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# Bay Leaf

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## 1. BOTANY

### 1.1 Introduction

Bay leaf (*Laurus nobilis*) (Fig. 5.1) is an evergreen perennial shrub that belongs to the laurel family (Lauraceae). It has been used for 1000 years, and it is an essential ingredient in cooking and in many traditional practices (Parthasarathy et al., 2008). The genus *Laurus* has a range of 24,00 to 25,00 species, and their varieties are native to the Southern Mediterranean region, the subtropics and tropics of Eastern Asia, South and North America, the Balkans, and Asia Minor. The great variability among species is largely attributed to the uncertainty in the exact number of species. Due to the morphology, flower color, growth habitat, leaves, stems, and chemical composition, variability is found. Two laurel species are traditionally found: *Laurus azorica* and *L. nobilis*. There are number of plants outside the genus *Laurus* with the common name bay laurel, including bay rum tree, or simply bay (*Pimenta racemosa*) (Akgül et al., 1989). *L. nobilis* is known by different names. In Urdu, it is known as teejh pat. In English, it is typically called bay leaf or sweet bay. In Arabic, it is known as *waraq ghaar*. In German, it is known as *lorbeer*. In Greek, it is



FIGURE 5.1 Bay leaf.

called *dafni*. In India, specifically in Hindi, it is called *teejpatta*. In Meghalaya, bay leaf unit production ranges from 30 to 70 kg per tree per year, but in Nepal, the average range is 13 kg of the dry leaves. About 900 tons of bay leaf are produced in Udaipur district, and 2100 tons are exported by Nepal to India (Choudhary et al., 2014). Aegean and Eastern Mediterranean regions are the biggest collection areas of bay leaf for export (Nurbaş and Bal, 2005). Turkey exported 4869 tons of bay leaf to the United States in 2002 (Deniz, 2012).

## 1.2 History/Origin

The origin of bay leaf is most probably South Asia, from where it spread to Asia Minor and all over the world.

## 1.3 Demography/Location

Bay leaf is grown in different ecologic and climatic conditions. Wet, sandy soil that has a large quantity of water or some moist atmospheric conditions close to the ocean shore are optimum and the best conditions for rapid luxuriant growth (Patrakar et al., 2012). In warmer weather, leaves may burn; therefore partial sun shade, well-drained sandy soil that has some moisture, and a pH range of 4.5–8.2 are preferred. Bay bears black fruit and yellowish-white fluffy flowers in warmer areas. Temperatures below 28°F and extensive freezing will kill the bay (Kemp et al., 1983). Bay is widely growing in the following countries: India, Pakistan, other Southeast Asian countries, some Pacific islands, Australia, around the coast of the Mediterranean and Southern Europe, Greece, Portugal, France, Turkey, Spain, Algeria, Morocco, Belgium, Central America, Mexico, Southern United States, and the Canary Islands (Parthasarathy et al., 2008).

## 1.4 Botany, Morphology, Ecology

Bay leaf is native to South Europe (Patrakar et al., 2012). It is a multi-branched, deciduous shrub having height up to 6–8 m and diameter up to 15–40 cm with smooth, thin, and brown bark containing a shady crown (Patrakar et al., 2012). Leaves are alternate, lanceolate, and bipinnate compounds with smooth or sharp margins 29–30 cm long containing 24 leaflets that are lanceolate, 4.8–4.9 cm long, and 1.7–1.8 cm wide with 0.5 cm long petiole. Flowers are ebracteate, four-lobed, white, scented, and small, having eight to 12 male stamens and two to four female staminoids, and the fruit is 10–15 mm, in small clusters, ovoid, thin pericarp enclosing spinach-green seeds and black when ripe. Calyx is pubescent having five clefts and five petals along with glabrous glands, free and white.

## 2. CHEMISTRY

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Bay leaf has a sharp and bitter taste. The difference in fragrance and aroma is due to the presence of essential oils in leaves and other parts of the plant. It has flavonoids, tannins, eugenol, citric acid, carbohydrate, steroids, alkaloids, triterpenoids, and essential oils. Antioxidant properties were discovered in the extract of bay leaf to have phenolic compounds. Each of these chemical constituents varies depending on the type of species. Tanine is a liquid glycoside derived from polypeptide and ester polymer that can be hydrolyzed by the secretion of bile (3, 4, 5–trinitrobenzoic acid) and glucose (Sumono, 2008). Tanine or tanat acid isolated from some part of plants can be found in the market. It is a cream-colored powder, aromatic, with astringent taste (Sumono, 2008). Tanine is used as an astringent for the gastrointestinal tract or skin and can cause precipitation of the cell membrane protein. It also has a little penetration activity, so it can influence the permeability of the cell membrane.

Bay leaf has traces of fats; (that is, a low amount is present) so it has low caloric value. It is also known as a good and main source of vitamin A and many minerals. One ounce of bay leaf gives 54 calories, 1–1.2 g protein, 12–13 g carbohydrates, a trace of fat, 1–1.5 mg of iron (Fe), 51–53 mg of calcium (Ca), 2000–3000 IU of vitamin A, 14–15 mg of vitamin C, and a small amount of potassium. Bay seeds are rich in dietary fibers. In bay leaf, compounds like eugenol (11%–12%), methyl eugenol (9%–12%), and elemicin (1%–12%) are significant for the spicy aroma of bay leaves, and for determining effective quality of bay leaf, these are used as significant influencers (Biondi et al., 1993). The essential oils in leaves vary from 0.8% to 3% and dry bay fruits from 0.6% to 10%. Structures of some active compounds found in bay leaf are given in Fig. 5.2.

## 3. POSTHARVESTING TECHNOLOGY

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Bay leaf can be harvested at any time of the year from a fully mature plant. Fresh bay leaves have a bitter and pungent taste; therefore before use, leaves should be dried. After picking the leaf, it should be left for 48–72 hours for drying. Better and deeper flavor is observed in freshly dried leaves. Harvesting should be avoided, when plant is wet.

## 4. PROCESSING

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Bay is consumed in a variety of ways and for various purposes. In addition to its fresh leaves, other common processed forms of bay include whole dry leaves, frozen, powdered leaves, and extracted essential oils.

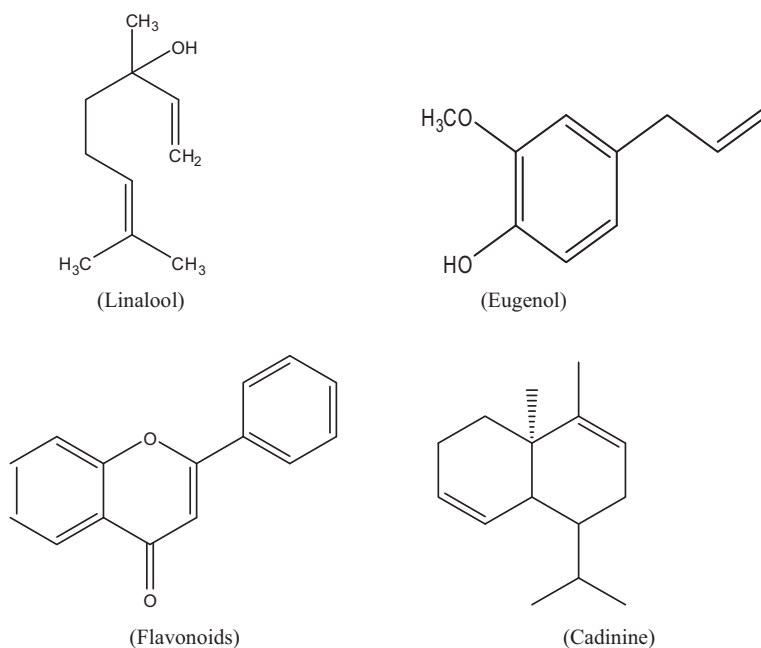


FIGURE 5.2 Structures of some active compounds found in bay leaf.

Leaves can be stored frozen for the sake of use for extended time beyond its fresh shelf life. For drying of bay leaf, different drying methods are available. Traditionally, it is dried in open air for 10–12 days. Sun drying has some disadvantages, like natural color loss and essential oil loss that result in low market value of bay leaf. Hot air drying at 60°C is the best method for producing bay leaves. Steam distillation is the best method for the recovery of essential oils from the bay leaf plant. Essential oil extracted from bay leaf is in two forms, fixed oil and volatile oil, that are collected from bay fruits (Bozan and Karakaplan, 2007).

## 5. VALUE ADDITION

Bay leaf can be combined with a variety of other herbs including cloves, thyme, tomato, mustard, parsley, paprika, sage, and pepper for use in soups, stews, as well as with fish, vegetables, and meat. Bay leaf with cloves and thyme is used to form tomato sherbet. Bay leaf with beef stock and large egg yolks forms Provençal bay tomato soup. Bay leaves with whole celery seeds, whole cloves, peppercorns, dried parsley, and thyme can be used in bouquet garni. Bay leaf pound cake can be made by using milk, sugar, butter, eggs, cake flour, and baking powder with bay

leaves. The leaves of bay have a camphor-like volatile oil that can be used as a coolant, insecticide, germicide, and irritant. Roasting of bay seeds gives them a spicy, coffee-like flavor, and by removing pungency, they become crispy and brown. Small leaves of bay are used in salads, rice, and vegetarian dishes. Its woody branches can be used in steamed meat, drinks, and soups, while leaf bark is used as a condiment in many spices. Bay leaf has universal industrial importance as dried leaves and essential oils give courtesy flavor to foods as in meat products, canned soups, stews, baked goods, sausages, fish, cosmetics, and drugs. Spices and essential oils of bay leaf may extend storage life of foods, as they have antimicrobial and antioxidant activities (El et al., 2014). Chilling of bay leaf retains the taste of this shrub more effectively than drying.

## 6. USES

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Many herbs and spices contribute significantly to health despite low amounts of consumption, as they are full of antioxidants and certain mineral compounds. It is not clear how much bay must be consumed to get its health benefits. Researchers do not have particular recommendations about the specific amount of use. Nevertheless, bay is full of antioxidants and is a good source of minerals and dietary fibers. It complements food flavor, and bay tea is used to treat stomachaches, clear up mucus in the lungs, colds, and sore throat. Poultice of bay leaves is used for the treatment of rheumatism and neuralgia (Goodrich et al., 1980). To treat headache, leaf of bay is kept in a nostril or under the headbands to relieve this pain. Traditionally, it has been used for the treatment of gastrointestinal problems such as impaired digestion, flatulence, eructation, and epigastric bloating and used as diuretic and has many analgesic effects (Elmastaş et al., 2006). Bay is great to add flavor and taste to food and many dishes with added health benefits.

Bay has many uses ranging from culinary to religious. There are number of curious beliefs associated with the historical use of bay leaf. The Temple of Delphi, dedicated to Apollo, used many bay leaves. The roof was made of bay leaves, and priestesses would have to eat bay before giving their oracles. This may have been aided by bay's slightly narcotic qualities. Thus bay leaves are said to aid with psychic powers, particularly prophetic dreams, clairvoyance, protection, healing, purification, strength, wishes, magic, exorcism, divination, visions, inspiration, wisdom, meditation, defense, and accessing the creative world. Israelite society consider the bay leaf as a symbol of victory over misfortune; they were very impressed by this tree. Ancient Mediterraneans said this tree radiates protective power and prevents them from misfortune, so it is

planted near houses to keep lightning away. The Romans and Greeks used this as a head band mainly for their respected citizens, poets, heroes, and priests, and they consider sleeping with bay leaves to make a man a poet. Romans also believed that this tree protects from lightning, so Emperor Tiberius always kept a bay leaf hat because he had a fear of thunderstorms; and from witches and wizards. The French sometimes call bay the “berries of bay,” and they crowned intelligent people with its berries and leaves, which are burned to increase the psychic powers and protect from evil and negativity. Chinese have a belief that to remove evil messes and crossed conditions, bay leaf with washed water can be used. Many people kept them in mojo bags to prevent unwanted interference from people.

Going beyond the ritualistic uses, bay has been used in cooking, and it is versatile as used in wide range of dishes, sauces, and condiments. It is an essential ingredient of many herbs and used in soups, stews, and stuffings, as well as fish, meats, vegetables, sauce, pickles, and sausages. It is easily blended with many other herbs such as garlic, mustard, pepper, parsley, rosemary, thyme, and oregano. Bay can also be an important ingredient in teas, oils, cheeses, and liquors, and its essential oil is used in the cosmetic industry for soaps, perfumes, prepared foods, beverages, and dental products. Bay has many traditional medical uses. Leaves are used for the treatment of skin rashes, earaches, and rheumatism. The leaves have aromatic fragrance, so they are kept in cloths and used to cover up bad mouth odor. The leaves of this plant, having a pepper odor and clove-like taste, are used in cooking. In addition to cooking, leaves and bark are used in treatment of rheumatism, nausea, vomiting, fever, anemia, body odor, diarrhea, and colic due to having astringent, aromatic, stimulant, and carminative qualities. Seeds mixed with honey or sugars are used in cough and dysentery in children.

Bay leaves having anti-diarrheal, anti-inflammatory, and anti-diabetic activity are used for the improvement of the immune system. Antioxidants such as vitamin C, vitamin E, and carotenoids are used in many dietary sources and are used to lower blood cholesterol and uric acid level. Bay leaves have many sesquiterpene lactones that are responsible for inhibition of NO production, i.e., anti-inflammatory, inhibition of alcohol absorption, and may improve liver glutathione S-transferase activity (Fang et al., 2005). Using bioassay-directed isolation study, different cytotoxic and apoptosis-induced compounds are identified in bay leaf. Many components of essential oil of bay leaf such as eugenol, methyl eugenol, and pinene have anticonvulsant activity, while eugenol, methyl eugenol, and cineole produce sedation and motor impairment (Sayyah et al., 2002). Essential oil of this leaf also has analgesic and many anti-inflammatory activities (Barla et al., 2007). Many polar compounds



such as flavones, flavonol, and phenols are present in the methanolic extract of bay leaf and show antioxidative activity.

Traditionally, it has been used as herbal medicine against number of diseases such as rheumatism, sprains, indigestion, earaches, and to enhance perspiration (Fang et al., 2005). It was reported by different researches that bay leaf can also be used to treat diabetes and migraine (Fang et al., 2005). It is used with warm water for drinking to treat internal ailments; as a result, excess water is removed by body by urination and acts as an emetic to induce vomiting. Fresh, mature leaves are used to treat blood dysentery, inflammation, and congestion of kidney. Bay leaf is also used to treat arthritis, headache, fungal diseases, anorexia, colds, cataracts, diarrhea, colic ulcer, appetizer, neuralgia, and digestive stimulant traditionally (Parthasarathy et al., 2008). Bay is found effective against many infections from fungi, viruses, bacteria, and protozoa. Bay is also helpful in inhibiting growth of carcinogenic cells. The leaves of bay are specific for many fevers, cough, flu, bronchitis, asthma, influenza, cough, cold, lowering blood cholesterol level, chicken pox, diarrhea, and anti-stress agents. Bay juice is an effective medication for sore eyes and night blindness, which is generally caused by deficit of vitamin A. Bay seeds are mucilaginous and relieve indigestion, sore throat, constipation, and diarrhea.

## 7. PHARMACOLOGICAL USES

### 7.1 Wound Healing Activity

The aqueous extract of *L. nobilis* were compared with the aqueous extract of *Allamanda* and found to have better wound healing activity. Many excision and incision wound healing models were used to estimate the wound healing activity. Many factors were studied to assess the wound healing activity such as tensile strength, weights of the granulation tissue, rate of wound closure, period of epithelialization, histopathology of the granulation tissue, and hydroxyproline content of the granulation tissue. Animals treated with bay leaf were found to have a reasonably high rate of wound contraction, hydroxyproline content, and weight of granulation tissue. Bay leaf–treated animals showed a higher number of inflammatory cells and less collagen compared with the animals that were treated with *Allamanda cathartica* (Nayak et al., 2006).

### 7.2 Antioxidant Activity

Ethanol extracts of *L. nobilis* showed powerful antioxidant activities. The antioxidant activity was determined by evaluating free radical scavenging, hydrogen peroxide scavenging, superoxide anion radical

scavenging, reducing power, and metal chelating assays. Strong antioxidant activity of bay leaf was observed in linoleic acid emulsion at a concentration of 20, 40, and 60  $\mu\text{g}/\text{mL}$  (94.2%, 97.7%, and 98.6% inhibition of lipid peroxidation, respectively). The antioxidant activity of ethanol extract may be due to phenolic compounds present in the extract (Elmastaş et al., 2006).

### 7.3 Anticonvulsant Activity

*L. nobilis* leaf essential oil showed anticonvulsant activity in mice. Essential oil components such as eugenol, pinene, and methyleugenol are responsible for this activity (Sayyah et al., 2002).

### 7.4 Analgesic and Antiinflammatory

*L. nobilis* essential oil showed analgesic and antiinflammatory activities in mice and rats (Sayyah et al., 2003). Ethanol extract obtained from the leaves and seeds of bay leaf also show the highest antiinflammatory activities by using a carrageenan-induced hind paw edema model (Kozan et al., 2006).

### 7.5 Antimutagenic Activity

Ethyl acetate extract of bay leaf has 3-kaempferyl *p*- coumarate antimutagen, which was identified experimentally and purified chromatographically. The antimutagenicity was due to a desmutagenic action that converted the Trp-P-2 metabolically activated form into its crucial carcinogenic form (Samejima et al., 1998).

### 7.6 Immunostimulant Activity

Immunostimulant effects of powder of bay leaf were shown on rainbow trout by giving them dietary constituents. Three groups of rainbow trout were fed with experimental diets. After 21 days, nonspecific immune parameters such as phagocytosis in blood leukocytes, extra- or intracellular respiratory burst activities, lysozymes, and protein levels were examined and showed immunostimulant activity (Bilen and Bulut, 2010).

### 7.7 Antiviral Activity

*L. nobilis* essential oil containing beta-ocimene, 1,8-cineol, alpha-pinene, and beta-pinene constituents were reported for inhibitory activity in vitro against SARS-CoV and HSV-1 replication. Essential oil has this activity with an  $\text{IC}_{50}$  value of 120  $\mu\text{g}/\text{mL}$  and selectivity index of 4.16 (Bilen and Bulut, 2010).

## 7.8 Anticholinergic Activity

Essential oil, ethanolic extract, and decoction of *L. nobilis* were reported to have anticholinergic activity toward acetyl cholinesterase (AChE) enzyme and showed good anticholinergic activity. Ethanolic fraction of about 64% of bay leaf also shown this inhibitory activity (Ferreira et al., 2006).

## 7.9 Insect Repellent Activity

*L. nobilis* essential oils extracted from seeds were reported to have insect repellent activity against *Culex pipiens* (Erler et al., 2006).

## 7.10 Antimicrobial Activity

*L. nobilis* essential oil, methanolic extract of seed oil. and seed oil in vitro showed antibacterial activity. However, methanolic extract of seed oil has more effective antibacterial activity than essential oil and seed oil (Ozcan et al., 2010). Similarly, in another report the antibacterial activity of *L. nobilis* essential oil was determined against *Staphylococcus aureus*, *Bacillus subtilis*, and *Staphylococcus intermedius*. The *L. nobilis* essential oil showed good antibacterial activity with minimal inhibitory concentrations of 0.35 and 0.56 mg/mL, respectively. The major constituent of bay leaf, 1,8 cineol, might be responsible for its antibacterial activity (Derwich et al., 2009). Antifungal activity of *L. nobilis* was examined on seven strains of plant pathogenic fungi in vitro at different concentrations such as 50, 125, and 250 µg/mL. The greatest antifungal activity was obtained against the fungus *Botrytis cinerea* at a concentration of 250 µg/mL (Patrakar et al., 2012).

## 7.11 Acaricidal Activity

Acaricidal activity of bay leaf oils was observed against *Psoroptes cuniculi*. Acaricidal activity of bay oil led to a mortality rate of 73% at a concentration of 10% and at 5% average activity was considerably reduced to 51% (Macchioni et al., 2006).

## 8. SIDE EFFECTS AND TOXICITY

Bay leaf and bay leaf oil are likely safe for most people in food amounts. There is no choke possibility with ground bay leaf, as does exist with whole leaf. The whole leaf cannot be digested, so it remains intact while passing through the digestive system. There is not enough reliable

information about the safety of taking bay leaf during pregnancy or breastfeeding. Bay leaf might interfere with blood sugar control and may not be safe to use during diabetes. Bay leaf might slow down the central nervous system (CNS). There is a concern that it might slow down the CNS too much when combined with anesthesia and other medications used during and after surgery. It is recommended to stop using bay leaf as a medicine at least 2 weeks before a scheduled surgery.

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