



Phytochemical Screening And Potential Bioactive Properties Of Piper Betel Leaves: A Comprehensive Literature Review

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ABSTRACT:- *Piper betel L.* (locally known as Paan) is a widely distributed plant in the tropical and subtropical regions, its leaves being largely consumed as a mastication and mouth freshener. *Piper Betel Linn.* is an evergreen plant recognized for its diverse medicinal properties, including anti-inflammatory, antimicrobial, antifungal, antidiabetic, and anticancer activities. Historically, betel leaf extracts were commonly used in food preparation due to their flavour and aroma. The leaves contain various compounds such as alkaloids, flavonoids, tannins, and saponins, which contribute to these sensory qualities and health benefits.

Index term:- *Betel leaf, Phytochemistry, pharmacological activity, Applications*

INTRODUCTION:-

Piper betel linn.(known locally as "Paan") The dioecious annual creeper Piperaceae, which often grows in hotter and more humid regions of the nation, reaches a height of around one meter and climbs by numerous tiny adventitious rootless branches ^[3, 4]. It is widely distributed in moist woods and is cultivated in South-East Asian nations including China and Vietnam as well as India. Uttar Pradesh, Bihar, Bengal, Orissa, Tamilnadu, Andhra Pradesh, and Karnataka are among the Indian states where it can be found^[5]. Paan, a mouth freshener prepared from areca nuts, slaked lime, and betel leaves, is commonly made using betel leaves. The betel leaf, which is a member of the genus Piper, is known scientifically as Piper betel. A member of the Piperaceae family, betel leaf is mostly eaten as "Paan" in Asia and India.

Taxonomical classification^[1] :-

Kingdom: Plantae

Division: Magnoliphyta

Class: Magnolipsida

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: betel *L.*Figure 1. *Piper Betel Leaf***Different Varieties of *Piper Betel L.* :-**

<u>State</u>	<u>Popular varieties</u>
Andhra Pradesh	Karapaku, Chennor, Tellaku, Bangla and Kalli Patti
Assam	Assam Patti, Awani pan, Bangla and Khasi pan
Bihar	Desi pan, Calcutta, Paton, Maghai and Bangla
Karnataka	Kariyale, Mysoreale and Ambadiale
Odisha	Godi Bangla, Nova Cuttak, Sanchi and Birkoli
Madhya Pradesh	Desi Bangla, Calcutta and Deswari
Maharashtra	Kallipatti, Kapoori and Bangla (Ramtek)
West Bengal	Bangla, Sanchi, Mitha, Kali Bangla and Simurali Bangla

Morphological studies ^[6,7]:-

Growth Habit

- Type: Dioecious root climber.
- Height: Shoots can reach 3 to 10 m depending on climbing support.
- Branches: Lateral branches develop a couple of feet from the ground; stems exhibit dichotomous branching and can root at nodes.

Stems

- Structure: Stout, almost terete, and slightly flattened.
- Young Stems: Light green with short, raised whitish streaks and pinkish stripes at nodes.
- Dimensions: Internodes are about 12 cm in length and 1.2 cm in diameter.

Leaves

- Type: Simple, alternate, spiral, and exstipulate.
- Petiole: 2–5 mm long, pubescent, and channeled.
- Blade:
 - ✓ Characteristics: Glabrous, coriaceous, fleshy.
 - ✓ Colour: Greenish to yellowish, shiny.
 - ✓ Shape: Broadly ovate, 7–8.5 cm wide and 9–11 cm long.
 - ✓ Base: Cordate.
 - ✓ Apex: Acuminate.
 - ✓ Margin: Entire and narrowly recurved.
 - ✓ Venation: Reticulate with 7–9 veins in two or three pairs from the midrib.

Inflorescence

- Type: Axillary spike up to 5.5 cm long.
- Male Inflorescence:
 - ✓ Shape: Cylindrical pendulous catkin.
 - ✓ Dimensions: 10 cm long and 2 cm in diameter.
- Female Inflorescence:
 - ✓ Shape: Cylindrical and pendulous.
 - ✓ Dimensions: 2.5–4 cm long and 0.5 cm in diameter.
- Flowers: Minute, unisexual, with a couple of stamens and stigmas in the axil of each bract.
- Bracts: Orbicular, peltate, arranged in a thickly crowded spiral series.

- Aroma: Mature inflorescence is strongly aromatic.

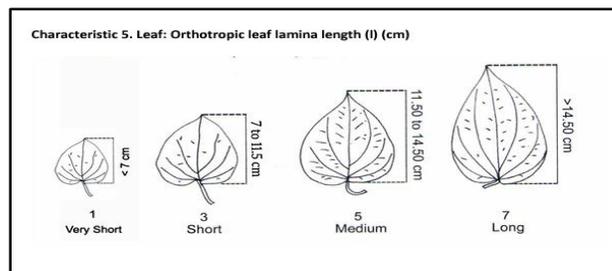


Figure. 2 Orthotropic leaf lamina length

Pharmacognostic Evaluation :-

Microscopy:

This microscopic study involves more detailed examination of a drug and it can be used to identify the organized drugs. The goal of the piper betel leaf microscopic investigation was to determine the leaf's diagnostic characteristics, or leaf constants

1. Number of vein-islets:

The number of vein-islets per square millimeter of the leaf surface, halfway between the midrib and margin,



Figure 3. Vien-islet present in the upper surface

2. Vein-termination:

It is defined as the quantity of veinlet terminations per square millimeter of the leaf surface, midway between the midrib and the edge.

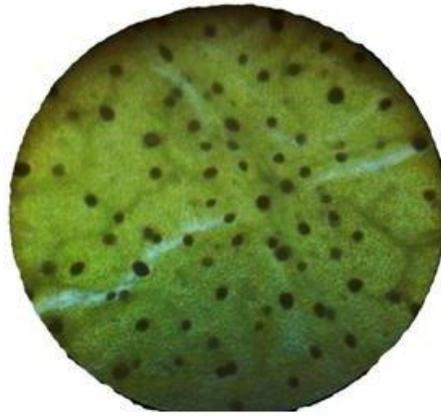


Figure 4. Vein termination of leaf

3. Stomatal number:

It is average number of stomata per sq.mm of epidermis of the leaf.

4. Stomatal index:

It is the ratio of the number of stomata to the total number of epidermal cells, with each stomata cell being recorded as one. It is computed using the equation that follows.

$$S.I = \frac{S}{E+S} * 100$$

Where,

- S.I=stomata index
- S= no. of stomata per unit area
- E=no. of cells in the one unit area

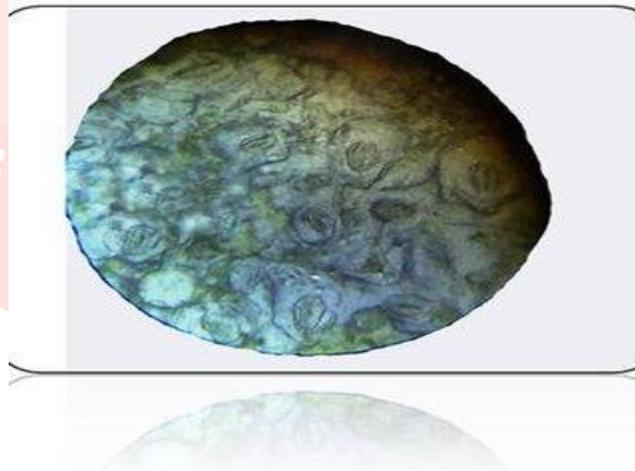


Figure 5. View of stomatal index

5. Stomata:

These tiny epidermal apertures, which are found on the aerial portions of plants, have the following traits.

I. A central pore

II. Two kidney-shaped cells that are identical in shape and include guard cells, along with a variable number of subsidiary cells that cover the guard cells.

6. Trichomes:

The leaf's epidermal cells' hairy outer growth is known as a Trichome.

7. Transverse section of betel leaf:

The midrib area was used for the transverse section. A proper histological examination of a crude medication under a microscope reveals the type of cells and their contents, as well as the arrangement of tissues in transverse and longitudinal sections.

Cultivation:-

They grow best in shaded tropical forests with rainfall between 2250-4750 mm, humidity of 40-80%, and temperatures from 15-40°C. In places with lower rainfall 1500-1700 mm, they need frequent small irrigations: daily in summer and every 3-4 days in winter. Good drainage is also important during the rainy season^{[8][9]}.

The ideal soil for cultivation is well-drained, fertile sandy or sandy loam, or sandy clay with a pH range of 5.6-8.2.

Phytochemical Screening :-

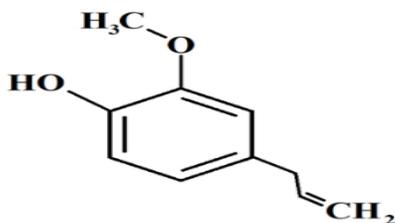
The chemical composition of betel leaves varies by geographical region.

The stem contains phytosterols (beta-sitosterol, betadacosterol, stirosterol, etc.), alkaloids (piperine, pellitorine).

The leaves also contain eugenol, chavicol, hydroxychavicol and caryophyllene.^[11,12]

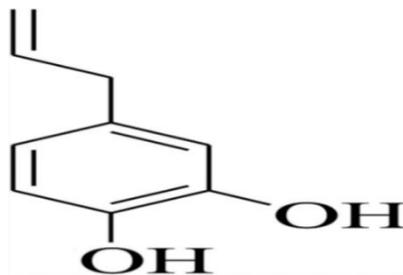
The essential oil consists of 50 different compounds, the main components being eugenol, caryophyllene, terpinolene, terpinene, cadinene and 3-carene.^[13]

1. Eugenol :



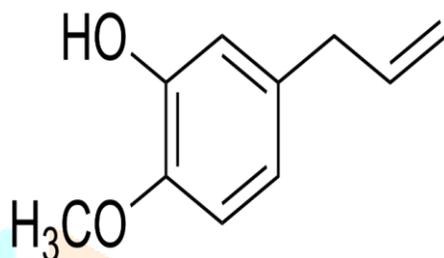
- It has a pleasant, spicy, clove like odour.
- The eugenol shows various activities like anti-inflammatory, anti-microbial, analgesic, anti-depressant, insecticidal, fungicide activities.
- Eugenol is mainly used as a pain killer and oral hygiene.^[14]
- 0.32 % Eugenol present in betel leaf.

2. Hydroxychavicol :



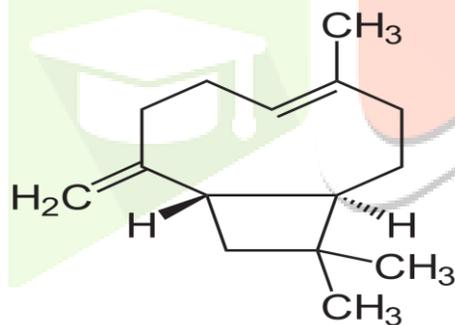
- It has a light smell of creosote.
- The hydroxychavicol has a biological properties such as anti-inflammatory, antioxidants, carcinogenic, gastric ulcer healing activity.
- The anti-mutagenic activity of hydroxychavicol is commonly used in the preparation of mouthwash for treating the oral infection.^[14]
- 66.6% Hydroxychavicol present in Piper betel leaf.

3. Chavibetol :



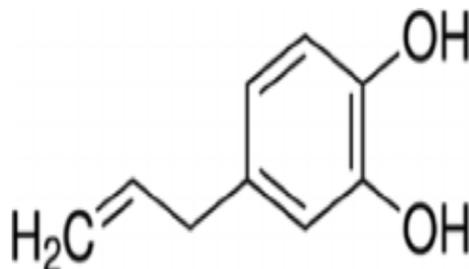
- The organoleptic property describes the spicy odour of chavibetol.
- The common biological activity like anti-inflammatory, anti-bacterial, antipyretic Activities.^[14]
- 53.1 % Chavibetol is present in the betel leaf.

4. Beta-Caryophyllene :



- The B-Caryophyllene is a chief volatile compound establish in huge amount in different spice and food plants.
- It has shown to posses the potent anti-inflammatory activity.
- The B-Caryophyllene in *Piper betel L.* issued as antidepressant, CNS stimulant, antioxidants, antiulcer and anti-infective activities.^[14]
- 3.71 % Beta-Caryophylleneis present in the betel leaf.

5. Allylpyrocatechol :



- It has a stimulatory outcome on pancreatic lipase and antioxidant activity ^[15].
- It shows antioxidative and mucin defensive property.
- 0.71% Allylpyrocatechol present in Piper betel leaf.
- The leaves include a phenolic component called allylpyrocatechol, which exhibits anti-obligate oral anaerobes that cause halitosis.

Pharmacological Activities:-

1. Anti-fungal properties :

Betel leaf (Piper betel) is often used in traditional medicine and has been found to help fight fungal infections.

The essential oil from betel leaf can effectively combat fungi like *Candida albicans*, *Aspergillus Niger*, and *Trichophytonmentagrophytes*^[1]. This antifungal effect comes from its active compounds, including eugenol, chavicol, and terpenes^[2].

Overall, Betel leaf is a promising natural treatment for fungal infections due to its antifungal qualities.

2. Antimicrobial properties :

The essential oil extracted from betel leaves exhibits antibacterial activity against pathogenic bacteria, including *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*.

Furthermore, the phenolic compounds and phytochemicals present in betel leaves provide protection against both gram-positive and gram-negative bacteria.^[16]

Betel leaf's antibacterial qualities also serve as a food preservative since it contains a variety of bioactive chemicals, including allyl pyrocatechol, chavicol, chavibetol, chavibetol acetate, and allyl pyrocatechol diacetate. It is protecting food ingredients from undesirable or dangerous microbes.

3. Anti-inflammatory properties :

Anti-inflammation is part of the complex biological response of vascular tissue to harmful substances, such as pathogens, damaged cells, and irritants. It is a natural defence mechanism and is characterized by pain, fever, redness, swelling, and loss of function^[17]. Terpenoids, flavonoids, and phenolic compounds are the primary active ingredients in betel leaf that give it its anti-inflammatory qualities. It has been demonstrated that these substances contain anti-inflammatory and antioxidant properties, which may aid in lowering bodily inflammation. Furthermore, flavonoids have anti-inflammatory, anti-allergic, antioxidant, anti-microbial, anti-cancer, and antidiarrheal properties. Betel leaf contains eugenol, a natural compound that has been shown to have anti-inflammation and analgesic properties^[18].

4. Anti-diabetic properties :

Betel leaf extract is known for its strong anti-diabetic effects and can help regulate blood sugar levels. In a glucose tolerance test, the extract also showed the ability to lower high blood sugar levels.^[19]

Lowers Blood Sugar: Betel leaf powder can help lower blood sugar levels in newly diagnosed type 2 diabetics.

Strong Antioxidant: It acts as a powerful antioxidant, protecting the body from damage caused by high blood sugar.

5. Anti-Cancer properties :

Betel leaf has important anti-cancer properties because it contains polyphenol compounds. These include bioactive components like chlorogenic acid and hydroxychavicol, which can reduce the cancer-causing effects of tobacco. Because of its phenolic compounds, betel leaf is considered an herbal medicine. Red betel leaf contains compounds like luteolin and apigenin, which can kill cancer cells.^[21]

Methanolic extracts of red betel leaf are used in studies to assess their effects on the movement and toxicity of metastatic breast cancer cells.^[20]

6. Digestive and Gastro Protective properties:

Traditionally, chewing betel leaves is believed to help with digestion and increase saliva production^[22]. Betel leaf extract is known to protect the stomach and can help prevent gastric ulcers.

Betel leaves are very nutritious and contain many vitamins and minerals. They also have enzymes like catalase and diastase, along with important amino acids such as arginine, lysine, and histidine.^[23]

7. Analgesic properties :

An excellent analgesic, betel leaf provides immediate pain relief. It can be used to treat cuts, bruises, and rashes to relieve discomfort. Use delicate betel leaves to make a paste, then apply it to the affected area. Body aches can be relieved by drinking betel leaf juice.^[24,25]

Betel leaves may have a cooling effect and analgesic qualities. It can be used to reduce the discomfort of very bad headaches

Traditional uses of Piper Betel L.^[25] :

- 1) Juice of *Piper betel* with honey is accommodating to treat coughs, dyspnoea, and indigestion.
- 2) A local application is recommended for inflammatory swelling such as orchitis, arthritis and mastitis.
- 3) Oil used for irritation in throat, larynx, bronchi, gargle and inhalation in diphtheria.
- 4) Juice of leaves is used as stomachic and febrifuge.
- 5) Paste of leaves is applied on cuts and wounds.
- 6) For curing obesity, *Piper betel* leaf mix with *Piper nigrum* is given for two months.

Different Formulation with Piper Betel Leaf ^[26] :

The Piper Betel L. are used in a variety of pharmaceutical preparations including lotions, cream, spray and tablets.

Lotions :

The betel leaf extract can be used to formulate lotion to treat the conditions like TineaVersicolor.

Creams :

The extract of *Piper betel L.* can be used to create skin lightening creams that reduce the hyperpigmentation.

Spray (Foot spray):

The foot spray is formulated by using the extract of betel leaf.

Gels :The gel of Betel leaf is used as a anti-fungal agent against *Candida albicans*.

Toothpaste :

The herbal toothpaste of betel leaves significantly decrease the plaque index.

Marketed products :



CONCLUSION :

Betel leaves represent a valuable herbal cash crop with significant economic, medicinal, and industrial potential. Their rich content of bioactive phenolic compounds supports various health benefits, and the increasing interest in their extracts for use in food, cosmetics, and pharmaceuticals highlights their versatility. However, further research is needed to enhance understanding of their phytochemical properties and preservation methods. With ongoing exploration of their biological activities, betel leaves hold promise as a sustainable source of green medicine for future applications. betel leaf (*Piper betle*) is a versatile herb with significant therapeutic benefits, including antioxidant, antifungal, antimicrobial, and antiseptic properties. Widely cultivated in India, it has applications in both ancient and modern sciences. Future research should focus on its shelf life and nutritional analysis to further understand its potential.

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