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# Medicinal values of betel leaves and its application in food products: A review

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**Abstract**
Betel is recognized as health promoting food due to presence of essential components such as minerals and vitamin usually calcium, carotene, thiamine, riboflavin, niacin, and vitamin C. Apart from it contain many essential amino acids as well as flavonoids and polyphenolic content. Due to its potential health benefits it is so far part of many food products such as noodle, dairy beverages and many food products. Overall this review provides a brief knowledge about the valuable phytochemicals and bioactive compounds present in betel, medicinal significance and its food application.

**Keywords:** betel, antioxidant, nutrition, food product, antimicrobial

## 1. Introduction
Betel leaves are the leaves of a betel plant that is both evergreen and perennial creeper. The fresh leaves of betel vine are popularly known as Paan in India. It belongs to the family *Piperaceae.* There are about 100 varieties of betel plant currently available in the world, of which about 40 had originated in India and 30 in West Bengal. It's plant are being grown in India, Bangladesh, Sri Lanka, Malaysia, Thailand, Taiwan and other nations of South East Asia. The key varieties produced in the states of Indian states are West Bengal is Bangla, Satchi Mitha (Guha, 2006) [11]. There are also some other variety in parts of the India like calcuttia, Saunfia Pan, Vishnupuri Pan in Madhya Pradesh, desawari, Benarasi in Uttar Pradesh, Kapoori tuni in Andhra Pradesh etc. (Seetha Lakshmi and Naidu, 2010) [31].
The betel plants are cultivated throughout India except the dry northwestern parts. It is best cultivated under the shaded and in tropical forest ecological conditions allowing rainfall of about 2250-4750 mm, relative humidity and temperature ranging from 40-80% and 15-40°C respectively. The soil condition should be well-drained fertile sandy or sandy loam or sandy clay soil with pH range of 5.6 –8.2 required for its cultivation (Guha and Jain, 1997) [10, 12]. When the case of less rainfall (1500- 1700 mm) areas the crop is cultivated under monitored irrigations, i.e. each day in summer and after 3-4 days interval time in winter time. However, for better production of the crop in rainy season adequate drainage is required (Mishra *et al.,* 1997) [17]. The betel leaves are popular known as "Paan" in India. After dinner betel leaves are also used as a mouth freshener. The leaves of *betel* have long been use in the Indian local system due to its medicinal properties. In ancient India, betel leaves are found auspicious and are still applied as part of our religious functions. It helps in curing various diseases like hypertension, diabetes, brain toxin, boils and abscesses, headache, leucorrhoea, cuts and injuries, ringworm infestation, swelling of gum, voice problems, rheumatism, wound healing, obesity, conjunctivitis, constipation, abrasion *etc*. (Aishwarya *et al.,* 2016) [2]. The current review was studied in light of health benefits of betel leave and its usefulness in various food products.

**Fig 1:** Betel leaf

### 1.1 Scientific Classification of betel leaf

Synonyms: Chavica Beta. Artanthe Hixagona
Kingdom: Plantae
Order: Piperales
Family: Piperaceae
Genus: Piper
Species: P.Petle
Test: Pungent tasting and warming.
Division: Magnoliphyta

### 1.2 Historical background of betel leaf

Studies done by Anthropologists have obtained traces of betel in Northwest Thailand in 5500- 7000BC. There is ample confirmation that the betel leaves and Arica nut have been used together from very ancient times but its origin time is still unknown. It is quite difficult to exactly predict the time when paan chewing tradition came into practice.

## 2. Nutritional fact about of betel

Betel leaves have tremendous health benefits due to many health promoting constituents. An analysis conducted on about its nutritional facts of betel leaf; it has 85.4% of moisture, 3.1% of protein, 0.8% of fat, 2.3% of minerals, 2.3% of fiber, and 6.1% of carbohydrates per 100 grams. Betel is good source of minerals and vitamin including calcium, carotene, thiamine, riboflavin, niacin, and vitamin C. Its calorific value is 44 kcal/100g. The leaves include extremely the enzymes catalase and diastase. There are many all amino acids present in betel leaves except lysine, histidine, arginine (Guha, 2006) [11].The leaves also contain significant amount flavonoid and polyphenolic content (Durgaprasad *et al.,* 2011) [8]. The aroma characteristics of betel leaf are due to the occurrence of essential oils, consisting of phenols and terpenes. The various terpenoids in betel leaf includes 1, 8-cineole, eugenol, cadinene, limonene, pinene, ally pyrocatechol, carvacrol, camphene, caryophyllene, Chavicol, safrole and chavibetol (Mazumdar *et al*., 2016) [16].

**Table 1:** Chemical compounds present in betel leaf and its uses

| Betel leaf bioactives | uses |
|---|---|
| a-Pinene | Anti-inflammatory and antibiotic |
| Camphene | fragrances and food additive for flavouring use |
| Sabinene | Antimicrobial properties |
| Myrcene | fragrances and food additive |
| A-Terpinene | Cosmetics and food |
| B-Phellandrene | Cosmetics and personal care |
| B-Ocimene | Perfume |
| Terpinolene | Perfumes and food additive |
| Cis-sabinene | Anti-Infective Agents |
| Terpineol-4 | disinfectants |
| Safrole | Beverages and candy preparation |
| Eugenol | Antiseptic and anaesthetic |
| Iso-safrole | Fragrance |
| B-Bourbonene | Flavour and fragrance agents |
| B-Elemene | Antiproliferative effect, chemotherapy for cancer treatment |
| Methyl Eugenol | Fragrance ingredient |
| Caryophyllene | Antioxidant, anti-inflammatory, anti-cancerous |
| Aromadendrene | Antioxidants and anti ageing |
| B-Farnesene | natural insect repellent |
| A-humulene | Anti-inflammatory, effective in reducing platelet activating factor |
| Methyl isoeugenol | Flavour and fragrance agents |
| Germacerene-D | Analgesic and anti-inflammatory properties |
| B-Selinene | Antibacterial chracteristics |
| A-Selinene | Aroma |
| A-Farnesene | Plant defence |
| Hydroxychavicol | Antimutagenic effect |
| Eugenyl acetate | Anti-virulence significance |
| A-Cadinene | Anticancer activity |
| Germacerene-B | Antimicrobial and insecticidal properties |
| E-Nerolidol | Flavouring property |
| Spathulenol | Antibacterial activity |
| Globulol | Antimicrobial activity |
| Chavibetol | Aromatic compound with a spicy odour |
| Allylpyrocatechol Diacetate | Antimicrobial activity |
| 1,8-Cineol | treatment of inflammatory diseases |

**Source:** Das *et al.,* (2016) [7]

## 3. Medicinal importance of betel leaf

### 3.1 Traditional Use

The traditional use of Betel leaf is signified for curing various diseases like bad breathing smell, boils and abscesses, conjunctivitis, constipation, headache, itches, mastitis, mastoiditis, leucorrhoea, swelling of gum, rheumatism, cuts and injuries (Agarwal *et al.,* 2012) [1]. Leaves are considered useful in treating bronchitis and dyspnea (Mula *et al.,* 2008) [19]. (Sarkar *et al.,* 2000) [30] studied the antimicrobial, antifungal, antiseptic and antihelminthic effects in fresh betel leaves.

### 3.3 Other biological uses

#### 3.3.1 Anti diabetic activity

Betel leaves possessing nutraceuticals for preventing diabetes mellitus in patients. Bhattacharya *et al.,* (2005) [5] demonstrated the possibility of betel extracted by hot water extract for treatment for type 2 diabetes patients.

#### 3.3.2 Antioxidants Activity

Betel leaf extract containing polyphenols compounds like chatecol, allylpyrocatechol responsible for antioxidant activity. Manigauha *et al*., (2009) [15] observed that the methanolic extracts of the betel leaves possess reducing power, DPPH radical and superoxide anion scavenging and deoxyribose degradation activities. Lei *et al.*, (2003) [14] have reported scavenging $H_2O_2$, superoxide radical and hydroxyl radical by aqueous extract of betel leaves.

#### 3.3.2 Anti-cancer effect

The betel leaves have also been reported to own anti carcinogenic properties and it destroys tobacco carcinogens due to existence of the bioactive components as hydroxychavicol and chlorogenic bioactives (Amonkar *et al.,* 1989) [3].

#### 3.3.3Antifertilityeffect

Research reported that betel extract can be used to decrease in reproductive organ weights, circulating level of estrogen, fertility, serum glucose concentration (Priya *et al.,* 2012) [24].

#### 3.3.4 Antimicrobial

The antimicrobial activity of betel leaves have been illustrated against *Streptococcus pyogenes, Staphylococcus aureus, E.coli, Pseudomonas aeruginosa etc.* Apart from this the bactericidal activity of leaf extract have also signified against pathogenic bacteria such as *Enterococcus faecalis, Citrobacter koseri, Citrobacter freundii, Klebsiella pneumoniae* etc (Chakraborty *et al.,* 2011) [6] present in the urinary tract. The bioactive molecule sterol is responsible for anti-bacterial activity.

#### 3.3.5 Cardiovascular and platelet inhibition activity

Betel Chewing induces secretion from catecholamine from the adrenal cortex that may have affect on the stamina, blood glucose, heart rate, and neural activity in our body. The bioactive isolated from betel leave i.e. piper betol, ethylpiperbetol, piperol may inhibit the platelet aggregation (Pisar *et al.,* 2007) [23].

### 4.0 Recent investigations in the areas of extraction of betel bioactive

Betel leaf was extracted by various solvents (methanol, ethanol, acetone, and ethyl acetate) to estimate the antimicrobial and antioxidant activities, phenol content, and -amylase inhibitory. On the basis of the study methanolic and ethanolic extracts (90%) showed maximum phenolic contents (205.2 and 202.9 mg GAE/g, respectively) and the highest DPPH scavenging activity was exhibited by 90% ethanol (Nourie *et al*., 2014) [21]. Taukoorah *et al.,* (2016) [34] investigated the extraction of betel leaves with ethanolic (EE), ethyl acetate (EAE), acetone (ACE), and dichloromethane (DCME) and its extracts was established the synergistic effect with antibiotics. Muruganandam *et al.,* (2017) [20] optimized parameters for the extraction of components from Betel leaves using ethanol by Soxhlet apparatus. The Optimum conditions for (10.94%) betel extract are 2 g betel leaves, ethanol (281.4 ml), temperature (72 °C) and time (3 hours). Fourier transmission Infrared spectroscopy (FTIR) and Gas chromatography mass spectroscopy (GCMS) analysis of betel leaf extract indicated the presence of Hydroxy chavicol (69.46%), 4-Chromanol (24%) and eugenol (4.86%), that has antioxidant, anti-inflammatory, anti-platelet and antithrombotic, antibacterial and antifungal activity.

### 5. Food applications

The global functional foods and beverages market value was 129.39 billion US Dollar in 2015 and is growing at rate of about 8.6% annually. The food applications of betel have been investigated by various researchers due to established effect of their antimicrobial, antioxidant, color, flavor and nutritional aspect (Table 2).

**Table 2:** Applications of betel leaf in Food products

| Food Products | Observations | References |
|---|---|---|
| Whey based mango beverages | Sensory analysis of product includes colour and Appearance, Flavour and Mouthfeel | Mugale *et al.,* (2018) [18] |
| Ladoo and Namkeen, cutlets | Sensory acceptable | Bhargava and Tyagi (2011) |
| Noodle | Noodles added with (0, 5, 10, 15, and 20%) betel leaf extract of flour weight). The hardness, elongation, adhesiveness, color, and sensory evaluation noodles evaluated | Nourie *et al.,* (2015) [22] |
| Spray drying of whey protein and betel leaves | Dried betel powder was investigated in terms of moisture content, powder yield and hygroscopicity. The processing parameters: inlet hot air temperature (120° C to 160°C), feed flow rate (4 ml/min to 15 ml/min), and whey protein isolate (5 - 20 w/v %) | Heng *et al*., (2013) [13] |
| Dahi | Dahi prepared with 0.5% betel leaves extract had showed reduced firmness and consistency compared to the control | Sivakumar and Dhanalakshmi (2016) [32] |
| Preservation of milk | antimicrobial and antioxidant activity, proximate composition | Sivakumar and Dhanalakshmi (2017) [33] |
| Khakhra | Shelf life study based on sensory evaluation khakhra were acceptable upto 60days | Vernekar *et al.,* 2018 [35] |
| Shrikhand | Goat milk shrikhand blended with sapota pulp and betel leaf extract. Study of sensory evaluation was carried out. | Yadav *et al*., (2018) [36] |
| Tomato paste | essential oil microemulsion for growth of *Aspergillus flavus* | Basak and Guha (2016) [4] |

### 6. Shelf life of betel leaf by different drying methods

The shelf life of the betel leaves is 3-5 days in summer and 5-7 days in winter after harvesting time. It belongs to perishable commodity around 35-70% of post harvest losses estimated totally of gross production every year (Rao and Narasimham, 1977) [28]. The shelf life of betel leaf was dried by various

methods to preserve the betel leaf nutritional content. Betel leaf was dried under sun (28-38 °C), shade (25-32 °C), and solar (40 to 47 °C) and According to Rayaguru *et al.,* (2007) [29] there were appreciable losses of volatile oil 30-35% during sun drying than fresh one. Ramalaksmi *et al.,* (2002) [27] found during mechanical and microwave drying the loss of volatile oil and chlorophyll was approximately 50% and 70% respectively. Puteri Farah Wahida *et al.,* (2012) [25] optimized the temperature (30, 40, 70 °C) and vacuum pressure (1.0, 0.5 atm.) and optimized 50 °C best condition of drying irrespective of vacuum pressure. Rai *et al.,* (2010) [26] studied the modified atmosphere packaging for betel leaves and it was effective found to maintain the chlorophyll content, phenolic content, and β carotene content in polypropylene film packaging with partial pressures of 2.5 kPa for $O_2$ and 6.2 kPa for $CO_2$.

## 7. Future trend

This review highlights the great potential of medicinal and nutrients value occupied by betel leaves. The leaves are very nutritive and contain considerable amount of vitamins and minerals. The leaves also contain the enzymes like diastase and catalase. It is source of significant amount of all the essential amino acids except lysine, histidine and Arginine. It has significant health benefits due to antioxidant activity, antiulcer, anti diabetic, immunomodulatory, cardiovascular and anticancer. Due to these health benefits betel leaves have been utilized in various food products and products are well chemically stable and sensory acceptable. However such food application is limited available but betel bioactive would have potential to enlarge its use in various foods by its noteworthy health benefits.

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