

A REVIEW ON NUTRITIOUS LEAF: *PIPER BETEL*Janaksinh Jadeja\*<sup>1</sup>, Pooja Khanpara<sup>2</sup>, Juvansinh Chauhan<sup>3</sup> and Dr. Shital Faldu<sup>4</sup><sup>1</sup>B. Pharm Scholar, Smt. R. D. Gardi B. Pharmacy College, Gujarat Technological University, Rajkot, Gujarat, India.<sup>2</sup>Associate Professor, Department of Pharmacognosy, ORCID No: 0000-0003-1203-2969, Smt. R. D. Gardi B. Pharmacy College, Gujarat Technological University, Rajkot, Gujarat, India.<sup>3</sup>B. Pharm Scholar, Smt. R. D. Gardi B. Pharmacy College, Gujarat Technological University, Rajkot, Gujarat, India.<sup>4</sup>Principal, Smt. R. D. Gardi B. Pharmacy College, Gujarat Technological University, Rajkot, Gujarat, India.

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## ABSTRACT

The World Health Organization accepted a major policy change when it agreed that most developing countries should use more traditional medical practices in primary care. *Piper betel* L. belongs to the *Piperaceae* family, commonly known as Pan. It is widely cultivated in Sri Lanka, India, Thailand, Taiwan and other Southeast Asian countries. This oil can be used as an industrial raw material for the production of medicines, perfumes, mouth fresheners, tonics, food, etc. The leaves are nutritious and contain anti-cancer substances that promise the production of a blood cancer drug. The purpose of this review is to summarize the medicinal values of Piper betel that have emerged from research activities using modern scientific approaches and innovative scientific tools.

**KEYWORDS:** *Piper betel*, Pharmacological activity, Pan, medicinal plant, Nutritious leaf.

## 1. INTRODUCTION

Betel leaves are frequently used to make Paan, a mouth freshener that is made from betel leaves, slaked lime, and areca nuts. We casually eat betel leaves without realizing the health benefits to our bodies. The scientific name for betel leaf, which belongs to the genus *Piper*, is *Piper betel*. Betel leaf is a perennial creeper with a heart-shaped leaf that grows in tropical and subtropical regions like East Africa, India, Sri Lanka, Malaysia, Indonesia, and the Philippines. Betel leaves are chewed and utilized for religious rituals. Based on morphological traits and the content of essential oils, there are five main groupings of betel vine cultivars.<sup>[1,2]</sup> Let's have a look at some amazing betel, which may be useful to humans.

Betel leaf is a vine from the *Piperaceae* family that is primarily consumed in Asia and India as "Paan" with tobacco or "Arcea Nut."

Southeast Asia is the home of the betel, or *Piper beetle*, a kind of flowering plant in the *Piperaceae* family.

Southeast Asia is home to a kind of flowering plant identified as betel, or *Piper beetle*, which belonged to the *Piperaceae* family of chilies. A dioeciously<sup>[3]</sup> vine with glossy, heart-shaped leaves and white catkins, it is evergreen. Betel plants grow for their leaves, which are

primarily utilized as flavoring when chewing areca nuts (also known as betel nuts).

The most important and effective asexually propagated cash crop, with an extensive range of cultivars, is betelvine.<sup>[3]</sup> It is a plant that likes sheds and is an element of the *Piperaceae* family. It has a perennial creeper and has 2-4 inch large, 4-7-inch-long leaves. It has flowers that are both male and female. Because it originated in Malaysia, it has become common in South and Southwest China. Usually, this crop is grown in Southeast Asian nations such as Taiwan, Malaysia, Thailand, Sri Lanka, India, and Sri Lanka.<sup>[4]</sup>

Different names for *Piper betel* (*P. betel*) have been employed in India, involving Pan in Hindi, Tambala in Sanskrit, Villayadela in Kannada, Vetulicolid in Malayalam, Vetali in Tamil, Tamalapaku in Telugu, Videch-pan in Marathi, Naggable in Gujrati, Pan in Bangladeshi, Tanbol in Arabic, and Burg-e-Tanbol in Persian.<sup>[5]</sup> The greater significance of this plant is felt worldwide in the areas of finances, medical treatment, and tradition.<sup>[4]</sup>

The betel leaves are primarily employed as a mouthwash, but they are also well known for managing a wide range of infectious and non-contagious conditions, which includes viruses, coughs, bronchial asthma, rheumatism,

pain in the stomach, and other conditions like bad breath, boils and abscesses, conjunctivitis, constipation, gum swelling, cuts, and injuries.<sup>[6]</sup> Betel leaf essential oil has antibacterial, anti-protozoan, and anti-fungal properties. According to the study, betel vine's aqueous extract lessens the adhesion of early dental plaque bacteria.<sup>[7]</sup> Additionally, both in vitro and in vivo models of prostate cancer have shown betel to have strong anti-proliferative action.<sup>[8]</sup> The most prevalent phytochemical found in betel leaves, hydroxychavicol, contributes to the antiproliferative effectiveness of betel leaf extract. This betel leaf phenolic substance prevents prostate cancer by inducing DNA damage brought on by ROS and apoptosis.<sup>[6]</sup>

Pinene, Safrole, Eugenol, Selinene, Hydroxychavicol, Cadinene, and Caryophyllene are a few of the leaf oil's key components. Table 1 lists the major betel leaf oil reported ingredients along with their CAS numbers, chemical formulas, molecular weights, and stated uses. The essential components of *P. betle* have developed into a reliable source of income and a means of obtaining foreign cash for the nation. The primary criterion used by betel manufacturers to classify their products in the marketplace is the size and color of the betel leaf. Five significant families of betelvine landraces, including Bangla, Kapoori, Meetha, Sanchii, and Desawari, have been identified based on the chemical components of the leaf essential oils.<sup>[9]</sup>



**Fig. 1: Betel plant.**<sup>[77]</sup>

Based on morphological traits and the content of essential oils, there are five main groupings of betel vine cultivars. Sharp flavour and a pale yellow fragrant essential oil are present. There are more than 90 different types of betel vine in the world, with roughly 45 of them being found in India and 30 in West Bengal itself. For its evergreen leaves, which are utilized in religious ceremonies and poojas and serve as a chewing stimulant, it is cultivated in tropical and subtropical regions.<sup>[10]</sup>

The leaves are combined with the areca nut (which is incorrectly referred to as the "betel nut" by association) and mineral slaked lime (calcium hydroxide) and chewed as a wrapped bundle. Other flavourings and spices may

be used along with catechu, known as kattha in Hindi. The lime maintains the active component in its freebase.

It can enter the bloodstream through sublingual absorption when it is in freebase or an alkaline form. The stimulant arecoline, which induces salivation and causes the saliva to be tinged red, is found in areca nuts. A "betel quid" is the term for this mixture, which has been around for a very long time. The *Piper* genus of plants is also used for a variety of other things, including food & spices, fish bait, fish poison, hallucinogens, pesticides, oils, decorations, and perfumes 3, 4. Due to its strong flavour, it is a potent anti-worm and great anti-infectious agent.

Due to its light qualities, it aids in restoring the digestive tract's natural function and is hence particularly useful in maintaining the digestive system. Additionally, it aids in clearing the mucus from the infusion made from the leaves and stems, which is also said to be effective in treating asthma, bronchitis, constipation, coughs, and indigestion. Children with dyspepsia and cough are treated systematically with leaf juice. There is a lot of potential information about *Piper betel* and its activities, such as its anti-malarial, anti-bacterial, anti-fungal, insecticidal, antioxidant, anti-diabetic, gastroprotective, anti-nociceptive, cytotoxic, anti-platelet, etc., that has been revealed by numerous research investigations to date.<sup>[11]</sup>

### 1.1 History

The *piper betel* plant, which God created and gave the shape of his own heart to, is blessed because it is both perennial and evergreen. Even before regular and organized agriculture began to be practiced, anthropologists have discovered betel traces in the spirit caves of Northwest Thailand dating as far back as 5500–7000 BC.

Similar discoveries dating back to 3000 BC have been made in Timor, Indonesia, and in the blackened teeth of a human skeleton discovered in Palawan, the Philippines, back to 2600 BC.

It had been included in the oldest historical work on Sri Lanka, the Palli-written "Mahawamsa." In Thailand, Myanmar, and Indonesia, some seasoned betel chewers have been discovered with blackened teeth as a result of many years of chewing. It is unknown when these two various stimulant ingredients were initially combined, however there is archeological evidence that betel leaves and areca nuts have been chewed together since very ancient times. It may therefore be challenging to pinpoint the exact time when the custom of chewing paan first began.<sup>[12,13]</sup>

However, the fact that it is mentioned in both the Raghuvamsa and the Kamsutra of the Vatsyayana attests to the practice's age. The social standing of pan can also be understood by the fact that in ancient India, receiving

paan bida, which is a pair of leaves stuffed with churna (lime), kattha (catechu), and supari (areca nut), from kings and nobility, was seen as a great honor. Words like Tambuladhikara, Tambuladyaka, Tambuladayini, and Tambulika, etc. were employed at this time (about 600

AD) in various works. Kadamberi mentions a few of the typical applications. In the Sakta-tantra, paan is mentioned as one of the ways to get siddhi. No siddhi was thought to be possible without chewing betel and providing paan to the Guru.<sup>[14]</sup>

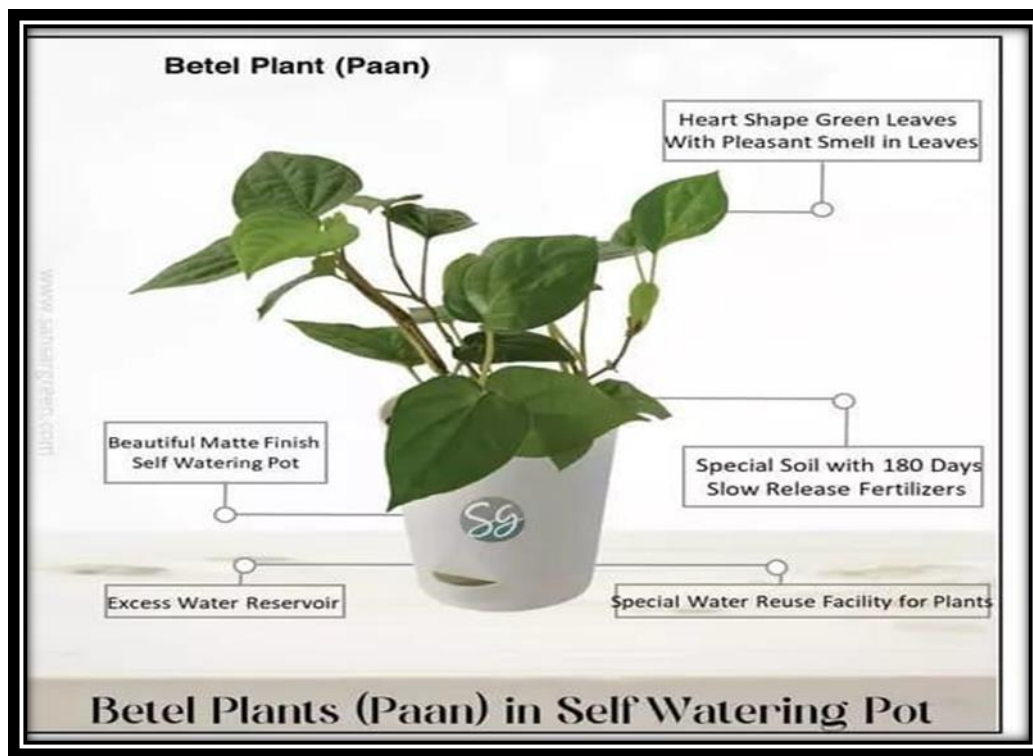


Fig. 1: Betel plant in self-watering pot.<sup>[18]</sup>

### 1.2 Ayurvedic Significance

*Piper betel* is a Vedic plant in the Vedic name Saptasira and the Sanskrit labels Tambool, Nagvelleri, and Nagani. It was used as therapy for a number of ailments. From Vatsyayana's Kamasutra and Panchatantra all the way to Kalhan's Rajatarngni (perhaps the last documented old Sanskrit writing of historical relevance), mentions to Tambool can be discovered. Tambool has thus roughly referred across a period of about 2000 years. In Ayurveda medicine system, the properties of betel leaf described as given below:<sup>[12,13]</sup>

Guna (Quality): Laghu, Ruksha, Tikshan

Rasa (Taste): Tikt

Vipak (Metabolism): Katu

Virya (Potency): Ushan

Prabhav (Impact): Hridy

Additionally, to its solitary usage as medicine, betel leaf extract is widely employed in Ayurveda as an adjuvant and blended with pharmaceuticals, possibly for better benefits. Tambola leaves have been defined in the Sushruta Samhita as aromatic, sharp, hot, acrid, great for the voice, a laxative, and an appetizer, in addition to the fact that they comfort Vata and promote pitta.<sup>[14]</sup>

### 1.3 Synonyms<sup>[15]</sup>

- Betel pepper.
- True pepper.

- Pepper vine.
- Piper.

### 1.4 Morphology of piper betel<sup>[16]</sup>

- Colour: Deep green colour
- Shape: Heart shaped
- Length: 15-18 cm long width: 10cm
- Odour: Aromatic
- Margin: Entire margin
- Apex: Acute
- Base: Symmetric base

## 2. HEALTH EFFECT

Epidemiological studies in India have shown a strong connection between chewing betel quid containing tobacco, areca nuts, limewater and betel leaf to the occurrence of cancer.<sup>[19]</sup> Chewing paan (betel quid) is strongly associated with a higher risk of developing head.



Fig. 3: Heals Injuries And Wounds.<sup>[22]</sup>

And neck cancer, as well as oropharyngeal squamous cell carcinoma (OPSCC), a form of cancer that affects the mouth, tonsils, and throat.<sup>[20,21]</sup> Tests have been conducted to confirm the carcinogenicity/mutagenicity of betel or its constituents. Betel leaf extract alone showed no adverse effects. Smokeless tobacco products have been shown to be mutagenic and carcinogenic. Research conducted in Japan found that laboratory rats that ate betel<sup>[23,24]</sup> leaves and areca nuts had severe thickening of the upper part of the digestive tract. to be the highest for those using any form of tobacco.<sup>[25]</sup> International Agency for Research on Cancer (IARC) and the World Health Organization (WHO) accept the scientific evidence whereas after a diet of betel leaves alone, only one laboratory rat developed a forestomach papilloma.<sup>[26]</sup> Multiple studies demonstrate that betel quid without added tobacco also causes oesophageal cancer, and in some instances, liver cancer. In a cancer diagnosis patterns study with patients<sup>[27]</sup> that chewed betel quid with different ingredient combinations, the risk was found that chewing tobacco and areca nut is carcinogenic to humans.<sup>[28,29,30,31]</sup> As with chewing tobacco, chewing betel quid with tobacco and areca nut is discouraged by preventive healthcare efforts.<sup>[21]</sup> Betel leaf alone has been reported to have beneficial effects, in part due to its antimutagenic activity against mutagens (tobacco and areca nut).<sup>[19]</sup> Although early studies suggested a possible mutagenic role for betel leaf in the development of oral

cancer, subsequent studies 200 million have shown that betel leaf contains compounds that play an antimutagenic role.<sup>[32,19]</sup>

### 3. CHEMICAL CONSTITUENT

The chemical composition of betel leaves varies by geographical region and is mainly chavibetol.<sup>[33, 34]</sup> Safrole is the main ingredient of Sri Lankan betel nut.<sup>[35]</sup> Eugenol, isoeugenol, and germanacene D are other compounds that predominate in other chemotypes.<sup>[36]</sup> The stem contains phytosterols (beta-sitosterol, beta-daucosterol, stysterol, etc.), alkaloids (piperine, pellitorine). The leaves also contain eugenol, chavicol, hydroxychavicol and caryophyllene.<sup>[37,38]</sup> piperidardine, guinein, etc.), lignan (pinosresinol) and other biologically active ingredients. Some of them are Oleanolic Acid, Dehydropipernaline, Piperolein-B, Bornyl cis-4Hydroxycinnamate and Bornyl p-Coumarate. The roots contain aristololactam A-II, a new phenylpropene, 4-allyl resorcinol and a diketosteroid stiryst-4-en-3,6-dione. The essential oil consists of 50 different compounds, the main components being eugenol, caryophyllene, terpinolene, terpinene, cadinene and 3-carene.<sup>[39]</sup>

### 4. ECONOMICS

In India, a 2006 study reported<sup>[41]</sup> that betel was grown on about 55,000 hectares of agricultural land, with annual production worth about Rs. \$9 billion (\$total, or an average of \$1,455 per acre). 400,000 to 500,000 farming families. A March 2011 report stated that betel cultivation is declining in India.<sup>[41]</sup> Although under ideal conditions, some farms can generate a gross annual income after expenses exceeding Rs IN. With an income of \$26,000 per farm to 10 decimal places (\$5,780 per acre), betel farm income is highly erratic from year to year., due to variations in rainfall and temperature and degradation rates of 35-70% during transportation on poor infrastructure.<sup>[42]</sup> At the same time, demand for betel leaves declined in India as consumers adopted gutkha (chewing tobacco) instead of the preparation "paan" made from betel leaves;<sup>[44]</sup> the report cited that the betel leaf trade had decreased by 65% from 2000 to 2000. 2010 and created an oversupply situation. As a result, the report claims that Indian farmers no longer find betel cultivation profitable.<sup>[41]</sup>



Fig. 4: A Bengali Women Selling Betel Leaves In Howrah.<sup>[43]</sup>



Fig. 5: Betel Leaves For Selling In The Market.<sup>[40]</sup>

## 5. DISTRIBUTION

Southeast Asia, particularly Indochina (Vietnam, Cambodia, Laos, Thailand, and Myanmar), East Timor, the Lesser Sunda Islands, and Peninsular Malaysia is where the pipe beetle originally originated. In addition to Southeast Asia, Papua New Guinea and Melasia, Micronesia, South Asia, the Maldives, Mauritius, Reunion Island and Madagascar, its cultivation spread through Austrian migration and trade. The Caribbean also collected it during colonial rule.<sup>[45,46]</sup>

## 6. CULTIVATION

Betel leaf is grown mainly in south and southeast Asia from India to Papua New Guinea. Needs a suitable tree or long pole for support. Betel needs well drained, fertile soil. Watery, salty and alkaline soils are not suitable for its cultivation.<sup>[47]</sup> In Bangladesh, farmers called barui prepare a garden called baruj where Figure 11: Betel plant cultivation in Bangladesh<sup>[49]</sup> betel is grown. Baruj is bordered with bamboo sticks and coconut leaves. The soil is plowed in furrows 10-15 m long, 75 cm wide and

75 cm deep. Oil cakes, manure and leaves are thoroughly combined with topsoil and wood ash in furrows. The cuttings are planted at the beginning of the monsoon season. Proper shade and irrigation are essential for the successful cultivation of this crop. Betel needs constantly moist soil, but there should not be excessive moisture. Watering is frequent and light, and standing water should not remain for more than half an hour. Dried leaves and wood ash are spread in the furrows every two weeks and a spray of cow dung. A monthly spread of different leaves is believed to be beneficial for the growth of betel. In three months, the vines reach a height of 150-180 cm and branch out. Harvesting begins when the farmer plucks a leaf and its stem with his right thumb. Harvesting takes from 15 days to one month. Betel plant has entered the research laboratories of many chemical and food companies in Bangladesh. Harvested leaves are consumed locally and exported elsewhere in Asia, the Middle East, Europe and the Americas. Betel is cultivated and grown as an important crop in rural Bangladesh.<sup>[48]</sup>



Fig. 6: Betel Plant Cultivation in Bangladesh.<sup>[48]</sup>

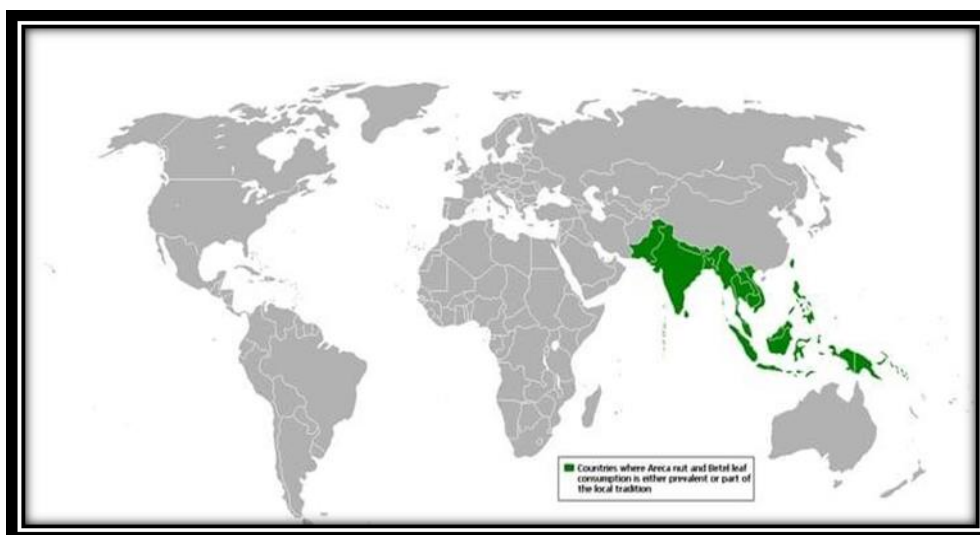


Fig. 7: Betel Leaf and Areca Nut Consumption In The World.<sup>[50]</sup>

## 7. Scientific classification<sup>[51]</sup>

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms
- Clade: Magnoliids
- Order: Piperales
- Family: *Piperaceae*
- Genus: *Piper*

## 8. Nutritional Value of Betel Leaves<sup>[52]</sup>

The value of betel leaf nutrition is given in the table below:

**Table 1: Nutritional Value of Betel Leaves.**

Nutritional Component	Composition
Water	85-90%
Protein	3-3.5%
Fat	0.4-1%
Minerals	2.3-3.3%
Fibre	2.3
Calcium	0.2-0.5%
Vitamin C	0.005-0.01%
Essential Oil	0.08-0.2%
Carbohydrate	0.5-6.1%
Potassium	1.1-4.6%

### 8.1 Properties of Betel Leaves<sup>[53]</sup>

Betel Leaves may possess the following properties:

1. It may protect against cancer
2. It may be an antioxidant
3. It may prevent the growth of fungi
4. It may protect against allergic reactions
5. It may heal wounds
6. It may be used in case of constipation

### 8.2 Side Effects of Betel Leaf<sup>[54]</sup>

Betel leaves may have side effects when consumed with tobacco, lime, and areca nuts, as follows:

1. May cause substance dependence
2. May cause a feeling of euphoria
3. May cause sweating
4. May cause salivating

### 8.3 Traditional importance

The betel leaf is mainly used as a wrapper for chewing areca nut (or nowadays tobacco), where it is mostly used for flavoring. This practice originated in the Philippines about 5,000 years ago (where the oldest remains of calcium from areca nuts and crushed shells were found in the archaeological site of Duyong Cave). It spread with the Austronesian migration to the rest of Southeast Asia, Taiwan, South China and South Asia. However, it is not known when or why betel leaves became associated with areca nuts, as areca nuts can also be chewed alone.<sup>[55]</sup>

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In India and Sri Lanka, betel leaves are traditionally offered as a sign of respect and an auspicious beginning. Remedies include greeting parents at wedding ceremonies, celebrating the new year, and offering rewards to doctors and astrologers (who are offered money and/or areca nuts on a bunch of leaves in gratitude for their blessings). In a Bengali wedding, the bride is brought to the groom, she sits on a chalice and her face is covered with betel leaves. In Papua New Guinea and the Solomon Islands, the flowering stem of the betel tree known as deka or "mustard stick" is consumed along with the leaves.<sup>[56,57]</sup>

Due to its peppery taste, it can also be used in cooking, usually raw. The use of Binglang, or betel, dates back more than 300 years in areas of China where it was once promoted for medicinal use.<sup>[58]</sup>

## 9. PHARMACOLOGICAL ACTIVITY

### 9.1 Analgesic activity (headache)

Betel leaves may have a cooling effect and analgesic (pain-relieving) qualities. It can be used to reduce the discomfort of very bad headaches. Checking betel leaves' impact on headaches will require more research with both humans and animals. You must see a doctor if you have a persistent headache or excruciating pain.<sup>[2]</sup>

### 9.2 Anti-cancer activity

The body may be protected from cancer by betel leaves' potential anti-cancer qualities. Studies have revealed that betel leaf extract contains phenolic-related substances that may have the ability to stop the formation of malignant cells. Betel leaves together with tobacco and betel nuts are a factor that increases the risk of oral cancer. However, it should be noted that the betel leaf alone is full of valuable phenolic compounds with antioxidant, mutagenic and anti-proliferative properties. Apart from these, betel leaves are also rich in phytochemicals that have anti-cancer properties.<sup>[65],[2]</sup>

### 9.3 Anti-fungal activity

The bioactive chemical hydroxychavicol (polyphenol) found in betel leaves, which can suppress the growth of fungi, may be utilized to treat fungal infections. Betel leaves are used as a topical antifungal or as a mouthwash to treat oral fungal infections.<sup>1</sup> However, additional research on the antifungal action of betel leaves in people is necessary. In case of a possible fungus infection.<sup>[2]</sup>

### 9.4 Anti-diabetes Activity

Several studies have shown that betel leaf powder can reduce blood sugar in newly diagnosed type 2 diabetics. Betel leaf is a powerful antioxidant that helps fight oxidative stress and reduce inflammation caused by

uncontrolled blood sugar and supports the treatment of diabetes.<sup>[2]</sup>



Fig. 8: Manages Diabetes.<sup>[78]</sup>

### 9.5 Analgesic activity

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.<sup>[59]</sup>

### 9.6 Laxative activity

Antioxidants found in betel leaves are potent and help the body get rid of free radicals. It treats an upset stomach by bringing the body's PH levels back to normal. Eating betel leaves is highly advised in Ayurveda to ease constipation. Crushed betel leaves should be soaked in water overnight. Drinking water first thing in the morning on an empty stomach will help with bowel motions.<sup>[59]</sup>

### 9.7 Improves Digestion

Ever wonder why one chews on a betel leaf after a satisfying meal? It is advised because to its carminative, intestinal, anti-flatulent, and other protective benefits for the gut qualities. Betel leaves stimulate the intestines and promote metabolism, causing circulation to increase.<sup>[60]</sup>

### 9.8 Lungs infection relives activity

Cold and cough-related problems are frequently treated with betel leaf. Asthma, chest tightness, and lung congestion can all be effectively treated with it. To relieve congestion, reheat a leaf with some mustard oil and apply it on your chest. You can also boil a few leaves in water with cardamom, cloves, and cinnamon. For fantastic relief from congestion and respiratory problems, reduce it to 1 cup and take this mixture two to three times each day.<sup>[61]</sup>

### 9.9 Antiseptic activity

Because they are rich in polyphenols, particularly chavicol, betel leaves have exceptional antibacterial

capabilities that provide double protection from pathogens. It is also often used to treat orchitis and arthritis.

The amazing antifungal capabilities of this substance offer immediate relief from fungus infections. Applying betel leaf paste to the affected area destroys the fungus that is causing the ailment.<sup>[62]</sup>

### 9.10 Anti-bacterial activity

Betel leaves contain a variety of antibacterial compounds that successfully attack a wide range of oral bacteria that cause bad breath, cavities, plaque buildup, and tooth decay. After meals, chewing a small amount of paan leaf paste improves gut health while also treating toothaches, gum discomfort, swelling, and oral infections. It also reduces bad breath and mouth Odor.<sup>[63]</sup>

### 9.11 Anti-inflammatory activity

Betel leaves contain a wealth of anti-inflammatory compounds that significantly reduce joint pain – a telltale sign of many chronic debilitating diseases such as rheumatoid arthritis, osteoporosis and more. By heating and binding fresh betel leaves tightly, diseased bones and joints significantly reduce the intensity of pain, inflammation in the area and alleviate the symptoms of arthritis. According to certain studies, paan leaves have natural anti-inflammatory properties. Paan leaves can reduce inflammatory conditions such as arthritis and asthma, which are often triggered by a histamine compound.<sup>[70][64]</sup>

### 9.12 Anti-depressant activity

Betel leaves have been used throughout the ages as a natural medicine to stimulate the central nervous system. The aromatic phenolic compounds in betel leaves stimulate the release of catecholamines, which promote a sense of well-being and elevate mood.

Hence, chewing betel leaves alone is an easy way to beat depression.<sup>[66]</sup>

### 9.13 Anti-hypertensive activity

High cholesterol is a risk factor for heart disease and stroke. Studies have shown that betel leaf helps lower total cholesterol, triglycerides, low-density lipoprotein (LDL) cholesterol, and high levels of very low-density lipoprotein (VLDL) cholesterol. In addition, it also helps to raise the level of HDL cholesterol. This lipid-lowering effect of betel leaf is due to the presence of eugenol, a natural antioxidant that neutralizes free radicals. Eugenol further inhibits cholesterol biosynthesis in the liver and reduces intestinal lipid absorption. This further increases the catabolic rate of "bad" LDL cholesterol. High levels of cholesterol and triglycerides are mobilized from the plasma to the liver and later removed in the form of bile acids. Thus, betel leaves help lower high lipid levels through various mechanisms.<sup>[67]</sup>

#### 9.14 Anti-microbial activity

The essential oil in betel leaves has antibacterial activity against pathogenic bacteria namely *Escherichia coli*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Additionally, the phenolics and phytochemicals in betel leaves help protect against both gram-positive and gram-negative bacteria.<sup>[68]</sup>

#### 9.15 Wound Healing activity

Studies have found that betel leaves help in the wound healing process. In addition, betel leaf extract has been found to have a very strong effect on wound healing in burns. Increased levels of oxidative stress slow wound healing. Betel leaf is an excellent source of antioxidants. These antioxidants reduce oxidative stress and further promote rapid wound healing.<sup>[68]</sup>

#### 9.16 Anti-malarial activity

Research has shown that in ancient times, betel leaves were used as an antimalarial medicine in rural Malaysia. Terpenes, a health-promoting compound found in betel leaves, have anti-malarial properties. Flavonoids in betel leaves have significant antiparasitic activity against

various malaria parasites. Thus, betel leaves contain new antimalarial compounds that can be used to fight malaria.<sup>[68]</sup>

#### 9.17 Anti-asthmatic activity




Asthma is considered an inflammatory condition. Betel leaf has antioxidant and anti-inflammatory properties, so it helps in the treatment and cure of asthma. Histamine is a neurotransmitter that plays an important role in causing asthma. Histamine causes bronchoconstriction, a hallmark of asthma, where the airways in the lungs narrow due to the contraction of smooth muscle. Studies have shown that the antihistamine effect of betel leaf can cause a reduction in the incidence of bronchial asthma.<sup>[68]</sup>

#### 9.18 Antioxidants activity

Bread leaves are naturally full of minerals and antioxidants such as flavonoids and phenolic compounds. These antioxidants help protect the body's cells from damage caused by harmful free radicals. Regular consumption of paan leaves can promote general well-being and prevent some chronic diseases.<sup>[69]</sup>

### 10. HOME REMEDIES OF BETEL LEAVES

Table 2: home remedies of betel leaves.

Sr.no.	Part used	Name of recipe	Photo	Use	Reference
1	Leaf	Betel leaf flavour cham cham	 <p>Fig. 9: Betel Cham Cham.</p>	Diigestive	70
2	Leaf	Coconut gulkand Ladoo	 <p>Fig. 20: Gulkand Ladoo.</p>	Anti – inflamatory	71
3	Leaf	Paan leaf dosa	 <p>Fig. 31: Paan Leaf Dosa.</p>	Food beverages	72



4	Leaf	Betel leaf sharbat	 A photograph showing three glasses of a green, frothy beverage (sharbat) served in a traditional copper or brass tray. Fresh green betel leaves are placed next to the glasses.	Soft drink Varietys	73
5	Leaf	Betel leaf fried rice	 A photograph of a plate of fried rice, garnished with finely chopped green betel leaves.	Food beverages	74
6	Leaf	Paan modak	 A photograph of several green, round, textured sweets (modaks) arranged on a decorative metal plate, garnished with pink and orange flowers.	Food beverages	75
7	Leaf	Paan shots	 A photograph of four glasses filled with a light green beverage (paan shots), each topped with a red decorative drizzle. The text 'Paan Shots' is overlaid at the top of the image.	Soft drink Varietys	76

## CONCLUSION

This review makes it quite clear that betel leaf includes a variety of phytoconstituents, indicating its potential applications for a range of medical conditions. The plant or any of its constituent parts can be used to treat a variety of illnesses in people, including diabetes, microbial infections, fungal infections, inflammation, antihistaminic, antiulcer, and local anesthetics. The betel leaves are actually an inexpensive, readily available, natural appetizer that is also mildly stimulating, aphrodisiac, and masticatorily refreshing. Even so, a great deal of research is needed to understand the betel leaf's mode of action in relation to other medicinal uses.

This sufficiently explains why it is referred to be the "Nutritious Leaf" and the "Green Gold of India." Betel leaves' safety profiles and antibacterial and antifungal qualities strongly encourage their use in the creation of a variety of goods, particularly in the food and pharmaceutical industries. The employment of betel leaves in the manufacturing of contemporary commercial items has the potential to boost the income of regional farmers, particularly in Asia. Furthermore, clinical research ought to be done to bolster the application of betel leaves in the medical domain. Collaboration between researchers, the government, and manufacturers might make this important work easier.

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