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Areca catechu L. (Chikni Supari): A Review Based Upon its Ayurvedic and Pharmacological Properties

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ABSTRACT

Areca catechu belongs to the family *Palmae* and is commonly known by different names such as chikni supari, areca nut and betel nut. The fruit of this plant is called the areca nut, which carries significant medicinal properties. This plant is also mentioned in various ancient Sanskrit scriptures. The plant is mainly used for chewing and religious purposes of the Hindus of India. India is the largest consumer and producer of areca nut globally, which produces about 52% of the world production. Medicinally, the plant is used to treat leucoderma, diarrhea, anaemia, obesity, leprosy etc. In Ayurveda, the plant is astringent, diuretic, digestion-promoting, stimulant, wound healing and laxative agent. The plant is associated with various therapeutic and pharmacological potentials, including wound healing, antidepressant, anthelmintic, antihypertensive, antioxidant, antiallergic, antifungal and antimicrobial properties. However, this plant is considered as carcinogenic as it can cause mouth cancer. In this review article, attempts have been made to summarize the phytochemistry, folk uses and ayurvedic uses along with its pharmacological activities.

Keywords: Chikni supari, Anthelmintic, Folk uses, Ayurveda, Rasapanchak.

INTRODUCTION

Areca catechu (as shown in figure no. 1) is commonly known as betel nut, chikni supari or areca nut palm that belongs to the *Palmae* family. Arecanut, betel nut or supari is the fruit or seed of the *A. catechu* palm tree^[1]. It is used as a masticatory nut for chewing purposes and betel leaf and tobacco with lime, giving the red colour to saliva. The word areca is derived from the Kanarese word adeke or the Malayalam adakka, which means cavalier. The plant holds an important place in the traditional medicinal systems such as Ayurveda, Unani and Homeopathy^[2, 3]. In the ancient literature books of Charaka and Sushruta, it is mentioned that the chewing practice of betel leaves after meals helps in digestion^[4]. In India, the fruit of this plant is chewed since ancient times (650 BC) and is also mentioned in 'Shishupala Vadha'^[5]. Arecanut is considered the 4th most ranked psychoactive substance after caffeine, nicotine, and alcohol, chewed by approximately 10% of the world's population^[6]. It is also predicted that about 400 million people chew betel quid daily. As per WHO, the areca nut possesses 25 medicinal properties^[7]. This plant was first described in Herodotus (ca. 340 B.C.E). The plant is also mentioned in the literature books of Chinese works before the Christian era as a Pin lang^[8]. India is one of the highest areca nut-producing countries in the world^[9]. Different parts of chikni supari are used medicinally as digestion-promoting, diuretic and antiparasitic drugs^[10]. Betelnut can also be used to disperse accumulated fluid in the abdominal cavity and kill worms. The nuts of this plant are used in Asian-pacific regions and Asian communities as a narcotic^[11]. The active constituents of *A. catechu* are tannins. Although, it is reported that betel quid and areca nut can cause oesophageal or oral cancer and is classified as a carcinogen to human beings by the International Agency for Cancer Research (IARC)^[12]. It is also reported that areca nut can cause oral cancer up to 50% in some low income and middle-income countries^[13, 14]. Instead, several studies showed that it had been used as a safe drug when administered at a prescribed dosage. In the traditional Chinese medicinal system, *A. catechu* is used in different forms like powder, infusions or decoction to treat gastrointestinal disorders such as dyspepsia, abdominal distension, cardiovascular diseases, constipation, dysentery, edematous and parasitic disorders. Also, in the last few years, the areca nut industry is fast developing in China and has become the pillar industry in Hainan province. Reported pharmacological activities of Arecanut include antioxidant, antidiabetic, antimalarial, wound healing, antihypertensive, antiallergic, antidepressant, anticancer, antifungal, anthelmintic, antimalarial, analgesic and hypolipidemic^[15]. Table no. 1 & 2 represents the vernacular names and taxonomical classification of *Areca catechu*.

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Table 1: Vernacular names

English	Betel Nut, Areca nut
Hindi	Supari
Persian	Popal
Arabic	Fufal, fofal
Sanskrit	Kramuka, ghonta, poogaphalam, gubak, pugah
Urdu	Chalia, supari
Unani	Fufal, Chhalia, Supari
Malyalam	Kamuku, Adackamaram
Tamil	Pukkumamaram
Bengali	Supari



Figure 1: *Areca catechu*

Table 2: Taxonomical Classification

Taxonomical Rank	Taxon
Kingdom	Plantae
Order	Arecales
Family	Areaceae
Genus	Areca
Species	Areca catechu
Common name	Chikani supari

Botanical Description

Chikni supari is a tall megaphanerophyte that belongs to the *Areaceae* family. The height of this plant can reach up to 15-25 meters.

Leaves: The leaves of this plant are binate, light green to green, present in the top of the stem as a bundle in 8 to 12 numbers, 1.3-2.7 m long with multitudinous lanceolate blades of length 30-60cm and 2.5-4 cm width. Superior blades are connate with uneven tooth-like cracks found at the apex [16]. Leaflets are partially fused with one or more midribs and consists of 62.5cm in length and 7 cm in breadth. The stem is woody, erect, solitary with conspicuous grey nodes and

10-20 cm in diameter. The inflorescence is spadix, produced in leaf axils, the stalk is short with 60 cm long branched rachis.

Fruit: Fruit are fibrous, monoecious, monocular varies from oval to round with length 5.3 cm and breadth 4.2 cm, colour ranges from yellow to orange and changes to red when mature with a thin fibrous layer of husk surrounded the endosperm. Seeds are ellipsoidal, globose, ovoid; flattened base; ruminant endosperm with rigid reddish tissue from internal integument spreading horizontally to pale brown [17].

Flowers: Flowers are unisexual; male flowers are produced in pairs, pistillate female flowers with the same inflorescence [18]. Female flowers are more prominent with six minor sterile stamens and ovaries carrying triangular stigma at three different apex points.

Geographical Distribution

A. catechu is a native species of South and Southeast Asia. It is cultivated in tropical countries like Sri Lanka, India, China, Malaysia, New Guinea, Indonesia, Vietnam, Thailand, Cambodia and the Philippines [19]. It can be cultivated in the plains, hill slopes and low lying valleys in the red loamy soils of Tamil Nadu, loamy soil of Orissa, West Bengal, Assam and high coastal alluvia of North Konkan. The plant is mainly exported from Sri Lanka, Penang, Singapore and Madras in large quantities. In India, this plant is cultivated in West Bengal, the West coast and Assam [20, 21].

Phytochemical Constituents

The chemical constituents present in *A. catechu* are polyphenols, alkaloids, flavonoids, tannins, triterpenes, steroids, fatty acids, etc. There are about 59 chemical constituents have been identified and extracted from this plant [22]. These chemical constituents are present in different parts of the plant include alkaloids (0.5%), fats (15%), polyphenols (20%), and starch (20%) [23]. Articaïne is considered a principal constituent of the Areca nut [24]. New phytochemical constituents extracted from areca nut using GC-MS were n-propylmalonic acid, 1-acetyloxidodecyl acetate, 2-nonanoic acid, carbromal, 3-nonanoic acid, 2-aminooxypentanoic acid, 2R, 3S-9-guanine and (2S,3S) -(-)-3-propyloxiranemethanol [25]. Figure no. 2 represents the structures of some major chemical constituents of *Areca catechu*.

Fatty acids: The fatty acids extracted from the seeds of *A. catechu* include lauric acid, palmitic acid, myristic acid, oleic acid, decanoic acid, tetradecenoic acid, dodecenoic acid, myristic acid, hexadecenoic acid and stearic acid [26].

Alkaloids: The alkaloids components include arecoline, arecaine, choline, guvacoline, arecaidine and guvacine, out of which arecoline is colourless volatile resembling nicotine [27].

Polyphenols: Polyphenols mainly include flavonols which include epicatechin (2.5%), (-)-gallocatechin, epigallocatechin, D-catechin, isorhamnetin-3-O-galactoside, (+) catechin (10%) and (+) leucocyanidin (12%). Also, the seeds of this plant constitute a series of trimeric, dimeric and tetrameric procyanidins [28, 29].

Tannins: Tannins present in *A. catechu* are in condensed form, termed proanthocyanidins [30]. Mainly catechin and epicatechin are found in the *A. catechu* plant. Other tannins components present in *A. catechu* include procyanidin A1, procyanidin B1, areca tannin B1,

procyanidin B2, areca tannin A1, areca tannin C1, areca tannin A2, areca tannin C1, areca tannin A3 and areca tannin B2 [31].

Mineral's content: It includes phosphorus, calcium, copper, iron, vitamin B6 and Vitamin C [32].

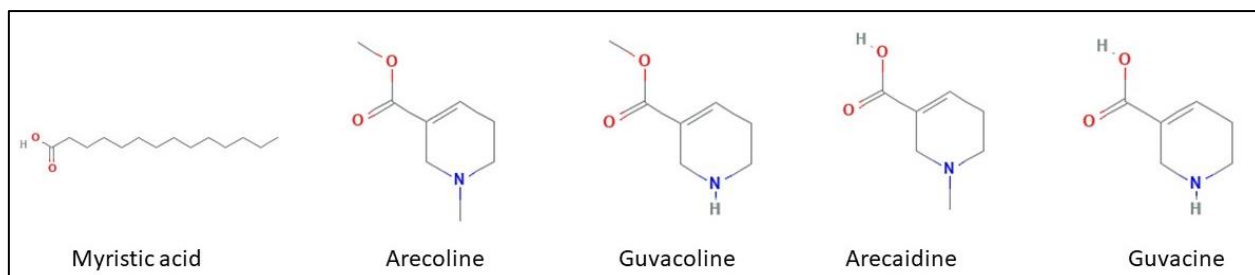


Figure 2: Phytochemical constituents of *Areca catechu*

Traditional And Modern View

Ayurvedic View: In recent years, Ayurveda has gained popularity. It is considered one of the oldest traditional medicinal systems which have been used since ancient times. *Areca catechu* holds a remarkable place in the ayurvedic therapeutic system [33]. It alleviates pitta and Kapha doshas. It is used as a stimulant and laxative. In Ayurveda, it is used to treat mental confusion, swollen eyes, pus formation and chronic urinary distress. Also, it is used as a nervine tonic and aphrodisiac. Chewing areca nut strengthens the gums, checks perspiration, removes bad taste from the mouth and sweetens the breath [34]. It is also used as a carminative, diuretic, digestive, antiulcer, antidiarrheal, antihelminthic, anti-heartburn and laxative agent [35]. The rasapanchak properties of *Areca catechu* are shown in table no. 3.

Table 3: Rasapanchak (properties) of *A. catechu*

Sanskrit / English	Sanskrit / English
Veerya / Potency	Sheet / Cold
Vipaka / Metabolic property	Katu / Bitter
Guna / Physical property	Guru / Heavy, Ruksha / Dry
Rasa / Taste	Kasaya / Astringent

Actions and Properties [36]

Doshakarman: It balances the three doshas on boiling and reduces the alleviated Kapha and pitta doshas of the body.

Sthaniyekarambahye: It has a wound healing property. Gargling with the decoction of supari helps in mouth ulcers and throat infections. Utarbasti therapy with betelnut decoction is used in leucorrhoea. Also, the areca nut is used as an ingredient in various toothpaste, which helps to strengthen teeth and gums. In addition, the oil of this plant is helpful in backaches and pain-related disorders.

Abhyantarnadisansthan: It is used as a nervine tonic and cures various pain disorders.

Raktavahsansthan: It maintains BP and is used as a cardiotonic.

Paachansansthan: It increases salivation, eliminates bad breath, improves taste and is used as a mouth freshener. It is used as an appetizer, cures diarrhoea, dysentery and is associated with the antihelminthic property.

Shwasansansthan: It causes contraction of bronchioles.

Prajanansansthan: It has an antifertility action on males, anti-inflammatory action on the uterus, and leucorrhoea.

Mutravahsansthan: It is helpful in polyuria.

Teacher: It induces sweating.

Satmikaran: It causes delusions and has narcotic action.

Folk Uses

As per ethnobotanical studies, it is revealed that indigenous knowledge plays a vital role in the identification of herbal plants for their medicinal uses in various diseases and disorders. It is the knowledge that has passed verbally from one generation to another. It provides the basis for research [37]. *Areca catechu* is also an indigenous plant used both externally and internally in different forms such as oil, decoction, powder and juice. In some regions, the nut of the plant and betel leaf is served to guests as a mark of respect [38]. The plant is used to treat gastric disorders, helminthiasis, respiratory disorders such as bronchitis and asthma [67]. In Taiwan, young green nuts are consumed at different stages of maturity [39]. In India and Pakistan, mature dry and cured nuts are used for chewing purposes.

Modern View

The global herbal drug industry is facing the threat of adulteration and substitution in today's scenario due to the rise in great market demand for herbal drugs [40]. Several other factors directly or indirectly promote the quality degradation of herbal medicines by the unavailability of required species, similar morphological appearance, mishandling, improper storage, deliberate substitution, and conflict in vernacular names [41]. These practices ultimately degrade the quality of herbal drugs [42]. Furthermore, it affects the business exertion of traditional herbal medicines [43]. AS per WHO, if more than 5% of the original drug is admixed with other substances, even if they are extracted from the same plant would be rejected [44]. Lack of standardization techniques is also responsible for the poor quality of drugs. It fails to detect the original drug, which ultimately exploits its usage in the traditional system of medicines [45]. So, there is a need to develop a Herbal Authentication System (HAS) that can serve as a regulator and helps in improving the quality of the herbal drug trade [46, 47].

Reported Therapeutic and Pharmacological Activities

Antibacterial and Antimicrobial

The acetone and ethanolic extracts of *A. catechu* were evaluated for the antibacterial and cytotoxic effect against selected gram-positive and gram-negative bacteria's using a well diffusion assay. Results showed that both ethanolic and acetonic extract showed notable antibacterial activity against *Staphylococcus aureus*, *Salmonella typhi*, *E. coli*, *S. paratyphi*, *Micrococcus species* and *P. aeruginosa* [48]. The aqueous and methanolic seed extracts were evaluated for the antibacterial activity against *Staphylococcus aureus* and *Escherichia coli* using the agar well diffusion test. It was found that methanolic extract inhibited the growth of *Staphylococcus aureus* and *Escherichia coli*, while aqueous extract was ineffective [49]. In another study, the antibacterial activity of silver nanoparticles synthesized using *Areca catechu* hydrothermal extract was examined against three species of resistant and three species of antibiotic-susceptible bacteria's using UV-Vis spectrophotometry, SEM, FT-IR, well diffusion assay and dynamic light scattering (DLS). Results showed significant antibacterial activity of AgNPs synthesized *A. catechu* extract by inhibiting the growth of bacterial species [50]. In another study, antimicrobial activity was shown by areca nut extract against *Staphylococcus aureus* and *E. coli* using the spectrophotometric method. Results showed a significant growth inhibition rate, i.e. up to 85-90% in gram-positive and gram-negative bacteria [51].

Antioxidant

The antioxidant activity of the methanolic and aqueous extract of seeds (ripe and unripe), roots and adventitious roots were investigated for the antioxidant activity using 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay and total phenolic using the Folin-ciocalteu method. Results showed that the methanolic extract of seed showed significant inhibitory activity than the root and adventitious roots. Also, the *in vitro* study of the methanolic and aqueous extract was carried out to evaluate the activity of phase II metabolizing enzyme, Glutathione-S-transferase (GST) in rat liver. The methanolic unripe seed extract showed specific inhibitory activity with an IC₅₀ of 115.05 µg/ml with maximum inhibition >70% [52]. In another study, the chloroform, petroleum ether and methanolic leaf extract of *A. catechu* were evaluated *in vitro* for antioxidant potential using DPPH assay, nitric oxide radical assay and hydrogen peroxide radical assay using Spectrophotometric method and compared with standard drug. The extract showed percentage inhibition when exposed using the above assays, which was found to increase with the increase in the sample concentration. The IC₅₀ value of methanolic extract was found to be 88.24 and chloroform extract was found to be 100.25, while the IC₅₀ value for the standard drug was 66.29. Thus showed significant antioxidant activity [53].

Anthelmintic

To evaluate the antihelmintic property, the *Areca catechu* (AEE) crude aqueous extract was evaluated *in vivo* and *in vitro* against *Ascaridia Galli* in Chickens. The *in vivo* study was carried out in 40 female chickens with *A. Galli* infection and divided into four groups. Group A was taken as a control sample treated with Aquadestilata; Group B was treated with 26 mg/ml of AAE, group C with 79 mg/ml of AAE and Group D treated with 50 mg/ml of pyrantel pamoate. The treatment was continued for 14 days. Results showed that AAE treated group showed significant morphological changes, reduced ascariasis severity in chickens and subsequent death in *A. Galli* in

vitro, thus increased overall body weight *in vivo* [54]. The ethanolic extract of *Areca catechu* and *Azadirachta indica* was evaluated *in vitro* for the anthelmintic activity against *Pheretima Posthuma* earthworm at a dosage of 100 mg/ml. Albendazole was taken as a standard drug. Results showed the more potent anthelmintic activity of the ethanolic extract of *A. indica* at a dose of 25, 50 and 100 mg/ml compared to *Areca catechu*. The extract inhibited the mobility of the isolated worms [55]. In another study, the seed extract of *A. catechu* showed significant anthelmintic activity against ascarides (*Ascaris suum*) and porcine flukes (*Fasciolopsis buski*) by calculating LT₅₀ and LT₁₀₀ values. In addition, the extract showed a 100% killing rate in tested porcine flukes at 125 mg/ml of concentration [56]. The anthelmintic activity of *Areca catechu* leaf extract was evaluated against liver flukes (*Fasciola sp.*) at 10, 20 and 40% concentrations where Albendazole was taken as a positive control sample and negative control sample was treated with 25 ml of nutrient broth. Results showed the higher efficacy rate with recorded motility time of 0.22 and 0.07 min at 10%, 20% and 40% extract concentration, whereas Albendazole produced 0.38 min motility timing [57].

Analgesic

The methanolic extract of the areca nut was evaluated for analgesic activity in Swiss albino mice. Indomethacin was used as a standard drug. The administration of the methanolic extract at a dosage of 500 and 1000 mg/kg reduced the pain induced by intraperitoneal injection of acetic acid to the abdomen of Swiss mice by 35.77 and 58.81%, respectively [58].

Wound healing

The ethyl acetate extract of betelnut and snake fruit was evaluated for wound healing activity against 20 rats using the maceration process. Bioplaceton was used as a standard drug. The rat models were divided into four groups. Parameters used were wound contraction and epithelialization period. Results showed more effective results of betelnut gel as compared with the standard drug and snake fruit gel [59]. In another study, the wound healing activity of ethanolic extract of *Areca catechu* incorporated polycaprolactone scaffolds was determined *in vitro* and *in vivo* using a rat model where polycaprolactone was used a standard sample. Cells treated with areca catechu incorporated polycaprolactone showed a fast wound healing effect compared to the polycaprolactone control [60]. Another study was conducted in the Wistar Rat model to determine the wound healing activity of betel quid extract ointment. Thirty male Wistar rats were taken and divided into five groups in which groups 1, 2 & 3 were treated with 5%, 10% and 5% concentration of betel quid extract ointment. In contrast, group 4 was taken as a positive control, treated with hyaluronic acid with a 0.2% ointment and group 5 as a negative control, treated with placebo ointment. The ointment was applied twice a day for ten days. Parameters used were the number of neutrophils and thickness of epithelium for ten days. It was observed that betel quid extracts reduced the number of neutrophils in the inflammatory phase. In addition, all the plant extract treated groups showed improvement in the epithelial thickness on the proliferative phase. Group 1 and 2 showed no significant difference with the positive control. Thus, showed wound healing activity [61].

Antinociceptive

The antinociceptive activity of total alkaloids seed extracts of *Areca catechu* plant was evaluated in mice model using acetic acid writhing reflex test, hot plate test, tail-flick test, capsaicin-induced nociception

and formalin-induced pain test. The oral administration of total alkaloids showed notable antinociceptive activity without affecting the locomotor activity of mice. Also, TA significantly down-regulated the expression levels of COX-2 in the dorsal root of mice at a dosage of 100, 200 and 400 mg/kg of dosage [62].

Antidepressant

The methanolic extract of *Areca catechu* was investigated *in vivo* for the antidepressant activity in mice model at a dosage of 400 mg/kg using the tail suspension, forced swimming, 5-HT induced head twitches and aggressive behaviour test. Results showed a significant change in the immobility for both the forced swimming test and tail suspension test, thus showing antidepressant activity [63].

Aphrodisiac

To evaluate the aphrodisiac property of the areca fruit extract, *in vivo* study was carried out using albino rats, Wistar strains. Sildenafil was taken as a negative control sample. It was found that the combination of areca fruit, ginseng and purwoceng (AGP) group improved the testosterone levels as compared to sildenafil. Also, areca fruit extract showed a significant rise in the FSH and LH levels in the treated rat model at a dosage of 50 mg/kg BW [64].

Anticoccidial

Areca nut extract (ANE) was evaluated for the anticoccidial activity using 270 one-day-old Wenchang broiler chicks, divided into six equal groups (n=15 per cage). Three groups were treated with ANE extract and the remaining were negative control, positive control and blank control groups. The birds in the three control groups were fed with basal diet without ANE supplementation, while three ANE treated groups were fed with basal diet at 100, 200 and 300 mg/kg feed. After 15 days, three ANE groups, negative and positive control groups, were challenged with 1×10^5 *Eimeria tenella* oocytes per chick. The positive control groups were supplied with diclazuril with drinking water after 48 h for five days. It was observed that ANE and diclazuril remarkably improved feed intake and gain body weight compared to the negative control group. In addition, it reduced the mucosal damage caused by coccidial infection. ANE supplementation diet reduced the cecal lesions compared to the NC group, increased nitric oxide level and interleukin 2 (IL-2) in infected chicken [65].

Antidiabetic and Antitumor

The antidiabetic activity of copper oxide nanoparticles (CuO NPs) of Areca catechu leaf extract was evaluated in yeast cells using UV-visible spectroscopy, powder x-ray diffraction, energy dispersive x-ray spectroscopy and SEM, HR-TEM. Results showed significant antidiabetic activity of CuO NPs by inhibiting alpha-amylase enzyme with IC50 value 260.33 mg/ml. CuO NPs of areca catechu extract showed significant antitumor activity against the human lung cancer cell line (A549) with a 50% inhibition concentration value [66].

Toxicity

Areca catechu is associated with carcinogenic property and is cause oral cancer. As per reported studies, the areca nut has many toxic effects based on its duration and dosages. It is proved to be carcinogenic for the larynx, pharynx, lungs, liver, uterus and oral cavity. It can also cause arrhythmia, coronary artery disease and also cause death due to myocardial infarction if used for the long term. It is

also reported to have a hepatotoxic effect and cause male infertility [67]. It can also cause palpitation, tachycardia, and hypotension and affect the parasympathetic nervous stem when taken in large doses [68]. Excessive use of supari leads to anaemia and the appearance of jaundice [69].

CONCLUSION

Areca catechu is a medicinally significant plant used in the indigenous medicinal system to treat various diseases and disorders. In Ayurveda, the areca nut is used to strengthen the teeth and gums, vomiting, nausea, and removing bad breath and other ailments. As per reported studies, this plant is associated with various therapeutic and pharmacological properties, including antidiabetic, anthelmintic, antimicrobial, antioxidant, antihypertensive etc. Besides, this plant is reported to have carcinogenic properties, leading to oral cancer when consumed for the long term. Excessive usage of supari may cause anaemia and other disorders. Moreover, supari in a limited dosage is considered safe for medicinal use and needs more research studies to explore its more chemical constituents and pharmacological activities.

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Conflict of Interest

None declared.

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