semecarpus anacardium possesses nootropic activity. Shodhana of fruits may be attributed to inhibition of cholinesterase activity and shows decreased nootropic activity [42].

Cardio protective Effect

Asdaq evaluated the cardio protective effect of hydroalcoholic extract of *S. anacardium* nuts against isoproterenol induced myocardial damage in rats.

The CK-MB activities were fallen in serum and elevated in heart tissue of animals treated with low and high doses of *Semecarpus anacardium* nut extract as compared to isoproterenol control. The LDH activity were significantly reduced in serum with both low and high doses of *Semecarpus anacardium* nut extract while no change was noted in heart tissue with both doses compared to isoproterenol control.

Hence it is concluded that SA possesses potential to ameliorate the myocardial damage induced by isoproterenol in rats [43].

Aphrodisiac Activity

Gupta evaluated the effect of chloroform extract of *Semecarpus anacardium* (150 mg/kg & 300 mg/kg' p.o.) in male mice. Mounting behaviour & mating performance were determined and compared with the standard drug Penegra (Sildenafile citrate). The extract of the *Semecarpus anacardium* were found to stimulate the mounting behaviour of male mice and also significantly increase their mating performance. The extracts of *Semecarpus anacardium* enhanced the sexual behaviour of male mice [44].

Anti-Tuberculosis Activity

A study was carried out by Singh to isolate, identify and evaluate bioactive compounds of SA nuts extracted using GC-MS.

Solvent extraction of SA nuts was done with petroleum ether, ethyl acetate, methanol and finally with water.

All the extracts were tested for their bioactivity against potential pathogen *Mycobacterium tuberculosis*. Water extract showed potential with MIC 6.25 µg/ml against M. tuberculosis during *in vitro* bioassay. Nuts extract showed anti-tuberculosis activity during *in vitro* bioassay investigations [45].

Conclusion

Semecarpus anacardium is a one of the most important medicinal plant which can be used as an alternative medicine. Traditional healers and physicians are using *Semecarpus anacardium* (Bhallatak) in their clinical practice. Several studies show that SA nut's extract have various phytochemicals which are able to fight against several disease. The toxicity of *Semecarpus anacardium* can be minimized by shodhana process. The nut extracts shows various activities like antiatherogenic, anti-inflammatory, antioxidant, antimicrobial, anti-reproductive, CNS stimulant, hypoglycemic, anticarcinogenic and hair growth promoter. More efforts are needed to study the traditional uses of the plant such as wound healing activity.

References

1. Mona Semalty, Ajay Semalty, Ashutosh Badola, Geeta Pant Joshi1, Rawat MSM. *Semecarpus anacardium* Linn.: A review, pharmacognosy review, 10-07-10
2. Sabita Upreti, Mohd Sauf Anam, Rajendra SV, Kuntal Das, Raman Dang. A review *Semecarpus anacardium* - a wonderful plant with varied medicinal properties, Journal of Pharmaceutical Research; c2016.
3. Paras Jain, Sharma HP. A potential ethno medicinal plant: *Semecarpus anacardium* linn.: A review, international journal of research in pharmacy and chemistry. 2003:3(3):2231-2781.
4. Ashwini Kumar A Raut, NS Sawant, Badre AS, Amonkar AJ, Ashok DB Vaidya. Bhallatak (*Semecarpus anacardium* Linn.)-A Review, Indian Journal of Traditional Knowledge. 2007;6(4):653-659.
5. Mishra Sanjeeb Kumar, Tiwari Prashant, Sahu Pratap Kumar. A review Pharmacology, Phytochemistry and Toxicology of *Semecarpus anacardium*, Int. J. Pharm. Sci. Rev. Res. 2017;42(2):(6)25-31.
6. Maurya SK, Seth A, Laloo D, Singh NK, Gautam DNS, Singh AK. Śodhana: An Ayurvedic process for detoxification and modification of therapeutic activities of poisonous medicinal plants. Ancient science of life. 2015;34(4):188.
7. Pawade Uday Venkatrao, a toxicological review of bhallataka (*Semecarpus anacardium* Linn), International ayurvedic medical journal. 2320-5091.
8. Ilanchezhian Rangasamya, Rabinarayan Acharyab, Roshy J Chowallurc, Vinay J Shukla, Shodhana (purificatory procedures) of Bhallataka (*Semecarpus anacardium* Linn.) fruit by traditional frying method / Asian Journal of Traditional Medicines, 2014, 9(1).
9. Lingaraju GM, Hoskeri HJ, Krishna V, Babu PS. Analgesic activity and acute toxicity study of *Semecarpus anacardium* stem bark extracts using mice, Pharmacognosy Res. 2011;3(1):57-61.
10. Arul B, Kothai R, Christina AJ. Hypoglycemic and antihyperglycemic effect of *Semecarpus anacardium* Linn in normal and streptozotocin-induced diabetic rats. Methods Find Exp Clin Pharmacol. 2004;26:759- 762.
11. Veena K, Shanthi P, Sachdanandam P. The biochemical alterations following administration of Kalpaamruthaa and *Semecarpus anacardium* in mammary carcinoma. Chem Biol Interact. 2006;161:69-78.
12. Abirami N, Raju VS, Rajathi K. Effect of *Semecarpus anacardium* against lead induced toxicity in rats. Anc Sci Life. 2007;27(2):24-27.

13. Pal DK, Mohapatra TK, Das A. Evaluation of anthelmintic activity of nuts of *Semecarpus anacardium*, Anc Sci Life. 2008;27(3):41-44.
14. Mathivadhani P, Shanthi P, Sachdanandam P. Apoptotic effect of *Semecarpus anacardium* nut extract on T47D breast cancer cell line, Cell Biol Int. 2007;31:1198-1206.
15. Sugapriya D, Shanthi P, Sachdanandam P. Restoration of energy metabolism in leukemic mice treated by a siddha drug: *Semecarpus anacardium* Linn, nut milk extract. Chem Biol Interact. 2008;173:43-58.
16. Arulkumaran S, Ramprasath VR, Shanthi P, Sachdanandam P. Alteration of DMBA-induced oxidative stress by additive action of a modified indigenous preparation Kalpaamruthaa, Chem Biol Interact. 2007;167:99-106.
17. Prabhu D, Rajwani LS, Desai PV. The antimutagenic effect of *Semecarpus anacardium* under *in vivo* condition, Asian J Chem. 2015;12:13-16.
18. Krishnarajua AV, Rao TV, Sundararajua D, Vanisreeb M. Assessment of bioactivity of Indian medicinal plants using brine shrimp (Artemia salina) lethality assay, Int J Appl Sci Eng. 2015;3:125-134.
19. Joice P Joseph, Sunant K Raval, Kamlesh A Sadariya, Mayur Jhala, Pranay Kumar. Anti-Cancerous Efficacy of Ayurvedic Milk Extract of *Semecarpus anacardium* Nuts on Hepatocellular Carcinoma in Wistar Rats, Afr J Tradit Complement Altern Med. 2013;10(5):299-304.
20. Farooq SM, Alla TR, Rao NV, Prasad K, Shalam K, Satyanarayana SA. Study on CNS effect of nut milk extract of *Semecarpus anacardium*, Pharmacology. 2007;1:49-63.
21. Sushma Y. Effect of Ethanolic Extract of *Semecarpus anacardium* Fruit on Carrageenan Induced Paw Edema in Albino Rats, international Journal of Science and Research. 2015;4(9):652-655.
22. Ramprasath VR, Shanthi P, Sachdanandam P. Immunomodulatory and antinflammatory effects of *Semecarpus anacardium* LINN, Nut milk extract in experimental inflammatory conditions. Biol Pharm Bull. 2006;29:693-700.
23. Satyavati GV, Prasad DN, Das PK, Singh HD. Antiinflammatory activity of *Semecarpus anacardium* Linn, A preliminary study. Indian J Physiol Pharmacol. 1969;13:37-45.
24. Premalatha B, Sachdanandam P. Potency of *Semecarpus anacardium* Linn, Nut milk extract against aflatoxin B(1)- induced hepatocarcinogenesis: Reflection on microsomal biotransformation, Pharmacol Res. 2000;42:161-166.
25. Selvam C, Jachak SM. A cyclooxygenase (COX) inhibitory biflavonoid from the seeds of *Semecarpus anacardium*, J Ethnopharmacol. 2004;95:209-212.
26. Bhitre MJ, Patil S, Kataria M, Anwikar S, Kadri H. Antiinflammatory activity of the fruits of*Semecarpus anacardium* Linn, Asian J Chem,2008:20:2047-2050.
27. Singh D, Aggarwal A, Mathias A, Naik S. Immunomodulatory activity of *Semecarpus anacardium* extract in mononuclear cells of normal individuals and rheumatoid arthritis patients, J Ethnopharmacol. 2006;108:398-406
28. Mythilypriya R, Shanthi P, Sachdanandam P. Therapeutic effect of Kalpaamruthaa, a herbal preparation on adjuvant induced arthritis in wistar rats. Inflammopharmacology. 2008;16:21-35.
29. Arulkumaran S, Ramprasath VR, Shanthi P, Sachdanandam P. Restorative effect of Kalpaamruthaa an indigenous preparation on oxidative damage in mammary gland mitochondrial fraction in experimental mammary carcinoma. Molecular and Cellular Biochemistry. 2006;291:77-82.
30. Verma N, Vinayak M. Bioscience Reports Immediate Publication; c2008, doi 10.1042/BSR20080035.
31. Sahoo AK, Narayanana N, Sahanaa S, Rajanb SS, Mukherjee PK. *In vitro* antioxidant potential of *Semecarpus anacardium* L. Pharmacologyonline. 2008;3:327-335.
32. Sharma K, Shukla SD, Mehta P, Bhatnagar M. Fungistatic activity of *Semecarpus anacardium* Linn Nut extract, Indian J Exp Biol 2002;40(3):314-318.
33. Sharma A, Barman N and Malwal M. Antimicrobial afficacy of nut oil of *Semecarpus anacardium*: A marking nut tree, Biotechnology 2010;9(3):383-386
34. Mohanta TK, Patra JK, Rath SK, Pal DK, Thatoi HN. Evaluation of antimicrobial activity and phytochemical screening of oils and nuts of *Semecarpus anacardium*, Sci Res Essay. 2007;2:486-490.
35. Nair A, Bhide SV. Antimicrobial properties of different parts of *Semecarpus anacardium*. Indian Drugs. 1996;33:323-328.
36. Sharma A, Verma PK, Dixit VP. Effect of *Semecarpus anacardium* fruits on reproductive function of male albino rats, Asian J Androl. 2003;5:121-124.
37. Narayan JP, John MS, Ghosh PK, Singh JN, Jha OP, Jha IS. Screening of some medicinal plants for spermatostatic and spermicidal properties. Proceedings of symposium on phytochemistry and Botanical Classification, CBS publishers and Distributors Pvt. Ltd, Delhi, India; c1985. p. 211-216.
38. Vinutha B, Prashanth D, Salma K, Sreeja SL, Pratiti D, Padmaja R. Screening of selected Indian medicinal plants for acetylcholinesterase inhibitory activity, J Ethnopharmacol. 2007;109:359-63.
39. Mary NK, Babu BH and Padikkala J. Antiatherogenic effect of Caps HT2, a herbal Ayurvedic medicine formulation, Phytomedicine. 2003;10(6):474-482.

40. Tripathi YB, Pandey RS. *Semecarpus anacardium* L, nuts inhibit lipopolysaccharide induced NO production in rat macrophages along with its hypolipidemic property. Indian Journal of Experimental Biology. 2004;42(4):432-436.
41. Vinutha B, Prashanth D, Salma K, Sreeja SL, Pratiti D, Padmaja R, Radhika S, Amit A, Venkateshwarlu K, Deepak M. Screening of selected Indian medicinal plants for acetylcholinesterase inhibitory activity, J Ethnopharmacol. 2007;109(2):359-363.
42. Mishra SK, Rout K, Prusty SK, Sahu PK. Shodhana decreases nootropic activity of *Semecarpus anacardium*. Asian J Pharm Clin Res. 2016;9(2):294-297.
43. Asdaq SMB, chakraborty M. Myocardial potency of *Semecarpus anacardium* nut extract against Isoproterenol induced myocardial damage in rats, International journal of pharmaceutical sciences review and research. 2010;2(2):10-13.
44. Gupta AK, Bindal MC, Gupta SK, Prakash D, Vedpal. Aphrodisiac activity of *Semecarpus anacardium* nut, Int. Res. J Pharm. 2013;4(4):202-204.
45. Singh R, Kakkar A, Mishra VK. Anti-tuberculosis activity and GCMS analysis of water extract of *Semecarpus anacardium* nuts, Der Pharma Chemica. 2015;7(2):278-285.