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Review article

# Potent Ethanomedicinal Plant *Semecarpus anacardium Linn*: A Review

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## 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*, Medicinal plant, CNS stimulant

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## 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.

## LITERATURE REVIEW

*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 color and it is quite rough in texture. The flowers are dull greenish yellow in color. The ripe fruits are black in color, fruits are quite smooth and shiny in texture however, it is toxic in nature. The nut is about 1 inch long (Semalty M, *et al*., 2010). 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 (Table 1)*.

**Table 1: Languages and common names of *S. anacardium***

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

### *Taxonomical classification*

**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 and in countries such as China, Nepal, India, and Northern Australia. It is available in hotter region in India up to the altitude of 3500 ft and in places such as Maharashtra, Karnataka, Konkan, Bihar, West Bengal, Orissa, Kanara forest of Tamil Nadu, Madhya Pradesh, etc. *Semecarpus anacardium* plants grow naturally in the tropical region having dry climate (Upreti S, *et al*., 2016).

### *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 color, 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 *(Figure 1)*.

**Figure 1: Flowering stage of plant *Semecarpus anacardium***

The fruits of plant ripens from December to March, ripen fruits are shining black in color 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 color, quiet rough in texture and exudes an irritant brown color secretion on incising. Seed appears brown in color 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 (Upreti S, *et al*., 2016) *(Figure 2)*.

**Figure 2: Ripe fruit nuts of *Semecarpus anacardium***

## RESULTS AND DISCUSSION

### *Properties*

Bhallataka is sweet and astringent in taste. It is extremely heat generating (Jain P and Sharma HP, 2003).

**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, s emecarpuflavanone, ga lluflavanone, ana carduflavone mono-olefin I , d iolefin II , bh ilawanol-A, bh ilawanol-B, am entoflavone tetrahydroamentoflavone s emicarpol, a nacardic a cid, t etrahydrobustaflavone, O-trimethyl biflavanone A 1, O -trimethyl b iflavanone A2 , O- tetramethyl biflavanone A 1, O -hexamethyl b ichalcone A , O -dimethyl b iflavanone B , O -heptamethyl b ichalcone B 1, O -hexamethyl b ichalcone B2, O-tetramethyl biflavanone C, phenolics (Semalty M, *et al*., 2010; Raut AKA, *et al*., 2007).

**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 (Kumar MS, *et al*., 2017). The various methods used for purification of fruits are as follows:

***1. 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 has absorbent property so irritant oil is absorbed from fruits. The process of purification does not effect 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 (Maurya SK, *et al*., 2015).

***2. 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 7 days 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 ($18^{th}$ day), the nuts were washed with hot water to remove the brick powder. This shodhana procedure was repeated three times (Kumar MS, *et al*., 2017).

***3. With brick powder:*** The ripened Bhallataka fruits which are submerged in water are selected for shodhanasanskara. The fruits which float on water 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) (Venkatrao PU, 2015).

***4. 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 becomes shuddha. Precaution during Shodhana sans-

kara-coconut oil should be applied on face, hand, legs and other exposed parts of body to avoid harmful effects (Venkatrao PU, 2015).

***5. 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 (Rangasamya I, *et al*., 2014).

### *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) (Raut AKA, *et al*., 2007) *(Table 2)*.

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

| Name of the formulation | Nature of product | Average dose | Common indication |
|---|---|---|---|
| Amrut bhallatakavaleha | Electuary | 1 to 2 tsf × 2 times | General tonic and vitalizer |
| Bhallatakasava | Wine | 2 to 4 tsf × 2 times | Neuralgia and asthma |
| Suran vatak | Pills | 2 pills (500 mg pill) × 2 times | Piles and anorectal diseases |
| Sanjeevani vati | Pills | 2 pills (250 mg pill) × 3 times | Dysentery and diarrhea |
| Bhallatak parpati | Powder | 250 mg × 3 times | Rheumatic diseases |
| Narsimha choorna | Powder | 1 to 2 gm × 2 times | General restorative |

### *Precaution while consuming formulation of Bhallataka*

- Pathya-milk and 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
- Diarrhea
- Nephritis (Venkatrao PU, 2015).

## 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 its 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 (Jain P and Sharma HP, 2003).

### *Toxicity and antidotes*

In Ayurveda Bhallatak is classified under the category of toxic plants. Bhallatak is usually avoided in pediatric age group, pregnant women, and 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 (Raut AKA, *et al*., 2007) *(Table 3)*.

**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 (Lingaraju GM, *et al*., 2011).

### *Hypoglycemic effect*

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 (Arul B, *et al*., 2004).

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 (Veena K, *et al*., 2006).

### *Hepatoprotective effect*

Abirami studied the plant to understand the antioxidant and protective effect of *Semecarpus anacardium* against lead acetate induced toxicity. He analyzed the phytochemicals such as flavanoids, alkaloids, resins, tannins, carbohydrates, proteins present in the plant which are probably responsible for the hepatoprotective efficacy (Abirami N, *et al*., 2007).

### *Anthelmintic activity*

Pal has studied anthelmintic activity of different extracts of nuts of *Seme-*

*carpus 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* (Pal D, *et al*., 2008).

### *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 (Mathivadhani P, *et al*., 2007). 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 (Sugapriya D, *et al*., 2007). 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 (Arulkumaran S, *et al*., 2007).

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 (Prabhu D, *et al*., 2005). 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 (Semecarpus anacardiaceae) showed significant cytotoxicity with $LD_{50}$ of 29.5 µg (Krishnarajua AV, *et al*., 2005).

Joseph studied the anticancer effect of Ayurvedic preparation made from SA nuts. He had given the ayurvedic preparation containing *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 (Joseph JP, *et al*., 2013).

### *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 (Farooq SM, *et al*., 2007).

### *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 (Sushma Y, 2013). Ramprasath investigated that *Semecarpus anacardium* significantly decreased the carrageenan-induced paw edema and cotton pellet granuloma (Ramprasath VR, *et al*., 2006). Satayavati and Bajpai reported the anti-inflammatory activity of *Semecarpus anacardium* for both immunological and non-immunological origin (Satyavati GV, *et al*., 1969). 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 (Premalatha B, *et al*., 2000). 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 $IC_{50}$ 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 (Selvam C and Jachak SM, 2004). 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 (Bhitre MJ, *et al*., 2008). 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 (Singh D, *et al*., 2006). 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 (Mythilypriya R, *et al*., 2008).

### *Antioxidant activity*

Shanmugam observed that rats treated with Kalpaamruthaa showed normal lipid peroxide level and antioxidant defences of *Semecarpus anacardium* (Arulkumaran S, *et al*., 2006). 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 (Verma N and Vinayak M, 2009). 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 ($IC_{50}$ values of 43.28 ± 4.34 µg/ml) (Sahoo AK, *et al*., 2008).

### *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 (Sharma K, *et al*., 2002).

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*) (Sharma A, *et al*., 2010). 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* (Mohanta TK, *et al*., 2007).

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 (Sharma A, *et al*., 2003).

### *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 (Narayan JP, *et al*., 1985).

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* (Narayan JP, *et al*., 1985). SA extracts feeding caused anti-spermatogenic effect evidenced by reduction in numbers of spermatogenic cells and spermatozoa in male albino rats (Vinutha B, *et al*., 2007).

### *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 (Mary NK, *et al*., 2003).

### *Hypolipidemic and hypocholesterolemic activity*

Tripathi have observed that *Semecarpus anacardium* nut extract oil fraction at a dose of 1 mg/100 g body weight significantly reduced serum cholesterol levels and increased HDL cholesterol levels in the rat fed with atherogenic diet (Tripathi YB and Pandey RS, 2004).

### *Memory enhancing effect*

*Semecarpus anacardium* improves memory by increasing cholinergic function (Vinutha B, *et al*., 2007). 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 (Mishra SK, *et al*., 2016).

### *Cardioprotective effect*

Asdaq evaluated the cardioprotective 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 (Asdaq SMB and Chakraborty M, 2010).

### *Aphrodisiac activity*

Gupta evaluated the effect of chloroform extract of *Semecarpus anacardium* (150 mg/kg and 300 mg/kg' p.o.=by mouth) in male mice. Mounting behaviour and 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 behavior of male mice (Gupta AK, *et al*., 2013).

### *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 (Singh R, *et al*., 2015).

## 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 has various phytochemicals which are able to fight against several diseases. The toxicity of *Semecarpus anacardium* can be minimized by shodhana process. The nut extracts shows various activities like antiatherogenic, antiinflammatory, 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.

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