

Utilisation of Betel Leaf (Piper Betel) and Its Chemical, Nutritional, Pharmacological Aspect

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Submitted: 15-02-2023

Accepted: 25-02-2023

ABSTRACT:

When it was decided that the majority of poor countries would need to rely on more conventional medical procedures for primary healthcare, the World Health Organization made a significant shift in its approach. The Piperaceae family, also known as Paan, includes piper betel L. According to phytochemical research, the concentration of a wide range of biologically active chemicals found in Piper betel varies according to the diversity of plant species. Numerous investigations have been conducted on Piper betel, and they have revealed that it contains significant chemical components such as chavibetol, chavibetol acetate, caryophyllene, allylpyrocatechol diacetate, camphene, chavibetol methyl ether, eugenol, α -Pinene, β -Pinene, γ -Limonene, safrole, 1-8-cine. These ingredients are prized as a stimulant for their therapeutic characteristics, such as anti-fungal, immunomodulatory, anti-diabetic, gastroprotective, anti-allergic, anti-fertility, anti cancer, anti bacterial, wound healing, and skin antiseptic etc. This paper put an view on nutritional and phytochemical properties along with pharmacological activity of betel leaf.

Key words: Betel leaf, Pharmacological activity, Piperaceae,

I. INTRODUCTION:

Piper betel L., the scientific name for the betel vine, is a member of the Piperaceae family. Since antiquity, India has had significantly greater popularity with the plant than any other nation in the world. They are frequently utilized by the local population as attractive plants, vegetables, spices, medicinal herbs, or as tools in customary rituals. The countless citations found in ancient literature, particularly the Indian scriptures, would demonstrate this. Every aspect of human life, including social, cultural, religious, and even daily living, has had its meaning explained, and this is still very true today. Most of South and Southeast Asia is where it is farmed. Paan, the local name for

betel leaf, is used for a variety of significant sociocultural purpose. There are about 700 different species of piper in the globe between 1400 and 2000 several varieties of piper come from different nations. There are roughly 23 different species of piper on the island of Java. They are extensively utilised by the neighbourhood as attractive plants, food, spices, medicinal herbs, or as props in ceremonial rituals.

One of the most valuable medicinal plants, piper betel, has several uses for leaves in medicine. The betel quid, which also contains an area nut (*Areca catechu* L.), tobacco (*Nicotiana tabacum* L.), and slaked lime, must include betel leaves. The leaves of piper betel are rich in hydration, protein, lipids, vitamins, minerals, phytochemicals, and antioxidants. It aids in the treatment and cure of a number of illness, including conjunctivitis, constipation, headache, hysteria, itches, ringworm, swelling of the gums, rheumatism, abrasion, wounds, and bruises, among others.

Traditional medicines are made from plant leaves and used to treat a variety of illnesses. Due to its enormous abundance and low cost, it might encourage more research in the food and pharmaceutical industries. Betel vine is another name for betel leaf. In most nations, including India, chewing is a common practice to prevent bad breath, strengthen the gums, and fire up the digestive system. Betel leaves are used as a mouthwash in India and as a therapy for vaginal douching in Indonesia. To cure skin conditions, betel leaf juice is extracted. Due to its astringent flavor, betel leaves are often cooked and used as a cough medication.

One health practice that may not be as well-known to as many people in as many parts of the world is betel leaf. The betel leaves occupy a special place in Indian culture. It is regarded as a beneficial plant. The leaves of this plant are frequently used as a unique form of trade during weddings, and special agreements. Its reputation has gone through ups and downs. It was claimed

that betel juice induced oral cancer in the 1980s. The Cancer Institute of India makes an attempt to refuse this claim by claiming that the betel quid, which contains tobacco, is what causes cancer, not the betel itself. In addition to its standalone use as medicine, betel leaf juice is frequently used in Ayurvedic as an adjuvant and combined with many other medications, possibly for better benefits. Tambool leaves have been characterized as aromatic, prickly, fiery, acrid, and beneficial for the voice, laxative, and in addition to the fact that they calm pita and aggravate vata. Other uses for piper plants include food and spices, fish poisoning, hallucinogens, oil, decorations, pesticides, and spices. Due to its bitter taste, it works well as an anti-infective and anti-worm agent. Due to its light qualities, it helps to normalize the digestive tract and is therefore highly helpful in maintaining the digestive system.

II. PLANT PROFILE



FIG.1: LEAF OF PIPER BETEL

A tropical perennial evergreen vine that enjoys shade is the piper betel vine. It can ascend up to 10-15 feet in height. Warm, humid weather is preferred by the Piper betel leaf. Simple, alternating, cordate, acuminate, or acute, whole, and bright green leaves are present. Male spikes on this plant are thick and cylindrical, whilst female spikes are pendulum-shaped. Each node produces roots that help anchor the plant to the host tree. While the odour of pepper betel is distinctive and pleasing, the colour ranges from yellowish green to dark green with a shiny upper surface. Because there are essential oils present, the betel leaves have a variety of flavours that range from sweet to pungent. The nodes of the plants branches are enlarged. The plant has long-stalked, shiny, alternating, heart-shaped leaves with a pointy tip. It has little flowers five to seven ribs that emerge from the base.

Taxonomical Classification:

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnolipsida

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: Betel

Vernacular Names:

Sanskrit: Tambool, Mukhbhushan, Varnalata

Hindi: Paan leaf,

English: Betle, Betle pepper, Betle-vine

Telugu: Nagballi, Tamalapaku

Tamil: Vetrilai Gujarati: Nagarbael

Bengali: Paan, Paana, Tambulaballi (plant), Parnakari (leaf).

Assamese: Paan, Paana.

Kannada: Eleballi, Panu, Vileyadele

Guajarati: Paan, Tanbolaa

Malayalam: Vettila Nepalese: Naagavallii (plant), Paan (leaf).

Indonesia: Bakikserasa, Daun sirih, Sirih, Serasa, Séwéh, Seureuh.

German: Betelpfeffer, Betel-Pfeffer

Ayurvedic Characteristics:

Guna (Quality): Laghu, Ruksha, Tikshan

Rasa (Nambitha): Tikt

Vipak (Metabolism): Katu

Virya (Power): Ushan

Prabhav (Impact): Hridya

III. TRADITIONAL USES



FIG-2: TRADITIONAL USES OF BETEL LEAVES

Betel leaf is well known for its traditional uses in a variety of medical ailments in addition to its sociocultural use. This betel leaf is also used in traditional home functions for welcoming people as the key of sharing love and joy. They also used in devotional ceremonies as dedicating to god. In India, as a traditional practice, betel leaf is

consumed after the commencement of a meal in order to improve digestion due to its astringent taste. The people traditionally use the intensely spicy, aromatic betel leaves to be masticated in their raw, natural state, along with other ingredients like sliced areca nut, slaked lime, coriander, aniseed, clove, cardamom, sweetener, coconut scrapings, ashes of diamond, pearl, jelly, peppermint, flavouring agent, fruit pulp, gold, and silver.

To treat coughs and asthma, the leaves are frequently steamed and rubbed to the chest. Sore throats can be soothed using the leaves. Inhaling betel leaf essential oil can treat catarrh and diphtheria and is used as a mouthwash.

The Unani medical system claims that the leaves' acid flavour and inviting aroma aid to increase hunger. The brain, heart, and liver all benefit from its tonic effects. Additionally, piper betel supports glowing skin and good teeth. The leaf is cooked and placed to the chest to lessen a cough and asthma by evacuating the mucus. It is also used as a treatment for wounds and ulcerated nostrils. When used as a suppository and purgative in newborns, the leaf is rolled up and wrapped in oil. It is thought that chewing betel leaves will improve voice quality and stamina. Additionally, the leaf is reported to have diuretic properties.

supplementary plant components, such as the fruits Children's coughs and dyspepsia are treated with Piper betel leaves, while long-acting female oral contraceptives are made from its root .

Several indigenous medicines in Asian nations are made with this plant as a common constituent. In contrast to similar Indian traditional plants like "Tulsi" (*Ocimum sanctum*), this plant has received very little research outside of the compelling ethnomedical claims. The traditional uses of betel leaves are consistent with the presence of bioactive compounds in the matrix. These bioactive compounds' presence is well supported by several scientific publications:

IV. NUTRITIONAL COMPOSITION: Nutritional Composition of Fresh Betel Leaf:

A plant with high nutritional value that exhibits enourous components is the betel leaf. Such elements are necessary for daily activities. Knowing the proportions of the leaf's constituents can help us analyse them precisely to learn more about their role or pharmacological activity. The proximate analysis of Piper betel leaves revealed that they contained phytochemicals listed in table, as well as macro and micronutrients.

S.NO	Constituents	Approximate Composition
1	Water	85-90%
2	Fat	0.4-1.0%
3	Minerals	2.3-3.3%
4	Protein.	3-3.5%
5	Fiber	2.3%
6	Chlorophyll.	0.01-0.25%
7	Carbohydrate.	0.5-6.10%
8	Nicotinic acid	0.63-0.89 mg/100g
9	Vitamin C.	0.005-0.01%
10	Vitamin A	1.9-2.9 mg/100g
11	Thiamine	10-70 µg/100g
12	Riboflavin	1.9-30 µg/100g
13	Tannin.	0.1-1.3%
14	Nitrogen.	2.0-7.0%
15	Phosphorus	0.05-0.6%
16	Potassium	1.1-4.6%
17	Calcium	0.2-0.5%
18	Iron	0.005-0.007%
19	Iodine	3.4 µg/100g
20	Essential Oil	0.08 - 0.2%
21	Energy	44 kcal/100 g.

V. CHEMICAL CONSTITUENTS:

In leaves, there are 3-3.5% protein, 0.5-6.10% carbohydrate, 2.3-3.33% mineral, and 0.1-1.3% tannin content. It includes vitamins B, C, and A as well as calcium, phosphorus, iron, iodine, potassium, and vitamin D. Additionally, it contains a few stable oils and aromatic chemicals like phenol and terpene. Eugenol, chavibetol α -pinene, β -pinene, 1, 8 cineole, and hydroxychavicol are also present. Safrole (48.7%) and chavibetol acetate (15.5%) were determined to be the two main components of common betel. Additionally, Piper betel contains allylpyrocatechol, caryophyllene, anethole, stearic acid, carvacrol, polyphenol, alkaloids, and saponin.

Piperol-A, piperol-B, and methyl piper betol have all been described as being in piper betel leaf and have also been isolated. The essential oil found in piper betel leaves contains terpinen-4-ol, safrole, eugenol, eugenyl acetate, hydroxyl chavicol, and piper betal, while the main ingredients in betel oil are cadinene allyl catechol,

pcymene, cineole, and estrago. Alkaloids, tannins, carbohydrates, amino acids, and steroidal components were all found in the leaves after a phytochemical examination. The primary component of the leaves is a volatile oil called "Betle oil" that is present in leaves from many nations and contains two phenols, betel phenol (Chavibetol and Chavicol).

The concentration of the several biologically active chemicals found in piper betel varies with plant variety, season, and climate. The essential oils, which are composed of phenols and terpenes that give betel leaf its aroma are present. Hydroxycatechol, caryophyllene, eugenol methyl ether, cadinene, γ -lactone, allyl catechol, p-cymene, cepharadione A, dotriacontanoic acid, tritriacontane, sesquiterpenes, n-triacontanol, triotnacontane, piperlonguminine, allylpyrocatechol diacetate, isoeugenol, 1, 8-cineol, α -pinene, β -pinene, sitosterol, β -sitosteryl palmitate, γ -sitosterol, stigmasterol, ursolic acid, ursolic acid β acetate.

CHEMICAL CONSTITUENTS OF PIPER BETEL LEAF

S.NO	Chemical constituents	% of Chemical Constituents
1	Chavibetol	53.1
2	Chavibetol acetate	15.5
3	Caryophyllene	3.71
4	Allylpyrocatechol diacetate	0.71
5	Chavibetol methyl ether	0.48
6	Eugene	0.32
7	α -Pinene	0.21
8	β -Pinene	0.21
9	Safrole	48.7
10	1, 8-Cineol	0.04
11	Allylpyrocatechol monoacetate	0.23
12	Tannins	0.1

VI. PHARMACOLOGICAL ACTIVITY:

(a) Anti Inflammatory:

An all-natural home treatment for mouth inflammation is betel leaf. In non-toxic areas, it has been claimed that the ethanolic extraction of betel

leaf has anti-inflammatory qualities. To a comprehensive model of mouse arthritis caused by Freund's adjuvant. One of the primary components of betel leaves, eugol, has been proven in numerous animal models examined by various inflamogens to

have anti-inflammatory properties. The complicated biological reaction of vascular tissue to noxious agents such as infections, injured cells, and irritants includes an anti-inflammatory response.

In the complete model of Freund's adjuvant-induced arthritis in rats, ethanolic extracts of betel leaf have been shown to have anti-inflammatory activities in non-toxic areas. In numerous animal models of investigations with various infectious agents, eugenol, one of the primary components of betel leaf, has been proven to have anti-inflammatory effects. In order to combat the so-called anti-geriatric chemicals known as Piper betel leaf extracts, our study set out to identify for the first time any potentially delayed activities. The high concentration of diverse phenolic and non-phenolic chemicals, as well as other non-phenol compounds, may affect its usage as nutrition, both as a preventative measure and in the treatment of inflammatory oxidative disorders. P. betel leaf extract shown proinflammatory activity and 29% reduced cell function as opposed to controls. The study's findings indicate that the chosen varieties of P. betel can be employed. According to the study's findings, the chosen varieties of P. betel can be utilized as a natural antioxidant and one or more complementary treatments for inflammatory bowel disease.

(b) Antioxidant Activity:

Eugenol, hydroxychavicol, and alphatocopherol, components of betel leaves have also been demonstrated to raise GSH levels in mouse skin and liver. All of these findings together strongly suggested that betel leaf extracts and some of its components boosted cellular antioxidants and partially mediated the chemopreventive effects. Ionizing radiation has significant effects on cellular membranes, including oxidative damage. Free radicals produced by the radiolytic breakdown of water can damage the fatty acid chains in membrane lipids in a cascade reaction. The presence of polyphenol chemicals in betel leaf extract, such as chatecol and allylpyrocatecol, substantially prevented the radiation-induced lipid peroxidation process. This might be explained by its capacity to scavenge free radicals that are engaged in the stages of initiation and propagation

(c) Skin Antiseptic:

Counting the microbial colonies before and after the antiseptic solutions were administered allowed researchers to determine the antiseptic efficiency. According to this study, there was a substantial decrease in mean colony counts of

between 27 and 100% when 20% Piper betel leaf infusion was applied as opposed to before. Comparing the mean colony counts before the solution was applied to the mean counts after 10% povidone-iodine administration; there was a substantial decrease of 88–100%. An antibacterial effect may be seen in the 20% Piper betel infusion. According to this study, there was a substantial decrease in mean colony counts of between 27 and 100% when 20% Piper betel leaf infusion was applied as opposed to before 88–100% less mean colony counts compared to the control group were observed after 10% povidone-iodine treatment.

There is an antiseptic potential in the 20% Piper betel infusion. This study shows that the mean colony counts decreased significantly ($p=0.001$) during the time before and after the application of a 20% Piper betel leaf infusion. The difference between the mean colony numbers before and after 10% povidone-iodine treatment was significantly reduced ($p=0.000$) by 88–100%. The 20% infusion of Piper betel has potential to be antiseptic.

(d) Anticancer Activity:

Globally, breast cancer is the most common disease in women with new cases incidence of 1.38 million per year. The high mortality rate is usually due to the late prognosis of the disease, such as recently detected in the metastasis phase. This phase is characterized by high expression of matrix metalloproteinases (MMPs), cell migration, invasion and other phenomena associated with metastatic cascade. These conditions cannot be treated only with radiation therapy or by surgery, but rather need to be developed through chemotherapeutic drugs. Methanolic extract of red betel leaf to evaluate the cytotoxic and anti-migration activity towards metastatic breast cancer. Red betel leaves (*Piper crocatum* Ruiz dan Pav) have long been used as a herbal remedy because they contain biphenolic compounds such as luteolin and apigenin derivatives, which are deadly to cancer cells.

(e) Anti-Allergic Activity:

The effects of Piper betel on lung epithelial cells and bone marrow-derived mast cells generation of allergy mediators were investigated. The effects of Piper betel ethanolic extract on the secretion of exotoxin and IL-8 by human lung epithelial cell line BEAS-2B and on the synthesis of histamine and granulocyte macrophage colony-stimulating factor (GM-CSF) by murine bone marrow mast cells (BMMCs) were examined in

vitro. The extracts dramatically reduced the levels of histamine and GM-CSF produced by an IgE-mediated hypersensitivity reaction as well as suppressed the release of exotoxin and IL-8 during an allergic reaction caused by TNF- and IL-4. The findings imply that Piper betel may decrease the generation of allergic mediators, hence controlling allergic diseases.

(f) Anti-Ulcer:

Study showed a significant healing effect on NSAID induced peptic ulcer in albino rats. The healing action was attributed to the free radical scavenging activity of the plant extract. APC, one of the phenol constituents showed significant protection against indomethacin induced ulcers in Sprague-Dawley rats. The protection was correlated with antioxidative and mucin protecting properties.

(g) Oral Care Agents :

Dental caries is a long-lasting endogenous illness brought on by the typical commensal flora in the mouth. The acid created by plaque microbes when they break down dietary carbohydrates causes demineralization of enamel and later dentine, which leads to the development of the carious lesion. Streptococcus mutant's bacteria are mostly to blame for dental decay in people. This enzyme is thought to play a specific role in the formation of dental plaque. As a result, it is the best natural ingredient and ranks as the second most popular daily consumable in Asia, contributing to the greatest dental hygiene.

(h) Antimicrobial Activity:

The betel exhibits antibacterial activity against *Pseudomonas aeruginosa*, *Proteus vulgaris*, *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Staphylococcus aureus*. In addition, the leaf extract has bactericidal activity against bacteria that cause infections of the urinary tract, including *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Citrobacter koseri*. The three species of highly specialised fungus known as the Dermatophytes create the condition known as dermatophytosis, which affects the keratinized parts of the body (skin, hair, and nail). Recent research was done to assess allylpyrocatechol's preventive and healing benefits against indomethacin-induced stomach ulcers in rats .

(i) Antifungal Activity:

The antifungal activity of hydroxychavicol, which was obtained from the chloroform extraction of the aqueous extract of *P. betel*, was examined against 124 strains of chosen fungi. Inhibitory effects of hydroxychavicol were seen in clinically significant fungi. Additionally, it demonstrated a suppressed emergence of mutants and a longer post-antifungal impact for *Candida* species. The findings point to a possible topical antifungal drug and a gargle for oral *Candida* infections.

(j) Antibacterial:

According to the study, PB was effective against all pathogens tested, including *Rastonia*, *Xanthomonas*, and *Erwinia*. Additionally, tests revealed that PB solvent extract had a more powerful effect than streptomycin. The ethanol extract of *P. betel* showed the greatest zone of inhibition against Gram negative and Gram positive bacteria, with the highest bactericidal activity against *E. coli*, *P. aeruginosa*, and *S. aureus*. The crude aqueous extract of *P. betel* demonstrated activity against most of the test bacteria.

(k) Anticoagulant Activity:

Piper betel compound's in vitro anticoagulant activity was investigated using column chromatography. It has been discovered that the piper betel's phenolic component is what gives it its anticoagulant propertie.

(l) Antihistaminic Activity:

The pharmacological evaluation of the ethanolic extract and essential oil extract of *P. betel* Linn. leaves for their antihistaminic effect on guinea pig has been done in the study. The histamine dose response curve (DRC) was shifted to the right in guinea pig tracheal chain preparation. As a common medication, chlorpheniramine maleate was employed. Additionally, *P. betel* disrupted histamine aerosol extracts cause bronchoconstriction in the entire guinea pig, with essential oil being more potent than ethanolic extract in this regard. They came to the conclusion that *P. betel* Linn's ethanolic extract and essential oil have antihistaminic effect.

(m) Hepato-Protective Activity:

The analysis revealed that the betel leaf extract protected the liver from the harm brought on by CCl₄ by reducing the expression of alpha smooth muscle actin (alpha-sma), inducing the

expression of active matrix metalloproteinase-2 (MMP2) through the Ras/Erk pathway, and inhibiting TIMP2 level, which subsequently attenuated the liver's fibrosis. These results suggest that betel leaf has the ability to prevent liver fibrosis through chemotherapy.

(n) Antimutagenic Effects:

Numerous investigations have demonstrated that betel leaves exhibit antimutagenic and anticlastogenic properties in addition to being devoid of mutagenic activity in both prokaryotic and eukaryotic assay systems. Betel leaves did not morphologically alter hamster embryo cells or produce sister chromatid exchanges in both virally transformed cells and PHA-stimulated human lymphocytes, according to in vitro investigations with cultured cells. Additionally, -ray induced clastogenesis in plasmids 1 has been described for the ethanolic extract of betel leaf.

(o) Gastroprotective Activity:

In mucosal defences against endogenous aggressors and acids, mucus layer is thought to be crucial. It also acts as a catalyst to speed up the healing process. The acidity or pH of stomach juice is not significantly inhibited by the greater dose of hot water extract. Numerous studies have demonstrated that antioxidants may be a useful defence not only against gastric mucosal damage but also against the advancement of gastric ulcers. The progression of ulcers is brought on by a chain reaction brought on by free radicals. As a result, its capture by radical scavengers aids in quicker recovery. Several in-vitro models have demonstrated the high antioxidant activity of allylpyrocatecol.

VII. MEDICINAL APPLICATION:



1. Filariasis can be treated with a paste made from Piper betel leaves mixed with salt and hot water.
2. Betel leaves are helpful in treating lung infections in children and the elderly.
3. The practise of applying leaves coated in oil to the breast during lactation, which is supposed to promote milk secretion.
4. It aids in the treatment of various eye ailments, skin conditions, and disorders of bodily physiology.
5. Locally applied Inflammations of the testicles, such as orchitis, can be effectively treated using piper betel leaves.
6. Black pepper-infused roots that cause sterility in women
7. Treats foul breath, eliminates body odour, and guards against tooth decay
8. Wounds can also be treated using the leaves. It is best to extract the leaf juice and apply it locally to the wounds.
9. Because the leaves are nutritious and contain significant amounts of vitamins and minerals, six leaves and a tiny amount of slaked lime are compared to around 300 ml of cow milk, mostly for the vitamins and minerals.
10. Piper betel leaves can be used to treat debility, nervous weariness, and pain associated with anxiety. A few betel leaf extracts combined with honey make a potent tonic.
11. The leaves' essential oils include qualities that are antibacterial, antiprotozoal, and antifungal. As a result, the oil prevents the growth of egregious bacteria that cause typhoid, cholera, tuberculosis, etc. and aids in correct assessment and utilisation.
12. These leaves have a pungent flavour and pleasant aroma, which, in accordance with Unani system, increase appetite.
13. Betle leaf has diuretic properties as well. Giving leaf juice mixed with milk or honey can make it easier to Urinate.

VIII. SIDE EFFECTS:

Although betel leaf extract alone has not been demonstrated to have major adverse effects, betel quid use has some unwanted effects (slices of areca nut). Increased heart rate, heart palpitations, potential cardiovascular disease, mouth tumours, and oral and brain cancer are among the health hazards associated with betel quid use. Before using it, as with any medication or dietary supplement, seek medical advice.

IX. CONCLUSION:

The above-discussed medical significance of the plant clearly demonstrates that betel leaf is one of the most promising commercial botanicals, having a history of being associated with numerous therapeutic benefits.

The betel leaves are mostly consumed as a refreshing, aphrodisiac, mildly stimulating, and inexpensive appetiser that is natural and readily available. However; there is still considerable work to be done on the betel leaf to better understand how it interacts with other therapeutic processes. This sufficiently explains why it is referred to as the "**Green Gold of India**". It was determined that betel leaf (*Piper betel*), which is employed in many different fields, is a great herb with potential advantages and uses. India has a diverse betel leaf farming industry. Because of its antioxidant, anti-fungal, and anti-microbial qualities, among others, betel leaves are used therapeutically. Betel leaf has a wide range of applications in both ancient and modern science, in addition to the medicinal uses that have gained popularity. Future research on betel leaf's shelf life and nutritional analyses is possible.

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